From:	Mary Hughes
To:	Gross Reservoir SI-20-0003
Subject:	Re: Docket#Docket # SI-20-0003:Gross Reservoir &Dam expansion
Date:	Friday, December 18, 2020 3:30:32 PM

Dear County Commissioners's,

In regards to the proposed expansion of Gross Reservoir Please read this article in the Associated Press, dated 12/16/20, as well as The Colorado Sun titled:

US: More must be done to protect Colorado River from drought

This has been put out by the US Bureau of Reclamation. Please heed their concerns and deny this expansion.

Thank you,

Mary Hughes
Nederland Colorado

On Sun, Dec 6, 2020 at 8:09 AM Mary Hughes <hughesmj52@gmail.com> wrote:

> Dear Board of County Commissioners,
>
> As a 38 yr long resident of Western Boulder County I'm writing to say I vehemently oppose the expansion to Gross Reservoir. This boondoggle being proposed by Denver Water violates many of the land Use Codes put forth in Boulder County's Land Use permit application. This project will affect the forests, flora, fauna, rocks, air and citizens in a profoundly negative way for many many years to come.
>
> Taking water from the already depleted and overused Colorado River must stop. There are so many critical issues due to climate change and the loss of critical snow mass which feeds this beautiful river that this project will alter it and our lives for centuries to come.
>
> The only solution is to educate and implement strict regulations to the public and municipalities that live along the Front Range. Significant fines need to be legislated to the extent that the practice of water conservation is the #1 priority of our citizens, state and local governments.
>
> Please heed my cry for conservation and education for the sake of the Colorado River.
>
> Thank you,
> Mary Hughes
> 31 Wildewood Dr
> Nederland, Colorado 80466

From:	Norman Lederman/Oval Window Audio
To:	Gross Reservoir SI-20-0003
Cc:	Norman Lederman/Oval Window Audio
Subject:	Public comments re: Docket SI-20-0003: Gross Reservoir & Dam Expansion
Date:	Friday, December 18, 2020 1:57:44 PM

December 17, 2020

EMAIL TO: grossreservior@bouldercounty.org

SUBJECT: Docket SI-20-0003: Gross Reservoir & Dam Expansion

Thank you for extending the comment period during this time of national chaos that is affecting many aspects of America’s present and future.

We support the conservation & sustainability of *existing* natural resources, rather than new development & expansion projects that threaten them, such as the proposed Gross Reservoir & Dam plans.

Historically, the West has engaged in “water wars” in which the biggest, politically and economically strongest and, for awhile, the best armed, were the winners. This is an approach that is no longer sustainable or viable in the long term. While our future is uncertain, this summer’s burning West brought the issues into clearer focus.

Responsible water conservation is the only meaningful pathway open to us. Even Denver, instead of just taking, can learn new ways of living more in line with a future of limited resources.

Sincerely,

Paula Hendricks & Norman Lederman

33 Wildflower Ct.

Nederland, CO 80466

From:	dan
To:	Gross Reservoir SI-20-0003
Subject:	gross reservoir expansion
Date:	Thursday, December 17, 2020 4:30:23 PM

Dear Planners and Commissioners,

The proposed expansion of the Gross reservoir resulting in the largest dam in Colorado would have only a minor impact on Denver's water storage capacity, but would have major detrimental effects on Boulder County, its residents, and surrounding forest ecosystems. It would constitute the largest construction project in Boulder County's history, located less than 5 miles from the city of Boulder and practically in the back yards of hundreds of mountain residents. It would require clear-cutting of hundreds of thousands of trees and destroy sensitive habitats and alter migration paths of elk and other wild animals. The project is expected to last for 7 years and would involve years of round-the-clock blasting and other heavy construction activities introducing abundant air, noise, and light pollution that would not only make life miserable for hundreds of local Boulder County mountain residents, but also impact Boulder city residents living down-wind from the construction site and those who recreate at Walker Ranch, Meyers Gulch, and Gross Reservoir itself. The proposed project does not adequately address these issues, violates Boulder County ordinances on noise and light pollution, and makes a joke of Boulder County's stringent measures to protect the environment and its enjoyment by its residents, such as restrictions on size, lighting, and visibility of new residential construction. Moreover, the proposed expansion of the reservoir would only exacerbate the already monumental depletion of Frasier and Colorado rivers. Allowing this project to proceed would go against everything Boulder County stands for.

Sincerely,

Daniel Feldkhun
71 Benthaven Pl.
Boulder O 80305

From:	Bill Merline
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	STOP Gross Dam project
Date:	Thursday, December 17, 2020 4:21:24 PM

Dear Boulder County Commissioners:

This is a follow up to my letter of Nov 13 in objection to the Gross Reservoir project.

I have spent significant additional time studying the incomplete, insufficient, and incompetent plans of Denver Water in this project and related analyses.

In particular, I urge you to study again the letter submitted by my colleague, also in November, Dr. Clark Chapman, who has been heavily involved in opposition for well more than a decade. It demonstrates that the plans and voluminous documentation from Denver Water is mostly fluff and not at all relevant and does not address the real problems. It demonstrates what I have seen from consultants and other government entities elsewhere --- in response to any questions, they simply repeat what they said before, they pile on huge numbers of tangentially relevant or irrelevant documents into the record, and then hope that no one notices or that people get tired of questioning their plans or assertions.

Today, I attended a Board meeting of the Gilpin Commissioners, and you will see a letter of opposition to this project from them. They not only have major environmental concerns for the project overall, but the plans for traffic through Gilpin County for large trucks is simply unacceptable.

I would say, as an observer, that any plan to funnel logging trucks down the entire length of Gilpin County on Hwy 119, every 20 minutes for years and years, is insane and irresponsible. That section of 119 is just recovering from the same level of truck traffic for the last 1.5 years for the Exel pipeline expansion. It nearly drove residents out of their minds.

Let me suggest that if Boulder County REALLY thinks it is a good idea to approve this absurd project, then they need to direct all truck traffic to use only Boulder County roads to move materials. It is not acceptable to approve it and then push the problems off to another county. Shame on you for even considering it.

Further, I have just heard that the updated number of trees to be removed is 650,000 not 200,000 as my previous letter used in my estimate of the lost value to Boulder County from the trees alone. This brings my new estimate to 6.5 BILLION dollars instead of 2 BILLION dollars previously. Really? Does the County REALLY want to throw away nearly $7B in resources to help Denver's quest for thirsty and unrestrained expansionism?

And what really takes the cake is that we learned from the Gilpin County attorney today that the fate of 85% of the removed trees is to be moved to a landfill near US 6 and Hwy 93, where they will be chipped and BURIED!! What kind of an environmental terrorist came up with this ingenious plan? To bury that volume of organic material in the time of climate change has to be perhaps the largest environmental crime in the history of this region. They couldn't even have the common decency to suggest that they be turned into usable lumber?

This is not only the largest construction project in Boulder County history, it will be the County's largest environmental nightmare ever.

Someone is out of their rocker on this project and it simply needs to be stopped in its tracks.

Thanks for the consideration. Please do the right thing.

Dr. William J. Merline
Staff Scientist
Southwest Research Institute
Boulder CO 80302

(Boulder County and Gilpin County property owner)

merline@boulder.swri.edu
303.582.9691
720.878.7858

From:	Diane Merline
To:	Gross Reservoir SI-20-0003
Subject:	Opposition to Gross Reservoir Expansion Project
Date:	Thursday, December 17, 2020 4:03:44 PM

To Whom it May Concern,

Since I last wrote to you in early November, I have learned more about this project and it has only served to make me MORE adamantly opposed to this project.

It would be detrimental to the environment and lifestyle of many and I urge you to consider an alternative project.

Thank you for your consideration.

Sincerely,
Diane (Merline) Miller
Boulder County Property Owner

From:	James M. Ausberger, AIA
To:	Gross Reservoir SI-20-0003
Subject:	Docket SI-20-003 Gross Reservoir & Dam Expansion
Date:	Thursday, December 17, 2020 4:03:37 PM

Re: Traffic & CDOT

As a resident of Lakeshore Park, I want to bring up the issue of increasing traffic congestion on Flagstaff. We have noticed a significant increase in traffic following the opening of the reservoir to recreational boating. Some drivers are oblivious to others, leading to unsafe conditions. Speeding drivers are not the issue; It's the slow drivers. On multiple occasions we witness cars stopping in the middle of the road to photograph wildlife. At other times, drivers move at speeds between 10 and 20 mph, never checking their mirrors as cars accumulate behind. At one time this fall, I was the 14th car behind such a driver.

To the best of my knowledge, there is no other 10 mile stretch of state highway in Colorado without a passing lane.

To accommodate the ever increasing load on the highway, I would like to request a few items to help reduce the potential hazards of the current situation.

1. Add an official passing lane north of Kosler Reservoir.
2. Add designated pull outs for slower traffic to pull over.
3. Add a signs at the bottom of the hill requesting the use designated pull-offs to allow commuters to pass. "Please show courteously to all: Slower traffic please pull-over."

With additional traffic, potential for conflict increases. It's in everyone's best interest to address this in a manner that reduces the potential for automobile collisions, bicycle safety, and the avoidance of potential conditions leading to road rage.

It's a beautiful area, and we are blessed as residents (unless it's a Saturday or Sunday afternoon). We are more than willing to share. Let's work together to foster a good relationship between residents and visitors.

Thank you.

James M. Ausberger, AIA, LEED AP
Associate
VAN TILBURG, BANVARD & SODERBERGH, AIA
SUITE 2250, 1670 BROADWAY, DENVER, CO 80202
T: 303 675 0041 x 208 C: 303 642 0500 www.vtbs.com
jausberger@vtbs.com

From:	johnwmackay@gmail.com
To:	Gross Reservoir SI-20-0003
Cc:	Lorena de Santa
Subject:	GROSS RES: COMMENT AND REQUEST TO TABLE
Date:	Thursday, December 17, 2020 3:23:48 PM
Attachments:	Gross Res - MacKay.pdf

Thank you, please confirm receipt. JM

JOHN MACKAY

1742 Lazy Z Road
Post Office Box 2
Nederland, CO 80466
johnwmackay@gmail.com
720.361.6023

17 December 2020

Boulder County
grossreservoir@bouldercounty.org

RE: DENVER WATER'S GROSS RESERVOIR EXPANSION PROJECT, COMMENT AND REQUEST TO TABLE

Dear Boulder County:

My wife and I own the property located at 1742 Lazy Z Road, Nederland, CO 80466. Our property is adversely impacted by the project proposed in Denver Water's Areas and Activities of State Interest (1041) permit application. I request that the application process be tabled until we get through the COVID-19 public health crisis. These are my concerns:

DENVER WATER EXPECTS YOU TO RUSH.

In the cover letter that accompanied its application, Denver Water explained that it "seek[s] expeditious review and consideration", and went on to request:

"that the County process this application in a timely manner, as any delay would jeopardize Denver Water's ability to comply with federal permits and the Federal Energy Regulatory Commission's July 16, 2020 Order, which amended the hydropower license for the Project and requires construction of the Project according to specified deadlines and milestones. Any undue delay in the County's processing of this 1041 permit application would compromise Denver Water's ability to plan for Project construction consistent with its schedule, the needs of its customers, federal permits, and the FERC Order." (Emph. added.)

Denver Water is in a hurry. It expects you to jump to attention and rush this application through. Perhaps its own haste is why the same cover letter fails to mention a significant and inconvenient loose end – the coronavirus.

WE'RE IN THE MIDST OF THE PANDEMIC.

When the letter and application were submitted, Colorado was six months into the COVID-19 disaster emergency. On November 20, 2020, the Department of Public Health and Environment issued its Second Amended Public Health Order 20-36, imposing severe restrictions on the movement, activities, and assembly of all Coloradans, based on how a community scores on the COVID-19 dial. Boulder County is presently at **Level Red: Severe Risk**. The county, the citizens of this state, and the residents of this county cannot effectively examine, research, and fact-check the application, much less confer and respond.

Yet Denver Water has the effrontery to insist that Boulder County race through its examination and consideration of a project that would "**build the tallest dam in the history of Colorado and be the biggest construction project in Boulder County history**" (Pagosa Daily Post, December 11, 2020.) It expects you to slop together some sort of quick approval, public be damned, lest it be inconvenienced like the rest of us.

Denver Water's proposal is itself compromised by COVID-19. Under Recreation Surveys, Denver Water reports that "These on-site outreach and survey activities <u>will continue during future summer recreation seasons, when COVID-19 social distancing guidelines are no longer required.</u>" (Emph. added, page 30.) At page 31, Events, One-on-one/group outreach, Office hours, Denver Water admits: "<u>When the COVID-19 social distancing guidelines began in March 2020, Denver Water paused all in-person activities to ensure the safety of staff and the public.</u>"

NEVER HAS AN APPLICATION CALLED FOR MORE SCRUTINY.

The scope of the proposal is heart-stopping. I haven't been through it all (there is a pandemic going on) but this one example stands out:

Denver Water proposes to flood SR 72 with heavy truck traffic: "**up to 7,200 tons (approximately 288 trucks) of cement and fly ash deliveries will be required every week during RCC production.**" (Supply Trucks for Gross Reservoir Expansion, page 304.) That's 288 huge haulers per week, one trip up, then one trip down. Assuming a 40 hour week, that's **14.4 cement and fly ash haulers per hour, about one every four minutes, coming up or down Coal Creek Canyon - a winding, two-lane mountain road.** Not to mention tree removal material transporters (page 306), construction workers' vehicles, concrete mixers, and other haul trucks. A road we mountain people use to escape fires, and firefighters use to get to fires, when need be and on a moment's notice.

I would call that a colossal impact. Denver Water instead says this, as to recreational safety: "the presence of additional heavy truck traffic may present a <u>temporary moderate adverse impact</u> on the recreational experience and on the safety of road bicyclists who utilize this road." (Emph. added, page 259.) "Moderate" seems nothing more than an effort to minimize the enormous and outlandish scale of this project.

Denver Water doubles down on its artful choice of words with this: "The timing for deliveries of cement and fly ash can <u>easily be adjusted</u> to accommodate the traffic restrictions established by Denver Water for the GRE project, as well as critical commute times." (Emph. added, page 302.) I call BS! Have you ever been caught behind a fully-loaded hauler, going up a steep, winding, two-lane mountain road? Much less a day-long caravan of them spaced eight minutes apart? With another caravan of haulers coming down the other side of the road, also spaced eight minutes apart? The line-up builds quickly and there aren't many places for those haulers to pull over. How easy will it be to "adjust" when we've gotten the reverse 911 call, we're on our way down, and the firefighters are on their way up? <u>**By the way, does Denver Water propose to continue these 288 weekly cement and fly ash deliveries, plus 288 weekly return trips, during Red Flag warnings?**</u>

A brief digression re word choice: this is what Denver Water says about Lazy Z Road, the steep, winding, always bumpy, and usually icy or muddy dirt road on which dogs and wildlife run, children ride their bicycles and sleds, neighbors gather, and Lorena and I live:

"For tree removal from the west side of the Gross Reservoir, the proposed route includes approximately 3.2 miles of travel on Lazy Z (CR 97E) road to CR 132 and approximately 24 miles of travel on SH 119 between US 6 and County Road (CR) 132. Transport of these materials will result in increased traffic on the west side access routes, however <u>the existing traffic volumes on these roadways are very low and impacts to the traveling public will not be significant</u>. The Corps considered that traffic related to tree removal would result in <u>moderate temporary impacts.</u>" (Emph. added, Tree Removal, page 306.)

I live on Lazy Z. I know Lazy Z. I've talked to my Lazy Z neighbors about the traffic on Lazy Z. Without more analysis, "will not be significant" is Denver Water's way of saying "we don't know"; "moderate temporary impacts" (there you go again, Denver Water), is its way of saying "we don't care".

LISTEN TO DR. FAUCI.

Here's what Dr. Fauci said this last Monday, December 14, 2020:

"**By the time we get to the fall, we can start approaching some degree of relief where the level of infection will be so low in society we can start essentially approaching some form of normality."** (www.msn.com, Money Talk News.)

How can you – how can we, the people of this state and this county – examine, investigate, consider, confer, and respond to a proposal of this magnitude under our current circumstances? A proposal that, if approved without significant trimming, will change Boulder County for the worse. Forever. We cannot. The just approach is to table this application until the fall – when we have essentially approached some form of normality. That is my request.

Thank you for your consideration.

Sincerely,

John MacKay
JWM/ae

From:	Gary Wockner
To:	Gross Reservoir SI-20-0003; John Barth
Subject:	Comment letter and Exhibits-Gross Reservoir-12-16-2020
Date:	Wednesday, December 16, 2020 9:59:09 AM
Attachments:	Gross-Res-comments-12-16-2020.pdf Exhibit-1_Woodling Aquatic Resources Assessment.PDF Exhibit-2-CoE-Letter-on-Moffat-GHG-Emissions-6-18-20151.pdf Exhibit-3-Final Firm Yield Calculation LRB 1 Oct 2015.pdf Exhibit-4-Udall and Overpeck - 2017 - The twenty-first century Colorado River hot drough.pdf Exhibit-5-Hydros Risk Phase III Final Report.pdf

Hello Boulder County Land Use:

On behalf of The Environmental Group and Save the Colorado, attached please find a comment letter and 5 exhibits regarding the proposed Gross Reservoir and dam expansion. Please confirm receipt.

Thank you,
Gary Wockner, Save The Colorado

Cc: John Barth, attorney

--
Gary Wockner, PhD, Director
Save the Colorado: Colorado River Waterkeeper Network
Author: "River Warrior: Fighting to Protect the World's Rivers" (2016)
PO Box 1066, Fort Collins, CO 80522
http://savethecolorado.org
http://www.facebook.com/savethecolorado
https://twitter.com/savethecolorado
970-218-8310

The mission of Save The Colorado is to protect and restore the Colorado River and its tributaries from the source to the sea. Save The Colorado focuses on fighting irresponsible water projects, supporting alternatives to dams and diversions, fighting and adapting to climate change, supporting river and fish species restoration, and removing deadbeat dams. Save The Colorado has thousands of supporters throughout the Southwest U.S. from Denver to Los Angeles and beyond.

Save The Colorado   The Environmental Group

December 16, 2020

By email at: grossreservoir@bouldercounty.org

Dale Case, Director
Boulder County Community Planning and Permitting
P.O. Box 471
Boulder, CO 80306

Re: Denver Water's Gross Reservoir Expansion 1041 permit application, Docket SI-20-0003

Dear Mr. Case:

On behalf of The Environmental Group and Save the Colorado ("local community groups") and their numerous Boulder County members living near the proposed expansion of the Gross Reservoir and related dam, we submit these additional comments on the current 1041 application materials posted by the County to its website[1]. These comments below (with exhibits) are in addition to the previous comments we submitted on November 13, 2020.

Comment #1, pertaining to: 8-507,D.7.b.iii (A)(B)(C) and 8-511-B.5.c.i, iv,vi,ix, x and 8-511,B.5.f. all subheadings.

The Woodling (2018, Exhibit #1) report on aquatic life refutes Denver Water claims that increased water volume in upper South Boulder Creek and prolonged colder temperatures of water below Gross Reservoir do not have any long-term impacts on fish populations. The 1041 permit is incomplete because aquatic resources in Boulder Creek both upstream and downstream of Gross Reservoir have not been fully defined, increases of upstream flows and reduced temperatures of stream flow downstream of the reservoirs would adversely impact trout populations in South Boulder Creek, and proffered mitigations are ineffective. In his report he states that:

1. **multi-staged release structures from the dam would mitigate aquatic life impacts on South Boulder Creek between Gross Reservoir and the South Boulder Diversion structure.**
2. Denver Water has failed to adequately describe aquatic resources in South Boulder Creek thus there is no basis for an impact analysis
3. higher flows in South Boulder Creek upstream of Gross Reservoir would reduce trout fry survival and increase erosion of banks - adding sediment to the stream.

[1] See, https://landuse.boco.solutions/boco.lu.docketlistings/app/detail.html?docket=SI-20-0003 (as of November 13, 2020).

4. downstream of Gross Reservoir water temperatures are already colder than would be expected on similar streams because releases are taken from the bottom of the reservoir which stratifies into October and that expansion of the reservoir would result in a 30 percent decrease in “degree days that are currently available for fish growth.”
5. the SEA does not provide any proof of their claim that fish populations in Gross Reservoir will benefit from a larger reservoir
6. monitoring and placement of signs warning of fish consumption do not decrease the likelihood of increased mercury in fish
7. the 5,000 AF environmental pool is not well thought out as further increasing the size of the reservoir it would exacerbate downstream water temperature issues
8. Of the 8 “mitigation” projects proffered by Denver Water, 6 entail monitoring only which do not qualify as mitigation. Two mitigations are the environmental pool (#7 above) and the tree removal program (which does not benefit aquatic resources).

Comment #2, pertaining to: 8-507.D.7.v: Air quality analysis in the 1041 application for the Moffat project is incomplete because it does not address greenhouse gas emissions (GHG) of the project reported and requested in the STC’s July 18, 2015 letter (Exhibit #2). GHG emissions would be included under Section B of (v), “other adverse impacts on air quality anticipated from the proposal.”

Exhibit 14 of the 1041 application examines:
1. exhaust emissions associated with construction equipment
2. on-road vehicle engines
3. fugitive dust emissions associated with equipment and vehicle travel on unpaved roads, material handling, excavation activities and wind erosion.

Air quality analyses reported in Exhibit 14 of the 1041 permit focus on estimates of carbon monoxide (CO), nitrous oxides (NOx), sulfur dioxide (SO2), and particulate matter (PM10 and PM2.5) emissions.

Carbon dioxide emissions were evaluated in Appendix C of the Final Borrow Haul Study included in the FERC Final License Amended Application Volume III. This analysis included only direct GHG emissions - those owned and controlled by the reporting entity - of hauling materials to and from the site (page C-6). The Borrow Haul Study discusses the February 18, 2010 Council on Environmental Quality (CEQ) Draft Guidance Memorandum requirements under NEPA (page C-7) for

- “the treatment of GHG emissions that may <u>directly or indirectly</u> result from proposed federal action” and
- “the analysis of potential climate change impacts upon the proposed federal action.”

In addition, they note that “the threshold of 25,000 metric tons of CO_2-equivalent GHG emissions annually is suggested as a “useful, presumptive, threshold for discussion and disclosure . . . .” All federal agency actions requiring NEPA review . . . . are covered by this guidance” (page C-7).

Direct CO2 emissions noted in the Final Borrow Haul Study amount to 4,247 tons/year due to fuel consumption when hauling aggregate, cement, fly ash, timber and ash slash one-way to the site (Table C-3). It is anticipated that GHG emissions would approximately double if trucks were to drive both to and from the site.

The 1041 permit is incomplete because it fails to include indirect GHG emissions of the Moffat project - in particular, the large amount of GHG emissions from production of cement - and fails to include direct GHG emissions from construction and tree removal activities at the site.

Comment #3, pertaining to: 8-511:B.3: "**Adequate water supplies, as determined by the Colorado State Engineer, are available for the proposal if applicable."**

Full Use to Project Water Supply Not Sufficient to Provide 18,000 AF of Firm Yield

The 1041 application on page 5 states that "Water diverted under existing water rights and facilities from the Upper Williams Fork and Fraser Rivers and South Boulder Creek to the expanded Gross Reservoir will provide 18,000 acre feet per year of additional supply and improve Denver Water's system reliability."

This statement is not consistent with the FEIS in which only additional diversions between their Full Use Baseline and the Project would be available to supply the additional 18,000 AF – thus limiting potential impacts of the project on both the east and west slope streams to this smaller portion of the additional diversions. In addition, system reliability also depends on how climate change will impact streamflow in the source basins – a factor that has not been addressed in the FEIS, the 401 certification, the SEA, or the 1041 application.

Table H.7-1 of the FEIS provides PACSM model results of Gross Reservoir levels and resultant stream flow for both the east and west slope streams. In particular, the FEIS claims that an increase of 10,285 AF per year on average (the difference in Moffat Tunnel flows between their Full Use baseline and the project diversions) is all that is required to supply an expanded Gross Reservoir with 18,000 AF of additional water supply. This additional supply is needed to maintain flows of 30 mgd at the Moffat Water Treatment Plant (MWTP) during the winter months. Previously, the MWTP was shut down in the winter time. Table H.7-1 shows that, per their PACSM model, post-project Gross Reservoir storage in average years would decrease by 24,243 AF between November and April. This compares to a pre-project (Full Use) decrease of 6,111AF in these months; or a difference of 18,132 AF.

An increase in supply of only 10,285 AF is not sufficient to supply this additional amount of water to the MWTP. A water balance estimate completed in 2014 (Buchanan, 2014 revised in 2015, Exhibit #3) showed that all additional water at diversion structures (between the existing measured baseline equal to the average Moffat Tunnel flows through 2012 and the Project) in both the Williams Fork and Fraser River basins is necessary to provide an additional 18,000 AF of firm yield to the expanded Gross Reservoir. However, the FEIS states that this additional firm yield will be attained only with the addition of water supply between the Full Use and Project amounts. If the latter is true, e.g. if the amount of water that can be diverted under Full Use is already allocated elsewhere, then additional water must be supplied by another source, one that must be available to Gross Reservoir and the Moffat Water Treatment Plant. Please explain where the additional water would come from and if it would increase flows in upper South Boulder Creek.

When finalizing the South Boulder Creek Stability and Monitoring Plan design criteria need to include the highest flows that are anticipated from western slope diversions. If an additional water source is to be used to supplement the 10,285 AF then additional flows through the Moffat Tunnel into South Boulder Creek need to be incorporated into that design.

<u>Additional withdrawals combined with climate change increases the risk of a compact call on the Colorado River</u>

Temperature increases caused by climate change have been linked to reduced streamflow in the Colorado River basin (Udall and Overpeck, 2017, Exhibit #4). In particular, the drought that started in the early 2000s and continues into the present has resulted in very low levels in both Lake Powell and Lake Mead - 44% and 39 % of full capacity as of November 23, 2020 (Glen Canyon Institute, Vol 19, No 11, Nov 24, 2020 - Colorado River Lowdown). Climate change and additional trans-mountain diversions (TMD) from the upper Colorado to the eastern slope of Colorado raise two concerns.

1. Limiting the PACSM analysis to the 1947 to 1991 time frame does not reflect how climate change has impacted Denver Water's water supply in the upper Fraser and Williams Fork basins. It is unclear if this water supply will continue to provide the same yield as in the 1947 to 1991 historical hydrologic record. **The PACSM model period needs to be extended to 2020 to evaluate how drought would affect operation of the expanded Gross Reservoir.**
2. **Additional TMDs compound the effects of climate change on Upper Colorado River basins.** If Lake Powell levels decline to the point where the upper basin cannot provide the 7.5 MAF or 8.25 MAF (including our obligation to Mexico) per year (75 MAF or 82.5 MAF average over 10 years) allocation to the lower basin states the risk of a compact call increases.

The Phase III Hydros report (2019, Exhibit #5) evaluated which water rights would be most at risk if a compact call were to occur by quantifying post-compact (post-1922) water right depletions or usage in each Colorado basin. In-basin or western slope use was separated from Trans Mountain Diversions in the Upper Colorado River Basin. If a compact call were to require a full curtailment of all post-1922 water rights, the Upper Colorado TMDs would make up 57.1 percent or, on average, 531,952 AF of the total post-compact curtailment (931,969 AF) - Table 6 and Figure 12 of the Hydros report. Note that it is still undecided how Colorado would administer a compact call on the Colorado River.

TMDs that transfer upper Colorado River water to the eastern slope include Colorado Big Thompson (CBT), Windy Gap, and Moffat projects. **Though Moffat project water via Gross Reservoir is used by customers in Denver, removal of additional water from the Upper Colorado River's western slope streams could contribute to risk of a compact call on CBT and Windy Gap water used by other Front Range communities within Boulder County. These include Boulder, Longmont, Louisville, Lafayette, Erie, Lyons, and Superior.**

At this time, Denver Water has not evaluated how the Moffat project would factor into the risk of a compact call on the Upper Basin of the Colorado River. Denver Water has also not evaluated how climate change would impact the Moffat Project. Its assessment of water supply is therefore, incomplete.

Comment #4, pertaining to: 8-507:D.7.b.ii (D), 8-511:B.5.d.i, ii, iii: Groundwater quality and Water Levels

Earlier comments (Nov.13, 2020) submitted by John Barth for Save the Colorado and The Environmental Group discuss how Denver Water has omitted any analysis of impacts to residential groundwater wells per i, ii, and iii below. The following comment is in addition to earlier comments.

i .Changes to aquifer recharge rates, groundwater levels, aquifer capacity including seepage losses
ii. changes in capacity and function of wells within the impact area
iii. Changes in quality of well water within impact area.

The Moffat 1041 application does not address the impact of substantially higher reservoir levels - up to 142 feet - on water supply wells at nearby residences - particularly at the nearest residences on the north shore of Gross Reservoir. Per Appendices in the FEIS, Table H.7-1, the average change in reservoir elevations between the lowest level, typically seen in April, and the maximum level, typically seen in June or July, averages approximately 50 feet. **Reservoir levels, particularly as they vary each year, could have a substantial impact on the operation of residential wells. Denver Water needs to include annual April (minimum) and June (maximum) levels for each year of the model period.** Average reservoir levels do not provide enough information to determine how reservoir levels will vary each year - important information for residences that need to operate their residential groundwater wells.

In addition, it is unclear if boat ramps extend far enough to be useable when reservoir levels are low, for instance under drought conditions. Annual minimum reservoir levels need to be used to design recreation facilities at the expanded reservoir. Extending the model period beyond 1947 to 1991 would provide valuable information on how the expanded Gross Reservoir would respond to more extensive droughts of the early 2000s. This information is important for residential wells as well as for design of recreation facilities.

Comment #5, pertaining to: Tree Removal Plan: (Appendix E-6 of the FERC Application) Land Stewardship LLC, February 2008). This plan needs to be completed.

A preliminary plan for tree removal was completed in 2008 by Land Stewardship LLC. In this report, the area that would be inundated by the expanded Gross Reservoir, that would be logged, is separated into Stand numbers based on types of trees, hillside slope (greater or less than 40 percent slope), access to existing roads, and anticipated methods of logging the trees. The acres, hillside slope compared to 40 % grade, number of "stems" or trees, and tonnage of material to be removed is noted in Table 2 of the report. This report compared various methods of slash/tree disposal including:

- Air Curtain Destructors which entails burning slash in an efficient incinerator. One ton of slash would produce 48 to 80 pounds of ash for disposal in a landfill.
- Grinding of whole trees which produces a large volume of chipped wood. A grinder can grind 22.5 tons per 20 minutes and would take 2,666 hours to grind slash from the project. They anticipate using several grinders but would then be limited by the ability to transport chipped wood from the site; anticipated to be 23 tons/truckload or a total of 2,174 loads.
- Hauling timber which is less efficient than removing chipped wood and would require more truckloads.

The western staging area would be located on Winiger Ridge at a helicopter pad site. Helicopters would be used to remove individual trees from hard to access areas and to remove logs from staging areas where ground based logging methods are employed.

To reduce the number of temporary roads and volume of chipped wood, Land Stewardship also prepared an Alternative Tree Removal document that utilizes a slash bundler which wraps or bundles the upper "slash" portion of trees that would be placed in landings for transport to the helipad by helicopter.

Here are some comments on the preliminary plan that need to be addressed in a final Tree Removal Plan:

1. chipped wood should be delivered to a composting facility rather than placed in a landfill. Anaerobic degradation of wood in the landfill will produce methane. If composted, wood materials can be used as amendments to soils in the future. The report states, that as of 2008, a compost facility of sufficient size was not available to handle the volume of slash or chipped wood. Additional compost facilities may be currently available.

2. It is assumed that logging roads will likely be installed to access trees for removal. Also, the report states that "portions of Forest Roads 359 and 68 would need to be improved in order to haul the necessary equipment for logging, residue removal etc." The final Tree Removal Plan needs to provide details for improvement of FS 359 and 68 and for additional temporary roads.

3. The preliminary Tree Removal plan fails to describe the number of helicopter trips that will be required both under the original and alternative plans to bring slash and logs to the helipad staging area. For instance, can helicopter deliveries keep up with removal/treatment activities.

4. The final Tree Removal Plan needs to provide details of staging areas on both the east and west sides of Gross Reservoir including areas where tree debris are handled.
5. The final Tree Removal Plan must finalize which slash/tree disposal techniques will be used.
6. The final Tree Removal Plan must provide a schedule of operations over the entire tree removal period.
7. The final Tree Removal Plan must also provide an erosion control plan for deforested and de-vegetated areas that lie below the full reservoir elevation that will be exposed when reservoir levels drop. Steep denuded slopes below the water line of the expanded Gross Reservoir would be more prone to erosion than prior to implementation of the project.

Comment #6, pertaining to: Traffic Impact Analysis (Stantec, September 17, 2020, Exhibit 4 of the Moffat 1041 Application): 8-511-J2. "The volume of traffic to be generated by the proposed development shall be compatible with the traffic handling characteristics of the interchange and the access road and existing, affected traffic roads." This plan needs to be finalized.

A total of 288 truckloads per week of cement and fly ash need to be delivered to the Gross Reservoir staging area on the east side of the dam via SH72 and Gross Dam Road. Deliveries will be made on four days per week (M, W, Th, S or F) over 8 hours a day; this means that 72 truckloads per day (9 per hour) with an interval between truckloads of 7 minutes. During peak construction times Stantec estimated that 15 truckloads of construction materials would be delivered each hour; this reduces the interval between truckloads to 4 minutes. Construction would take place over two years; 2025 and 2026. Tree removal would occur in 2026 and 2027 overlapping deliveries of construction materials in 2026. On the east side they estimate that 2 logging trucks would need to use the Gross Dam Road and SH72 per hour for a total of 17 trucks per hour on this road with an interval of every 3.5 minutes. Construction is expected to last from April through November.

Trees would be removed from the west side of the reservoir via FS road 359, CR 68 to FS 359, to Lazy Z Road (CR97E), Magnolia Road (CR132) to SH119 (plugging into SH119 just south of Nederland) and exiting onto HWY 6 (in Clear Creek Canyon) and finally onto HWY 93 where trucks will travel either to the Republic Services landfill on HWY 93 or to Longmont with salvageable timber. Per the Stantec report, removal of trees and slash would take 36 truckloads per day for one week per month or 4 truckloads per hour during that time.

Some comments are:

1. The Stantec report states that vehicles traveling behind trucks will be delayed 12 minutes on the Gross Dam Road (likely due to the difference in speed limits between trucks and passenger cars). With trucks arriving at the staging area every 3 to 4 minutes during the day, there is a high probability that vehicles will be delayed whenever they travel the Gross dam road whether they are traveling to or from the reservoir. Vehicles traveling behind trucks on the west side will be delayed by 25.5 minutes (for instance on Magnolia Road). Yet the traffic impact analysis states that construction traffic will not impact local traffic significantly. For people who live along these roads, this is a major imposition.

2. Cement and fly ash need to be utilized shortly after delivery to the site. If it rains or snows, the materials will not be useable. Is there sufficient capacity in the concrete production plant and construction work on the dam to utilize the trucked in materials as they are delivered? Similarly, is there sufficient storage area at the staging areas to handle this many loads of cement and fly ash per day?

Comment #7, pertaining to: Noise; page 81 of EA. The application states that "construction noise effects will be short-term - only 4.1 years of direct, moderate adverse effects. **Noise effects over 4 years will adversely affect local residents that do not live in the area to be part of a construction site.**

"Denver water intends to use noise studies to work with community to develop measures that aim to monitor, minimize, and mitigate noise disturbance during construction to the extent reasonable and possible. DW is considering project noise goals and potential forms of restitution when construction activities exceed those goals at determined monitoring locations."

There are no details in this description. What are the project noise goals, what are the forms of restitution and where would the monitoring locations be installed?

Potentially all of the following could occur at the same time increasing noise levels:

- the aggregate processing plant that will produce enough aggregate for the concrete production plant.
- blasting at the quarry and during dam foundation excavation would occur once per day for over one year.
- Burrow Haul trucks between the quarry and processing location
- Tree Removal activities including noise from numerous helicopter trips, chainsaw, Grapple Skidder, Hydro-ax, cable yarding, grinding of slash and trees in one or more grinders, truck traffic to haul tree materials, and potentially incinerators for high efficiency burning of slash.
- Truck trips to deliver cement and fly ash to east side of Gross Dam.

Two reports are included in the 1041 application for the Moffat project, both authored by Behrens & Associates Inc. The 2014 report, included as Attachment E-9 to the Final FERC License Amendment Application Volume III, evaluates noise and vibration impacts at 6 locations caused by haul trucks along SH72 and Gross Dam Roads as well as vibration impacts of a test blast at a residence on the north shore and at the existing dam. The 2017 report evaluates noise impacts of blasting and construction activities at the dam site at 3 locations. Neither report evaluates noise issues associated with tree removal activities alone or in conjunction with other construction at the site.

Table 4-1 of the Behrens & Associates In (2017) provides Non-Vehicular Boulder County noise standards for sources located in a residential area (Boulder County Noise Ordinance 1.01.050d):

- 55 dBA from 7 am to 7 pm
- 50 dBA from 7 pm to 7 am

For construction sites this noise standard is raised to 80.0 dBA for continuous noise and 75 dBA for instantaneous noise levels such as for blasting (Tables 6-5 and 6-6). Additionally, the 2014 report, page 14, states that **the noise threshold would be exceeded if the "proposed project generates noise levels significantly greater than the existing ambient noise levels around the project site" - this threshold is set at 5 dBA**.

The Behrens (2014) report measured ambient noise levels at six locations; two along SH72 and 4 locations along the Gross Dam Road - locations are shown on Figure 5-1 of the 2014 report.

- Location 1: Highway 72 below turnoff to Gross Dam Road, 82 feet from road
- Location 2: Highway 72 above turnoff to Gross Dam Road, 30 feet from road
- Location 3: Lichen Lane off Gross Dam Road; 360 feet away
- Location 4: On Gross Dam Road at Crescent park Drive, 15 feet away
- Location 5: On Gross Dam Road at Chute Road, 82 feet away
- Location 6: 18 Juniper Heights Road; 15 feet off of Gross Dam Road

Ambient noise levels at these locations are compared to anticipated noise levels from haul trucks taking cement and fly ash to the staging area at the dam site.

Table 1: Ambient Versus Haul Road Noise from Behrans (2014)

Location	Daytime Ambient Noise Level (dBA)	Haul Truck Noise Level (dBA)	Difference in Noise Levels (dBA)
1	57.9	61.6	3.7
2	65.4	68.8	3.4
3	46.3	55.3	8.4
4	62.3	67.4	5.1
5	56.0	64.4	8.4
6	56.6	63.1	6.5

At four of the six locations, the increase of 5 dBA threshold was exceeded in this analysis. Further modeling brought the average of all 6 locations to 5 dBA and it was stated that the average was good enough. This will not mitigate noise impacts at 4 of the 6 locations evaluated. **Denver Water's results show that haul trucks along the Gross Dam Road will raise noise levels to greater than the allowable threshold of 5 dBA above ambient conditions at several locations. Residents close enough to Gross Dam Road would routinely be affected by truck noise during the daytime.**

The Behrens (2017) report evaluates how construction noise at the processing and blasting site will impact three locations: Receptor 1 at 370 Lakeshore Drive on the north shore and 0.65 miles away from the staging area at the dam, Receptor 2 at Miramonte Road 0.4 miles away from Osprey point, and Receptor 3, Coal Creek Canyon Road 1.18 miles from Osprey Point. Ambient noise data show that background noise ranged from 30 to 55 dBA in the February 22 to March 1 test period (Table 5-1).

Noises from several construction activities were combined in this assessment. The resultant construction noise level at each receptor was between 30 and 50 dBA all below construction standards of 80.0 dBA. Blasting noises ranged from 34 to 65 dBA, again below the instantaneous limit of 75 dBA. However, Receptor 2 in this study is located close to Osprey Point and to the haul route between Osprey point and the processing area for aggregate. Table 2 shows how this location would be impacted the most by construction activity at the blasting and dam site with the noise threshold routinely exceeded in all of the first three years of construction.

Table 2: Ambient Versus Construction Noise at Receptor 2 : Behrens (2017)				
Ambient Daytime Noise (dBA)	Osprey Quarry With Haul Trucks (dBA)	Change in Noise Levels (dBA)	Osprey Quarry With Conveyor (dBA)	Change in Noise Levels (dBA)
Year 1 and 2 of Construction Activities				
41.6	47.0	5.4	48.9	7.3
Year 3 of Construction Activities				
41.6	47.2	5.6	49.0	7.4
Blasting Alone				
41.6	Noise of Blast at Receptor 2 = 64.4 dBA		Change of 22.8 dBA	

Residents in areas surrounding the Gross Dam construction site are accustomed to natural outdoor noises. Additional noise caused by construction activity, even if those noises would potentially be below standards for construction activities, would deleteriously alter the environment for residents at Receptors 1 through 3 but particularly and routinely for residents on Miramonte Road as this area is closest to the Osprey Point quarry area and the construction haul route.

In both Behrens reports, noise from either delivery trucks on the Gross Dam road or construction/blasting noise were addressed. Combined noise levels for both of these activities were not addressed. In addition, noise from logging operations was not included in either report. Logging has the potential to affect residents on both the north and south sides of Gross Reservoir since trees and brush need to be removed from the entire shoreline of the new reservoir bringing these activities close to residences. Helicopter and grinder noises are certainly noticeable even if they do not exceed thresholds or noise standards.

How will these noises, that impact nearby neighbors, be addressed and mitigated.

Comment #8, pertaining to: Cumulative Effects: page 87 of EA; "Denver Water would monitor water quality and aquatic biota in compliance with WQC conditions, which would reduce effects of these resources." then they list all the plans they are going to produce which will reduce cumulative effects on resources. The plans are not done and there is no discussion of how success of the plans will be evaluated; i.e. what monitoring results will be a threshold for changing operations at the construction site. These need to be clearly defined.

The following is a list of Plans that Denver Water needs to complete before Boulder County can issue a 1041 permit for the Moffat Project. Noted are Boulder County's Land Use Code associated with LUC 8-511. Also noted are the document, primarily the FERC Environmental Assessment (EA), where each required plan was listed. Most of the plans have not been included in the 1041 Application for the Moffat Project. Some such as the Traffic Management Plan, the Tree Removal Plan, and a Quarry Operation (or Noise) Plan are drafted but need to be finalized. These plans are discussed in more detail above. Many of these plans were included in a list provided by STC in their preliminary comments on the completeness of Denver Water's 1041 permit application for the Moffat project.

1. South Boulder Creek Channel Stability and Monitoring Plan - B.5.c.iv, ix, x.
2. DO and Temperature Monitoring Plan - B.5.c.i, ix. B.5.f.all subheadings: need tiered release structures
3. Stormwater Management Plan - B.5.c.i, iv, v, vii
4. Erosion Control and Reclamation Plan - B.5.c.i, iv, v, vii on FS lands
5. Quarry Reclamation Plan - B.5.c.i, iv, v, vii - for osprey point quarry
6. Reclamation and Revegetation Seed Mixes and Mulch Materials - B.5.c.iv, v, vii pg 20 EA
7. Erosion and Sediment Control Plan - B.5.c.iv, v,vii
8. Pit Development and Reclamation Plan - B.5.c.iv, v, vii for Final EIS quarry on FS lands
9. Bank Stability Monitoring Plan - B.5.c.iii,iv,v,vi, vii
10. Quarry Operation Plan - I.5. will not cause nuisance factors such as excessive noise or obnoxious odors at Osprey Point quarry - discussed further in STC comments.
11. Tree Removal Plan: I 1,2,4,5. by FERC order 423; one year after the order a draft to Boulder county of preliminary concept- will be expanded for a final plan. Discussed further in STC comments.
12. Aquatic Nuisance Invasive Species Monitoring Plan
13. Recreation Management Plan (Article 416) page 16 of the EA; May 14, 2004.
14. Invasive and noxious Weed species Management Plan - page 17 of EA
15. Winter Ridge Recreation Management Plan + Monitoring - page 17 & 20 of EA
16. Fire Management and Response Plan - page 21 of EA
17. Special Status Plants Relocation Plan - special status plants on FS land page 21 of EA; A list of special status plants for Boulder county has been compiled in Exhibit 18 but a relocation plan needs to be completed.
18. Visual Resources Management Plan - page 22 of EA
19. Traffic Management Plan - F1,2,3 per order 425; page 22 of EA - manage construction traffic; required road maintenance and improvements, road damage due to construction activities, ensuring community traffic patterns are not disrupted. Will provide traffic management plan to Boulder county for review and comment within 1 year of FERC order. Discussed further in STC comments.
20. Historic Properties Mangement Plan - manage and protect cultural resources. page 23 EA.
21. Road Maintenance Plan: EA page 77; requirements for road work on FS lands.
22. Fugitive Dust Control Plan: EA page 84 to include measures to reduce fugitive dust from construction activities.
23. Public Safety and Law Enforcement Plan: revise old plan as needed for after construction is completed for recreation at the new reservoir.
24. Road Management Plan; page 91 EA.

Thank you for the opportunity to comment on the incompleteness of Denver Water's 1041 application for the Gross Reservoir and dam expansion. For the reasons stated herein, we request that you make a finding that the 1041 application is incomplete and direct Denver Water correct these deficiencies as outlined in this letter.

Please include Save the Colorado and The Environmental Group on all further correspondence and public notices for this project.

Sincerely,

Gary Wockner
Director, Save The Colorado
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Fort Collins, CO 80522
Gary@SaveTheColorado.org
970-218-8310

List of Exhibits

1. Woodling Report, 2018, "Aquatic Resources Assessment Of Federal Energy Regulatory Commission Supplemental Environmental Assessment For Gross Reservoir Project & Denver Water's Proposed Moffat Collection System Project"

2. Save The Colorado et al. "Climate Change and Greenhouse Gas Impact Analysis"

3. Buchanan Report, 2015, "Final Firm Yield Calculation LRB 1 Oct 2015"

4. Udall and Overpeck, 2017, "The twenty-first century Colorado River hot drought"

5. Hydros Risk Phase III Final Report

Aquatic Resources Assessment
Of
Federal Energy Regulatory Commission
Supplemental Environmental Assessment

For

Gross Reservoir Project & Denver Water's Proposed Moffat Collection System Project

John Woodling, Ph.D., Woodling Aquatics

April 2018

Executive Summary

Denver Water wants to divert additional water from the Fraser River Basin and the Williams Fork Basin to the South Fork of Boulder Creek on the eastern slope of Colorado. The Federal Energy Regulatory Commission released a Supplemental Environmental Assessment (EA) that is part of the approval process for The Moffat Project. The EA, like the Final Environmental Impact Statement (FEIS) failed to adequately describe the environment that will be potentially impacted, failed to describe and measure the impacts and failed to describe appropriate mitigation measures that would reduce these negative impacts. The failure of the EA to achieve these three objectives occurred due to general issues and specific issues pertaining to aquatic resources.

General Issues

The EA was written in such a manner as to guide the reader to the conclusion that introduction of nonnative flows to South Boulder Creek basin (including Gross Reservoir) from the Fraser River may improve fisheries or have almost no impact. The message was conveyed that artificially increasing the flow regime in the South Boulder Creek basin does not have any long term negative impacts. Another general message was that reducing temperatures in part of South Boulder Creek will likewise have little impact. Aquatic communities develop in response to all environmental factors, including elevated spring flows during the snowmelt period that maintain stream channel integrity. The value of a natural temperature regime was distorted to indicate abnormally low water temperatures in summer months will not have any impact on fisheries. Decreases in stream temperature were minimized.

Specific Issues relating to the EA

The EA failed to accurately describe the aquatic resources in South Boulder Creek. Information presented for each stream reach was limited to a few general claims and the naming of a few species. Potential environmental impacts to the section were presented in a few sentences without any support from the peer reviewed literature, data analysis or support documentation. The EA failed to accurately describe the potential impacts to aquatic resources in the South Boulder Creek basin. The main assessment tool utilized to assess potential impacts to fish population was an interpretation of Weighted Usable Area (WUA). WUA as utilized in the EA, which was not an appropriate tool to assess impacts to fish populations. The observation that WUA failed as an analytical tool is supported by multiple articles in the peer reviewed literature, the review of the draft FEIS by the US EPA, the US BLM EIS and by the authors of the FEIS. The environmental impacts to fish resources in the EA were opinions expressed by the document's authors, not an assessment based on analysis of data.

Other specific issues that contributed to the failure of the EA to accurately assess the aquatic resources in the south Boulder Creek basin included,

1. An assertion in the EA that enlarging Gross Reservoir could result in increased fish diversity in that water. The fish assemblage is comprised of mostly nonnative fish species. Size of the reservoir does not preclude stocking of other fish species. That could be done at any time.
2. An assertion in the EA that fish density in Gross Reservoir would increase as would productivity. Some increased productivity is possible but the level of increased productivity will be reduced by the tree removal program that is also scheduled.
3. The failure of the EA to recognize that mercury levels in fish flesh will continue at existing levels or increase. The 401 certification presented two reasons why mercury may increase in fish tissues if Gross reservoir is enlarged.
4. The failure of the EA to recognize the impact of increased flow levels on fish populations in South Boulder Creek upstream of Gross Reservoir attributable to increased spring flows
5. The failure of the EA to recognize the impact of reduced temperatures on fish populations in South Boulder Creek downstream of Gross Reservoir.

The EA did not accurately describe the aquatic resources in South Boulder Creek basin. The description of aquatic resources in the Study Area was not of sufficient detail and accuracy to serve as a basis of defining and assessing environmental impacts to aquatic resources. As a result the EA failed to identify, quantify or qualitatively measure potential environmental impacts to the waters throughout the South Boulder Creek basin.

Mitigation

The EA listed a series of eight projects and described those projects as mitigation. Six of the eight actions were limited to monitoring. Monitoring is not mitigation. Actual mitigation actions were not described, except for the creation of a 5,000 acre Environmental Pool and removal of trees from the area that would be inundated in an expanded Gross reservoir if the Moffat Project is completed. The 5,000 Environmental Pool may actually make temperature issues in South Boulder Creek worse if the Moffat Project is completed. The tree removal project does not benefit fish populations in Gross Reservoir. The best available mitigation project was not included in the EA. A multi-stage release from Gross Reservoir would eliminate all environmental impacts in South Boulder Creek downstream of Gross Reservoir. Denver Water refuses to consider this option. Denver Water could have earned a lot of respect from the environmental community by agreeing to install and operate a multistage drain system. As written, the mitigation section of EA tries to claim the monitoring projects are actually mitigation projects. The EA, like the FEIS did not assess potential environmental impacts and did not include appropriate mitigation projects.

Federal Energy Regulatory Commission

Analysis of Supplemental Environmental Assessment

Pertaining of Aquatic Resources

Introduction

Denver Water seeks to enlarge Gross Reservoir and transfer additional water from the western slope of Colorado (The Fraser River Basin and the Williams Fork Basin) to the South Fork of Boulder Creek on the eastern slope of Colorado for delivery to customers via the reservoir and South Boulder Creek. The Federal Energy Regulatory Commission prepared a Supplemental Environmental Assessment (EA) that will be part of the basis for the approval process for enlarging Gross Reservoir.

A purpose of the EA is review environmental effects related to a Federal Energy Regulatory Commission approval of Denver Water's proposal to increase the size of Gross Reservoir that were not addressed in the Corps' 2014 Final Environmental Impact Statement. The EA has to describe and measure the impacts and to describe the mitigation measures that will be used to reduce these negative impacts. This EA reflects and addresses comments to FEIS that were received from a wide range of public and private entities.

I have been asked by Mike Chiropolos to review the portions of the EA that deal with aquatic natural resources of South Boulder Creek and Gross Reservoir. However, other waters involved in the Moffat project will be indirectly impacted by actions described in the EA. The other waters that are involved include the Fraser River Basin, the Williams Fork Basin, and the Blue River downstream of Dillon Reservoir, and the mainstem Colorado River to a point downstream of the confluence with the Williams Fork.

I have reviewed the sections of the EA that pertain to aquatic resources within South Boulder Creek and Gross Reservoir and have found several topics that warrant concern. First, the aquatic resources within the project area are not adequately described and assessed. Secondly, the impacts to the aquatic resources within the project area are consistently diminished in scope and magnitude. As a result, the EA underestimates the actual negative environmental impacts of the Denver Water Project and does not provide adequate mitigation measures for some of the actual impacts to aquatic resources.

The following sections of this manuscript describe issues that I found with the EA. My comments are primarily limited to sections of the EA addressing aquatic resources. Other issues that require attention include water quality, water temperature and the interaction of stressors on aquatic resources.

General Comments

Stream and river ecosystems are the result of a complex and millennial-long sets of interactions between geological and climatological factors. Precipitation levels, temperature, and wind interact with local geology to create drainage basins as water flows from areas of higher elevation to lower elevations. In Colorado, the local geology includes the Rocky Mountains, rising to more than 14,000 feet above sea level. Eon- long interactions resulted in the drainage basins that are found along the backbone of the Continental Divide in Colorado.

The resulting stream and river systems support diverse and abundant flora and fauna as the waters flow from the highest mountains to the warmer desert and grassland regions at lower elevations. The highest elevation headwater streams tend to have lower water temperature regimes, a steep gradient (thus faster water velocities) and substrates comprised of mixed materials ranging in size from very large boulders to cobble, gravel sand and silt. Lower elevation streams and rivers increase in size as small tributaries merge with the mainstem. At the same time water temperatures increase, water velocity slows and silt, sand and gravel substrates become more prevalent. River valleys become wider so streams meander back and forth across the floor of these valleys.

Stream and river systems in Colorado continue to be comprised of interactions between water and rock. The larger bed load material (boulders and large cobble) moves downstream during peak flood events such as the one hundred-year and one thousand-year flood events. A hundred-year flood results from a storm event that occurs on the average once every 100 years. On the average the stream becomes bank full once every two years. The bank full events help maintain channel integrity.

Seasonal patterns of flow and temperature exist in the streams and rivers that drain the Rocky Mountains in Colorado. Base (or low flows) are routinely present in late fall and winter months, as most if not all precipitation is in the form of snow that covers the ground until the spring thaw. Stream flows increase in the spring as snow melts. Silt and sand are picked up and borne downstream by the quickly moving, high flow level stream conditions. Snow melt flows reach maximum levels usually in May or early June, every two years on the average reaching bank full levels. Water levels then decline (often quite rapidly) to lower levels in the summer. Late in the summer water levels start down to base flows once again.

Over longer time periods stream flow responds to drought and wet-year cycles. During severe drought, spring snow melt flow levels do not increase stream flows much over the base flow condition. Smaller headwater streams may even be dry. During wet cycles, spring snowmelt levels may reach bank full levels frequently, and over top the river banks. Stream channels are created and maintained by the water regime of the basin over long periods of time.

The stream channels of the Fraser River basin and South Boulder Creek basin were formed and maintained over eons. These channels are now responding to changes in flows that have existed only for decades. The proposed additional diversions of water and the manner in which the water is moved and then used will further alter not only South Boulder Creek but the Fraser River system. The following sections will assess the EA in relation to the interaction of altered flows, stream habitat and aquatic life in the South Boulder Creek basin and some portions of the Fraser River.

Gross Reservoir

The EA included sections concerning Gross Reservoir. Gross Reservoir would be enlarged to store the additional water diverted from the western slope as part of the Moffat Project. Water stored in spring and summer months will be released for use in late fall and winter months. The EA included the following statement concerning fish populations in Gross Reservoir,

> "The Final EIS found that enlargement of the reservoir would cause a short-term, beneficial increase in reservoir productivity that would result in higher fish densities. It also found that the additional shoreline habitat resulting from the enlargement would increase reservoir fish population fish diversity and abundance through increases in available habitat" (Section 5.1.4, first paragraph).

These sentences are misleading and partially incorrect. First, one phrase in the preceding statement from the EA asserts the "additional shoreline habitat resulting from the enlargement would increase reservoir fish population fish diversity." This statement is incorrect in relation to diversity as related to the number of fish species present. The fish populations found in Gross Reservoir are, for the most part, nonnative species that were stocked to produce sport fishing opportunities. Longnose sucker and white sucker are two native fish species found in Gross Reservoir (in large numbers) and neither are target species sought by anglers. The only native fish species sought by anglers is the native cutthroat trout which is mostly extirpated from the South Platte basin and is not found in Gross Reservoir. Other nonnative fish species were stocked to create fishing opportunity, ranging from the lake trout to the rainbow trout. Nothing precludes introduction of other nonnative fish species at the present time to increase diversity. Enlargement of the reservoir is simply not a needed component of a decision to stock additional species. Enlarging the reservoir would likewise not mandate the stocking of additional species to increase diversity.

Similarly, the claim was made that fish numbers would increase "through increases in available habitat," a reference to a larger reservoir. The reservoir will increase seasonally in spring and summer and then decrease as water is released. Fish density is not regulated by the maximum amount of habitat available for a short time periods, but by a complex interaction of fish spawning times, seasonal water levels, amount of critical habitat for emerging fry and fingerlings, food supply, etc. The author of the EA did no analysis to demonstrate that fish populations would increase simply due to a short-term seasonal increase in habitat.

The statement is also made that enlargement of the "reservoir would cause a short-term, beneficial increase in reservoir productivity," leading to increased fish densities. A well accepted fact of fisheries management is that productivity increases as a land mass is first impounded upstream of a filling reservoir. The productivity increase is the result of the decomposition of terrestrial vegetation that is inundated by the rising waters. In the case of Gross Reservoir, the increase in productivity will not be nearly as pronounced, as the terrestrial vegetation will be removed **prior** to impoundment. The vegetation is being removed in an attempt to modulate the mercury levels in the fish populations of Gross Reservoir (see following paragraphs). The claim that fish densities would increase is not supported by literature citations or other examples. Some increase in productivity will result for a few years at a much reduced level. The EA failed to analyze the interaction of vegetation removal and claims of increased reservoir productivity.

Language in the EA likewise asserted that,

> "Raising the maximum reservoir elevation from 7,282 feet to 7,406 feet, would increase the surface area of the reservoir from 418 acres to as much as 842 acres, and increase the total length of the reservoir shoreline from 11 miles to as much as 14 miles. This would result in the development of as much as 3 additional miles of littoral shoreline aquatic habitat, which would benefit those fish species that currently utilize littoral areas. Similarly, increasing the maximum storage capacity of the reservoir from 41,811 acre-feet to 118,811 acre-feet would create additional pelagic habitat, benefiting fish that utilize open-water habitat areas. Overall, the effect of reservoir enlargement on littoral and pelagic species would be long-term and beneficial" (EA page 55).

These statements are also misleading. Water levels in the enlarged Gross Reservoir will fluctuate. The water level is likely to fluctuate to a greater degree than under current conditions (Colorado Water Quality Control Division Rationale for conditional 401 certification of Moffat Collection System Project, page 23). As noted above, fish density is not regulated by the maximum amount of habitat available for a short time period (when the reservoir is filled to capacity) but a complex interaction of fish spawning times, seasonal water levels, amount of critical habitat for emerging fry and fingerlings, food supply, etc. The author of the EA did no analysis to demonstrate that fish populations would increase simply due to a short-term seasonal increase in reservoir volume.

The EA does not provide any proof that fish populations in Gross Reservoir will benefit from a seasonal increase in reservoir size due to the Moffat Project. Productivity would increase for a short time but that benefit does not provide a substantive mitigation for any long term habitat loss due to the project.

Mercury levels in fish flesh is an existing issue in Gross Reservoir. Mercury levels currently warrant a Fish Consumption Advisory. (Colorado Water Quality Control Division Rationale for conditional 401 certification of Moffat Collection System Project, page 23). For example, mercury levels in lake trout routinely exceeded the Colorado Health Department action level of 0.3 ppm from 2011 through 2015 and a large brown trout (18 inches) likewise exceeded the action level in 2011 (Colorado Department of Public Health data). The single tiger muskie sampled (2007) had a mercury level of 0.56 ppm.

The enlargement of Gross Reservoir is likely to create conditions "conducive to the methylation of mercury" (Colorado Water Quality Control Division Rationale for conditional 401 certification of Moffat Collection System Project, page 24). The first condition is the decomposition of newly submerged plain material as the newly enlarged reservoir fills. In addition, the fluctuation of water level may result in additional methylation of mercury as reservoir surface is alternately "exposed and rewetted," and when volumetric oxygen demand increases as the level of water in the reservoir falls resulting in a smaller hypolimnion. Mercury levels in fish will not diminish but likely increase since the reservoir substrate will alternately experience the recolonization of terrestrial plants during dry years and subsequent inundation when water levels increase. This pattern of plant growth on a dry section of a reservoir substrate during dry years can be seen in reservoirs throughout Colorado and other western states.

Language in the EA asserts that,

> "The Final EIS also found that short-term increases in methylmercury levels would be expected in tissue of fishes in Gross Reservoir," (page 52),

and

> "Implementation of Denver Water's tree removal plan and compliance with WQC condition 13 would reduce the likelihood of significant elevations in mercury levels in fish, and would also help to protect human health," (EA page 55).

The tree removal program will mitigate against the increase in mercury levels in fish, via the food chain, when the enlarged reservoir is first filled. However, fluctuating reservoir levels will result in periodic episodes of terrestrial plant regrowth on the reservoir substrate during drought periods. Mercury levels could increase as enlarged reservoir is refilled and the newly grown plant material begins decomposing. No proof is offered that any increased mercury in fish flesh will be short-term. “Condition 13” refers to a monitoring program and a signing program. The monitoring will measure fish mercury levels and the signs will be a public warning concerning fish consumption. The implementation of Condition 13 in no way will “reduce the likelihood” of an increase in mercury levels in fish in Gross Reservoir if he Moffat Project is completed.

No actual mitigation for increased mercury levels is included in the FEIS, the 401 or this EA. Nothing in either the FIES or EA does anything past the first tree removal program to prevent adverse impacts to the ecosystem and food chain in Gross Reservoir relative to mercury in fish flesh.

South Boulder Creek Moffat Tunnel to Gross Reservoir

The object of the Moffat Project is to move additional waters from the west slope of Colorado for use by Denver Water via Moffat Tunnel. These waters would be diverted to South Boulder Creek during the spring and summer months. The amount of water being diverted is relatively large compared to the existing stream channel of South Boulder Creek. The changes in water flow would be rather dramatic. Mean monthly flows could be up to 25% greater in South Boulder Creek from the Moffat Tunnel to Gross reservoir in the months of June and July (FEIS Chapter 4-514). High flow events would occur more often such that the five year maximum flow event would occur every four years and the ten year event would occur every seven years. As a result increased bank instability (FEIS Chapter 4-514) would occur and erosion rates would increase. The increased bank instability is an expected response to increased flows. The stream bed will begin to be modified by the higher flows until an equilibrium is reached and once again the five year flow event will happen on the average every five years and the ten year event every ten years.

Increased summer flows negatively impact trout reproduction when stream flows reach, or exceed, bank full events. Bank full events are those flows that occur every two years in most Colorado trout streams. Those flows would be more common in this section of South Boulder Creek after the Moffat Project is completed due to increases in June and July. Recently emerged trout fry require habitat with a zero stream flow and a shallow depth to avoid predation by adult trout. These zero flow areas are less abundant as the water volume in a stream increases. Survival of trout fry is negatively correlated to stream flow levels. Ironically, fry survival is high in periods of drought and low in wet years. Fingerling survival is further reduced when stream flows are so high that bank instability leads to bank erosion. The impact of increased June and July flows on fry survival was not specifically included in the FEIS or EA.

The FEIS included language that asserted changes in the Weighted Usable Area[1] for trout would decrease but that the changes would be "negligible for all life stages in all year types (FEIS Chapter 4-5-5). The FEIS included a recommendation that "further 'bank' stabilization could become necessary," but that "no changes is Water quality would occur," while there "would be mostly minimal changes in trout habitat availability," (FEIS Chapter 4-515). The FEIS did not adequately describe the impact of habitat change due to increased water flows in South Boulder Creek upstream of Gross Reservoir. Instead, qualifying words were used such as further bank stabilization "could" become necessary and changes in trout habitat would "mostly" be minimal. The success of bank stabilization is highly questionable. The flow regime in a stream determines stream bed morphology. Permanently higher spring flows will widen and deepen the stream channel over time without regard to human attempts to stabilize a stream bank that is too narrow and too shallow.

The FEIS did not address the impact of the Moffat Project on South Boulder Creek just upstream of Gross Reservoir. The EA attempts to describe the impact of the Moffat Project on the 5,000 feet of South Boulder Creek immediately upstream above Gross Reservoir that would be periodically inundated after reservoir enlargement. The following language was included in the EA,

> "Specifically, water levels in Gross Reservoir after the reservoir enlargement would be lowest in April. The reservoir would then begin to fill in May, and would be highest from June through September. It would then decrease from October through March. Because water levels would be increasing in May through June, when rainbow trout and sucker spawning occurs, spawning areas for these species near the mouths of Winiger Gulch and South Boulder Creek would not likely be affected. Eggs of rainbow trout and suckers require flowing water to provide and replenish oxygen to survive; therefore, already incubating eggs would be deprived of oxygen and likely be lost as lotic habitat transforms into lacustrine habitat. Spawning areas and eggs of brook trout and brown trout, which also require flowing water for oxygenation, would largely be unaffected, because brook and brown trout spawn in October and November when reservoir water levels would generally be decreasing. Surviving trout and sucker fry would move to suitable areas of the tributary to rear," (EA page 54).

This paragraph is incomplete, contains factual errors and is misleading to some degree. Both white sucker and longnose sucker spawn in rivers and streams but both species can spawn in lakes. The presence of both sucker species in Gross Reservoir is independent of flow regimes in South Boulder Creek and Winiger Gulch. Incubating eggs of rainbow trout indeed would likely

[1] I would assert the WUA is not appropriate and several peer reviewed publications support that contention. The reader is referred to the following section (South Boulder Creek from Gross Reservoir to Boulder Diversion Canal) for a discussion of this issue.

die as water velocity slows over redds and silt covers the stream bed during summer months of increased flow rates.

Brown trout and brook trout are fall spawning species. Fertilized eggs of both species require about 405 degree days to hatch. The recently hatched fry stay submerged in the gravel until the yolk sac is absorbed. The fry then "swimup" into the water column and look like a miniature trout. These fry require waters with a zero flow velocity that are fairly shallow. Brown trout swimup into the water column in late April to May as water levels will rise in South Boulder Creek. The number of brown and brook trout that will survive decreases as the water level in the stream increases (Woodling et al. 2005, Woodling and Rollins, 2008). Despite the claim in the EA, brook trout and brown trout reproduction will be affected by the increased flow regime in South Boulder Creek upstream of Gross Reservoir as spring flows reach bank full levels. Areas of zero flow rate will be relatively rare in most years if a five year flow event occurs every four years.

The last claim in the above quote from the EA is that,

> "Surviving trout and sucker fry would move to suitable areas of the tributary to rear."

Recently emerged trout require zero flow water for shelter immediately upon emerging from the gravel. June and July flows can be up to 25% following enlargement of the reservoir, while five and ten year flood events will become more common. "Suitable" habitat for recently emerged trout, of all species, will be rarer in South Boulder Creek upstream of Gross Reservoir than in most trout streams in Colorado which do not receive an infusion of nonnative stream flows during the snowmelt months.

The description of fish in this section of South Boulder Creek is superficial and incomplete. Some of the observations are in error. The description and analysis would have to be done again in detail, using on-site field studies to actual impacts to trout in South Boulder Creek upstream of Gross Reservoir.

Aquatic macroinvertebrate resources South Boulder Creek, Gross Reservoir to South Boulder Diversion Canal

The FEIS did not address the impact of the Moffat Project on South Boulder Creek just upstream of Gross Reservoir on macroinvertebrates. The EA attempts to describe the aquatic macroinvertebrate impacts attributable to the Moffat Project on the 5,000 feet of South Boulder Creek immediately upstream above Gross Reservoir that would be periodically inundated after reservoir enlargement. The following language was included in the EA,

> “The current benthic macroinvertebrate community supports rearing juvenile trout and suckers. However, when reservoir water levels are increased and inundate tributary streams, the macroinvertebrate communities in those streams would likely shift to species that prefer lentic conditions. When reservoir water levels decrease, rheophilic benthic macroinvertebrates would recolonize previously-inundated areas, displacing those that prefer lentic environments. Therefore, effects of reservoir filling and operations on benthic macroinvertebrates would be temporary and minor,” (EA page 55).

No literature citations, studies or examples were offered to support the statements presented in this paragraph. Many of these ideas appear to be unsupported opinion. Many aquatic macroinvertebrates pass the winter months in a quiescent (non-moving, non-active) stage, such as an egg, or as a pupa. These quiescent lentic species would die as water levels decrease in winter months and flowing waters once again fill the South Boulder Creek stream bed. Many aquatic macroinvertebrates in South Boulder Creek upstream of Gross Reservoir would likewise be in a quiescent life stage in winter months and would not drift into the recently exposed stream bed. Of course many aquatic macroinvertebrates appear to be active through the winter (such as the mayfly genus *Baetis*). Thus, some benthic macroinvertebrates would drift downstream into the previously-inundated areas. Many others would not.

Likewise, lentic species may well colonize the stream bed as water levels increase in the spring and the stream substrate once again becomes the bottom of a reservoir. The rate of colonization will be rather slow. These insects are small and do not move very quickly and 5,000 feet is a long distance.

The EA and the FEIS both fail to describe the habitat of the South Boulder Creek upstream of Gross reservoir. Only superficial level of analysis and comparison was performed. Additional work would be needed to accurately assess both the aquatic habitat and fisheries of this stream reach. This is the same conclusion that could be applied to each section of the EA and FEIS that address aquatic resources.

Gross Reservoir to South Boulder Diversion Canal

South Boulder Creek downstream of Gross Reservoir to South Boulder Diversion Canal is a focal point of impacts that would be attributable to completion of the Moffat Project. The current temperature regime of this stream reach is far colder than would be expected in a stream of the same elevation as South Boulder Creek downstream of Gross Reservoir. Denver Water releases water to South Boulder Creek from outlet structures located deep in the reservoir at the base of the dam that impounds Gross Reservoir. Gross Reservoir stratifies in the summer so that the water when released remains very cold in the depths where the release structures are found. Temperatures do increase downstream of Gross Reservoir in the summer and reach maximum levels in October, only to decrease once again in the fall (WQCD 2016). “The maximum temperature below the reservoir occurs when stratification ends and the fully mixed reservoir is more or less isothermal (WQCD 2016).

This temperature pattern is different than found in most Colorado mountain streams. Warmest waters downstream of Gross reservoir are currently measured in September, not in July or August and range from 13°C to 15°C (WQCD 2016). During summer months, temperatures currently range from 5°C in June to 8°C or 9°C in August (WQCD 2016), far lower than found in streams and rivers at similar elevations in the mountains of Colorado. Fish and aquatic macroinvertebrates are cold-blooded and growth is controlled by temperature. Growth of fish and aquatic macroinvertebrates is lower and slower downstream of Gross Reservoir in relation to waters in streams with warmer temperatures. The temperature of South Boulder Creek upstream of Gross Reservoir is warmer than downstream during the summer months as the sun warms the shallow waters of South Boulder Creek. Water temperatures do not rapidly increase farther downstream in Boulder Creek "as there is little warming of water in this segment" (FEIS Page 4-516-517).

Completion of the Moffat Project will eliminate the early fall period of warming that is currently observed downstream of Gross reservoir (WQCD 2016). More water will be held by the dam and the depth of the hypolimnion will increase so that release of cold water will be of longer duration in the fall. Operation of the reservoir after completion of the Moffat project would result in a 30% decrease "of degree days that are currently available for fish growth" (WQCD 2016).

The FEIS description and analysis of fish habitat in South Boulder Creek was limited to a single analysis of habitat using Weighted Usable Area (WUA). Influences of temperature (or other factors) were not described in any meaningful and in-depth manner. The FEIS presented an analysis of available habitat that concluded,

> "The increases in winter flows would result in large increases in rainbow trout habitat availability and the small decreases in spring runoff flows would decrease conditions that may be stressful to early life stages of this species," (Chapter 4 page 4-517).

As I noted in my analysis of the FEIS (Woodling 2015),

> "The main assessment tool utilized throughout Chapter 4 to assess potential impacts to fish population was an interpretation of Weighted Usable Area (WUA). WUA as utilized in the Final EIS was not an appropriate tool to assess impacts to fish populations. The observation that WUA failed as an analytical tool was supported by multiple articles in the peer reviewed literature, the review of the draft EIS by the US EPA and US BLM EIS and by the authors of the EIS. The environmental impacts to aquatic resources in the Final EIS were opinions

> expressed by the document's authors, not an assessment based on analysis of data," (Woodling).

WUA measures only one aspect of the environment, regardless of how appropriate the method may be. I would assert the WUA is not appropriate and several peer reviewed publications support that contention. However, an analysis of any environment based on a single variable is not adequate when attempting to describe the impacts of a project where factors other than the amount of usable habitat are also being altered.

Fishery resources South Boulder Creek, Gross Reservoir to South Boulder Diversion Canal

Water temperature is a critical component of the environment, especially when the proposed change limits the growing season for trout by 30%. Rainbow trout hatch in the summer months and emerge into the water column. The fry begin feeding and start growing. The fish must grow to a certain length and amass a certain lipid level to survive the winter months (Biro et al. 2004). Growth and lipid levels would differ by water. Salmonids in general do not feed when water temperatures are less than 4°C. Growth of rainbow trout (including fry) will be reduced significantly in South Boulder Creek when summer temperatures range from 5°C (June) to 8°C (August). The impacts of the proposed temperature regime on rainbow trout populations is simply not known and was not explained in the EA.

Impacts of temperature on brown trout populations were likewise not included in the FEIS. Brown trout spawn in Oct, and perhaps the first two weeks of November. The eggs hatch after exposure to about 405 degree days of temperature. Temperatures in South Boulder Creek downstream of Gross Reservoir will be warmer than any other time of year when the brown trout spawn. The eggs may hatch by December. The young sac-fry will remain in the gravel until the yolk sacs are completely utilized. Young brown trout potentially could swimup into the water column when winter flows are still elevated. Swimup fry must find habitat where still water is present, water with no measurable flow rates. Brown trout could potentially swimup during the late winter (February or so) when stream flows would be higher than currently found in South Boulder Creek. The higher the water level the less zero flow habitat available for trout fry. Strangely, the comparatively warmer water temperatures in October and November could negatively influence brown trout reproduction. An analysis of both instream temperature and emergence time would be needed to determine the impact of an altered temperature regime on brown trout.

The FEIS needed a detailed analysis of how the extremely low water temperatures in South Boulder Creek post-project would impact fishery populations, and not just trout. The FEIS did not include a detailed analysis of the impacts of temperature on fish, noting in passing,

> “The cooler temperatures throughout the year would limit trout growth and survival and likely dampen the beneficial effects of greater habitat availability,” (Chapter 4 page 4-517).

No proof was presented that changes in habitat would be significant in relation to temperature. A statement cannot be made one way or the other concerning “dampening”

The EA description of impacts to the South Boulder Creek fish assemblage is as follows,

> “Within South Boulder Creek downstream of Gross Dam, the Final EIS determined that the expansion of the Moffat Collection System would overall have minor, beneficial impacts to fisheries and aquatic resources because flows downstream in South Boulder Creek would be higher in winter and peak flows would be reduced. It also found that overall cooler water temperatures would be provided downstream of Gross Dam, which would limit fish growth and survival. The Final EIS determined that certain mitigation measures proposed by Denver Water, including operations of the Environmental Pool, a Fish and Wildlife Mitigation Plan, and a Fish and Wildlife Enhancement Plan would benefit fish and aquatic resources,” (EA page 52).

The EA concluded that the listed mitigation measures “would benefit fish and aquatic resources” in South Boulder Creek (see above paragraph). This conclusion is incorrect for two reasons. First, as noted by WQCD 2016, operation of the Environmental pool could make the impact of lower temperatures greater because the volume of the reservoir would be increased. The Environmental Pool would worsen conditions instead of mitigating the issue of colder water downstream of Gross Reservoir. Secondly, as noted above, the FEIS and EA do not adequately describe the fishery resources of South Boulder Creek and how those resources would react when water temperatures are reduced even farther than current conditions. Current mitigation measures as proposed by Denver Water cannot be evaluated against environmental impacts attributable to the Moffat Project because those environmental impacts have yet to be properly described. Decreased temperature and reduced growth rate of fish are two factors that are of paramount importance when analyzing the impact of the Moffat Project on South Boulder Creek. Neither was addressed in the EA or the FEIS.

Aquatic macroinvertebrate resources South Boulder Creek, Gross Reservoir to South Boulder Diversion Canal

The aquatic macroinvertebrates found in Boulder Creek likewise are coldblooded species that are regulated by temperature. Aquatic macroinvertebrates often are found along an altitudinal gradient from higher elevations to lower elevations. Water temperature is the principal environmental factor that influences this elevational distribution. The elevational gradient of aquatic macroinvertebrates was determined in Boulder Creek a long time ago (Dodds and Hisaw, 1925). Further work on elevational zonation was developed for mayflies (Ward and Berner 1980) and stoneflies (Knight and Gaufin 1966). Higher elevation waters are colder than low elevation waters. South Boulder Creek is very similar to Boulder Creek so the species distribution along an elevational gradient should be similar for the two waters.

The temperature regime of South Boulder Creek currently is colder than most trout streams of similar elevation in the area. The temperature regime will decrease even more if the Moffat Project is constructed. Any analysis of aquatic macroinvertebrates in South Boulder Creek would require an analysis of how current and future temperature regimes have influenced the species assemblage in South Boulder Creek downstream of Gross Reservoir. The community may be more like a higher elevation stream than a stream of similar elevation.

The FEIS analysis of aquatic macroinvertebrates was performed using the Multi Metric Index developed by the Colorado Water Quality Control Division. The Division uses this tool to determine if streams and rivers in Colorado are attaining the aquatic life designations that are assigned to stream segments by the Colorado Water Quality Control Commission. The MMI is a useful tool. A MMI score usually increases as the number of taxa of a particular group (such as Mayflies, or predators, or species that "cling" to a rock) increases. The MMI does not indicate much about the ecology of individual species, specifically temperature preferences or temperature requirements. For example, many coldwater obligate species are members of taxonomic groups that contribute to a high MMI score. Other members of the same group may prefer warmer, lower elevation streams and rivers. MMI scores may not increase or decrease as elevation changes and one member of a metric group may be replaced by another that is perhaps more tolerant of higher water temperatures. Therefore MMI scores at a site downstream of Gross Reservoir may not change as cold water obligate species of a sensitive group such as Ephemeroptera replaces a member of the same taxonomic group that does not tolerate cold water.

Sampling aquatic macroinvertebrates in South Boulder Creek appears to require a different approach to determine impact of low water temperatures on the species assemblage. The species assemblage present could be compared to the elevational gradients developed by Dodds and Hisaw (1925), Knight and Gaufin (1966) and Ward and Berner (1980). The water temperature in South Boulder Creek is very cold and will become colder if the Moffat Project in operation. Entities involved in assessing the conditions in South Boulder Creek could use a species ecology based approach to determine if colder temperatures are impacting the aquatic macroinvertebrates of South Boulder Creek downstream of Gross reservoir. More analyses than solely the MMI are needed to determine if colder temperatures alter the benthic community in this stream.

Neither the FEIS nor the EA have described the benthic community of South Boulder Creek adequately. No determination can be made concerning the relationship of aquatic macroinvertebrates and lower stream temperature regimes that would be present if the Moffat Project is completed. More detail is needed to determine if mitigation programs are needed.

Evaluation of proposed mitigation actions.

Several proposed mitigation actions proposed by Denver Water were included in the EA. Six address Water Quality issues and two address Fisheries and Aquatic Resources. These actions are.

1. Finalize a tree removal plan for trees in the inundation area
2. Monitor continuous temperature at four locations in South Boulder Creek
3. Monitor metal concentrations in South Boulder Creek
4. Monitor dissolved oxygen and temperature in Gross Reservoir for 3 years
5. File with FERC a revision to its approved South Boulder Creek Channel Stability Monitoring plan
6. Store a 5,000 acre foot Environmental Pool in Gross Reservoir
7. Develop an Aquatic Nuisance Invasive Species Monitoring Plan
8. Monitor "health" of aquatic macroinvertebrates downstream of Gross Reservoir

Monitoring is not mitigation. Mitigation actions are supposed to lead to an environmentally preferred outcome (Sutley 2011). Monitoring is used to monitor the effectiveness of mitigation, in this case reducing impacts to South Boulder Creek caused by increasing the volume of water flowing through the system and lowering water temperature in South Boulder Creek. Likewise, developing an Aquatic Nuisance Invasive Species Monitoring Plan is not a mitigation program. Aquatic nuisance species issues appear everywhere and entities everywhere have to deal with the problem. Some of the invasive species that could appear in Gross Reservoir could negatively impact treatment costs for Denver. Dealing with an environmental nuisance species that may appear in the future is not mitigation for enlarging Gross Reservoir.

The tree removal program for Gross Reservoir likewise is not entirely mitigation. The trees are being removed to possibly modulate mercury accumulation in fish. However, tree removal will also decrease the magnitude of any post impoundment increase in productivity of Reservoir. The tree removal program does not benefit the natural resources in any manner and should not be considered to mitigate for environmental damage.

The 5,000 acre foot Environmental Pool is not a well thought out mitigation action. The 5,000 acre foot storage will actually make water temperature issues downstream of the reservoir worse (WQCD 2016, Appendix A.

The EA did provide information that leads readers of the EA to the conclusion that two environmental issues will likely develop if the Moffat Project is completed. First, the increased amount of water diverted from the Fraser River may well result in a long-term change in the physical habitat of South Boulder Creek upstream of Gross Reservoir. Bank instability was predicted to increase along with erosion. Higher spring flows and an increased frequency of high flow events will both result in modifications of the stream channel. The stream channel will evolve over time to handle the increased flows. Downstream siltation levels will increase. The EA and the FEIS should address this issue in far more detail and plan appropriate mitigation.

The EA includes a mention that increased bank stability may require bank stabilization. However, bank stabilization is not included as a mitigation program. Efficacy of bank stabilization is questionable in this case. Increased spring snowmelt flows will result in stream channel modification as the geology and artificially altered water regime in South Boulder Creek move to an equilibrium. The stream channel over time will adapt to the new flow levels. Human actions to stabilize existing stream banks will last only a relatively short time.

Secondly, the water temperature regime downstream of Gross Reservoir will remain in the single digits if the Moffat Project is completed. The maximum temperature would be about 9°C in October. Fish growth would be reduced and fish reproduction issues may also result. No mitigation actions for this impact were included in the EA.

The EA did not include any mitigation action in South Boulder Creek that would actually mitigate for the environmental impacts associated with the Moffat Project. A series of monitoring programs was included in the EA and listed as mitigation even though no environmental improvement results from monitoring. One possible project exists. A multi-stage release from Gross Reservoir would eliminate all environmental impacts in South Boulder Creek downstream of Gross Reservoir. Denver Water refuses to consider this option. Thus mitigation like the FEIS and EA is actually an ineffective and empty process.

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SAVE THE COLORADO SAVE THE POUDRE WATEKEEPER ALLIANCE
WILDEARTH GUARDIANS LIVING RIVERS THE ENVIRONMENTAL GROUP

June 18, 2015

TO: Rena Brand and Kiel Downing, U.S. Army Corps of Engineers

Re: **Moffat Collection System Project: Climate Change and Greenhouse Gas Impact Analysis**

Dear Ms. Brand and Mr. Downing,

Climate change presents a critical challenge to Colorado, the Southwest United States, and our planet. The organizations signed below are deeply concerned about the current and coming effects of climate change, and are committed to finding solutions to environmental problems that do not create new environmental problems or worsen existing problems. At a minimum, environmental decision-making must be fully informed by comprehensive analysis of potential climate impacts so that agency action can be designed to avoid, minimize, and mitigate impacts.

This letter is submitted to inform and assist the Corp's analysis as it formulates the Record of Decision for the Moffat Collection System Project. The Corps has committed that it will accept "meaningful and substantive comments on the analysis until the agency makes a decision on the project…"[1]

The National Environmental Policy Act requires that the U.S. Army Corps of Engineers analyze all environmental impacts associated with the proposed Moffat Collection System Project ("Moffat"). Because Moffat requires permitting under the Clean Water Act, the Corps' assessment of the project must address the EPA's 404(b)(1) guidelines (see 40 C.F.R. § 230), and the Corp's "public interest" factors (see 33 C.F.R. §§ 320 et seq.) including:

- Rejecting a permit if there is a practical alternative that would cause less adverse impact
- Ensuring that permitting the project does not cause significant degradation to waters of the U.S., including jurisdictional Waters of the U.S. such as riffle-pool complexes and "jurisdictional wetlands"
- Mitigating any impacts

Commensurate with increasing scientific recognition of the nature and scale of the threat, law and policy are evolving with regard to the level of climate change analysis needed in federal environmental reviews. The Counsel of Environmental Quality (CEA) recently issued new "draft

[1] http://www.dailycamera.com/boulder-county-news/ci_25989891/epa-see-plans-gross-reservoir-expansion-threat-water

guidance" (Dec. 2014) about climate change emissions from projects evaluated under NEPA. According to the CEQ's summary of the new Draft Guidance:

> This guidance explains that agencies should consider both the potential effects of a proposed action on climate change, as indicated by its estimated greenhouse gas emissions, and the implications of climate change for the environmental effects of a proposed action. The guidance also emphasizes that agency analyses should be commensurate with projected greenhouse gas emissions and climate impacts, and should employ appropriate quantitative or qualitative analytical methods to ensure useful information is available to inform the public and the decision-making process in distinguishing between alternatives and mitigations. It recommends that agencies consider 25,000 metric tons of carbon dioxide equivalent emissions on an annual basis as a reference point below which a quantitative analysis of greenhouse gas is not recommended unless it is easily accomplished based on available tools and data.[2]

The Guidance concludes:

> This guidance document informs Federal agencies on how to apply fundamental NEPA principles to the analysis of climate change through assessing GHG [greenhouse gas] emissions and the effects of climate change for Federal actions subject to NEPA. It identifies opportunities for using information developed during the NEPA review process to take into account appropriate adaptation opportunities. Applying this guidance will promote an appropriate and measured consideration of GHG emissions and the effects of climate change in the NEPA process through a clearer set of expectations and a more transparent process, thereby informing decisionmakers and the public and resulting in better decisions.
>
> This guidance also addresses questions raised by other interested parties.73 Agencies are encouraged to apply this guidance to all new agency actions moving forward and, to the extent practicable, to build its concepts into currently on-going reviews.[3]

Case law decisions by the judiciary are keeping pace with Executive branch actions and the emerging scientific consensus regarding climate change threats. In June 2014, the United States District Court for the District of Colorado issued a decision involving proposed coal mining operations on Colorado's West Slope holding that federal agencies' NEPA analysis process must estimate GHG emissions associated with combustion of coal.[4] High Country Conservation Advocates v. U.S. Forest Service (D. Colo. 2014).[5] The Court found that the USFS Coal Mining EIS

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[2] https://www.whitehouse.gov/administration/eop/ceq/initiatives/nepa/ghg-guidance (emphasis added)
[3] https://www.whitehouse.gov/sites/default/files/docs/nepa_revised_draft_ghg_guidance_searchable.pdf at 30-31 (emphasis added)
[4] http://www.scribd.com/doc/231657158/US-District-Court-order-on-West-Elk-coal-mine-expansion-in-Sunset-Roadless-area-Colorado at
[5] http://www.coloradoindependent.com/148011/judge-blocks-colorado-coal-mine-plan-orders-feds-to-evaluate-climate-impacts

violated NEPA by not considering an expert report submitted by Plaintiffs regarding GHG emissions forecasts. Id. at 31. The decision directed that the federal "defendants are immediately enjoined from proceeding with the Exploration Plan in any manner that involves any construction, bulldozing or other on-the-ground, above-ground or below-ground disturbing activity in the subject area." Id. at 36.

Responding to the federal agency's claim that no accepted methods were available to calculate the social cost of carbon emissions, the court found "a tool is and was available: the social cost of carbon protocol. Interagency Working Group on Social Cost of Carbon, Technical Support Document (Feb. 2010) [. . .] The protocol—which is designed to quantify a project's contribution to costs associated with global climate change." Id. at 17. This tool should be utilized by the Corps in its analysis of the Moffat project.

In a decision dated May 8, 2015, the same federal court held that NEPA's hard look standard requires that agencies analyze the "increase in greenhouse gas emissions" among other air quality impacts of proposed projects. Wildearth Guardians v. U.S. Office of Surface Mining, Reclamation and Enforcement (D. Colo. 2015).[6] The court's holding applies to both direct and indirect impacts from the project. "Indirect effects are effects that "are caused by the action and are later in time or farther removed in distance [than direct impacts], but are still reasonably foreseeable." 40 C.F.R. § 1508.8(b)." Id. at 26. Applied to the proposed Moffat project, this indicates that the Corp's analysis should encompass the climate impacts of any new development, such as residential subdivisions and related traffic patterns that are expected to be permitted and built as a result of a decision approving the proposed additional Moffat diversions.

Consistent with NEPA and the law and policy summarized above, we evaluated the potential greenhouse gas emissions that would be produced by the Moffat Collection System Project to consider whether the project, as proposed in the FEIS, would contribute to climate change. At least three significant sources will contribute to climate change emissions from the proposed Moffat project: 1) the construction of the project, 2) harmful impacts to the hydrology of over 600 acres of wetlands and riparian areas due to watershed depletions in the tributaries from which Moffat collects water, from the Fraser River, and from the Upper Colorado River, and 3) emissions of methane, nitrous oxide and carbon dioxide from the fluctuating water levels and operations of an expanded Gross Reservoir. The Corps project team should determine what additional sources warrant inclusion in the climate analysis for direct, indirect, and cumulative impacts.

In terms of (1) above, we have calculated that the total climate change emissions produced during the construction of the project – also called "embodied" emissions – would be at least 782,000 metric tons CO_2-equivalents. These emissions from construction alone would be equal to or greater than the emissions from more than 164,000 automobiles on the road for one year, or, the burning of more than 840 million pounds of coal.

[6] http://www.wildearthguardians.org/site/DocServer/OSM_Colorado_Ruling_5_08_15.pdf?docID=16002

In terms of (2) above, harmful impacts to the hydrology of over 600 acres of wetlands and riparian areas, we have calculated that the total climate change emissions for Moffat would likely be more than 38,000 metric tons CO_2-equivalent. These emissions would be equivalent to the emissions from 8,000 automobiles on the road for one year.

In terms of (3) above, the scientific literature has not yet reached consensus on quantifying methane and carbon dioxide emissions from reservoirs in Western semi-arid environments. However, the existing literature clearly documents emissions in this category, establishing that the emissions from Gross Reservoir are likely to be at least several thousand metric tons of CO_2-equivalent each year. As this science progresses over the coming months, we will offer additional input to you.

The Corps of Engineers must analyze these emissions so that the project complies with the National Environmental Policy Act and other federal laws and regulations, and consider the analysis in the Record of Decision for Moffat.

These estimated results would be significant greenhouse gas emissions at a time when we should be doing everything we can to reduce greenhouse gas emissions in every aspect of our lives. Importantly, our initial estimate of GHG emissions from Moffat -- at least 780,000 metric tons -- is over 30 times greater than what the draft guidance indicates is a minimum threshold for analysis and mitigation.

Our calculations are based on the following methodology:

1. Embodied emissions from construction of the project – including fuel burned on site, concrete manufacturing and use, rock fill, an estimated 23,600 truck trips, and excavation in the construction of the project – would total more than 782,000 metric tons CO_2-equivalent[7] [8], which is more than 43 metric tons CO_2-equivalent per acre-foot of water proposed to be yielded from the project. We calculated these emissions by matching the projected materials and excavation amounts in the financial cost estimates for the project with the embodied emissions calculated in the Inventory of Carbon and Energy (ICE) database.

2. The project's proposed action would affect more than ~600 acres of riparian-associated wetlands and riparian areas in the Fraser River, Upper Colorado River, and tributaries from which the Moffat project will collect water. Carbon in soils and wetland vegetation are a major sink for ecosystem carbon, and reduced wetland hydrology would have significant impacts upon those wetlands, the loss of which would likely result in a major source of emissions to the atmosphere of at least 38,000 metric tons CO_2-equivalent per year. We evaluated the Natural Resource

[7] Technical Memorandum, Northern Integrated Supply Project, Glade Complex, Facilities Update and Cost Estimate
[8] ICE database (http://www.circularecology.com/ice-database.html#.U1Z4B_ldVgg)

Conservation Service (NRCS) SSURGO soils database for wetlands soils in the affected region[9], and the U.S. Forest Service FIA database for riparian vegetation in the affected area[10], and then modeled the soils under drained and undrained conditions using the CENTURY model[11] [12] and estimated the shifting of vegetation from wetlands and riparian forests to non-riparian shrublands.

3. Reservoirs in the American West are significant sources of greenhouse gases, and the reservoir expansion for the project, if built, is likely to emit thousands of metric tons CO_2-equivalent per year[13] [14]. While we are unaware of a current model to predict the greenhouse gas emissions from temperate reservoirs, available research indicates that no temperate reservoirs have been found to be a net year-round sink for carbon. Nearly all reservoirs studied to date appear to be net sources of greenhouse gas emissions, and there is no reason to indicate that an expanded Gross Reservoir would be any different. Recent measurements indicate emissions are particularly high from reservoirs that fluctuate significantly over the course of the year, as do most reservoirs in Colorado such as Gross Reservoir. Emissions of the greenhouse gas methane in particular can be extremely high from hydropower facilities such as Gross Reservoir.[15] [16]

These projections constitute significant new information that must be used and analyzed as a part of the Environmental Impact Statement (EIS) for Moffat. The Record of Decision (ROD) must be informed by the best available science, and without this analysis, the EIS would not satisfy the requirements of the National Environmental Policy Act or recent court decisions. If the Corps has not already done so, we recommend that the Corps conduct a rigorous scientific analysis of the climate impacts for this project, borrowing the methodology and conclusions presented above as appropriate. The analysis will have direct bearing on how the Corps complies with the mandate that the ROD selects the Least Environmentally Damaging Practicable Alternative.

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[9] Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/. Accessed 2/15/2014.

[10] USDA Forest Service. 2000. Forest inventory and analysis national core field guide, volume 1: Field data collection procedures for phase 2 plots, version 1.6. USDA Forest Service, Internal report. On file at USDA Forest Service, Washington Office, Forest Inventory and Analysis, Washington, D.C.

[11] Parton, W.J., D.W. Anderson, C.V. Cole, J.W.B. Stewart. 1983. Simulation of soil organic matter formation and mineralization in semiarid agroecosystems. In: Nutrient cycling in agricultural ecosystems, R.R. Lowrance, R.L. Todd, L.E. Asmussen and R.A. Leonard (eds.). The Univ. of Georgia, College of Agriculture Experiment Stations, Special Publ. No. 23. Athens, Georgia.

[12] Century Model Home Page. http://www.nrel.colostate.edu/projects/century/, viewed on 2/15/2014.

[13] Soumis, N. *et al.* 2004. Greenhouse gas emissions from reservoirs of the Western United States. Global Biogeochemical Cycles 18(3): GB3022.

[14] Deemer, B.R., J.A. Harrison, and M.T. Glavin. 2012. Water level drawdown boosts greenhouse gas production in a small eutrophic reservoir. Poster at the Ecological Society of America Annual Meeting, Portland, OR.

[15] http://ecowatch.com/2014/08/14/dams-not-clean-energy-climate-change/

[16] http://www.climatecentral.org/news/hydropower-as-major-methane-emitter-18246

Scientists across the globe increasingly recognize that climate change has civilization on the brink of a looming climate crisis should current trends continue unchecked. The earlier and more decisively action is pursued, the later and less cataclysmic impacts will occur. Effective action starts with informed environmental decision-making, the core goal of NEPA.

Thank you for the opportunity to provide input and make requests of your offices regarding the environmental impacts of the Moffat System Collection Project. Your organization and ours mandate objective, scientifically valid information to thoroughly comply with applicable law and policy, including the recent court holdings summarized above. Please acknowledge receipt of this letter.

Respectfully,

Gary Wockner
Executive Director
Save The Colorado

Mark Easter
Board Chair
Save The Poudre

Pete Nichols
National Director
Waterkeeper Alliance

Jen Pelz
Wild Rivers Program Director
Wildearth Guardians

John Weisheit
Colorado Riverkeeper
Living Rivers

Chris Garre
Board Chair
The Environmental Group

LR BUCHANAN CONSULTING

Evaluation of Feasibility of Attaining 18,000 AFY of Firm Yield from Excess Flows Remaining in the Fraser and Williams Fork Basins Combined with 72,000 AF Additional Storage in the Expanded Gross Reservoir.

For: The Environmental Group (TEG)

5/15/2014 Revised 10/1/2015

By: Lisa Buchanan Scientist/Engineer

Additional 10,280 AFY of water diversions from the Fraser and Williams Fork Basins through the Moffat Tunnel, in combination with the enlarged Gross Reservoir that affords 72,000 AF of additional storage volume, provide the needed 18,000 AFY additional firm yield in only 55 % of years of the test period. If all of additional diversions between the historical post-diversion baseline and the proposed project approximately twice that allocated for the proposed project or 20,300 AFY are included, the required firm yield will be met in only 77% of years of the test period. Therefore, the project does not meet the PN1 screening criteria and should have been screened from further consideration in the FEIS. To attain the firm yield in 100 % of test period years would require additional diversions from the planned expansion of the Williams Fork collection system to Darling Creek. Impacts analyses of these required additional diversions need to be addressed in the FEIS.

Summary

Alternative 1A of the Moffat-Gross FEIS would increase storage in Gross Reservoir by 72,000 AF and Denver's firm yield water supply by 18,000 AF/YR. Water for this alternative would come from the Fraser and Williams Fork basins on the west slope through the Moffat Tunnel into Gross Reservoir on the east slope of the continental divide. Because stream flows in these basins are already depleted, up to 70 or 80 percent at the Fraser River at Winter Park USGS gage in the irrigation season, this analysis was undertaken to evaluate how much water remains in the basins, referred to as excess basin water, above and beyond what is currently diverted to the existing 41,800 AF Gross Reservoir.

Since measured flow data at Denver's diversion structures is not available, annual excess basin flows are estimated using USGS flow data and Gross Reservoir storage data over the 44 year period of 1966 to 2013, when data were available at all monitoring locations in all but three years. Estimated ground and surface water inflows that enter the stream between the diversion and USGS gage locations, sometimes over several miles, are subtracted from measured stream flows. Excess basin flows, equal to the yearly sum of the adjusted stream flows at the USGS gages, are applied each year toward storage in the expanded portion of Gross Reservoir and/or the 18,000 AF additional firm yield for Denver's water supply system. Firm yield, which accounts for both the water supply inflow and available reservoir storage from previous years, is assessed annually over this 44 year period.

The firm yield of expanded Gross Reservoir is tested against two flow situations. 1) Use of all calculated excess basin flows to test the firm yield of the combined reservoir/water supply system; this simulates the modeled "current condition" baseline in the EIS. 2) Use of all calculated excess basin flows <u>minus</u> the average annual diversion between the modeled "current" and "full use" EIS scenarios; this simulates the "full use" baseline in the EIS. Diversions up to and including the "full use" model scenario of the EIS when combined with 41,800 AF of storage in the existing Gross Reservoir meet Denver's projected water supply demands through 2022 according to the EIS. As stated in the EIS, after 2022, expansion of Gross Reservoir by 72,000 AF is required to provide the additional 18,000 AFY of firm yield required by 2032. The EIS only considers incremental basin impacts caused by diversions between the "full use" baseline and the proposed project to be project related.

Overall, results of this analysis indicate that the stated 18,000 AFY firm yield requirement for the proposed project, expansion of Gross Reservoir to almost three times its current volume, cannot be met under both of the flow situations above representing both the "current" and "full use" EIS baseline model scenarios. Results of this analysis are as follows.

- The average of all calculated annual excess basin flows closely match the FEIS average additional diversions between the "current" and "proposed" model scenarios of the PACSM water supply model . In fact the average calculated excess basin flow is greater than average modeled diversions by approximately 2,600 AFY and so represents a "best case" estimate of the ability of the proposed project to meet the firm yield requirement of 18,000 AFY.
- Current conditions EIS baseline: Including storage in the expanded portion of Gross Reservoir and all estimated basin excess flows, the reservoir would fill in only 3 years out of 44; the 72000

AF of extra storage would be depleted or zero in 12 years; the required yield of 18,000 AF/YR would be met in 32 years (72.7%) and not met in 12 years (27.2%). The EIS PN1 screening criteria is not met.

- "Full Use" EIS Baseline: Under the "full use" baseline, a portion of the excess basin flows would be diverted through the Moffat Tunnel and the existing Gross Reservoir to the Moffat Water Treatment Plant without requiring expansion of the reservoir. The remaining 10,280 AFY are allocated for the proposed project. Under this baseline, that preferred in the EIS, the expanded reservoir would fill in only 1 year out of 44; the 72000 AF of extra storage would be depleted or zero in 20 years; the required yield of 18,000 AF/YR would be met in 24 years (54.5%) and not met in 20 years (45.5%) of this 44 year period of record. The percentage of years where the firm yield of 18,000 AF/YR was NOT met is substantially lower than 100%, the EIS alternative screening PN1 criteria; the project should have been screened from further consideration in the alternatives screening process.
- Incremental additional diversions from the Fraser and Williams Fork basins are included in the "current condition", "full use", and "proposed project" model scenarios. Of these, the impacts of only the last, the "proposed project" diversions, on basin stream flow are considered to be project impacts in the EIS. If all of the modeled additional diversions, equal to all additional diversions between the historical post-diversion and proposed project or approximately twice that of the "proposed project" diversions, are utilized the stated project firm yield of 18,000 AFY is met in 77 percent of the years; still below the acceptance criteria of 100 %.
- Basin impacts attributed to the "project" should reflect all additional diversions included in the "current", "full use", and "proposed project" model scenarios and are likely greater than twice that stated in the EIS.
- Guidance published by the New Jersey Department of Environmental Protection (NJDEP, 2011) define firm or "safe" yield as a continuous quantity of water that can be provided even through a historical critical drought period. Even with 4,000 AFY of additional excess basin flows, storage and firm yield in the expanded Gross Reservoir were zero from 1976 through 1978 due to average or below average years leading up to these three years. This is in contrast to the selected 1950s critical drought years (1953 to 1957) of the PACSM modeling where the expanded Gross Reservoir filled in wet year 1952 just ahead of the drought period. The mid-1970s should also be included as a critical drought period against which to evaluate the feasibility of the project to achieve the additional firm yield of 18,000 AFY.

Analysis Description

Alternative 1A of the FEIS calls for a substantial increase in Gross Reservoir Storage; from 41,811 AF adding 72,000 AF for a total storage volume of 113,811 AF; an increase in storage volume of 172 percent. Alternative 1A is noted as the preferred alternative. Because stream flows in the Fraser River basin are already depleted under the current configuration of Gross Reservoir this evaluation was undertaken to estimate the additional firm yield of the Fraser and Williams Fork basins if storage in Gross Reservoir is increased.

The FEIS page 2-25 states that "*additional water is available for diversion under the existing Denver Water Rights from the Fraser River, Williams Fork River and South Boulder Creek.*" and (FEIS pg. 2-28) "*the existing diversion and conveyance facilities (i.e.* Moffat Diversion tunnel and South Boulder Creek Diversion Canal*) have adequate capacity to divert and carry additional flows."* However, it is unclear how much additional water remains at Denver Water's diversion structures for diversion to the expanded Gross Reservoir because 1) Denver Water does not measure surface water flow at each of their diversion structures in the Fraser and Williams Fork Rivers and 2) stream flow is monitored by the USGS gages that are located one half to several miles below Denver's diversion gates (See Figure 1). Measured flows not only reflect Denver diversion operations but also surface water and ground water inflows to the stream that enter between DW diversion points and the USGS gage locations. Therefore, it is not clear how much excess flow is available at the point of diversion for storage in an expanded Gross Reservoir. Flows measured at stream gages located a distance downstream of the diversion structures over-estimate the amount of water physically available at the diversion structures.

Measured USGS stream flow data and storage data in Gross Reservoir are utilized in the following analysis to estimate excess flows from the Fraser and Williams Fork basins that would be used to fill the expanded reservoir and to satisfy Denver's increased firm yield of 18,000 AF/YR. Basin excess flows that exceed the firm yield of 18,000 AF/YR would be placed into storage in the expanded reservoir for use in years when basin yields are below the target demand rate.

Depletion of Stream Flows in the Fraser River Basin Observed at USGS gages

Stream flow data at the USGS gage (09024000) "Fraser River at Winter Park" located downstream of the west portal of the Moffat Tunnel were used to evaluate depletion of native flows in the Fraser River caused by current DW Moffat diversions. This USGS gage has recorded flows from 1911 to the present. Years 1911 to 1935 represent the time period prior to Moffat diversions. Pre-Moffat flows were compared to years 1936 to 2013 representing the time period when water was diverted out of the Fraser Valley through the Moffat Tunnel (Post-Moffat). Average and median monthly pre- and post-flows are shown in Figure 2. The percent reduction in monthly average and median pre- to post-time periods is presented in Figure 3.

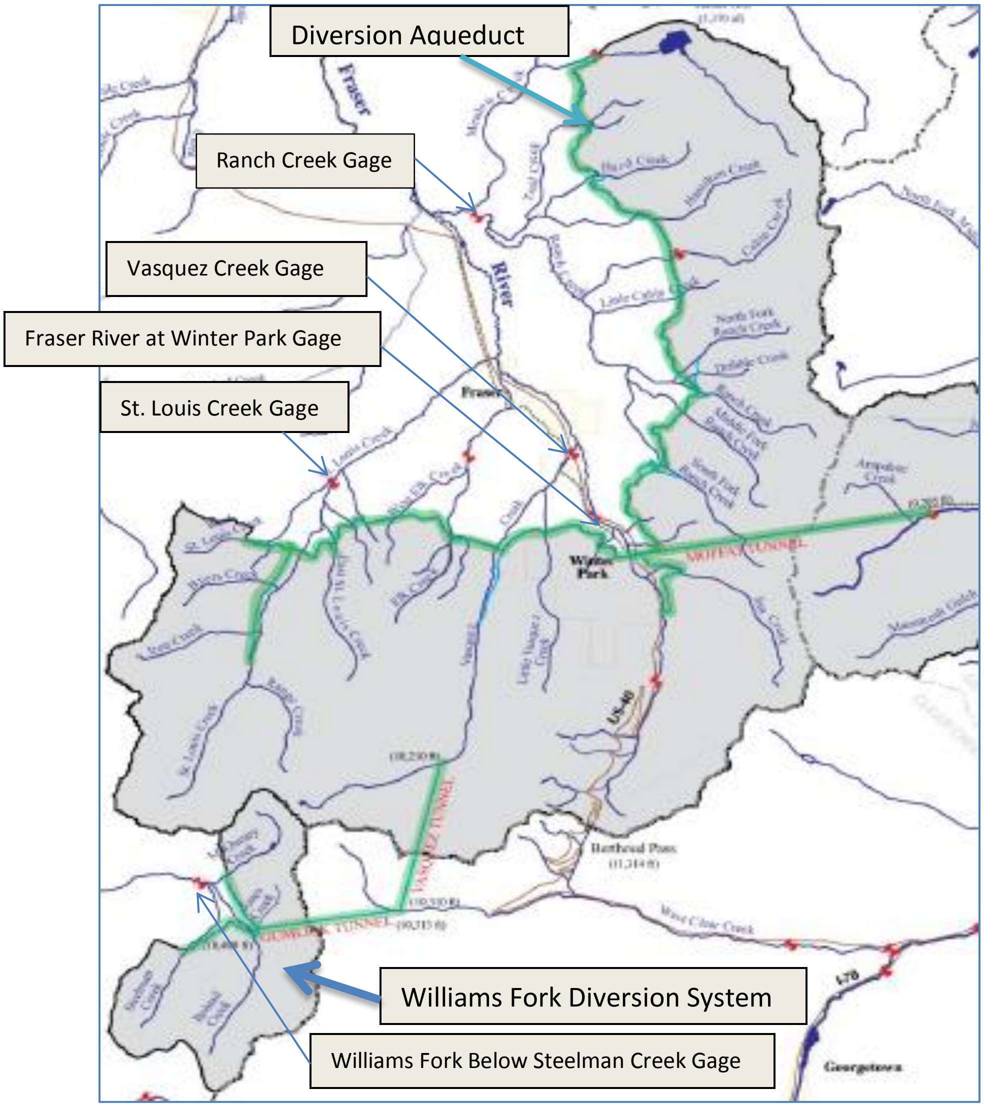
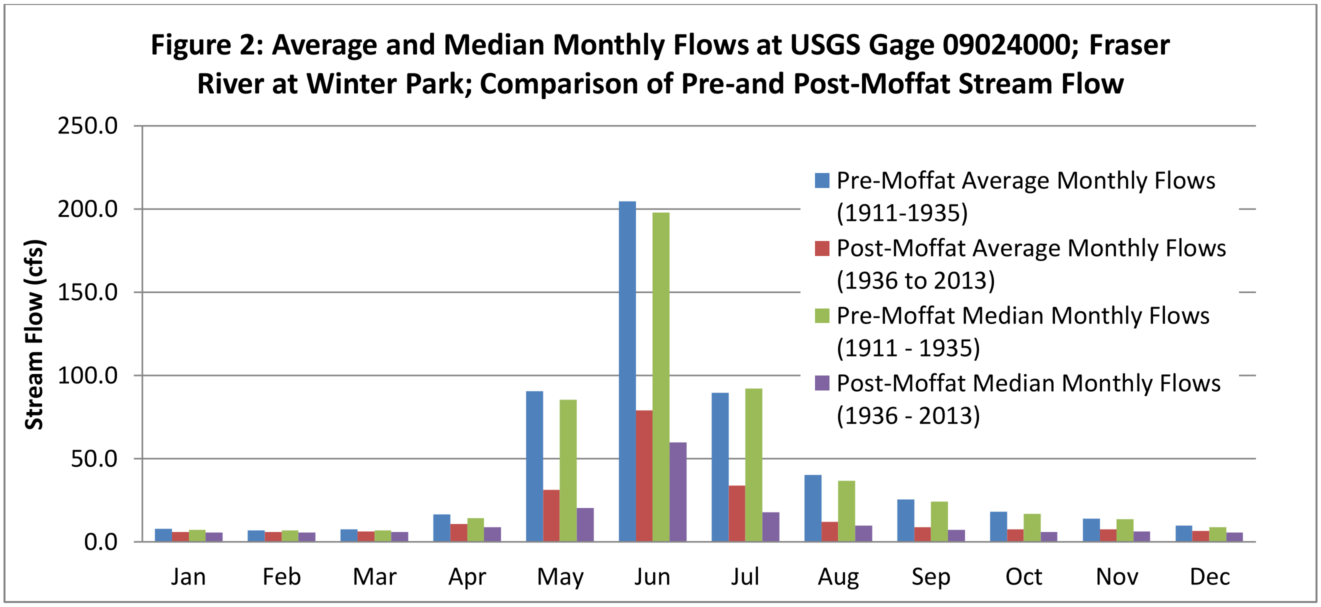
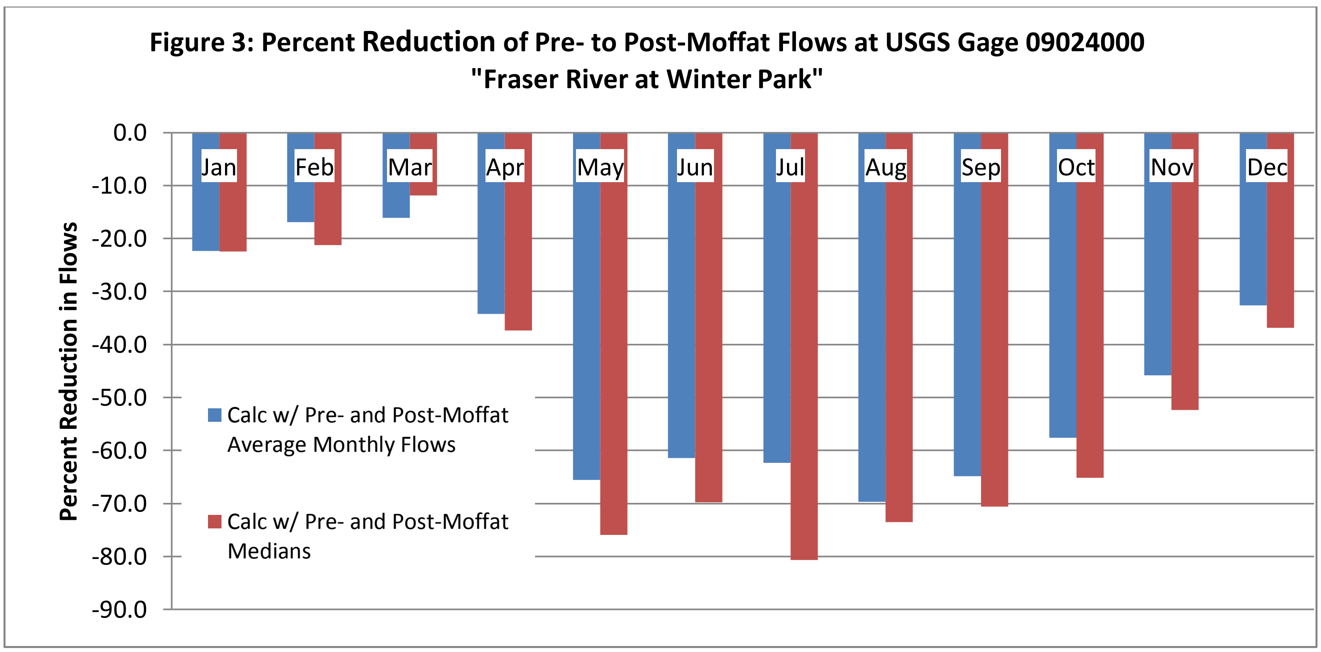


Figure 1 : Denver Water's Diversion System and USGS Gage Locations in the Fraser and Williams Fork River Basins

Source: Figure 1-1 FEIS





Stream flow in the Fraser River at Winter Park is substantially depleted under current operating conditions and Gross Reservoir storage at 41,811 AF. Average stream flows have been reduced by between 60 and 70 percent in May through September. Median monthly stream flows, lower than average monthly flows, are reduced by 70 to 80 percent from pre- to post-Moffat diversion periods in May through September under the EXISTING Gross Reservoir configuration. This means that half the time flow depletion at the Fraser River at Winter Park gage could be greater than 70 to 80 percent in these months.

Given the substantial depletion of flow on the main stem of the Fraser River, it is unclear if there is sufficient water in the Fraser and Williams Fork basins to fill an additional 72,000 acre feet of an expanded Gross Reservoir or if there is an additional 18,000 AF of firm yield in the basin particularly since additional flows will be obtained primarily during the months of May, June, and July.

Estimate of Additional Firm Yield of Fraser and Williams Fork Basins

Additional Firm Yield from the Fraser and Williams Fork basins was estimated as follows:

1. Excess water at USGS gages in the irrigation seasons (May, June and July) of the 1966 to 2012 period was calculated by adjusting USGS stream flow data with estimated inflows between Denver Water diversion gates and gage locations. These months were selected for analysis because Denver's proposed additional diversions would occur in the high flow months (May through July) according to the FEIS.
2. Since storage capacity is utilized to meet firm yields in low water years; any supply that exceeded 18,000 AF each year was placed into storage in the 72,000 AF of additional storage volume of the expanded Gross Reservoir in this analysis. Water stored from earlier years was combined with water supply inflows in each year to achieve the 18,000 AFY firm yield in years when the yearly basin flow was less than 18,000 AF. In addition, it was assumed that the firm yield would be used in a flow through manner; thereby maximizing the amount of water available for storage in Gross Reservoir while allowing for use of 12,758 AF of storage in Ralston Reservoir.
3. Excess storage volume at the end of each irrigation season was added to the additional basin yield of the next irrigation season; this sum equal to the total amount of water in each historical year of record that would be available to meet the additional 18,000 AF of demand plus additional losses from evaporation (514 AF/YR). The incremental increase in conveyance losses was not included in this estimate though it would further decrease yields from the expanded Gross Reservoir.
4. The number of years when the 18,000 AF of firm yield could and could not be met was tallied; if the additional yield could not be met in some years the PN1 screening criteria of 100% of the years was not met.
5. Excess yield from this calculation corresponds to the difference noted between the modeled "current" to "proposed" scenarios of the FEIS. In the FEIS these excess flows are divided into the "Full Use" and the "proposed" scenarios where "Full Use" operates under the current configuration of Gross Reservoir at 41,800 AF of storage. Therefore, as stated in the FEIS, the incremental increase in diversions between the "Full Use" and the "proposed" scenarios would be used to fill the additional 72,000 AF of storage and provide the additional 18,000 AF of firm yield under the proposed alternative. The incremental increase of diversions noted in the FEIS from "current" to "full use" were thus subtracted from the excess basin flows and the firm yield evaluated as in number 4 above.

Yearly Excess Basin Flows

The amount of excess water available during the months of May, June, and July in the Fraser and Williams Fork Basins was estimated using USGS measured stream flow and reservoir storage data from 1966 to 2012. This period was chosen because:

- Stream flow data were available at all USGS gages in the Fraser and Williams Fork Basins that monitored stream flow below DW diversion structures (Downloaded from the Colorado Decision Support System (cdss) website).
- Gross reservoir storage data were available in all but three years of this period (1967, 1987, 1989) also available through the cdss website. These three years were omitted from the evaluation.
- This resulted in a 44 year period of record with sufficient measured data to estimate historical excess flows and evaluate if a firm yield of 18,000 AF/YR could be achieved with the enlarged Gross Reservoir.

This evaluation is based on two assumptions:

1. When the Current Gross Reservoir was NOT full (storage was below 41,000 AF), Denver Water diverted all available flow at their diversion structures drying up the stream just downstream of their gate; therefore, stream flow measured at the USGS gages when Gross Reservoir was NOT full reflects surface water and ground water inflow between the diversion points and the gages plus any flow obligations downstream of the collection system.
2. Excess flow would be available only in months of May, June, and July when Gross Reservoir was full; this is the when Denver's proposed additional diversions would occur according to the EIS.

Current Operations at Denver Water Diversion Structures

Currently Denver Water diverts water that is "*physically and legally available at each diversion point subject to minimum bypass flows and calls from downstream senior water rights*." "*Streams that do not have minimum bypass requirements (even those with downstream senior rights) are fully diverted at times during the year..." "This results in no stream flow for some distance below the diversions. This is how Denver Water has operated in the past and plans to operate in the future."* (FEIS p. 3-35)

In dry years Denver Water diverts "*all available flows at each diversion point except for flows required"* to meet downstream obligations. In wet years Denver Water diverts "*100 percent of the water from streams that do not have minimum bypass flow requirements,"* therefore, these streams "*are fully diverted and dried up early in runoff season similar to dry years. Once Denver Water anticipates filling Gross and Ralston reservoirs and water demand is being met, Denver Water will begin to reduce diversions"* and allow water to flow past their diversion structures in the Fraser Valley until "*Gross Reservoir begins to be drawn down, typically in mid-summer,* when *Denver Water will again divert the maximum amount available to keep Gross Reservoir as full as possible." (FEIS p. 3-36).*

Historically then, except for downstream obligations, Denver Water often dries up flows downstream of their diversion points in the Fraser Valley, spilling water past diversion points only when Gross Reservoir is full. What volume of spilled water is available <u>at diversion points</u> in the Fraser Valley and Williams Fork watersheds and is this volume sufficient to provide the 18,000 AF of firm yield for an expanded Gross Reservoir?

Historical Storage Data for Gross Reservoir

Historical storage volumes in Gross Reservoir, read at the end or beginning of each month and sometimes mid-month, were evaluated to determine how often and when Gross Reservoir filled between 1966 and 2012. Months when storage in Gross Reservoir was greater than 41,000 AF are noted in Table 1. According to the FEIS, water used to fill the enlarged Gross Reservoir would be diverted primarily in the months of May, June, and July, therefore, these months were used in this evaluation. Note that the existing Gross Reservoir 941,800 AF) filled only once in May and did not fill in the irrigation season in 11 years of the 44 years of record.

Table 1: Months Gross Reservoir Filled; Storage Levels Above 41,000 AF

Water Year	May	June	July	Water Year	May	June	July
1966	Max 39,979 AF in Jul			1990		x	
1967	Missing storage data in irrigation season			1991		x	
1968	Max 39,419 AF in Aug			1992		x	
1969		x	x	1993			x
1970			x	1994		x	
1971		x		1995			x
1972			x	1996		x	
1973			x	1997		x	
1974	Max 40,800 AF in Jul			1998	x	x	
1975			x	1999	Filled in Sept and Oct		
1976	Max 27,096 AF in Jun			2000		x	
1977	Max 39,898 AF in Jun			2001		x	
1978	Max 40,062 AF in Jul			2002	Max 22,956 AF in Feb		
1979		x		2003		x	x
1980		x		2004	Max 40,381 AF in Oct		
1981		x		2005		x	
1982			x	2006	Max 40,859 AF Jun		
1983		x	x	2007		x	
1984		x	x	2008		x	
1985		x	x	2009		x	x
1986		x	x	2010		x	
1987	Missing storage data in irrigation season			2011		x	
1988		x		2012	Max Storage 38,350 in June		
1989	Missing storage data in irrigation season			2013	Storage Data not Entered		

Historical storage data from Gross Reservoir (Colorado Decision Support System - cdss)

Adjusted Stream Flows

Monthly stream flow measurements in May, June, and July in years 1966 to 2013 were used to estimate excess flows at the following USGS gages shown in Figure 1:

- Fraser River at Winter Park (09024000),
- Vasquez Creek near Winter Park (0902500),
- St. Louis Creek near Fraser (09026500),
- Ranch Creek near Fraser (09032000), and
- Williams Fork below Steelman Creek (09035500).

It is assumed that excess flows would only be available for additional storage at times when the existing Gross Reservoir was full. Therefore, when Gross Reservoir was NOT full there would be no additional water available in that month at that location.

The median of monthly flows for months when Gross Reservoir was NOT full during the time period 1966 to 2012 was assumed to represent the inflow between diversion structures and USGS gages; or "native downstream inflow" plus downstream water obligations. This median flow (shown in Table 2) was subtracted from monthly flows measured at the USGS gages in months when Gross Reservoir filled to estimate the adjusted excess stream flow. Adjusted flows that were negative, where total flows were less than the median adjustment factor, were changed to zero for this calculation.

Table 2
Median Monthly Flows (1966 to 2012) For Months When Gross Reservoir Did NOT Fill
Used to Adjust Monthly Stream Flows in Months When Goss DID Fill

USGS Gage	Elevation Feet	May AF/Mth (cfs)	June AF/Mth (cfs)	July AF/Mth (cfs)
Vasquez Creek near Winter Park (09025000)	8911	1051 (17.1)	878 (14.8)	760 (12.4)
St. Louis Creek near Fraser (09026500)	8773	1507 (24.5)	2705 (45.5)	1904 (31.0)
Fraser River @ Winter Park (09024000)	8985	1257 (20.5)	1928 (32.4)	1471 (23.9)
Ranch Creek near Fraser (09032000)	8665	1139 (18.5)	1236 (20.8)	382 (6.2)
Williams Fork Below Steelman (09035500)	9806	1181 (19.2)	5776 (97.1)	2362 (38.4)

Inflow between DWs diversion structures and the USGS gages originate from:

- Mary Jane Creek up to 11,000 feet elevation on the Fraser River;
- Lower elevation areas, up to 9,500 feet, on Vasquez Creek,
- Deadhorse and Spruce Creeks up to 11,584 feet at Bottle Peak on St. Louis Creek,
- Lower elevation areas, up to approximately 9,500 feet, on Ranch Creek, Hurd Creek, Hamilton Creek, Trail Creek, Cabin Creek, Little Cabin Creek, and Dribble Creek.
- Alpine areas up to 12,348 feet including St. Louis Peak (12246 feet)in the Williams Fork Basin. High inflows in June and July are consistent with drainage from high alpine areas, however, operations at the Williams Fork basin diversion structures that optimized filling Williams Fork Reservoir once Gross Reservoir was nearly full also added to flows recorded at the Williams Fork below Steelman Creek USGS gage during this time period (see Williams Fork section).

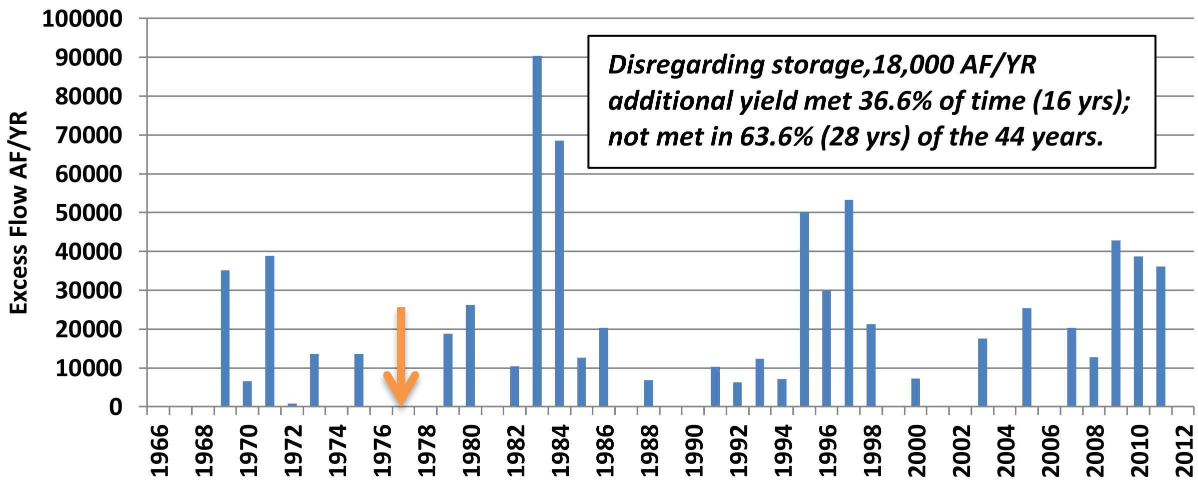
Minimum bypass requirements (FEIS Table 3.1-8) of 10 cfs on the Fraser River, 8 cfs on Vasquez Creek, 10 cfs for St. Louis Creek, and 4 cfs for Ranch Creek between May 15 and September 15 are reflected in excess flow values above. Bypass flows were incorporated into Right of Way agreements between Denver Water and the US Forest Service in 1970. As part of the Clinton Reservoir Agreement of 1992 Denver Water reserved the right to reduce bypass flows if mandatory restrictions to in-house domestic water use were imposed on its customers (FEIS 3-28). Table 3.1-9 of the FEIS notes that bypass flows were reduced in 1975, 1977, 1980 and consistently in September 2001 through July 2004, the end of the FEIS historical period of record (1975 to 2004). The median inflow value noted in Table 2 above (1966 to 2012 period of record) likely reflects times when bypass flows were both honored and reduced.

In addition, calls by higher priority water rights holders on the Fraser River likely increased flows past Denver Water diversions during the 1966 to 2013 period of record. Senior water rights holders include but are not limited to Beaver Dam Ditch, Deberard Ditch and Reservoir, Earl Ditch, Joy Ditch, Hammond Ditch, Ostrander Ditch, Peterson Ditch, Scybert Ditch, and Winter Park West Wells. For purposes of this evaluation, it was assumed that calls coming from the Fraser River were reflected in the historical flow records at the USGS gages and were not available for diversion by Denver Water.

Excess Basin Flows

Adjusted monthly stream flows in May, June, and July were summed to estimate the yearly total excess basin flow that would be available to fill the expanded Gross Reservoir storage of 72,000 AF. Estimated yearly excess flows are shown in Figure 5.

Figure 5: Excess Yearly Flow in Fraser and Williams Fork Basins Estimated Using USGS Flows and Gross Reservoir Storage Data in May, June, and July: 1966 to 2012



Storage Data missing in 1967, 1987, and 1989; these years omitted from analysis.

Average and median excess flows at each USGS gage location are shown in Table 3. Average estimated excess flows compare favorably to average tunnel diversion increases from “current” to “proposed” conditions modeled in the FEIS using the PACSM model (Table 4). In fact, the average of the estimated excess flows in both the Fraser and Williams Fork basins combined actually exceeds the modeled increase in Moffat flows by approximately 2,600 AF/YR on average and so represents a "best case" estimate of the ability of the proposed project to meet the firm yield requirement of 18,000 AFY. Average excess flows calculated for the Fraser Basin alone compare closely to the modeled increase in the Moffat Tunnel diversions.

It is valid to compare excess flow derived here with the modeled "current to proposed" scenario's diversion increases because full use system changes occur after 2006 (of the 1966 to 2012 period of calculation). The Full Use scenario included, among others, upgrades to the distribution system from the Foothills and Marston treatment plants, changes to Big Lake Ditch Denver water rights such that additional water could be stored in Williams Fork Reservoir (as of 2013), and an increase in demand of 60,000 AF/YR (as of 2006 per the EIS). It is not clear if water demand remained at the 2006 level through 2013. Full use did not include any additional storage in Denver's northern water system, including Gross Reservoir.

Table 3
Average and Median Excess Flows at USGS Gage Locations Available to Fill 72,000 AF of the Expanded Gross Reservoir and Provide Denver Water's 18,000 AF/YR Additional Yield

USGS Gage Location	Average of Estimated Excess Flows (AF/YR)	Median of Estimated Excess Flows (AF/YR)	Maximum of Estimated Excess Flows (AF/YR)
Williams Fork (WF) Below Steelman	2,682	2,150	11,314
Ranch Creek near Fraser	2,891	1,636	17,797
Fraser River @Winter Park	3,323	971	20,837
St. Louis Creek near Fraser	3,546	2,430	18,693
Vasquez Creek near Winter Park	3,115	1,183	21,942
Total Flow Fraser (excluding WF)	12,875	6,220	NA
Total Flow Fraser & Williams Fk. Basin	15,557	8370	NA

Period of Record = 1966 to 2012 not including 1967, 1987, and 1989. Maximum excess flows occurred in 1983 at all locations except the Williams Fork basin where maximum flows occurred in 1984.

Table 4
Average Modeled Increases of Tunnel Diversions noted in DEIS (Table H-7.1)

Gumlick Tunnel comparable to estimated excess flows in Williams Fork Basin	
"Current to Full Use"	887 AF/YR
"Full Use to Proposed"	1,904 AF/YR
"Current to Proposed"	2,795 AF/YR
Moffat Tunnel compares to sum of estimated excess flows in Fraser & Williams Fork Basins	
"Current to Full Use"	2,713 AF/YR
"Full Use to Proposed"	10,284 AF/YR
"Current to Proposed"	12,998 AF/YR

Williams Fork Diversions

Water rights belonging to Denver Water in the Williams Fork Basin, including those that are currently used for trans-mountain diversions on McQuery Creek, Jones Creek, Bobtail Creek and Steelman Creek (See Figure 1), are noted in Table 3.1-12 of the FEIS. Other rights in this basin include conditional flow rights from Middle Fork and South Fork of the Williams Fork River, Allen Creek, and Darling Creek that have not been developed as well as a storage right for the Williams Fork Reservoir for 96,637 AF. "*Denver Water's headwater diversions are protected by Williams Fork Reservoir such that when the Denver Water rights are out of priority with respect to senior diverters below Williams Fork Reservoir, the reservoir releases water to satisfy the senior diverters….Williams Fork Reservoir is operated in part to exchange water to replace out of priority diversions at Denver Water's Moffat Collection System, Roberts Tunnel, and Dillon Reservoir" (FEIS pg.* 3-42).

As stated in the FEIS (pg. 3-42), "*Denver Water often diverts 90% to 100% of the average monthly native flow from McQueary, Jones, Bobtail, and Steelman creeks from October through April… During the summer from May through September, the average monthly percentage of native flow diverted by Denver Water varies more and ranges from 24% to 94% under Current Conditions. During those months, Denver Water diverts the greatest percentage of native flow in April, May, August and September when flows are typically lower. In June and July, Denver Water diverts a much lower percentage of the native flow at these locations (24% to 43% on average) because flows are typically much higher during runoff."* According to the Upper Colorado River Basin Information report prepared as part of the Basin Round Table efforts for the Upper Colorado Basin (CWCB website 1/1/2007), the "*primary operational objective [for Williams fork diversions] is to fill Gross Reservoir. Once filled, the general practice is to cease diversions at the collection system in favor of storage in the Williams Fork Reservoir*." Denver now owns the water rights for the Big Lake Ditch which historically diverted just upstream of the Williams Fork Reservoir to Reeder Creek. As of 2013, this water, approximately 10,000 AF/YR, will be used for storage in Williams Fork Reservoir. In addition, under the 10,825 agreement, Denver no longer is required to release 5,412 AF to meet USFWS flow recommendations in the 15-Mile Reach in Grand Junction. Therefore, approximately 15,400 AF/YR of additional water is now available to Denver Water for storage in the Williams Fork Reservoir providing more flexibility for additional diversions through the Gumlick Tunnel from the upper Williams Fork basin. It is unclear how their operations have changed since 2013.

The assumption in this evaluation, that diversion head gates remain open when Gross Reservoir was not full, is not valid during June and July for the upper Williams Fork Basin. However, calculated excess basin flows for the Williams Fork diversion points (2,682 AF/YR average) very closely match the modeled increase between the "Current" and "proposed" PACSM model scenarios (2,795 AF/YR average). Therefore, calculated excess flows from the upper Williams Fork basin were retained in this firm yield analysis.

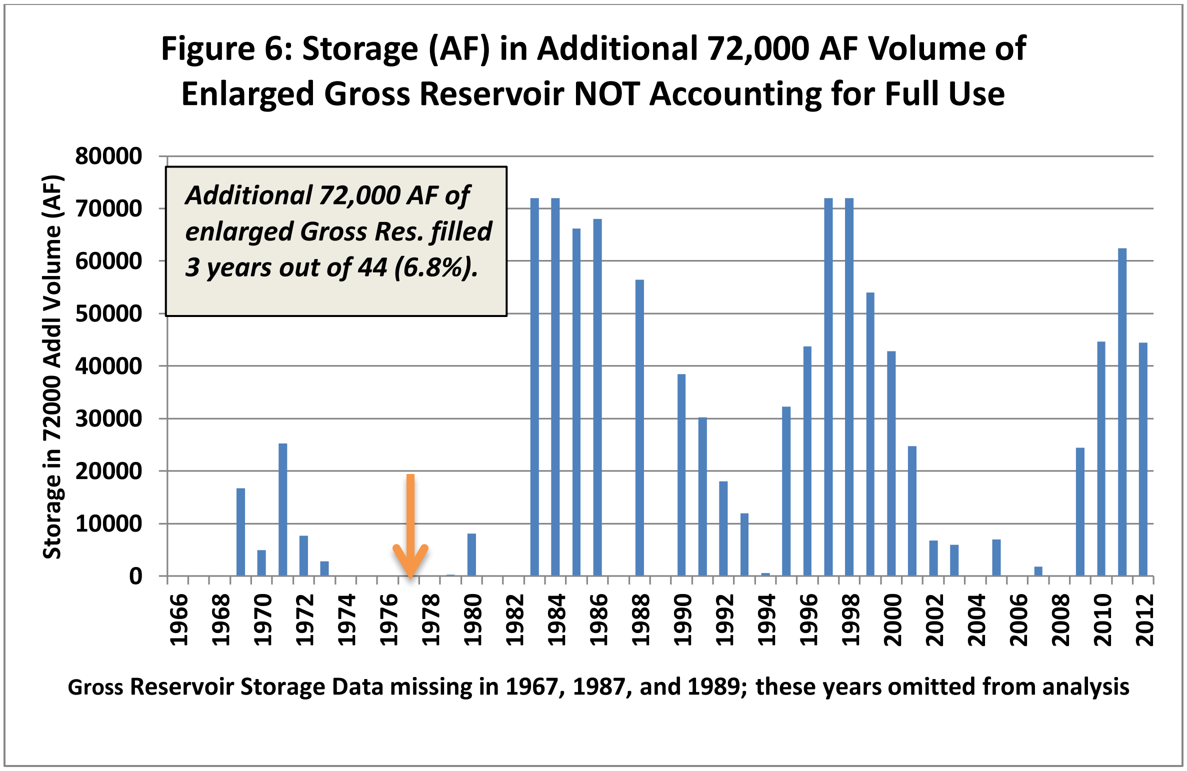
Average (Median) flows at the Williams Fork Below Steelman USGS gage in June and July over the 1966 to 2013 period of record are 6,862 (7926) and 3,448 (2875) AF/mth, respectively. Arbitrarily assuming that "native" inflows entering below the diversion structures but upstream of the USGS gage are 1000 AF (16.8 cfs) and 500 AF (8.4 cfs) in June and July, respectively; additional water available from the upper Williams Fork, on average, would be 5,862 and 2,375 AF/mth or 8,200 AF in these two months alone. This additional water from the Williams Fork Basin plus the 2,600 AF overestimate of calculated excess basin flows (compared with modeled numbers) is more than sufficient to supply the observed average 7,300 AF/Y discrepancy between measured and modeled Moffat Tunnel diversions under the "current" conditions scenario (See : Discrepancy Between Measured and Modeled Current Diversions section below).

Firm Yield of Excess Flows Diverted from Moffat and Williams Fork Basins NOT Accounting for Full Use Diversions: Current Use Baseline

In Alternative 1A Gross Reservoir needs to produce an additional firm yield of 18,000 AF/YR to meet Denver's future water demands. "Firm" yield takes into account storage of extra water (above the required yield of 18,000 AF/YR) that can be stored in the reservoir, in this case in the upper 72,000 AF of the expanded Gross Reservoir, and used in years when 18,000 AF of excess water is not available in the basin or 64 percent of the years between 1966 and 2012 (See Figure 5). "Firm yield" of excess basin water was calculated as follows:

- End storage for each irrigation season was calculated as end storage from the previous year's irrigation season plus additional excess basin water provided in the current irrigation season minus 18,000 AF, the required firm yield for the system. An additional 514 AF was subtracted from the yearly total to account for the incremental increase in evaporation in the expanded Gross Reservoir compared to the "Full Use" configuration (as discussed on page 5-15 of the FEIS). Incremental conveyance losses were not accounted for in this calculation.
- If storage for a given year was negative (i.e. there was not enough water to provide the 18,000 AF/YR yield) ending storage for that year was set at zero; assuming that water would not be taken from the current 41,811 AF in Gross Reservoir to meet the demand.
- If storage for a given year was over 72,000 AF it was set to 72,000 AF assuming that the current 41,811 AF or the existing reservoir would also be filled in these years.
- The previous year storage for the first year (1966), in the 72,000 AF portion of the total 113,800 AF expanded storage volume, was assumed to be zero as construction of Gross dam would have just been completed.

Estimated storage in the 72,000 AF of the expanded Gross Reservoir for 44 years between 1966 and 2012 (omitting 1967, 1987, and 1989) is shown in Figure 6. Storage levels and the ability to meet the firm yield requirement of 18,000 AF/YR in the expanded reservoir depend on hydrologic conditions in the first few years of filling, periods of drought (mid-1970s and mid 2000s), and periods of high flow (mid 1980s, late 1990s, and 2011). Based on this estimate of firm yield of the Fraser and Williams Fork Basins the expanded gross reservoir would fill in only 3 years and the 72000 AF of extra storage would be depleted or zero in 12 years (assuming all available yield under 18,000 AF would be used).



Year 1983 was notable. High snow pack and spring rains produced major flooding on the Colorado River. June and July issues of High Country News were awash in news of the flood:

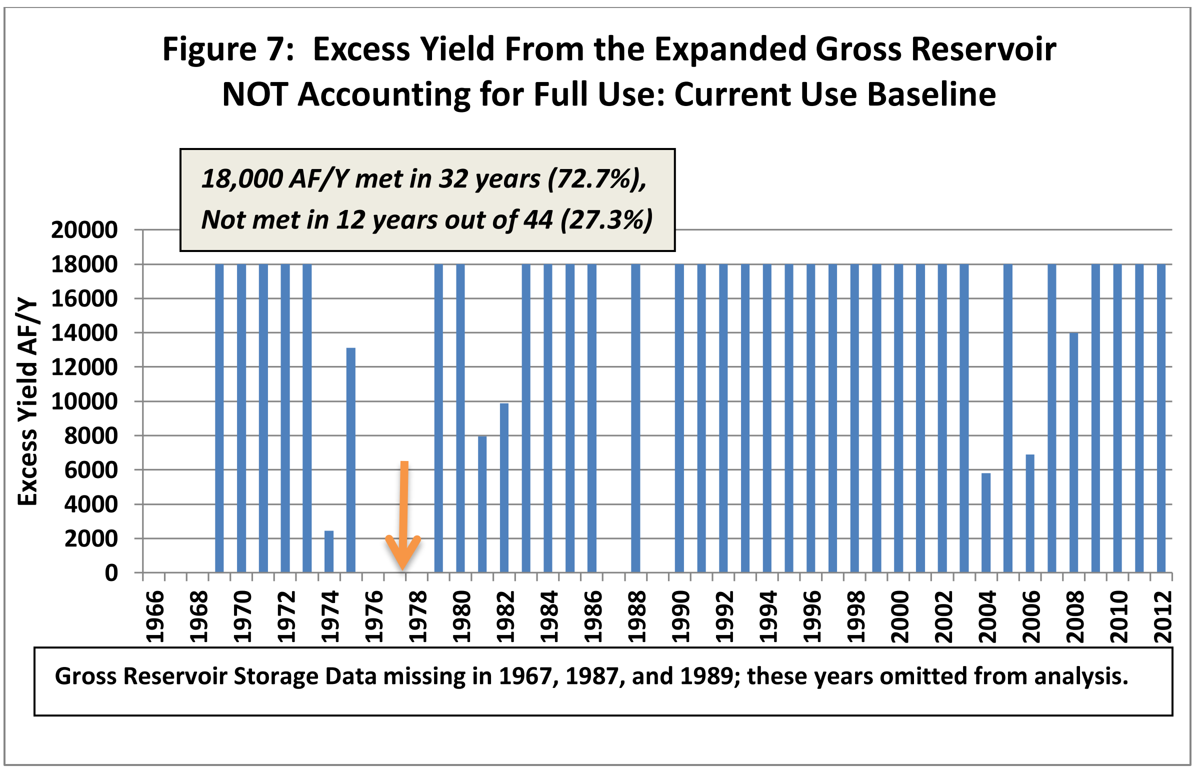
"A record 120,000 cfs was flowing into Lake Powell from late spring snow and rain in the Rocky Mountains that no one had anticipated. On July 2, the lake - considered full at 3700' - was just 3.5 feet from its maximum capacity of 3711' and rising three inches a day."

"The July 8 issue reported that the dam's spillway began breaking up when officials upped the release to 92,000 cfs. The high velocity water was carving out huge holes in one of the tunnels, a process known as cavitation that sent chunks of concrete and red silt from the eroding Navajo sandstone bedrock shooting into the clear river below the dam.

The expanded Gross Reservoir almost filled for the first time in 1983 in this calculation. Previous year (1982) excess storage was estimated at 0 AF with an additional 89,919 AF available from 1983 runoff: however, after filling an additional volume to 71,919 AF and subtracting 18,000 AF of firm yield, no additional water would have passed DWs diversion gates in 1983. Not only is this an indication of the substantial size of the new reservoir but also that filling it will depend on very high flow years, the frequency of which may decrease due to climate change. In this initial analysis, the expanded Gross Reservoir was estimated to fill in three years, 1984, 1997, and 1998. Extra water that could not be stored in the expanded reservoir amounted to 49,880, 5,812, and 2,723 AF in these years respectively. In all other years barring calls on the river and bypass flow requirements, diversion gates in the Fraser valley could remain open throughout the irrigation season, dewatering streams just downstream of the diversion gates, and there would be sufficient storage in the expanded reservoir to accommodate all of the flows.

Firm yield of 18,000 AF/Y was not met in 12 years out of the 44 year period of analysis or 27.3 percent of the time (Figure 7). In particular, an extended dry period occurred in the mid-1970s. Even though 18,000 AF/Y of excess yield could be achieved in 1969 through 1973, only in 1971 was storage sufficient to provide an additional yield of this amount. A prolonged period of dry years in the 1970s, perhaps a second critical period after the 1950s drought, resulted in low to no excess yield from 1974 to 1978. In drought years 2002 and 2012, there was sufficient storage in the expanded Gross Reservoir to achieve the desired excess yield of 18,000 AF/Y, however, following high flow years of the late 1990s, storage was depleted such that in two years of the mid-2000s excess yield was below 8,000 AF/Y.

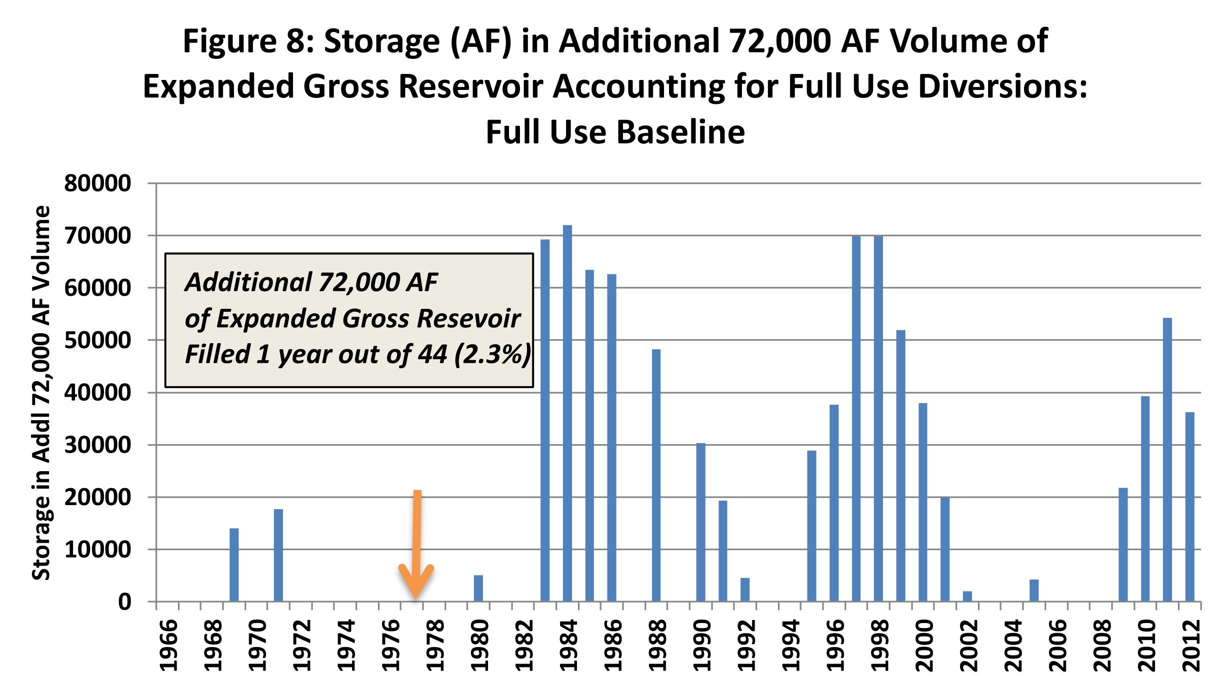
Even with extra diversions; the calculated over-estimate of 2,600 AF/Y and the additional average amount water of 2,713 AF/Y that was not allocated to the proposed project ("current" to "full use" model scenarios), the firm yield of 18,000 AF/Y was NOT met in 100% of the test period years and so did not meet the PN1 screening criteria.



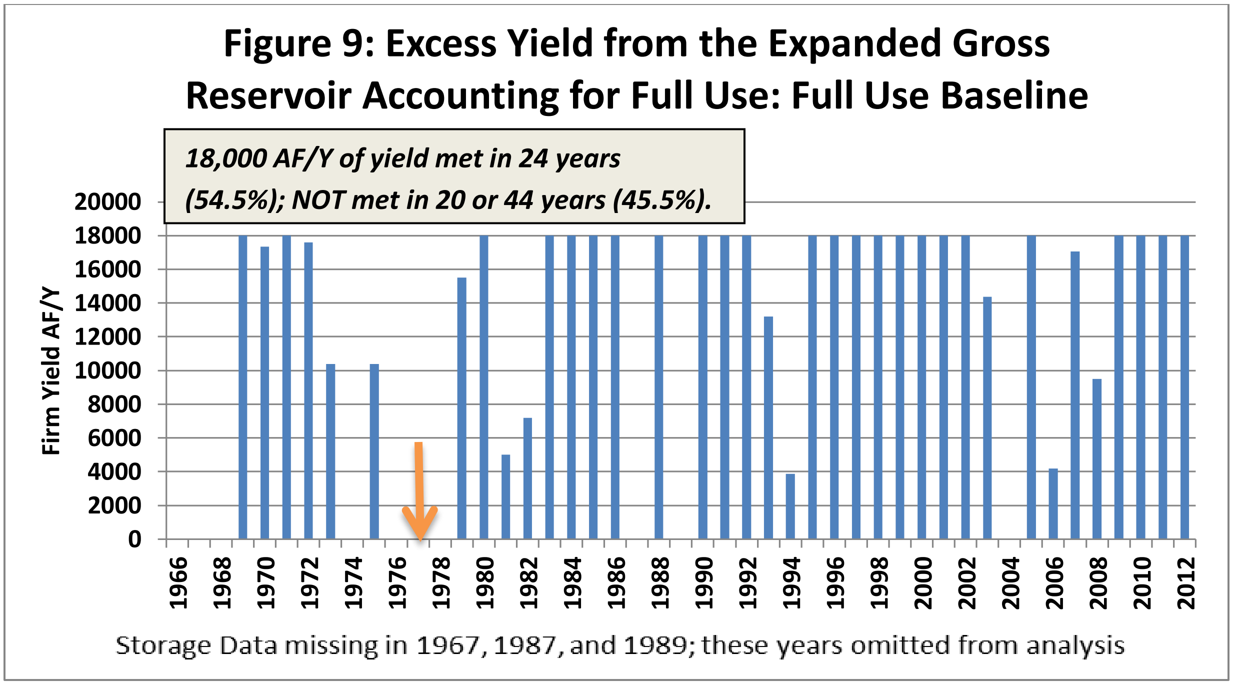
Firm Yield of Excess Flows Accounting for Full Use Diversions: Full Use Baseline

Because the FEIS states that any water diverted from the basin above and beyond that for the Full Use Scenario would be used to fill the expanded Gross Reservoir and contribute to the firm yield of 18,000 AF/YR, the average annual increase in Moffat Tunnel diversions from “current” to “Full Use” scenarios (FEIS Table H-7.1) of 2,713 AF/YR for an average year was subtracted from the adjusted flows and the calculation completed as described above. Storage in the additional 72,000 AF volume of the expanded Gross Reservoir is shown in Figure 8.

Based on this estimate of firm yield of the Fraser and Williams Fork Basins, accounting for Full Use diversions noted in the FEIS, the expanded gross reservoir would fill in only 1 year (1984) with 44,454 AF of extra water that could not be stored in the expanded reservoir. The 72000 AF of extra storage in the expanded reservoir would be depleted or zero in 20 years (assuming all available yield under 18,000 AF would be used).   In particular, from 1972 through the end of the 1970s, excess storage in the expanded Gross Reservoir was zero with excess yield also low to zero during this time period (Figure 9). As before, 18,000 AF of additional yield was achieved in 2002 because of high flow years in the late 1990s. However, excess storage in the expanded Gross Reservoir was depleted by 2002 and very low or zero from 2002 to 2008. Perhaps the 1970s and mid-2000s should be included as other critical time periods by which to judge the feasibility of the proposed project.



1. Gross Reservoir Storage Data missing in 1967, 1987, and 1989; these years omitted from the analysis.
2. Average annual increase in Moffat diversions under Full Use of 2,713 AF subtracted from the adjusted excess basin flows in each year from 1966 to 2012.



Even with additional excess basin flows of 2,682 AF/Y over-estimated in this calculation, the required yield of 18,000 AF/YR would be met in 24 years (54.5%) and not met in 20 years (45.5%) of this 44 year period of record. The percentage of years where the firm yield of 18,000 AF/YR was met was much less than 100% and so did not meet the PN1 FEIS screening criteria.

Climate Change Considerations

Climate change is predicted to decrease surface water supply in the south western United States by approximately 10 percent (Averyt, 2013). Water stress, estimated using the water supply stress index (WaSSI), the ratio of water demand to water supply, is predicted to increase due to climate change from between 0.4 and 4.0 percent (representing the range in stress index from different basins) to between 0.1 and 20 percent in western slope Colorado basins (Averyt, 2013). Note a WaSSI index of greater than one means water supply is less than water demand. Climate change is expected to substantially impact water supplies in western Colorado.

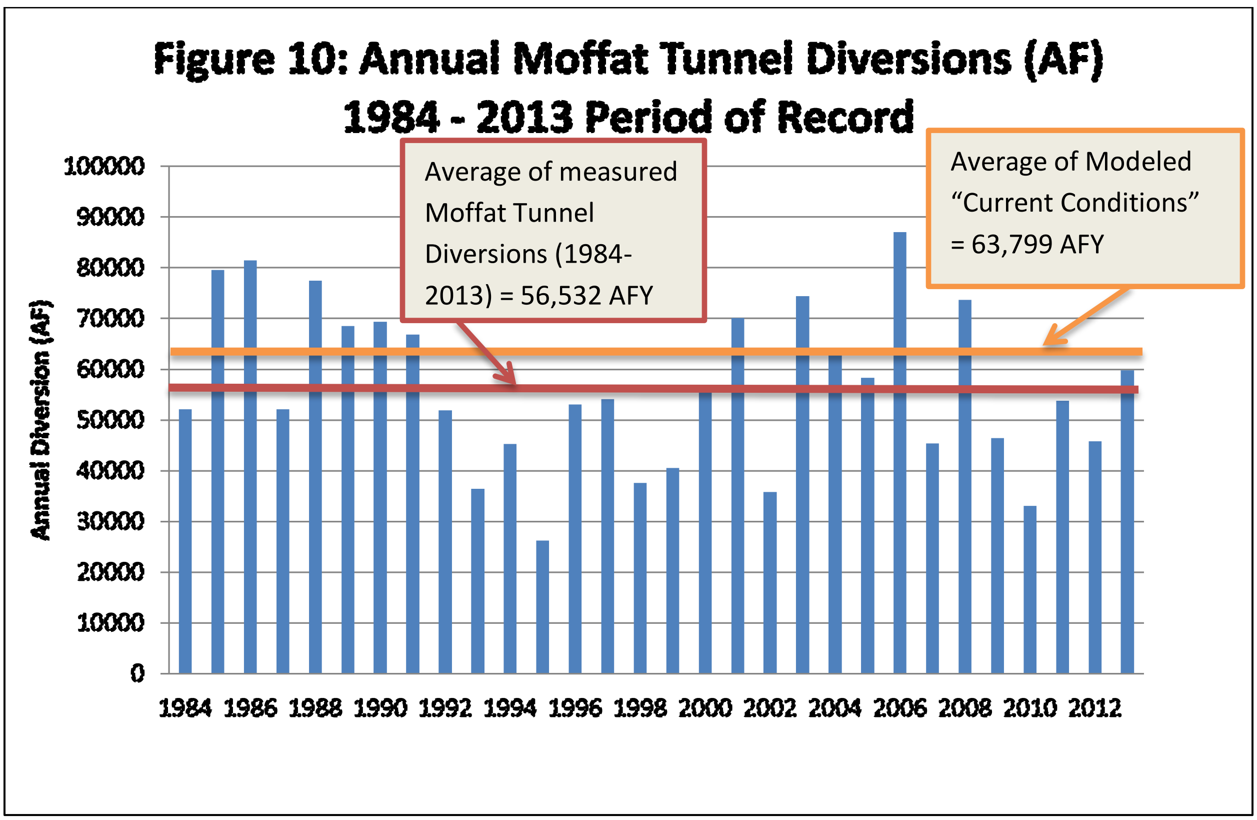
Truncated excess basin flows that account for “full use” model diversions were reduced by 10 percent in years when excess flows were available in the Fraser and Williams Fork basins (i.e. when the existing Gross Reservoir filled) and the firm yield of 18,000 AFY evaluated as before. Because flows in 1983 and 1984 were very high, the expanded Gross Reservoir filled in 1984 with 29,209 AF spilled below the diversion structures. The firm yield of 18,000 AFY was NOT met in one additional year (21 years) or 47.7 percent of the 44 year period of evaluation. Firm yields are controlled by high flow years of 1983, 1984, 1997, and 1998. As before, no additional yield was available from 1976 through 1978. Of course, the past record cannot predict the timing, volume, and sequence of future water supply years though it is anticipated that, due to climate change, droughts may become more severe than the historical record.

Basin Impacts are Hidden in Incremental Model Scenarios

Additional diversions through the Moffat Tunnel are presented incrementally in the FEIS. First, 7,300 AFY above measured average diversions are diverted as part of the “current condition” modeling. Second, the “full use” model scenario utilizes an additional 2,713 AFY on average. Third, the proposed project utilizes an average of 10,280 AFY more water from the Fraser and Williams Fork basins. Only the third incremental increase is considered project water in the FEIS. Therefore, impacts to river flows are limited to only this last increase in diversions in the EIS analysis. “Current condition” model results are considered one of the baselines of the FEIS and so the first 7,300 AFY is not presented nor addressed in the FEIS document.

Discrepancy Between Measured and Modeled Current Diversions

Diversions through the Moffat and Gumlick (or Williams Fork Tunnel) Tunnels are monitored and data reported in the Colorado Decision Support System database. Average measured tunnel diversions from 1984 to 2013 are 56,532 AFY (Figure 10). Average modeled Moffat Tunnel diversions reported on Table H-7.1 are 63,799 AFY; 7,267 AFY more than the measured average. Measured Gumlick Tunnel diversions average 4,954 AFY from 1984 to 2012 and compare to modeled current conditions average diversions of 8,853 AFY. Modeled diversions from the Williams Fork Basin exceed measured averages by 3,900 AFY. Therefore, of the 7,300 AFY discrepancy noted for the Moffat Tunnel diversions, 3,400 AFY on average are supplied by water from the Fraser Valley in the PACSM model.



Tunnel Diversions in 2006, used to delineate “current conditions” in the PACSM modeling, exceeded every other year in the 1985 to 2013 period of record by at least 5,600 AFY. Year 2006 did not represent a new plateau in Denver Water’s water supply needs as diversions after 2006 were substantially lower, averaging 55,619 AFY and approximately 900 AF less than the 1984 to 2013 30 year average. Use of the 2006 baseline condition inflates withdrawals and reduces basin flows under the “current conditions” model scenario compared to actual measured stream and diversion flows in the Fraser and Williams Fork River Basins.

Discrepancies between modeled current flow and measured flows are seen at the Fraser River at Winter Park and the Williams Fork Below Steelman USGS gages (Table 5) but not at the Vasquez Creek and St. Louis USGS gages. It is unclear why the average annual flow discrepancies (8,961 AF) do not add up to that observed for the Moffat Tunnel diversions (7,300 AF) but may, in part, be due to conveyance losses in the Moffat collection system and Tunnel.

Table 5
Comparison of Average Post-Moffat Measured Flows with Modeled “Current Condition” Flows

Location	Average of USGS Post-Moffat Flows	Average Modeled “Current Condition” Flows[1]	Volume of Discrepancy Between Flows (AF)
Fraser River at Winter Park Gage (1936 – 2013)[2]			
Average Annual Flow (AF/YR)	13,020	8529	4,491
April Average Flow (cfs)	11	4	408
May Average Flow (cfs)	31	17	876
June Average Flow (cfs)	79	59	1,185
July Average Flow (cfs)	34	21	781
Total Summer months Fraser River at Winter Park			3,250[3]
Williams Fork Below Steelman Creek Gage (1966 – 2013)			
Average Annual Flow (AF/YR)	14,074	9,600	4,470
May Monthly Flow (cfs)	28	10	1,135
June Average Flow (cfs)	115	88	1,626
July Average Flow (cfs)	56	50	374
August Average Flow (cfs)	10	5	316
Total Summer Months Williams Fork Below Steelman			3,451[3]
Total Discrepancy at Fraser and Williams Fork Basin Gages: Measured vs Modeled			
Discrepancy Between Average Annual Flow (AF)			8,961
Summer Months Discrepancy (AF)			6,700

[1]Current Condition Flows from Tables H-7.1, H-1.33, and H-1.55.

[2]Averages for the post-Moffat period of record at each gage.

[3]Additional 1,209 AF discrepancy summed from August through April at Fraser River at Winter Park Gage and 971 AF summed from September through April at Williams Fork Below Steelman Gage.

Comparison of Calculated Excess Basin Flows with Modeled Diversions

The sum of the three incremental diversions from the FEIS, discussed above, matches calculated excess basin flows that are required to attain a firm yield of 18,000 AFY in the expanded Gross Reservoir at a frequency of 77% of the test period years (Table 6). These equal the sum of all additional diversions between the historical post-diversion baseline and the proposed project. To achieve the firm yield in 100 % of test period years will require even more additional diversions out of the Williams Fork basin from the planned expansion of the Williams Fork collection system to Darling Creek.

Table 6: Comparison of Calculated Excess Basin Flows with Modeled Diversions

Description of Calculated Excess Flow	Calculated Excess Flows (AFY)	Modeled Diversions (AFY)	Description of Modeled Incremental Diversions
Total Calculated Excess Basin Flows;	15,557	7,300	Average discrepancy between measured diversions and current conditions model
Additional Flow Required to Meet 18,000 AFY Firm Yield in Expanded Gross at a sufficient frequency.	4,000	2,713	Current to Full Use Model Scenarios
	---	10,284	Full Use to Proposed Model Scenarios
Totals	19,557	20,297	

Note: Calculated Excess flows do not include incremental conveyance losses within the Moffat Collection System.

Impacts to basin stream flow discussions in the FEIS should reflect all diversion increases that are required to operate the expanded Gross Reservoir at a firm yield of 18,000 AFY. Limiting responsibility of basin impacts to a small incremental increase in diversions in the FEIS significantly under-represents those impacts.

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Water Resources Research

RESEARCH ARTICLE

10.1002/2016WR019638

The twenty-first century Colorado River hot drought and implications for the future

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Key Points:

- Record Colorado River flow reductions averaged 19.3% per year during 2000–2014. One-third or more of the decline was likely due to warming
- Unabated greenhouse gas emissions will lead to continued substantial warming, translating to twenty-first century flow reductions of 35% or more
- More precipitation can reduce the flow loss, but lack of increase to date and large megadrought threat, reinforce risk of large flow loss

Supporting Information:

- Supporting Information S1

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Citation:
Udall, B. and J. Overpeck (2017), The twenty-first century Colorado River hot drought and implications for the future, *Water Resour. Res.*, *53*, 2404–2418, doi:10.1002/2016WR019638.

Received 14 AUG 2016
Accepted 14 FEB 2017
Accepted article online 17 FEB 2017
Published online 24 MAR 2017

Abstract Between 2000 and 2014, annual Colorado River flows averaged 19% below the 1906–1999 average, the worst 15-year drought on record. At least one-sixth to one-half (average at one-third) of this loss is due to unprecedented temperatures (0.9°C above the 1906–1999 average), confirming model-based analysis that continued warming will likely further reduce flows. Whereas it is virtually certain that warming will continue with additional emissions of greenhouse gases to the atmosphere, there has been no observed trend toward greater precipitation in the Colorado Basin, nor are climate models in agreement that there should be a trend. Moreover, there is a significant risk of decadal and multidecadal drought in the coming century, indicating that any increase in mean precipitation will likely be offset during periods of prolonged drought. Recently published estimates of Colorado River flow sensitivity to temperature combined with a large number of recent climate model-based temperature projections indicate that continued business-as-usual warming will drive temperature-induced declines in river flow, conservatively −20% by midcentury and −35% by end-century, with support for losses exceeding −30% at midcentury and −55% at end-century. Precipitation increases may moderate these declines somewhat, but to date no such increases are evident and there is no model agreement on future precipitation changes. These results, combined with the increasing likelihood of prolonged drought in the river basin, suggest that future climate change impacts on the Colorado River flows will be much more serious than currently assumed, especially if substantial reductions in greenhouse gas emissions do not occur.

Plain Language Summary Between 2000 and 2014, annual Colorado River flows averaged 19% below the 1906–1999 average, the worst 15-year drought on record. Approximately one-third of the flow loss is due to high temperatures now common in the basin, a result of human caused climate change. Previous comparable droughts were caused by a lack of precipitation, not high temperatures. As temperatures increase in the 21st century due to continued human emissions of greenhouse gasses, additional temperature-induced flow losses will occur. These losses may exceed 20% at mid-century and 35% at end-century. Additional precipitation may reduce these temperature-induced losses somewhat, but to date no precipitation increases have been noted and climate models do not agree that such increases will occur. These results suggest that future climate change impacts on the Colorado River will be greater than currently assumed. Reductions in greenhouse gas emissions will lead to lower future temperatures and hence less flow loss.

1. Introduction

A large number of studies over the last 25 years have considered the future runoff of the Colorado River (Figure 1) under climate change. Nearly all of these studies have cautioned that future warming will deplete the flow of the river, but the results have varied from minor to major [*Nash and Gleick*, 1991; *Christensen et al.*, 2004; *Milly et al.*, 2005; *Brekke et al.*, 2007; *Christensen and Lettenmaier*, 2007; *National Research Council*, 2007; *Seager et al.*, 2007; *Barnett and Pierce*, 2008; *Ray et al.*, 2008; *Barnett and Pierce*, 2009; *Rajagopalan et al.*, 2009; *Cayan et al.*, 2010; *Reclamation*, 2013; *Harding et al.*, 2012; *Seager et al.*, 2012; *Vano et al.*, 2012; *Ficklin et al.*, 2013; *Vano et al.*, 2014; *Ayers et al.*, 2016; *Milly and Dunne*, 2016]. In contrast, the latest U.S. Government assessment implies little or no change is likely because precipitation increases will be sufficient to maintain temperature-depleted flows [*Reclamation*, 2016]. Fifteen years into the twenty-first century, the emerging reality is that climate change is already depleting

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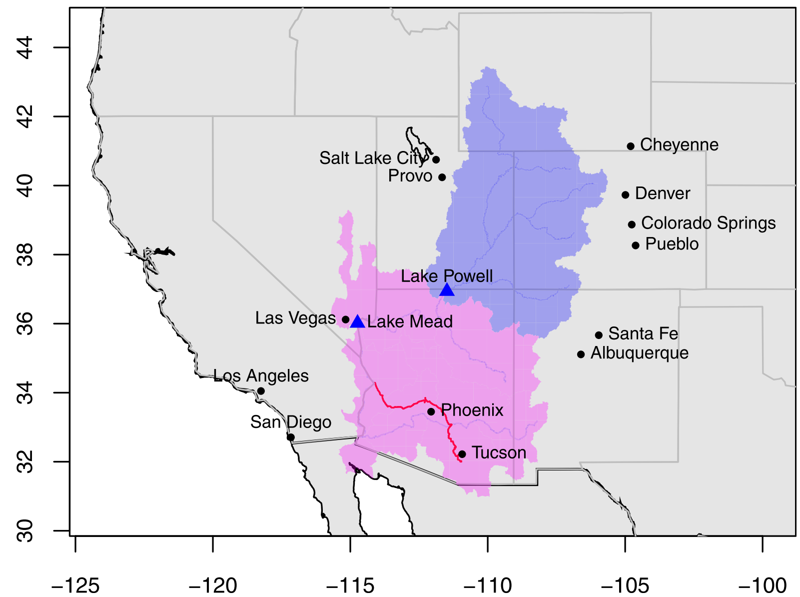

Figure 1. Map of the Colorado River Basin. Lower and Upper Basins, major U.S. cities receiving Colorado River water, major tributaries, and Lakes Mead and Powell are shown. The Central Arizona Project canal in red.

Colorado River water supplies at the upper end of the range suggested by previously published projections. Record setting temperatures are an important and underappreciated component of the flow reductions now being observed.

Between the start of the drought in 2000 and the end of 2014, our analysis period, annual flow reductions averaged 19.3% below the 1906–1999 normal period, and Lakes Mead and Powell, the nation's two largest reservoirs, ended the period at approximately 40% of maximum volume despite starting the period nearly full [*Wines*, 2014; *Colorado River Basin Stakeholders*, 2015] (Figure 2a). This drought has continued into 2015 and 2016 with higher, but still below normal, flows estimated at 94% in 2015 and 94% in 2016 with unusual late season May and June precipitation in both years that raised runoff by nearly 20% [*Alcorn*, 2015, 2016]. Despite these smaller recent reductions, Lake Mead continues to decline and in May 2016 it hit a level not seen since its initial filling in the 1930s [*James*, 2016]. The overall Colorado River reservoir system stores 4 times the annual flow of the river, one of the largest ratios in the world. This storage provides a large drought buffer when full. However, when the reservoirs are low, shortage risk can be high for years because high demands, now equal to twentieth century average flow, make it difficult to refill system storage [*Reclamation*, 2012]. While the multiyear California drought has been garnering more national attention, the more slowly unfolding Colorado River drought is every bit as serious and also has national and international ramifications [*Wines*, 2014].

The Colorado River Basin encompasses seven states and northern Mexico and is home to 22 federally recognized tribes. The river provides municipal and industrial water for 40 m people distributed across every major Southwestern city both within and without the basin, including Los Angeles, San Diego, Las Vegas, Phoenix, Tucson, Salt Lake City, Denver and the entire Front Range of Colorado, Albuquerque, and Santa Fe [*Reclamation*, 2012].

Continued low flows would result in additional declines at Lake Mead, eventually requiring Lower Basin (Arizona, California, Nevada) water delivery shortages with mandatory cutbacks imposed primarily on Arizona, but also Nevada and Mexico [*Verburg*, 2011]. At the same time, Upper Basin (Colorado, New Mexico, Utah, Wyoming) water users would continue to endure physical shortages from a lack of water. These initial Lower Basin Lake Mead delivery shortages and Upper Basin physical shortages are manageable to a point; however, under current operating rules with continued low flows during the next 6 to 8 years Lake Mead would drop to elevation 305 m (1000 feet) above sea level, resulting in a number of serious and unprecedented problems [*Collum and McCann*, 2014].

In the Lower Basin, Arizona could theoretically lose its water allocation for the entire Central Arizona Project canal, a critical $4.4B, 530 km cross-state 2 bcm/yr water source for 4.7 m people, multiple sovereign Indian

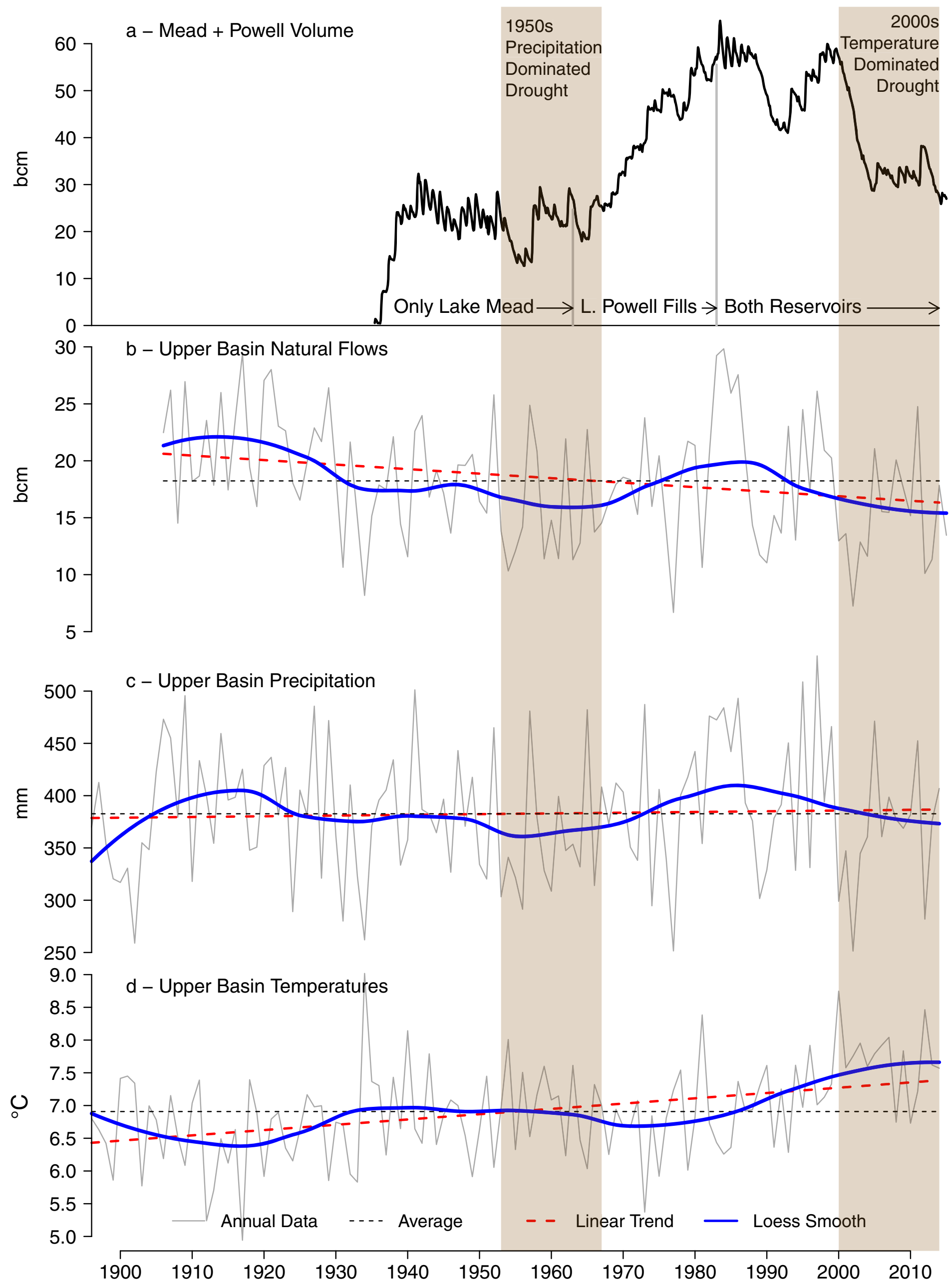

Figure 2. (a) Lakes Mead and Powell combined monthly contents. Upper Basin annual Colorado River (b) runoff at Lees Ferry from 1906 to 2014, (c) precipitation and (d) temperatures from 1896 to 2014. Mead first filled in 1935, Powell in 1963 (supporting information Text S1). Two 15-year drought periods, 1953–1967 and 2000–2014, are highlighted and discussed in main text.

nations, and over 120,000 irrigated hectares [*Glennon*, 1995; *Colorado River Basin Stakeholders*, 2015]. This canal currently relies on occasional but uncertain "equalization" releases from Lake Powell that only occur with irregular and rare large Powell inflows. The extra water is delivered when Lake Powell reaches levels substantially higher than Lake Mead, a use allowed under the 1922 Colorado River Compact section III (e) and formalized most recently under rules established in a 2007 Record of Decision for coordinated operations of Lakes Powell and Mead and for shortage sharing in the Lower Basin [*Department of Interior*, 2007].

Under normal operating rules, without these extra inflows, Lake Mead has excess outflows of 1.5 bcm per year, the so-called Lower Basin "structural deficit" [*Collum and McCann*, 2014]. The structural deficit was created in 1968 when Congress authorized the Central Arizona Project (CAP). In order to obtain the support of

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the large California Congressional delegation, Arizona agreed to rely on this unused, but in the long run unreliable water, because there was not enough remaining unallocated Lower Basin water. The CAP had long been a desire of Arizona and the state was willing to make this bargain despite its flaws [*Johnson*, 1977]. This same water is first available for use by the Upper Basin under the Colorado River Compact, but heretofore has not been developed for Upper Basin use. A plan to augment the Colorado River with flows from outside the basin, discussed during the hearings on the legislation, but not included in the final package due to opposition from potential source areas, was never revisited by Congress. Reclamation in 2011 said that such augmentation was now unlikely.

The structural deficit only became a problem when the CAP was fully completed in the mid-1990s combined with the drought that began in 2000. Upper Basin demand growth has also played a small role, although Upper Basin demands are still much less than forecast in 1968 for the year 2000 [*Tipton and Kalmbach, Inc*., 1965; *Johnson*, 1977]. The recent Lake Mead declines are strongly influenced by this imbalance, and solutions to this deficit have been a recent focus of the Basin states and federal government [*Central Arizona Project*, 2016; *Davis*, 2016].

The Upper Basin also has serious issues, one of which ripples into the Lower Basin. When the surface of Lake Mead declines to an elevation 305 m (1000 feet) above sea level, Lake Powell will also be below its minimum power pool 75% of the time [*Collum and McCann*, 2014]. This occurs in part because low Mead levels make "equalization" releases from Powell more likely thus driving Powell lower. Hydropower losses at Lake Powell could result in substantial rate increases for irrigators who rely on the reservoirs for long term lower cost power contracts, and would also dry up funding for basin-wide programs necessary for water delivery environmental compliance [*Adler*, 2007; *Collum and McCann*, 2014]. Under such low reservoir conditions, there is also a high likelihood that the Upper Basin states would have to curtail existing water deliveries to cities such as Denver, Colorado Springs, Albuquerque and Salt Lake City in order to make required deliveries to Lake Mead. Heretofore, largely because of the structure of the Colorado River Compact, the Upper Basin and Lower Basin have been managed separately. With permanent flow declines of approximately 20%, however, the required deliveries to Lake Mead would become a hardship on the Upper Basin, as well as create Lower Basin delivery shortages [*Reclamation*, 2007; *Barnett and Pierce*, 2009; *Rajagopalan et al*., 2009]. The original compact, signed during one of the wettest periods in the last 450 years [*Woodhouse et al*., 2006], did not envision how large scale flow declines would be managed between the basins, and such declines could cause an allocation crisis between the Upper and Lower Basins [*Adler*, 2008].

Understanding the cause of, and reacting properly to, the ongoing drought is critical to the future of the Southwest. Herein we investigate the role of precipitation versus temperatures as causes of the current drought, provide temperature-based and precipitation-based twenty-first century flow projections and provide policy implications of these findings. Our approach separates the impacts of high-confidence temperature projections from those associated with the much lower-confidence projections of future precipitation using a simple but powerful sensitivity technique. Moreover, we make a novel—and important—case that there is a high likelihood that the impacts of continued atmospheric warming will overwhelm any future increases in precipitation because prolonged dry periods lasting multiple decades are likely to negate the beneficial impacts of additional precipitation during other times.

2. Causes of the 2000–2014 Drought

The 2000–2014 drought is defined by the lowest average annual flows for any 15-year period in the historical record. To analyze this drought, gridded 4×4 km temperature and precipitation data from 1896–2014 for the area above Lees Ferry were obtained from the Precipitation-Elevation Regression on Independent Slopes (PRISM) model [*Daly et al*., 1994; *Guentchev et al.*, 2010; *Oyler et al.,* 2015a, 2015b; *Rangwala et al.,* 2015]. In addition, we obtained reservoir contents and natural flows at Lees Ferry from the U.S. Bureau of Reclamation (Reclamation) (Text S1). Lees Ferry is situated just below Lake Powell and is the Compact dividing line between the Upper and Lower Basins. Approximately 85% of the flow originates above Lees Ferry [*Christensen and Lettenmaier*, 2007].

Historically, Upper Colorado River Basin precipitation has been the main Colorado River runoff driver such that high flow years (1920s, 1980s) were associated with high precipitation and low flow years (1930s, 1950s) with low precipitation (Figures 2b and 2c). The current drought (our study period is 2000–2014, but

Table 1. Winter/Summer/Annual Upper Basin Mean Water Year Precipitation

	1953–1967			2000–2014			1896–2014	
	mm			mm			mm	
	Total	Anomaly	Anomaly % of Mean (%)	Total	Anomaly	Anomaly % of Mean (%)	Mm	% Avg
Winter (Oct to Mar)	176	−16	−8.6	187	−5	−2.7	192	100
Summer (Apr to Sep)	184	−7	−3.6	179	−12	−6.4	191	100
Total	359	−23	−6.1	365	−17	−4.6	383	100

the drought is still on-going), with its modest −4.6% precipitation decline and −19.3% flow decline, stands in stark contrast to the second-lowest 15-year flow period (1953–1967), a precipitation-driven drought with averaged precipitation reductions of −6.1% per year and flow reductions of −18.1% per year (Figures 2b and 2c and Table 1). Compared to the 1950s drought, the 2000s feature much more (near normal) winter precipitation (−8.6% 1950s decline versus −2.7% 2000s) and significantly less summer precipitation (−3.6% 1950s decline versus −6.4% 2000s). The 2000s precipitation decline is only 75% of the decline in the 1950s, thus begging the question of why the recent drought was more serious. What has changed is that temperatures in the runoff producing Upper Basin are now 0.9°C above the 1896–1999 average and are the highest in the gaged record; whereas temperatures during the 1953–1967 drought were much cooler and only slightly above the 1896–1999 average (Figure 2d and Table 2). This makes the current drought unprecedented in the gaged record.

In contrast to the more precipitation-driven current California drought [*Diffenbaugh et al*., 2015; *Williams et al*., 2015], lack of precipitation is only partially to blame for the Colorado River runoff declines during the last 15 years. Instead, approximately a third, or more, of the recent Colorado River flow reduction is most likely a result of record-setting warmth. Since 1988 an increase in the frequency of warm years has been strongly associated with lower flows than expected [*Woodhouse et al*., 2016], suggesting an important role for temperature in flow losses. Such temperature-driven droughts have been termed "global-change type droughts" and "hot drought," with higher temperatures turning what would have been modest droughts into severe ones, and also increasing the odds of drought in any given year or period of years [*Breshears et al*., 2005; *Overpeck*, 2013]. Higher temperatures increase atmospheric moisture demand, evaporation from water bodies and soil, sublimation from snow, evapotranspiration (ET) from plants, and also increase the length of the growing season during which ET occurs [*Pitman*, 2003; *Weiss et al*., 2009; *Seneviratne et al*., 2010; *Seager et al*., 2015a]. Warm season (April to September) warming has been identified by models as especially important in reducing Colorado River flows because of the increases in ET from longer growing seasons [*Das et al*., 2011]. Increases in measured vapor pressure deficits in the Southwest caused by warming and a decrease in water vapor provide strong support for higher ET during the recent drought [*Seager et al*., 2015b]. As increasing temperatures drive further drying, additional positive feedbacks are possible in the form of lower humidity and less evaporative cooling, decreased cloudiness and increased incident radiation, as well as decreased snow cover and more radiative heating [*Betts et al*., 1996; *Brubaker and Entekhabi*, 1996; *Pitman*, 2003; *Seneviratne et al*., 2010]. In the twentieth century, droughts were associated almost exclusively with a lack of precipitation. In this century, however, high temperatures alone can lead to anomalously dry conditions.

Table 2. Upper Basin Water Year Flows and Temperatures

	Average Annual Flow		Average Annual Temperature	
Period	bcm	% 1906–1999	°C	°C Anomaly to 1896–1999
1953–1967	15.38	81.9	7.0	0.2
2000–2014	15.15	80.7	7.7	0.9
1906–1999	18.77	100.0	6.8	0.0
1906–2014	18.27	97.3	6.9	0.1

3. Estimates of 2000–2014 Temperature-Induced Flow Loss

Over the last several years several studies specific to the Colorado River Basin have investigated the specific relationships among temperatures, precipitation and flow in the basin using the concepts of temperature sensitivity and precipitation elasticity [*McCabe and Wolock*, 2007; *Nowak et al*., 2012; *Vano et al*., 2012, 2014; *Vano and Lettenmaier*, 2014]. Temperature sensitivity is defined as the percent change in annual flow per degree rise in annual temperature. Precipitation elasticity is defined as the fractional change in annual flow divided by the fractional change in annual precipitation [*Vano et al*., 2012]. Note that elasticity has been studied for both increases and decreases in precipitation, whereas sensitivity is typically investigated only for temperature increases. These numbers can be determined empirically and through model studies.

Previous studies on temperature sensitivity and precipitation elasticity show that future impacts to streamflow from increases in temperatures and changes in precipitation can be considered separately using sensitivity and elasticity, and then added together to produce flow estimates [*Vano et al*., 2014; *Vano and Lettenmaier*, 2014]. Considering these effects separately and additively is a powerful conceptual tool for investigating climate change impacts because of the ease in measuring the two variables for current impacts and the wide availability of temperature and precipitation projections from global climate models for assessing future impacts. In addition, the large differences in certainty associated with future changes in the two variables (temperature will surely increase, whereas precipitation may increase or decrease—see below) helps to set apart the risk of future changes in flow associated with each variable.

Vano et al. [2012, 2014], *McCabe and Wolock* [2007], and *Nowak et al*. [2012] provide multiple estimates of the flow sensitivity of the Colorado River flow to temperature using three different methods. *Vano et al*. [2012, 2014] utilized six high-resolution, commonly used hydrology models and two different temperature adjustment methods to obtain Lees Ferry temperature sensitivities. They report an average sensitivity of −6.5%/°C warming with a one standard deviation range from −3.0% to −10.0%/°C for the Upper Basin. Approximately 50% models show increasing sensitivity and 50% decreasing sensitivity as temperatures warm so we elect to use a constant sensitivity over all future temperatures. *McCabe and Wolock* [2007] constructed a simple water balance model that infers an average temperature sensitivity of −8.9%/°C and *Nowak et al*. [2012] found an empirical temperature sensitivity of −13.8%/°C.

We use the complete one standard deviation range (−3%/°C to −10%/°C) of the *Vano et al*. [2012, 2014] temperature sensitivity estimates as they were the most conservative and rigorous of the three studies we investigated. Using this range, we found that recent warming of 0.9°C has likely already reduced river flows from −2.7% to −9% from the mean 1906–1999 flow. This represents approximately one-sixth to one-half (average of one-third) of the total flow loss during the 2000–2014 drought.

The higher temperature sensitivities of the two other studies suggest the actual Colorado River temperature sensitivities are near the upper end and possibly exceed the *Vano et al*. [2012, 2014] estimates. These higher sensitivities imply much greater temperature-induced losses during the current drought (−7.9% to −12.3% versus −2.7% to −9%). Empirical results from the 2000 to 2014 drought also point to mid to high temperature sensitivities. *Vano et al*. [2012] report precipitation elasticities ranging from 2 to 3 at Lees Ferry. Thus, using a midrange precipitation elasticity of 2.5, the 2000–2014 annual −4.6% precipitation decline implies runoff reductions of −11.4%, leaving the remaining −7.9% decline to be explained by other causes. If temperature were the sole cause of this remaining decline, the inferred temperature sensitivity is −8.8%/°C. Using a precipitation elasticity of 3.0 implies a temperature sensitivity of −6.2%/°C, very close to the midrange Vano et al., sensitivity. These temperature sensitivities imply large losses as temperatures rise, the subject of the next section.

4. Twenty-First Century Flow Response to Changing Temperatures and Precipitation

For the analysis on how future temperatures and precipitation would affect runoff, and for investigating how well current linked climate-hydrology models can reproduce the current drought, we used Reclamation's climate projection data sets [*Brekke et al*., 2013, 2014]. These data sets use Coupled Model Intercomparison Project 3 and 5 (CMIP3, CMIP5 after the class of climate models used) climate model projection data linked to the Variable Infiltration Capacity hydrology model to produce flows from 1950 to 2099 (supporting information Text S2, Figures S2, and S3)] [*Liang et al*., 1996; *Meehl et al*., 2007; *Moss et al.,* 2010; *Taylor et al*., 2012].

The same temperature sensitivity and precipitation elasticity numbers discussed above can be used to estimate future flow reductions using climate model outputs under high (business-as-usual, SRES A2 and

RCP8.5) and moderate (somewhat reduced by mitigation, SRES A1B and RCP4.5) greenhouse gas emissions to the atmosphere. By 2050, moderate and high emissions are projected to yield Upper Basin *mean* warming of 2.6–2.8°C (Figure 3), three times recent warming, and by 2100, warming of 3.6°C under moderate emissions and 5.4°C under high emissions. This warming implies total multimodel mean temperature-induced flow losses at midrange sensitivity of −6.5%/°C of about −17% by midcentury and −25% to −35% at end-century (Figures 4 and 5). The multimodel mean complete flow loss *range* over both periods and both emissions is approximately −8% to −55% using the lower and upper temperature sensitivities (Figures 4 and 5). As discussed above, there is little empirical evidence that the true temperature sensitivity of flow to temperature increase is near the low sensitivity.

Temperature-induced losses may be somewhat buffered by projected additional precipitation that can increase runoff by 2–3% for every 1% change in precipitation [*Vano et al*., 2012]. At midcentury precipitation increases of +4–+11% given a midrange elasticity of 2.5 would balance the range of temperature-induced flow losses at a midrange—6.5%/°C sensitivity (Figure 5, right *y* axis). At end-century, with the same sensitivity and elasticity, additional precipitation increases of +4–+20% would balance the range of possible temperature-driven losses. At a higher −10%/°C sensitivity, the balancing precipitation would need to be as great as +15% or more at midcentury and +22% or more at end-century. While these may seem like relatively small increases in precipitation, and thus possible, they would represent a major and unprecedented change in precipitation regime compared to the observed historical variation in precipitation (Figure 2c). During the twentieth century, for example, the wettest 10-year period (1983–1997) had only a +8% precipitation increase. This unusual period was marked by major floods downstream of Lakes Powell and Mead due to uncontrolled reservoir spilling and the near catastrophic loss of the spillways at Glen Canyon Dam [*Udall*, 1983].

Vano and Lettenmaier [2014] argue that the sensitivity-based approach used in our projections provides similar estimates of future streamflow to those generated with more computationally intensive coupled-model methods, except for some (i.e., 10%) overstatement of flow reductions at the highest levels of possible warming by 2100 (e.g., the business-as-usual SRES A2 scenario used in the CMIP3 projections and the RCP8.5 in the CMIP5 projections). This would reduce the end of century high emissions mean flow reductions shown in Figure 5 to a still very significant −45% by 2100.

Recent studies have suggested that CO_2 fertilization may increase plant water efficiency thus reducing future evapotranspiration which could serve to mitigate our projected losses [*Milly and Dunne*, 2016; *Swann et al*., 2016]. Both studies call into question results that show large portions of the globe drying in the twenty-first century [e.g., *Dai*, 2012; *Cook et al*., 2014]. However, *Milly and Dunne* [2016] and *Swann et al.* [2016] show that, despite this increase in plant water use efficiency, the Southwestern US will still dry, a finding that is consistent with multiple global assessments showing substantial drying risk to midlatitude areas such as the Colorado River Basin. Moreover, a recent Australian study found that higher

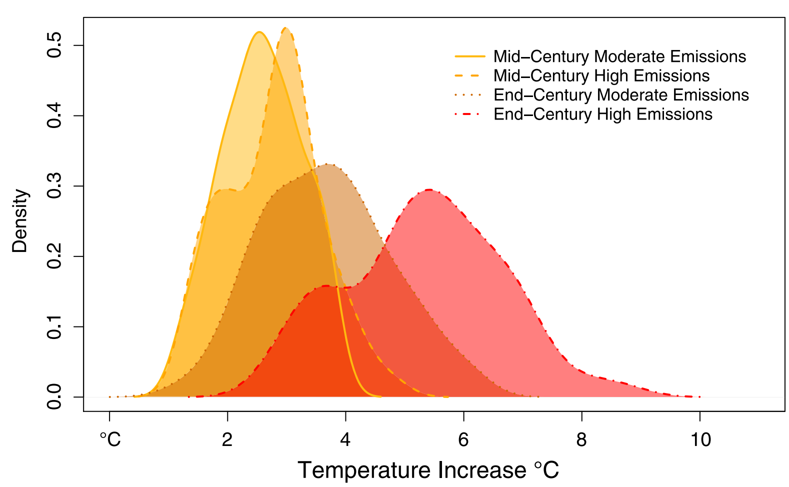

Figure 3. Probability density functions of Upper Colorado River Basin temperature projections for midcentury and end-century under moderate (SRES A1B and RCP4.5) and high (SRES A2 and RCP8.5) emissions.

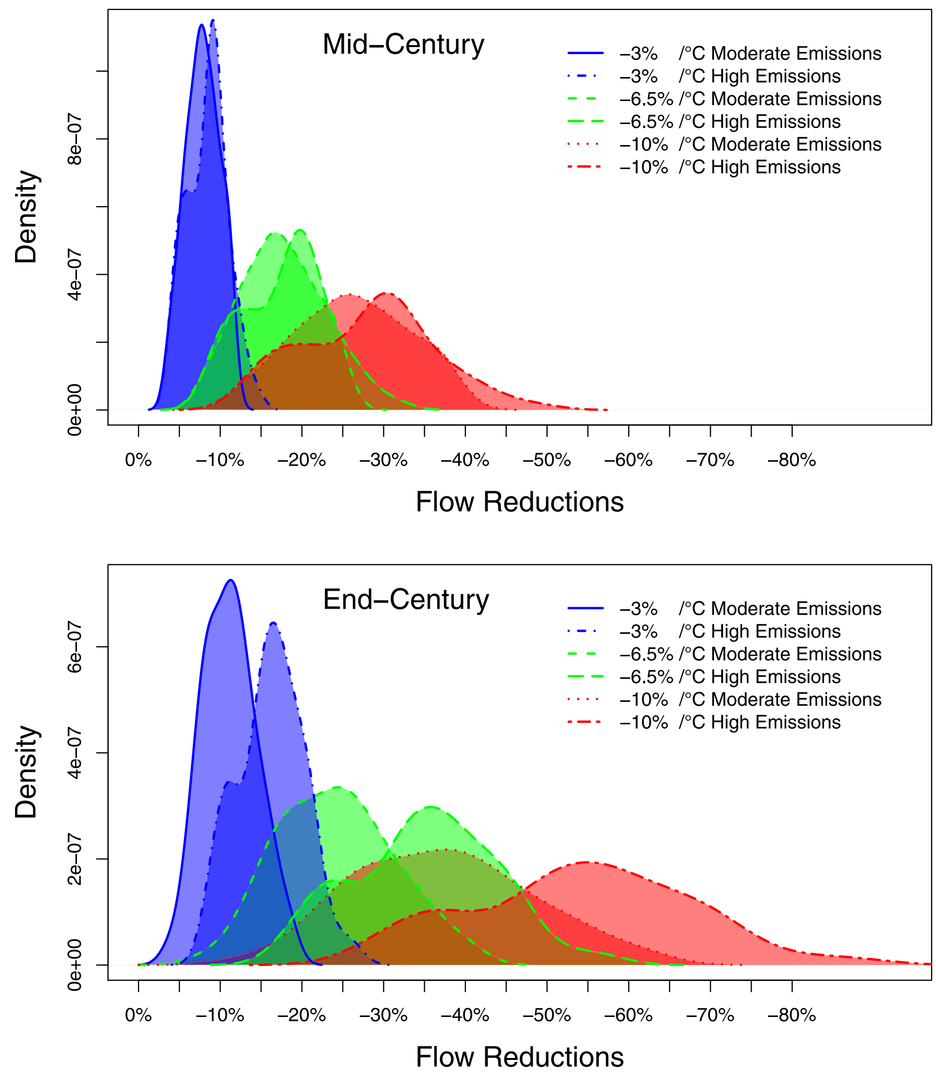

Figure 4. Probability density functions of Upper Colorado River Basin temperature-induced flow reductions for midcentury and end-century with the three temperature sensitivities (−3%, −6.5%, −10%) and the two levels of emissions (Moderate: SRES A1B and RCP4.5 and High: SRES A2 and RCP8.5).

evapotranspiration associated with the increased plant growth stimulated by higher CO_2 outweighed any CO_2-related water-use efficiency effect, and served to reduce streamflows in semiarid regions [*Ukkola et al.*, 2015], a trend that must be exacerbated by the temperature-induced lengthening of the growing season. These results suggest that plant physiological responses are likely consistent with our results, and in any case, do not invalidate them.

5. Megadrought Risks to Flows

Megadroughts lasting decades in the Colorado River Basin have occurred in the past, with resulting substantial flow reductions [*Meko et al.*, 2007]. Multiple papers now suggest there is high twenty-first century risk for megadrought in the American Southwest and that the risk will increase as temperatures rise [*Ault et al.*, 2014; *Cook et al.*, 2015; *Ault et al.*, 2016]. In addition, current GCMs underrepresent the frequency of megadrought [*Ault et al.*, 2012, 2013]. These findings provide additional support for large flow reductions during at least multidecadal drought periods and suggest that current twenty-first century flow projections underrepresent this risk.

Significant Colorado River flow losses occurred during previous multidecadal megadroughts. During the twelfth century, flow reductions of approximately −16% occurred during one 25-year period [*Meko et al.*,

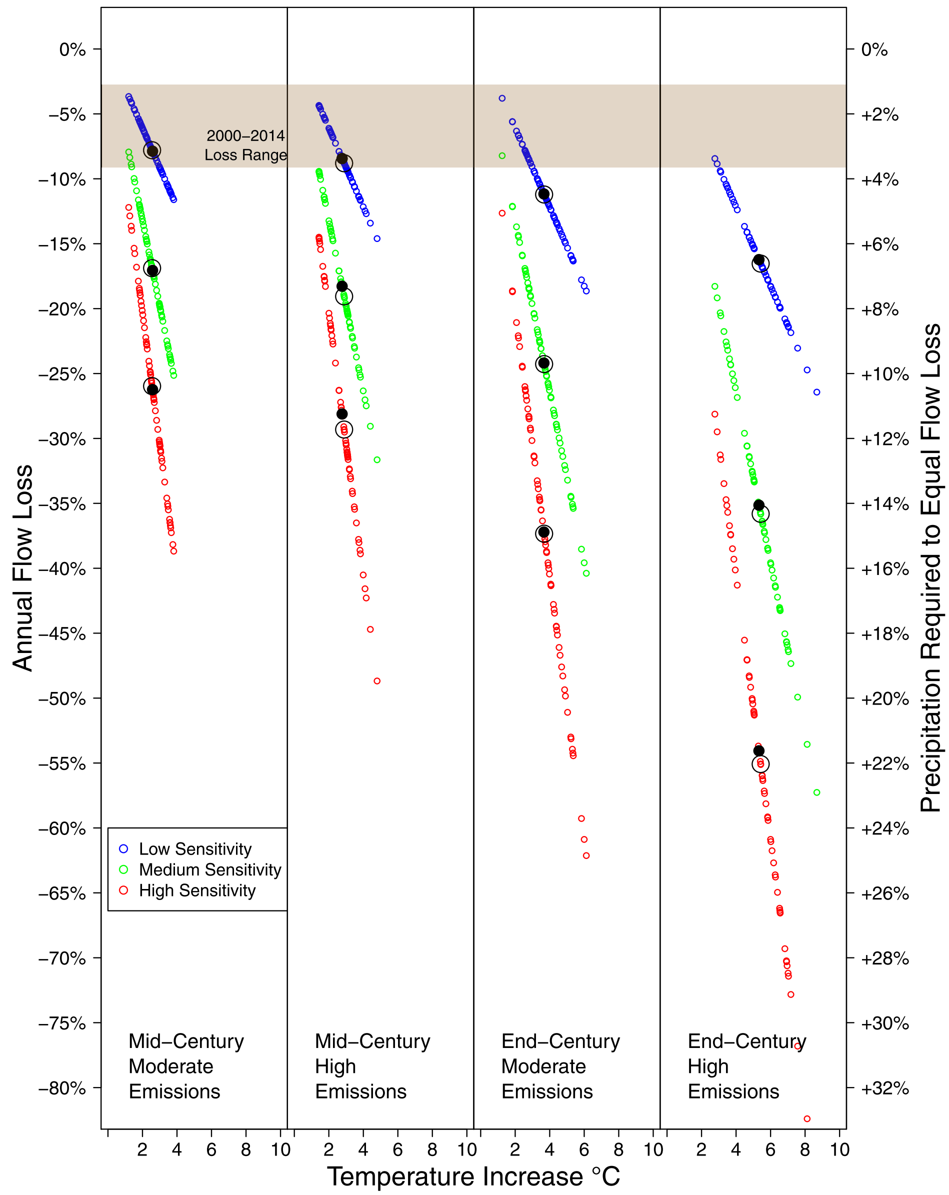

Figure 5. Temperature-induced flow losses by model run (one per dot) with temperature increases shown on horizontal axis. For each period (midcentury, end-century) and emissions type (moderate, high), flow losses for each model run are shown with the 3 (low = −3%/°C, medium = −6.5%/°C, high = −10%/°C) temperature sensitivities. Black dots/circles are averages/medians for each sensitivity. Precipitation increases needed to counteract flow losses at right are based on 2.5 precipitation elasticity. Range for the temperature-induced losses during 2000–2014 drought are shown in shaded brown at the top (supporting information Text S5).

2007]. Evidence indicates that hemispheric and Southwest temperature anomalies were significantly smaller during past megadroughts than the rapid on-going current warming that could easily exceed 4–5°C by the end of century under business-as-usual emissions [*Salzer and Kipfmueller*, 2005; *Mann et al.*, 2009; *Salzer et al.*, 2014] (Figure 5). Using the additivity concepts discussed above, additional warming of 1°C, 2°C, or 3°C beyond the historic twelfth century megadrought temperatures would have reduced the −16% flow declines by an additional −6.5%, −13%, or −19.5% at medium temperature sensitivity. These additional reductions would have thus turned a −16% flow decline into declines of −21.5%, −28%, or −34.5%, losses near the middle of our projections.

There is recent strong evidence that continued warming over the next 80 years could increase the risk of multidecadal drought [*Ault et al.*, 2014, 2016; *Cook et al.*, 2015]. Independent of the added drought risk due to continued warming, the risk of a 35-year precipitation-deficit drought later in this century exceeds 15% within a 50-year period [*Ault et al*., 2014]. In contrast, with continued anthropogenic warming, the risk of multidecadal megadrought in the Southwest increases to over 90% over this century if there is no increase in mean precipitation; even if modest precipitation increases do occur, the risk will still exceed 70% [*Ault et al*., 2014, 2016]. At medium warming (4°C), 20–30% precipitation increases will be needed to reduce megadrought risk below 50% and at high amounts of warming (>6°C), it will take a ~40% increase in precipitation to reduce megadrought risk below 50% [*Ault et al*., 2016]. These changes in precipitation are huge and unlikely, and they would still only reduce megadrought risk to below 50%.

Both the CMIP3 and CMIP5 Global Climate Models may not adequately reproduce the frequency of occurrence of known past decadal and multidecadal precipitation droughts [*Ault et al*., 2012, 2013]. In the Colorado River Basin empirical evidence of this problem can be found in the linked GCM-hydrology model results from Reclamation's projections for the basin [*Brekke et al*., 2014]. Approximately half of the CMIP5 models and one-quarter of the CMIP3 models cannot simulate the 2000–2014 drought at any point in the twenty-first century (supporting information Text S3 and Tables S1–S4). This wet bias significantly affects the mean flows of drought-capable and nondrought capable models. At the end of the twenty-first century, the models unable to simulate the current drought are much wetter (109% of twentieth century average Lees Ferry runoff for CMIP3, 113% for CMIP5) than the models that are able to simulate the current drought (85% of average runoff for CMIP3, 91% CMIP5) (supporting information Tables S1–S4). These flow differences are greater than 20%, and represent the difference between serious management challenges and significant oversupply.

6. Risk-Based Framing of Future Runoff Projections

At present, some outputs from global climate models are ready to support reliable risk-based policy while others are not as ready. A key novel aspect of our research is to provide more insight into where confidence is warranted, and where it is not, with respect to projections of future climate and flow change in the Colorado River Basin. In the case of the Basin, every single moderate and high emissions model simulation agrees that temperatures will continue to rise significantly with continued emissions of greenhouse gases to the atmosphere—this result is robust, highly certain and well-suited for informing policy choices. The fact that observations also show substantial warming only strengthens this assertion.

On the other hand, simulated future precipitation change in the Basin is clouded with much greater uncertainty due to substantial disagreement among models and a highly uncertain ability to simulate realistic change in key phenomena such as storm-track position or decadal and longer-scale drought. Whereas climate models are in general agreement that cool season (warm season much less certain) precipitation declines are likely in the Lower Colorado River Basin, these same models disagree when it comes to the sign and amount of precipitation change that is likely in the Upper Basin. This is because precipitation change in the Upper Basin will depend heavily on the exact changes in the position of cool season jet stream and storm-tracks, two aspects of climate change that are not simulated with confidence by global climate models [*Collins et al*., 2013].

Moreover, there is strong evidence that the mean positions of both the jet stream and storm-tracks are likely to push poleward, expanding the area of aridity in the Colorado River Basin, but the amount of this expansion is poorly constrained [*Collins et al*., 2013]. Multiple studies, including some focused on the American Southwest, suggest that the proximate cause of this drying, Hadley Cell expansion, is already well underway and will continue [*Seager et al*., 2007; *Scheff and Frierson*, 2012; *Feng and Fu*, 2013; *Norris et al*., 2016; *Prein et al*., 2016].

Our results regarding future changes in Colorado River flows agree with many previous studies in suggesting climate change translates to flow reductions, although our work is generally not directly comparable because we separate out high confidence temperature-related impacts from the possible effects of much less certain and highly variable precipitation projections. However, our work, as well as this larger body of literature, appears to be at odds with the recent Reclamation projections for the Colorado River Basin, which are widely cited and used. Reclamation's projections use a global climate model output that is downscaled to drive a hydrology model. It is worth understanding why our results emphasize substantially greater risks along with apparently greater flow losses.

The 2011 CMIP3 climate change flow projections by Reclamation indicate a modest multimodel median flow decline of −9% by 2060 for the river, but with a wide range of outcomes from flow increases to flow decreases [*Reclamation*, 2012] (supporting information Table S1). Reclamation's most recent CMIP5 projections show no change in mean and median basin-wide flow by 2070s [*Reclamation*, 2016], but also embody a wide range of results. Compared to CMIP3, the CMIP5 results show increased precipitation, especially in the northern parts of the basin including Northeast Utah, Northwest Colorado's Yampa River and the Green River in Wyoming [*Brekke et al*., 2014; *Ayers et al*., 2016] (supporting information Tables S1 and S3). The increased precipitation in the CMIP5 model runs compared to CMIP3 can be attributed to more southerly storm tracks in CMIP5 that occur in late spring [*Brekke et al*., 2014].

Another issue arises in both the CMIP3 and CMIP5 data sets when GCM precipitation is adjusted by the downscaling techniques necessary for off-line hydrology models. The first step in Reclamation's downscaling is a bias correction step. This step can add approximately 5% more precipitation to the raw GCM precipitation, and this increase appears to not have a physical basis [*Reclamation*, 2013; *Brekke et al*., 2013]. The final downscaling step, spatial downscaling, also increases GCM precipitation, although there is at least a plausible physical explanation for some of the increase: higher elevations in the Rockies receive large amounts of precipitation, but these elevations are not properly modeled by the GCMs. In one study of the CMIP5 data set after downscaling, dry and average models show precipitation increases of approximately +∼5% from the raw GCM output, but the wettest models show +∼10% increases, doubling future precipitation increases from +10% to +20% [*Lukas et al*., 2014]. This extra precipitation is manifested in a number of hydrology model runs that project huge and implausible flow increases in some years that are 150% of the highest known flows in the twentieth century (supporting information Text S4, Figures S2, and S3). The downscaling wetness problem has been identified, but has not been not resolved [*Lukas et al*., 2014]. Reclamation acknowledges that the newer CMIP5 projections have not been determined to be better or more reliable [*Brekke et al*., 2014]. It is noteworthy that internally consistent GCM-only Southwest runoff projections almost uniformly produce significant declines in both CMIP3 and CMIP5 runs [*Milly et al*., 2005; *Seager et al*., 2007, 2012; *Koirala et al*., 2014; *Milly and Dunne*, 2016].

Our results are generally comparable to Reclamation's most recent results when considering the full range of our analysis when both precipitation and temperatures are included. However, our focus and emphasis is on the large near-certain temperature-induced flow declines with a separate analysis of precipitation. Reclamation, by contrast, has a focused on climate multimodel-ensemble median declines, including medians calculated across emission scenarios [*Reclamation*, 2013, 2012]. Decision makers often treat these median outcomes as a proxy for risk despite the fact that the median obscures the wide range of results and lumps wet and dry, warm and hot, large and small emission increases and, most critically, near certain temperature increases and very uncertain precipitation changes.

We assert that the large precipitation increases necessary to offset substantial temperature-induced flow decreases appear unlikely to occur for a number of reasons. These reasons include the potential for storm tracks to go north of the basin due to Hadley Cell expansion, the high potential for megadrought to increase evaporation while reducing precipitation and runoff for extended periods, the large size of the needed precipitation increases, especially when compared to decadal historical increases, the consistent identification by global assessments of the Southwest as an area likely to dry, and finally the lack of any trend over the last century or last 16 years (Figure 2c). Hence, we choose to focus on highly likely temperature-induced declines with separate analysis of the precipitation needed to offset these declines.

7. Policy Implications and Solutions

The climate science take-home messages for Colorado River managers are thus: (1) there is little doubt (i.e., high confidence) that temperatures will continue to increase as long as the emissions of greenhouse gases to the atmosphere continue; (2) there is also high confidence that continued temperature increases will cause river flows to decline, ranging from −11% to as much as −55% by end of century under moderate to high emissions (Figures 4 and 5); (3) there is only low confidence associated with the possibility of storms and precipitation in the Upper Basin increasing enough to even partially offset the temperature-driven declines in river flows; (4) the risk of multidecadal megadrought in the Basin is significant even in the absence of continued anthropogenic climate change, and this risk rises substantially with continued global warming; (5) the likelihood of drought and megadrought means that there will likely be decades-long periods with anomalously low runoff even if there is an increase in precipitation relative to the historical mean during some other periods due to anthropogenic climate change.

Temperature-driven threats to the flows of the Colorado are thus large and real. The only way to curb substantial risk of long term mean declines in Colorado River flow is thus to work toward aggressive reductions in the emissions of greenhouse gases into the atmosphere. Our work shows that modest (e.g., RCP4.5) reductions in greenhouse gas emissions, while having better outcomes than the business-as-usual future (e.g., RCP8.5), still imply large Colorado River flow losses.

The record warm nature of the on-going Colorado River drought indicates that this drought is not just a natural drought, and our work demonstrates that flows are unlikely to return to the twentieth century averages if we only wait. Unusually wet periods like the 1920s and 1990s will still continue to occur, but they will co-occur with higher temperatures that will increase water demand from plants, soil, snow, and humans.

Climate models and theory suggest that flow reductions would be more severe in the Southern portions of the Upper Colorado Basin affecting tributaries such as the San Juan, Dolores, and Gunnison more severely, with smaller impacts to more northerly tributaries such as the Yampa and Green [*Ayers et al*., 2016]. Such spatial distribution would provide additional water management challenges in that the more southerly basins have in general more people, infrastructure, and uses. Such a distribution would create new localized water supply shortages in addition to the overall basin-wide issues.

Other known threats to streamflows include the potential large scale loss of conifers [*Breshears et al*., 2005; *Adams et al*., 2009; *Allen et al*., 2010, 2015], and the impacts of dust on snow [*Painter et al*., 2010; *Deems et al*., 2013]. These factors along with the observed and projected temperature-induced Colorado River flow declines, the inability of many linked climate-hydrology models to simulate persistent droughts, and the increasing likelihood of hot drought and megadrought, all imply that future Colorado River water supply risk is high. It is imperative that decision-makers begin to consider seriously the policy implications of potential large-scale future flow declines. Stable twentieth century Colorado River flow regimes may not reoccur for many centuries—the time scale of climate system readjustment to the complete cessation of greenhouse gas emissions [*Solomon et al*., 2009; *Collins et al*., 2013].

The Colorado River declines do not stand alone as the only warming-related threat to Southwestern water supplies. The Rio Grande also has a grim prognosis [*Reclamation*, 2013; *Elias et al*., 2015]. The drought in California has garnered national attention, and multiple studies have strongly implicated increasing temperatures as a contributor to these woes [*Griffin and Anchukaitis*, 2014; *Belmecheri et al*., 2016; *Diffenbaugh et al*., 2015; *Mann and Gleick*, 2015; *Seager et al*., 2015a]. Southern California is particularly at risk, with a critical economy and a very large population, all coupled with a large reliance on both climate-threatened in-state, as well as Colorado River, water.

Adjusting to the new reality of rapid climate change will not be an easy or fast task; water management and water policy change slowly. The Colorado River is managed by a complex set of agreements, interstate compacts approved by Congress, international agreements, legislation, and court decrees set in place over the last 100 years [*Verburg*, 2011]. Most agreements were derived from twentieth century state-based negotiations with win/lose policy prescriptions that minimized basin-wide considerations of economic prosperity and potential harm [*Adler*, 2008]. None expressly includes climate change risk management, nor the provision for flow reductions that will be relentless on decadal timescales. New agreements often take years to put in place [*Department of Interior*, 2007]. The recently proposed structural deficit solution [*Central Arizona Project*, 2016], while important and laudable for the short term, will not solve the problem of large scale flow losses. With reduced water supplies, much will have to change in these agreements to address equity, economics, and social concerns on regional, state, basin-wide, and even national levels. Climate change threats to western water supplies are very real, and should prompt great concern and urgency among both water managers and the citizens of the Southwest.

Acknowledgments
We thank the U.S. Bureau of Reclamation for data assistance and comments, and M. Kelly, D. Kenney, E. Kuhn, D. Lettenmaier, J. Robison, P. Troch, and C. Woodhouse for comments and discussion. A portion of this research was supported by the Colorado Water Institute, National Science Foundation, the NOAA Climate Assessment for the Southwest, and the U.S. Geological Survey Southwest Climate Science Center. We acknowledge the Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections archive at: http://gdo-dcp.ucllnl.org/downscaled_cmip_projections as well as the World Climate Research Programme's Working Group on Coupled Modeling and the U.S. Department of Energy, Office of Science. The views expressed in this article are those solely of the authors. All data used in the analysis and conclusions in this paper are available from links in supporting information.

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Colorado River Risk Study
Phase III Final Report

November 20, 2019

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Prepared for the Colorado River District and the Southwestern Water Conservation District

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Disclaimer

Hydros Consulting Inc., the Colorado River District, and the Southwestern Water Conservation District acknowledge that the findings presented herein are based on specific modeling assumptions and are intended for discussion purposes only. Neither this Report, nor any of the findings contained herein, represent an official or final position of the Colorado River District, the Southwestern Water Conservation District or any other entity with respect to the law of the Colorado River or State of Colorado water use, law, administration or policy. This study is a work in progress, and the assumptions and conclusions are subject to future modification based on pertinent developments and/or the intent of the proponents to study risk under different scenarios.

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I. Introduction

A. Background

The Colorado River Basin has experienced significantly lower than average annual flows since 2000. Whether this is the result of a long-term drought or the new "normal" is subject to debate. Regardless, average naturalized flows at Lee Ferry during the period 2000-2017 were approximately 12.6 million acre-feet (Maf)[1]. Storage levels in Lake Powell have remained below 65% full since 2000 (except for 2011; **Error! Reference source not found.**). In spite of a good snowpack in 2019 resulting in an increase in storage from the previous year, Lake Powell remains just above half-full, and is forecast to end 2019 about 58% full[2]. A repeat of the 1988-1993 or 2001-2006 severe drought periods could threaten hydropower generation at Lake Powell and possibly the Upper Basin's ability to meet its obligations under the 2007 Interim Guidelines, the Colorado River Compact, or both. Note that during both of those historical drought events which occurred prior to the 2007 Interim Guidelines, Powell was releasing 8.23 Maf/yr. Under the 2007 Interim Guidelines, releases in non-equalization years have averaged 8.8 Maf/yr.

Drought Contingency Plans (DCP) have been developed and approved for both the Upper and Lower Basins. While those plans, if fully implemented, would reduce the risk of a Compact deficit or critically low storage levels at Lake Powell, they may not completely eliminate the risks for the Upper Basin States.

Concurrent with the DCP efforts, Colorado completed its Water Plan (https://www.colorado.gov/pacific/cowaterplan/plan), which lays the foundation for a secure water supply for the State. Point #4 of the Plan's Seven Point Framework is to take actions that minimize the potential for an involuntary Colorado River Compact curtailment. That objective, plus concerns voiced by the Colorado River Basin Round Tables (BRTs) in a joint meeting in December 2014, provided the catalyst for the Colorado River Risk Study.

B. Phase III Purpose and Scope of Work

From the original scope: "*The purpose of Phase III of the Risk Study is to build on Phases I and II and continue to answer Colorado River system risk questions asked by the West Slope roundtables in the context of Colorado's Water Plan and the development of the IBCC Conceptual Framework. Most notably the Risk Study Phase III will continue to address the IBCC Conceptual Framework Summary Point No. 4 which states: An insurance policy that protects against involuntary curtailment is needed for existing uses and some reasonable increment of future development in the Colorado River system, but will not cover a new TMD.*"

[1] http://www.usbr.gov/lc/region/g4000/NaturalFlow/index.html
[2] https://www.usbr.gov/lc/region/g4000/24mo/index.html

Phases I and II set the stage for Phase III by evaluating system-wide risks in the Colorado Basin, and also by developing a new approach to modeling both in-state (Colorado) impacts of potential involuntary curtailment, and/or the development of a demand management program. This modeling approach utilizes the State of Colorado's StateMod water rights simulation model and Reclamation's CRSS (Colorado River Simulation Model). The models share data generated by evaluation of different management, conservation, and administration scenarios, and can be used to better understand the feedback mechanisms and relationships between in-State actions and Basin-wide conditions (particularly at Lake Powell). In Phase III we utilize these tools to revisit current and future risks, and explore some potential approaches to involuntary curtailment.

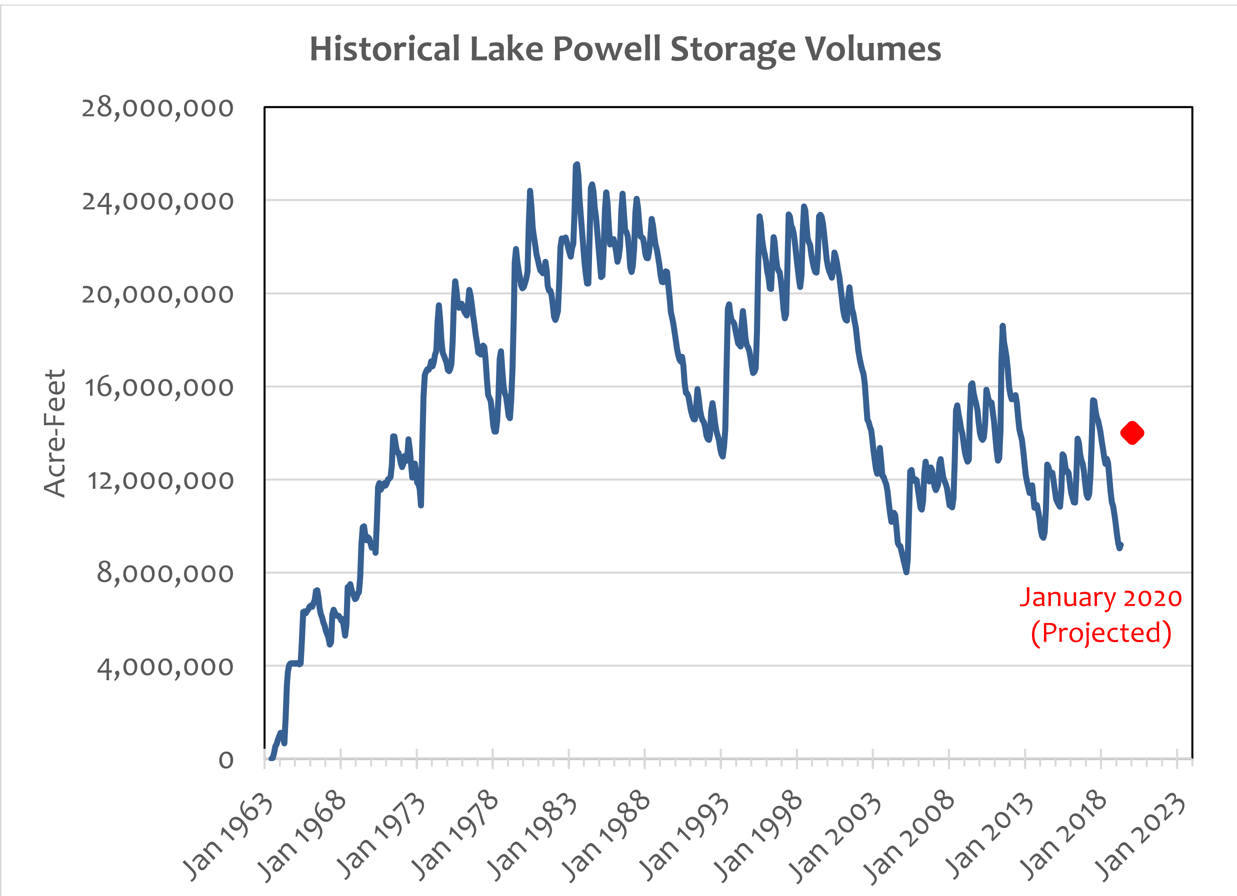

Figure 1. Historical Lake Powell storage with January 1, 2020 projection based on July 2019 24-month study.

The tasks identified for Phase III included:

a. Update the Lake Powell risk analysis (likelihood of dropping below elevation 3525' and likelihood of not meeting the 75 or 82.5 Maf over 10 year obligations) from previous phases to: 1) evaluate levels of risk using current demands as well as a reasonably probable increment of future growth, and 2) evaluate the efficacy of the Lower and Upper Basin Drought Contingency Plans (DCPs) in reducing or eliminating those risks.

b. Obtain, review, and modify as needed the State of Colorado's linked StateMod model. This model version was used for the State's Compact Compliance Study, which is being conducted under the purview of the Attorney General's office and remains confidential. The CWCB made the model publicly available in early 2018 (minus any model assumptions regarding future demands, hydrology, or analyzed approaches to administration of a Compact curtailment).
c. Evaluate a variety of scenarios in which an involuntary curtailment is applied to some or all post-Compact rights. These scenarios include conceptual "allocations" of a Compact shortage across basins and use-types, and include a variety of different deficit assumptions ranging from a full Compact call to different consumptive use reduction target volumes.
d. Evaluate the impacts to Lake Powell levels and risk with a hypothetical 1.0 Maf non-equalized demand management account. Volumes of 100 Kaf and 200 Kaf annually from the four Upper Basin states are assumed to come from voluntary, compensated, and temporary reductions in consumptive use. Colorado is assumed to contribute half of the total annual volume. Also evaluate the recovery time required when using part or all of the non-equalized pool, and the frequency and volumes of water supply deficit that the pool could not fully meet.

While Tasks A-C were completed as written with only minor modifications to scope, Task D will not be completed as part of Phase III and instead may be re-scoped for a future Phase IV. After the original scope and contract were approved, the 7 Basin States finalized, and Congress passed legislation approving the DCPs and their accompanying agreements. Significant to this study is the approval of a 500 Kaf storage account in one or more of the initial CRSP units that could be filled by a (yet-to-be fully defined) demand management program in the Upper Basin. Our initial approach to modifying the scope to align with the DCP was to reduce the volumes of both the demand management storage account and the annual contributions by half, to match the DCP. However, additional uncertainty exists over exactly when and under what circumstances water stored under an Upper Basin demand management program would be released – and hence no specific policy to follow when modeling these operations led us to postpone this task. In lieu of a full analysis of the potential benefits of a demand management account, we provide additional post-processing analysis of the one-time impacts such an account might have on Lake Powell elevations and Lee Ferry volumes (see Section III.c.)

II. Modeling Approach

Phase II of the Risk Study[3] described a new approach to modeling the complexities of both in-state water rights administration (using StateMod) and basin-wide "big river" operations (using CRSS). StateMod[4] is a highly detailed model capable of simulating water rights administration within the State of Colorado, and represents thousands of individual water rights, diversion structures and

[3] Colorado River Risk Study, Phase II Task 2 Final Report, Hydros Consulting Inc., 2018
[4] https://www.colorado.gov/pacific/cdss/statemod

reservoirs, as well as operating policies that govern numerous exchanges, instream flow requirements, interstate compacts, and other water rights administration actions. StateMod also includes the necessary physical representations of return flow timing and spatial distribution, and naturalized inflows for historical hydrology to enable simulation of the results of the combination of historical hydrology with current or future levels of demand. Herein it is used primarily to examine how possible Compact administration protocols might be implemented, the impacts of those protocols to each basin within Colorado, and the potential amounts of pre-Compact and post-Compact depletions in each of Colorado's west-slope basins.

CRSS is a comprehensive model of the Colorado River system, which simulates the policy-based operations of the major Federal reservoirs as prescribed by the 2007 Interim Guidelines[5] and the modified operations and water deliveries anticipated by the recently signed Drought Contingency Plans[6]. The larger spatial scale of CRSS in comparison to StateMod necessitates a higher level of spatial aggregation in representations both of inflow sources and smaller-scale water users, both of which exist primarily in the Upper Basin. The large contract water users and sparse inflows in the Lower Basin, as well as deliveries to Mexico, are also represented. CRSS simulations illustrate how the operations of the large mainstem reservoirs are affected by basin-scale factors such as regional hydrology and increasing demands due to regional population growth. In this study, CRSS allows for the evaluation of systemic risks such as critically low Lake Powell elevations impacting power generation and possible Compact deficits (flows past Lee Ferry), and is used to quantify the impacts of in-state activities on these metrics.

All of the risk profile analyses for Lake Powell and Lee Ferry in this Phase of the Risk Study use the linked StateMod/CRSS modeling tools previous developed in Phase II. This approach allows us to maintain consistency when modeling Colorado's water uses across both models. Additional information on the synchronization of the two models is provided in Section D below, while details on the model run sequencing and hydrologic trace simulation protocols are in Section E.

Technical details relating to comparisons made between the models are summarized in Appendix A. The versions of each model are listed in Appendix B, along with details on the process for obtaining each model.

A. Common Assumptions

Previous modeling using CRSS utilized demand datasets from the Colorado River Basin Study[7], which all increase over time based on various growth rate assumptions. StateMod uses fixed demands which do not vary over time, except to represent changes in irrigation water requirements due to variations in temperature and precipitation. StateMod models of individual basins within Colorado have differing lengths of hydrology data, and the linked StateMod model has a different hydrologic

[5] https://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf
[6] https://www.usbr.gov/dcp/
[7] https://www.usbr.gov/lc/region/programs/crbstudy/info.html

dataset than CRSS. Due to these differences, it was necessary to synchronize the demands and hydrology between the two models, so that the coupled simulations used the same data to the greatest extent possible.

All model runs for Phase III were carried out using fixed demand sets representing two different levels of use: "current demands" and "future demands" (described below). Hydrology data is from the years 1988-2015. This period is often called the "Stress Test", due to its lower-than-average flows (although it does include some periods of above average flows that are useful in simulating reservoir recovery), and was used extensively in Reclamation's modeling for the DCPs. Some hydrologic data filling was required in StateMod, because none of the basin models have hydrology extending through 2015.

B. StateMod Assumptions

StateMod simulations are carried out through a set of rules that execute in an order that follows the priority system used for water rights administration in Colorado. These rules include representations of direct diversions from streamflow, reservoir operations, exchanges, return flows, and many more water rights operations.

1. Hydrology

The physical processes simulated in StateMod are incorporated into algorithms that estimate timing and amount of flow, by accounting for the impacts of measured diversions and assumed return flows on observed stream gage flows from the historical record. The process of developing these input hydrologic datasets is described in detail in the modeling dataset documentation for each basin model, which is provided online, along with a detailed description of the assumptions applied for developing the demand dataset[8].

2. Current Demands

Current demands in StateMod are generally based upon historical acreage of irrigated lands, estimated crop water use requirements, and estimated system efficiencies. Historical and Baseline demand datasets exist for each basin model, with the Baseline dataset representing the best estimate of the demand for water by currently existing uses across the historical years of simulation. The Baseline demand dataset was used for this analysis, with adjustments as described below in Section **Error! Reference source not found.**. The total Baseline demand for depletions for the years 1988-2005 for the State of Colorado in StateMod is 2.803 Maf/yr. Annual supply shortages reduce the amount by 0.271 Maf/yr. resulting in an average simulated baseline annual depletion of 2.532 Maf/yr for the years 1988-2005.

[8] https://www.colorado.gov/pacific/cdss/modeling-dataset-documentation

3. Future Demands

Demands for the "future conditions" scenarios were developed through cooperation with Basin Roundtable technical representatives and staff from the two Conservation Districts. The purpose of the future condition demands was solely to examine how an increment of additional depletions could impact the risk profiles at Lake Powell and Lee Ferry. The identified increases in consumptive use were a combination of additional use of existing rights/projects as well as new uses. When available, Programmatic Biological Opinion (PBO) depletion allowances formed the basis for "allowable" growth without any Federal re-consultation requirements. PBO depletion allowances were used to set the future demand data for the Yampa, Gunnison, and Colorado mainstem basins. The southwest basins (San Juan, Dolores, and various tributaries), and the White basin future demands were developed primarily by in-basin BRT representatives with input from River District and Southwestern District staff. A total of 26 new or enlarged water use demands were identified and added to the model, consisting of agricultural, municipal, and industrial uses. The total increase in demands across all Colorado basins under the future growth scenario total 384 Kaf, or an increase of 13.7% over current demand levels. Actual modeled depletions from these demands averaged 11.5%.

C. CRSS Assumptions

The reservoir operational policies that currently guide system operations most significantly are the 2007 Interim Guidelines for Coordinated Operations of Lakes Powell and Mead, and these Guidelines are used as the operational policy throughout the simulation period. We recognize that the guidelines will be replaced by a new agreement after 2026, and that operations from 2027 into the future will likely be somewhat different. Nevertheless, absent a "better" guess at those future operations, the 2007 Guidelines are used throughout.

1. Hydrology

Natural flow hydrology input data for CRSS is developed by the Bureau of Reclamation, based upon the gage records of 20 stream gages in the Upper Basin, and 9 stream gages in the Lower Basin[9]. The streamflow data from these gages are processed along with historical demand datasets to calculate natural inflows. The demand sets used in development of the natural inflow data come from the Consumptive Uses and Losses Reports prepared by Reclamation[10]. The differences between the consumptive use amounts in the demand sets used for flow naturalization, and the scheduled amounts of consumptive use anticipated in the various demand sets used in simulations, are important to note and are discussed in detail in Appendix A.

2. Demands

CRSS contains spatially-aggregated representations of demands for depletions, and these demands were compared to the corresponding demands in StateMod to provide context for differences in simulation results. The basin-specific depletions simulated in CRSS were calculated through addition

[9] https://www.usbr.gov/lc/region/g4000/NaturalFlow/documentation.html
[10] https://www.usbr.gov/uc/envdocs/plans.html#CCULR

of computational sub-basins and a data object that summarizes depletions within each sub-basin. StateMod depletions were aggregated by basin and compared to the corresponding values in CRSS, and these comparisons are presented in Appendix A. The demands for all Upper Basin users outside of the State of Colorado were set based upon the 2007 UCRC demand schedule, which is the most recent UCRC demand schedule incorporated into CRSS. The demands for the Lower Basin were drawn from the demand schedule provided for the 2007 Interim Guidelines FEIS, with updated demands for Nevada from December 2016.

3. Drought Contingency Plans

The operations of the Upper Basin and Lower Basin DCPs are represented in CRSS as they were implemented for the round of modeling carried out by Reclamation in October of 2017 to support analysis of the impacts of the DCPs. These DCP implementations include re-operations of the Upper Basin CRSP reservoirs, and mandatory contributions in the Lower Basin with progressively greater reductions in use triggered as storage levels in Lake Mead decrease. The voluntary demand management program and corresponding non-equalized storage account that are discussed as potential options in the ratified version of the Upper Basin DCP are not explicitly included in CRSS, but the potential benefits from such programs are considered in the analysis of risk presented in Section III.

D. Model Synchronization

StateMod and CRSS are significantly different in terms of spatial and temporal resolution. The greater resolution of StateMod within the State of Colorado led to implementation of a model linkage where the portion of CRSS representing Colorado was replaced by StateMod.

1. Conceptual Linkage Implementation

The portions of CRSS that represent the State of Colorado were disconnected from the remainder of the model at points corresponding to the gage nearest the State line in each of the West Slope river basins. Table 1 lists these gages for each of the river basins on the West Slope of Colorado, along with the node in StateMod representing that gage, and the link in CRSS where the existing connection to the remainder of the Upper Colorado River Basin was replaced. The outflow simulated by StateMod at each of the nodes in Table 1 was input directly into CRSS as a reach inflow on a monthly timestep.

Table 1. Gages Linking StateMod and CRSS

River Basin	Linking Gage	USGS ID	CRSS Link
Yampa	Yampa River at Deerlodge Park, CO	09260050	YampaAtDeerlodge.GageInflow
White	White River near Watson, UT	09306500	WhiteNearWatson.GageInflow
Upper Colorado & Gunnison	Colorado River near CO-UT State Line	09163500	ColoradoNearCO_UTStateLine.GageInflow
Dolores	Dolores River near Cisco, UT	09180000	DoloresNearCisco.GageInflow
McElmo*	McElmo Creek near CO-UT State Line	09372000	LowerSanJuanRiver: BelowFourCorners.LocalInflow
Mancos*	Mancos River near Towaoc, CO	09371000	
La Plata**	La Plata River at CO-NM State line	09366500	SanJuanSJTribs.Inflow2
Animas**	Animas River near Cedar Hill, NM	09363500	
Los Pinos***	Los Pinos River at La Boca, CO	09354500	Navajo.Inflow
Piedra***	Piedra River near Arboles, CO	09349800	
San Juan***	San Juan River near Carracas, CO	09346400	

*   **   *** These outflows were combined using confluence objects in CRSS to enter the system as aggregated flows at the specified links

Figure 2 displays the connections for the Yampa, White, Upper Colorado, Gunnison, and Dolores Rivers, and Figure 3 displays the connections for the San Juan River and its many tributaries. These monthly inflows are re-sequenced as part of the Index Sequential Method trace generation process, along with the rest of the natural inflows in CRSS.

In the White and Dolores basins, the gages used to link the models are downstream of water users in Utah that are not represented in StateMod, which ends at the State Line in each basin, above the River Gages used for linkage. To account for this, the Utah depletions were subtracted from the flows at the basin outflow nodes in StateMod. These Utah depletions total 6,487 AF/yr in the Dolores River Basin, and 3,958 AF/yr in the White River Basin. Depletions of the San Juan River and its tributaries outside of the State of Colorado are represented explicitly in CRSS, due to the implementation of the linkage in those basins, which is depicted in Figure 3. The San-Juan Chama Project depletions were removed from both the demands and the inflows in the linked StateMod model since these uses occur in the Rio Grande basin in New Mexico, and are represented separately within the CRSS model.

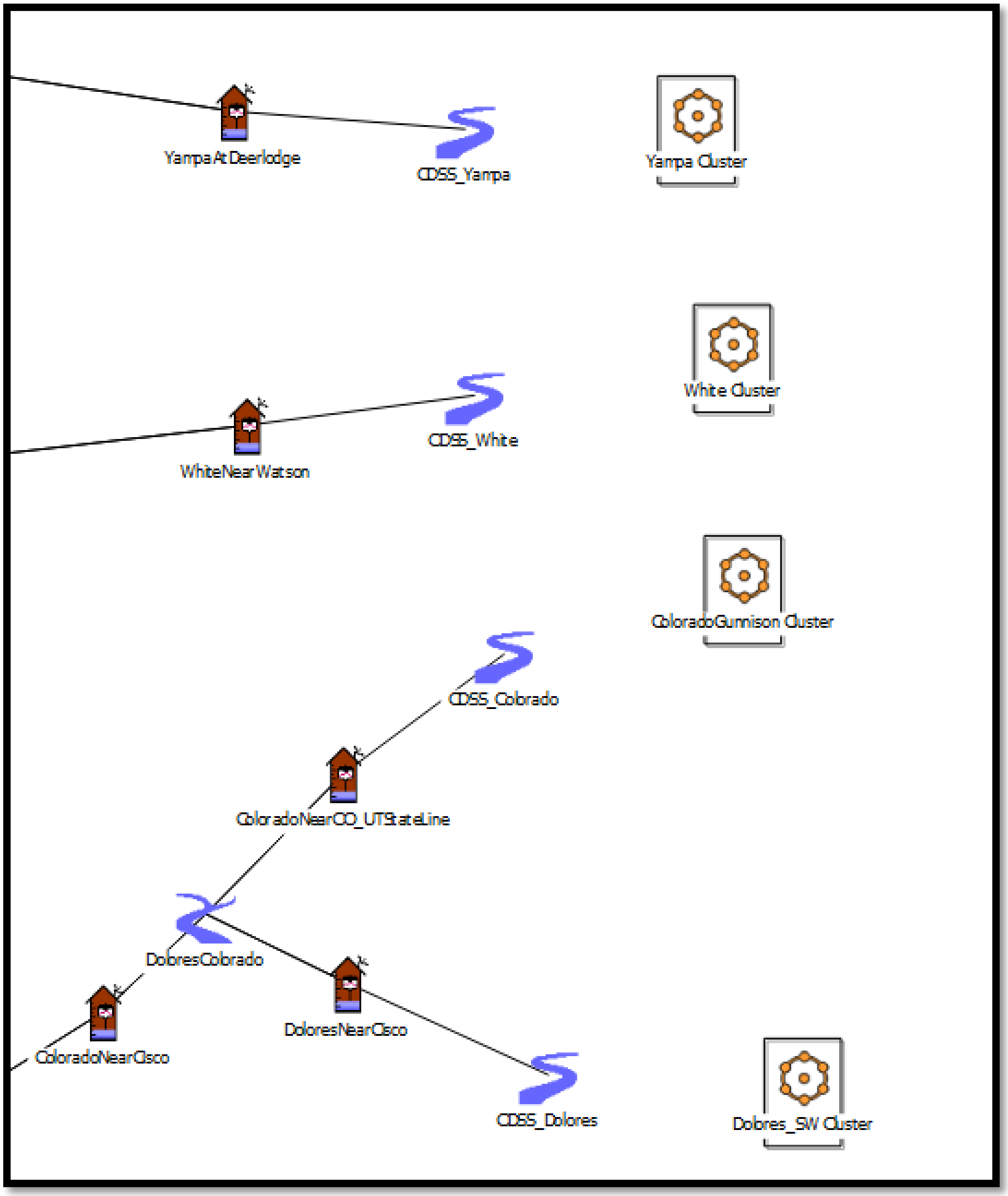

Figure 2. Yampa, White, Upper Colorado/Gunnison, and Dolores Basin Linkages

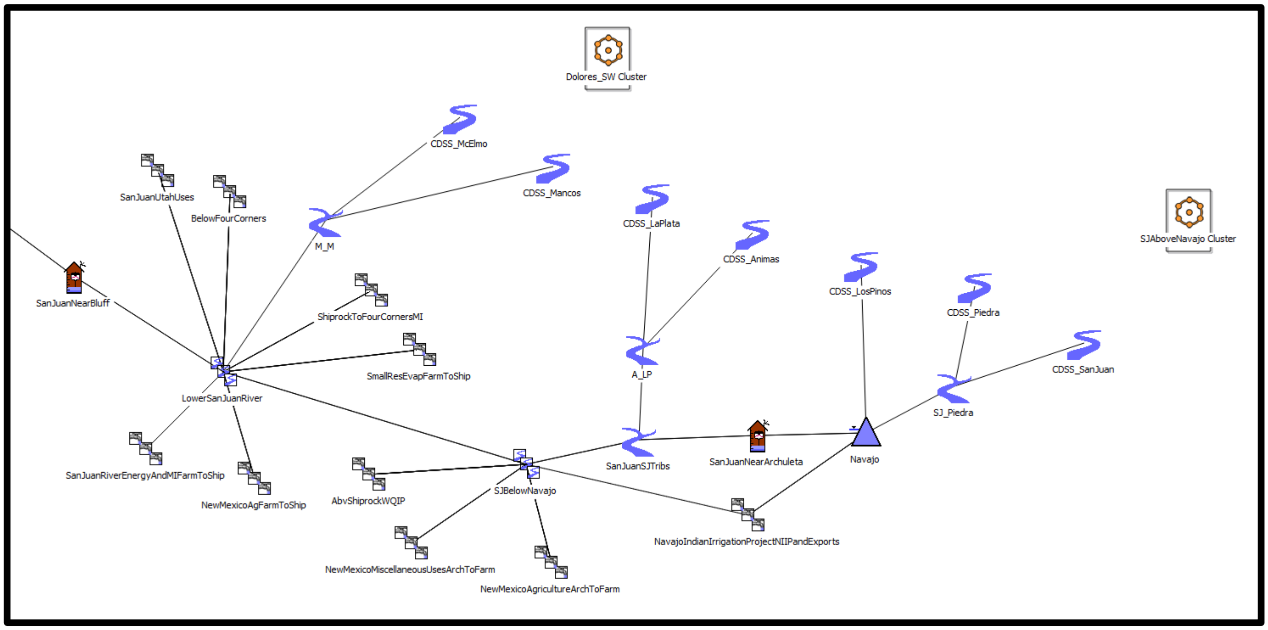

Figure 3. Southwest Colorado Basin Linkages

2. StateMod Surrogate Years

The simulation period for the StateMod linked model ends in 2005, while the Stress Test period used in CRSS covers the period 1988-2015. In order to fill in the years 2006-15 in StateMod, annual flow of the Colorado River at the Colorado-Utah state line for each of the years 2006-2015 was compared to the years 1909-2005, and the year with the closest total annual volume was selected as a surrogate. Table 2 lists the years and percent differences in flow, calculated by subtracting the observed flow in the recent year from flow in the surrogate year. The appropriate year-specific StateMod data from each surrogate year was then appended to the linked model input datasets.

Table 2. Surrogate Years for StateMod Extended Stress Test Simulation

Recent Year	Surrogate Year	% Difference in Flow
2006	1925	-0.7%
2007	1991	0.5%
2008	1938	-0.9%
2009	1971	-0.1%
2010	1991	0.3%
2011	1917	0.0%
2012	1981	3.0%
2013	1940	0.1%
2014	1948	-0.2%
2015	1944	0.1%

E. Simulation Protocols

As discussed above, both CRSS and StateMod were configured to run over the period 1988-2015. CRSS utilizes the Index Sequential Method (ISM) to generate multiple model runs using a single input dataset. In ISM, each year of the simulation period is used once as the first year of a trace (a "trace" as used herein describes one set of hydrology and demands that is run through the model). For the Stress Test period, there are 28 years of data, and thus 28 different traces that comprise a single CRSS scenario simulation. For example, when simulating the current demand schedule with the DCP, CRSS will cycle through the dataset 28 times, each time using a different starting year. Each trace can be thought of as a possible future, and we treat the 28 Stress Test traces as our collection of all possible futures for this analysis. Within a single trace's run, when the model reaches 2015, it loops back to 1988 and continues. All of the data associated with a given year remain synchronized through all the traces.

- Trace 1: 1988-2015
- Trace 2: 1989-2015 + 1988
- Trace 3: 1990-2015 + 1988-1989
- Trace 4: 1991-2015 + 1988-1990
- …
- Trace 28: 2015 + 1988-2014

StateMod does not have the ability to perform ISM-type simulations. However, the key outputs from StateMod that feed into the CRSS simulations are flows at the Colorado state line. It is thus straightforward to synchronize the StateMod outputs by year as inputs into the CRSS ISM method.

Model simulations in CRSS were carried out for each of the 28 traces for each scenario (e.g., current demands + DCP, future demands + DCP, etc.). Post processing to develop statistics for the model runs used the first 25 years of each trace, hence a total of 700 years (28 traces x 25 years per trace) is used to generate the frequency data presented in the CRSS results.

For the analysis of curtailment scenarios completed entirely in StateMod, we use both the linked StateMod model as well as the individual sub-basin models. The results presented for the curtailment scenarios (Section IV) are generally developed from model outputs for the period 1988-2005. A comparison of results from this subset of the available StateMod data shows only minor differences in average consumptive use when compared to the full period of simulation.

III. Analysis of "Big River" Risks

We evaluated the likelihood of reaching critically low Lake Powell elevations as part of Phase II of this Risk Study[11]. That analysis used Reclamation's CRSS model and demand schedules A and (a modified version of) D1 from the 2012 Basin Study, which escalate over time. The increasing demands in those data sets made it difficult to discern the impact of increasing demands as compared to changes in hydrology. This modeling builds upon that analysis by examining the increased risk associated with an increment of hypothetical future growth compared to current demands, both of which are simulated at fixed levels throughout their respective simulation periods. In other words, it was assumed that there were no changes in the current demands throughout the Baseline simulation period, and the values for the future demands were fixed and did not escalate over time in the "Future Demands" scenario. In addition, the recently completed and approved DCPs for both the Upper and Lower Basins were re-evaluated, to determine the impact those plans have on the risks associated with both current and future demand conditions. The DCP simulations include the Lower Basin's delivery reductions plus Mexico's contributions under Minute 323. The Upper Basin drought operations of CRSP reservoirs (Initial Units) is simulated, but no modeling of demand management or the corresponding use of the 500 Kaf storage pool as approved by the DCP was undertaken. We do provide a post-modeling analysis of the possible efficacy of a 500 Kaf demand management account, but a more robust evaluation is needed to better understand how and when such an account might be used. For these simulations, the 2007 Interim Guideline rules for Powell and Mead operations as well as Lower Basin shortages persist for the entire duration of the runs (i.e., beyond 2026). January 1, 2019 data are used for Initial reservoir storages.

Four scenarios were evaluated, combining each of the current and future demand sets with river operations both with and without the DCPs in place:

- Scenario 1: Current Demands Baseline (without DCP)
- Scenario 2: Future Demands Baseline (without DCP)
- Scenario 3: Current Demands + DCP
- Scenario 4: Future Demands + DCP

The risks of declining storage at Lake Powell and flow at Lee Ferry were analyzed for each scenario. The risk of flows at Lee Ferry dropping below assumed critical levels is related to the risk of declining storage at Lake Powell, but with the DCPs now in place, the timing of events and relative risks

[11] Colorado River Risk Study, Phase II Task 1 Final Report, Hydros Consulting Inc., 2018

needed to be revisited. We first address the timing and cumulative frequency of risk at Lake Powell, followed by the Lee Ferry / Compact deficit analysis, and finally a short discussion of potential demand management storage program benefits.

To be consistent with the modeling from previous Phases of the Risk Study, and to maintain consistency with the analysis of the DCPs, this study uses elevations 3525' and 3490' at Lake Powell as the indicators for critically low reservoir elevation. The origin of the use of the 3525' threshold for the DCP analysis is two-fold: 1) it represents the top of the Lower Elevation Balancing Tier from the 2007 Interim Guidelines, and 2) it is only 2.0 Maf above minimum power pool (3490'), and Reclamation staff have indicated that they would get "nervous" about the use of the turbines and power generation if Powell were to drop below 3525, because of possible air entrainment in the turbines and other hydraulic issues. Elevation 3490' is the nominal minimum power pool below at which no generation is possible.

Analysis of risk at Lee Ferry uses 10-year flow targets of 82.5 Maf and 75 Maf, which are the two most commonly cited volumes when defining a potential deficit or measuring compliance under Article III(d) of the Compact. The hydrologic and demand assumptions evaluated in this study, including the runs with additional future demands, did not produce 10-year flows below 75 Maf. Even so, it should be noted that this may not suggest a zero likelihood of such an occurrence, because the hydrologic data assumed for this study do not represent the full range of variability suggested in either the paleo-hydrologic record, or in simulations of the potential impacts of Climate Change. This result is also largely driven by the combined effects of the DCPs and the 2007 Interim Guidelines, which are assumed herein to continue beyond 2026.

Note that exact calculation of the risk of a particular event happening at some point in the future is only possible when the probability associated with all important factors is known. The deep uncertainty evident in the hydrologic record and the extent to which it reflects future conditions, combined with the uncertainty inherent in conflicting interpretations of guiding policy and administrative assumptions necessitates quantification of the relative risk associated with alternative policy actions that are controllable, such as implementation of DCP agreements, and incremental development of additional depletions. The incremental changes to the baseline risk profiles resulting from the modeling assumptions described above are analyzed here, solely to provide guidance in evaluating future policy decisions.

A. Risk Profile for Lake Powell Elevations

The modeled likelihood of Powell dropping below 3525 and 3490 are presented in Figure 4 and Figure 5, respectively. The plots show the cumulative frequency of modeled events. Recall that each scenario consists of 28 different traces. If in a single trace (out of the 28 traces) Lake Powell drops below the target level, that "event" is recorded. The timing of the event can be discerned from the increase in the cumulative frequency, while the total number of traces experiencing the event is shown as the maximum of the cumulative frequency plot.

For example, in Figure 4, Scenario 3 has a maximum (cumulative) frequency of 43% (12 of 28 traces). If our dataset of 28 "futures" are indicative of future hydrology, then there is a 43% likelihood of Lake Powell reaching that critical level at some point in the next 25 years. Because the initial condition for Lake Powell is relatively low (approximately 10 Maf), the majority of events when Powell hits 3525' occur relatively early in the simulation, if at all. Over the 28 year Stress Test period, there are some wetter years, and these wetter periods (particularly the late 1990s) refill the system enough so that the very dry periods that follow do not cause Powell to drop to critical levels. It is interesting to note as well that when the future demands scenarios are simulated (Scenarios 2 and 4), the frequency of hitting 3525' increases dramatically. The additional fixed demands in those Future scenarios is large enough that even through the wetter periods, Powell does not recover sufficiently to be able to make it through the dry years without going below 3525'. Finally, note that the DCPs provide a greater benefit over time under current demand conditions as compared to future demands. This is due to the essentially fixed magnitude of CRSP releases available under drought operations being overwhelmed by the magnitude of shortages under the future demands simulation.

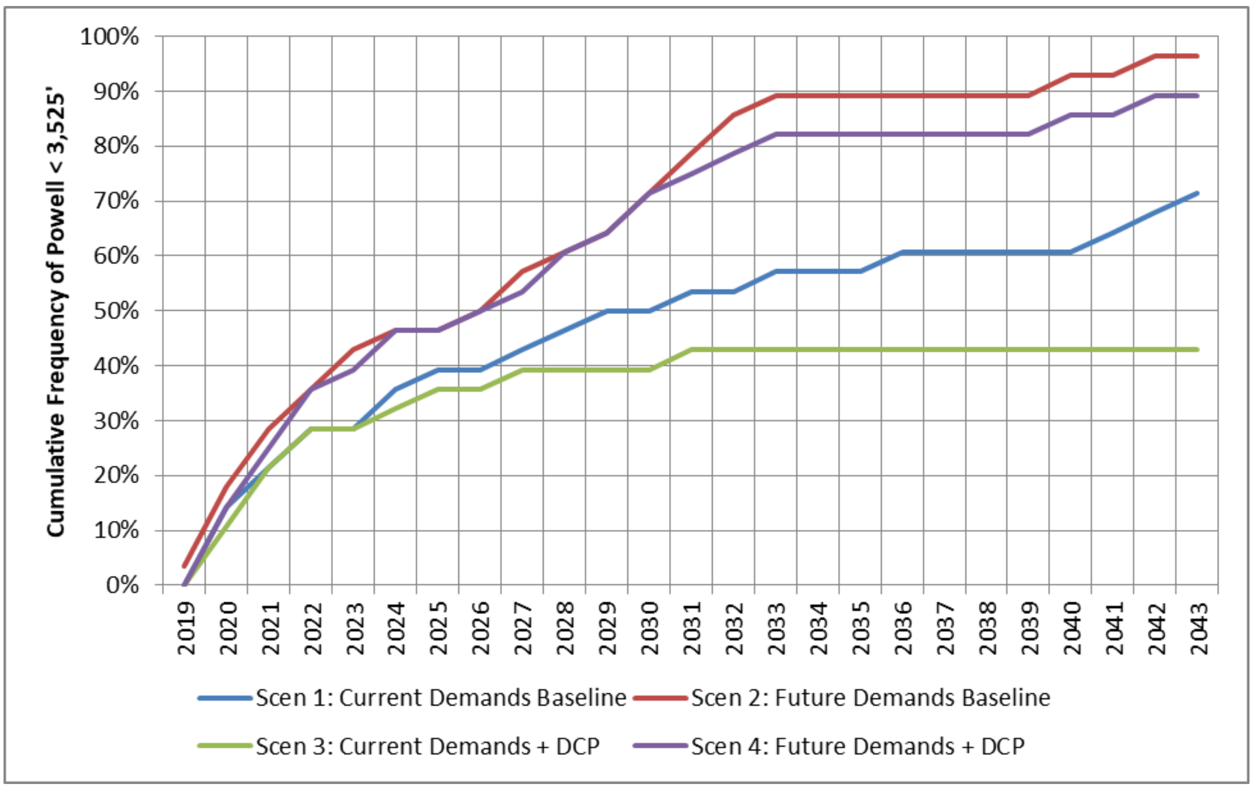

Figure 4. Risk Profile for Lake Powell elevation 3525'.

The benefit of the DCPs is more apparent under future demands when looking at the 3490' elevation power generation threshold (Figure 5). Under the future demand scenario, the DCPs act to significantly reduce the likelihood that Powell would drop below its minimum power elevation. This result is expected, as the CRSP drought operations turn on, and the Lower Basin conservation targets act to stabilize Lake Mead above elevation 1025'. With Mead stabilized above 1025, and

Powell dropping into its Lower Elevation Balancing Tier, releases from Powell are likely to be closer to 7.0 Maf than the 9.5 Maf maximum that is possible under the 2007 Interim Guidelines.

As with the 3525’ threshold, the impact of increased demands is also clear. The modeled increase in Upper Basin depletions of ~11.5% roughly doubles the risk (likelihood of Lake Powell reaching that critical level at some point in the next 25 years) at both the 3525’and 3490’ thresholds with the DCPs in place.

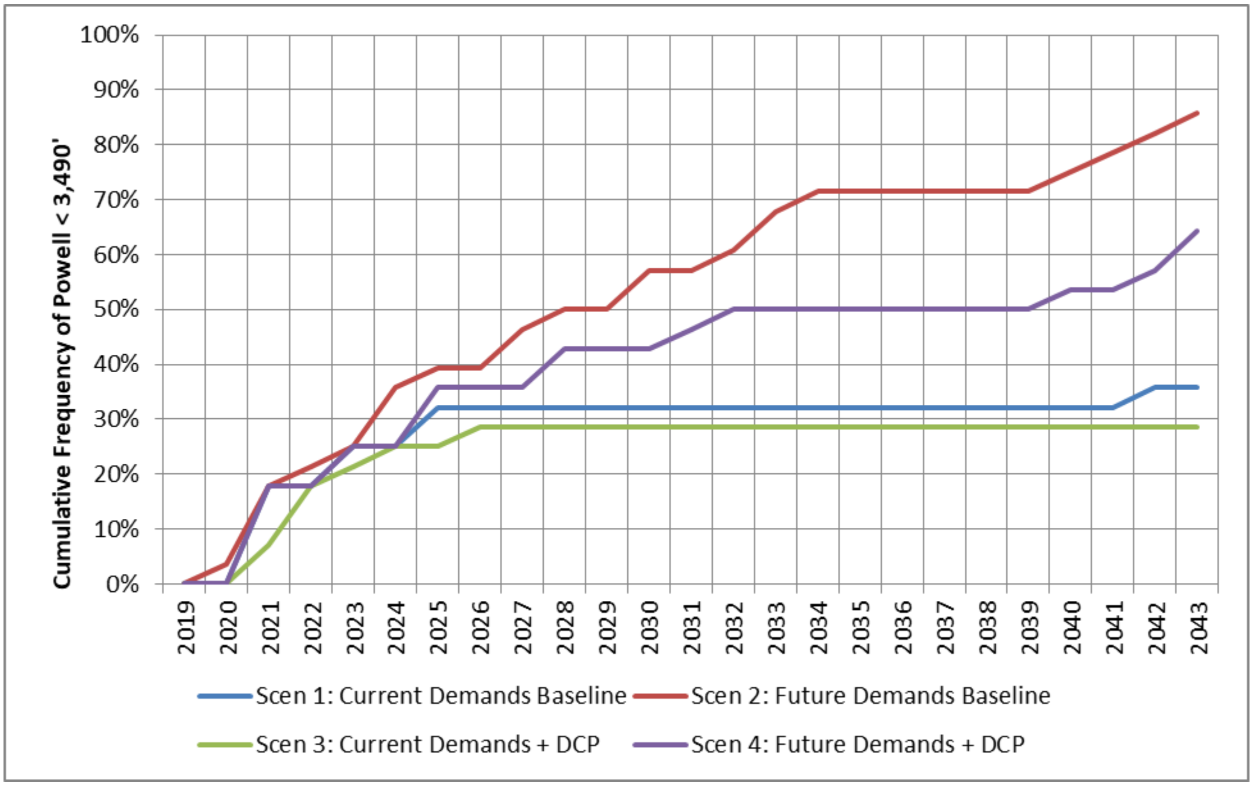

Figure 5. Risk Profile for Lake Powell elevation 3490'.

B. Risk Profile for Compact Deliveries

Exactly what the Upper Basin’s obligations are with respect to Lee Ferry “non-depletion” volumes under the Colorado River Compact is the subject of much debate and uncertainty, and this study makes no attempt to answer those questions. For this study, we analyzed the two most commonly cited volumes, 75 Maf and 82.5 Maf, both of which are computed using a 10-year running total. These represent the Upper Basin obligation under Article III(d) of the 1922 Compact to “*not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years*”, and an additional 750 Kaf annually, to reflect a conservative (i.e. disadvantageous to the Upper Basin) interpretation of what the Upper Basin’s obligation may be under Article III(c). As mentioned above, the simulations in this study produced no instances of 10-year totals dropping below 75 Maf. Minimum Lee Ferry volumes by scenario are shown in Table 3.

Table 3: Minimum 10-year Lee Ferry volumes by scenario.

Scenario	Minimum 10-Year Volume at Lee Ferry (af)
Current Demands Baseline	80,414,547
Future Demands Baseline	78,681,420
Current Demands + DCP	78,650,744
Future Demands + DCP	77,221,987

Figure 6. Cumulative Frequency of Lee Ferry flows < 82.5 Maf / 10-years.Figure 6 shows the cumulative frequency of dropping below the 82.5 Maf threshold at Lee Ferry for each scenario. As with the Powell elevation thresholds, the cumulative frequency statistic increases each time another trace within a given scenario drops below the 82.5 Maf threshold. For example, by the end of the 25 year time horizon, all but three of the Scenario 4 traces (see purple line) has experienced at least one year in which the trailing 10-year total was less than 82.5 Maf. Most of the Lee Ferry "deficits" at the 82.5 Maf threshold do not start occurring until 2024 or later. Because the model uses historical flows as initial conditions, and those flows have generally been in the 9.0 Maf range for the past several years, it takes several years of simulated Powell Releases of 7.48 Maf or lower before the 10- year total drops below 82.5 Maf.

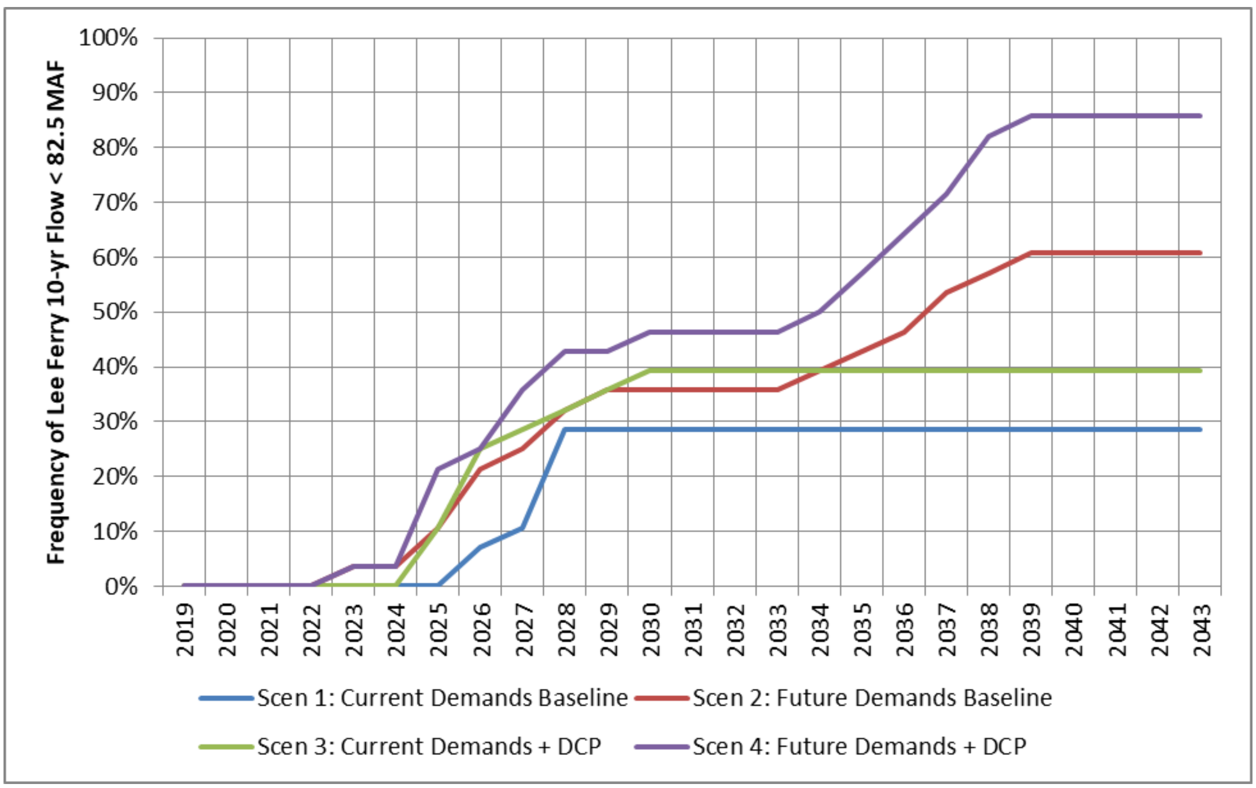

Figure 6. Cumulative Frequency of Lee Ferry flows < 82.5 Maf / 10-years.

The typical pattern of higher risk with the future demands dataset seen in the Lake Powell results carries through to Lee Ferry. However, note that the likelihood of a Lee Ferry deficit at the 82.5 Maf threshold *increases* when the DCPs are implemented. This result is expected, because the DCPs act to increase lake levels at both Powell and Mead. In doing so, the DCPs will tend to push Powell releases into the lower end of the ranges that are prescribed for each operating tier. In particular, DCP operations tend to keep Powell in the Mid-Elevation Release Tier for extended periods of time, by maintaining elevations above 3525' when possible. So instead of getting 9.0 Maf or 8.23 Maf releases, the DCP scenarios tend to result in a lot more 7.48 Maf releases. And if Powell does drop into the Lower Elevation Balancing Tier, it is more likely to have a 7.48 or even 7.0 Maf annual release than 9.0 Maf or 9.5 Maf. This trend towards reduced release volumes at Powell with the DCPs in place is further illustrated by Figure 7 and Figure 8. Under current demands, the likelihood of dropping below 82.5 Maf increases from 28% to 39% when including the DCP. The volumes of deficit increase as well, and the likelihood of a deficit greater than 1.5 Maf increases from 4% to 21%.

As seen above in Figure 4, the DCP operations do not significantly impact the cumulative frequency of maintaining Powell Pool elevations above 3,525' for the entirety of the simulation, but they can prevent the onset of shortfall for long enough, or promote recovery more quickly, such that the minimum elevation in Powell benefits significantly, as seen in Figure 5**Error! Reference source not found.**. This difference in the lowest resulting storage amounts in Powell is seen in reverse at Lee Ferry, as the amount of extra storage at Powell is equal to an amount not flowing past Lee Ferry.

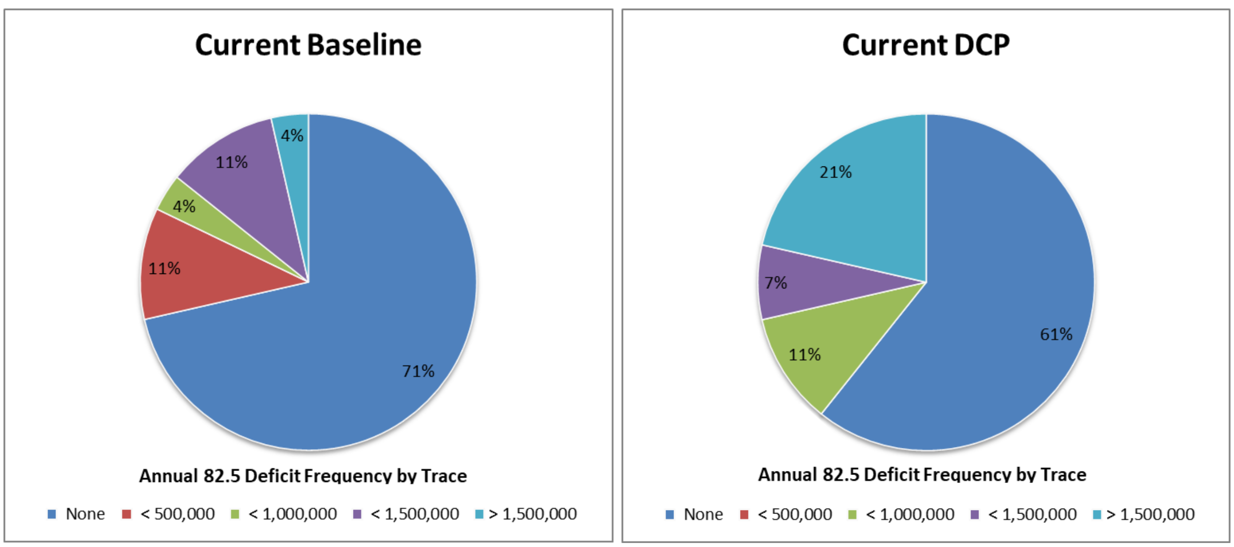

Figure 7. Current Demands Baseline and +DCP Risk Profile for Lee Ferry < 82.5 Maf. The volumes shown are the maximum deficit volumes seen in each trace.

The elevated demands in the Future Baseline scenario result in more traces with simulated Lee Ferry shortfalls, and shortfalls of greater magnitude, as compared to the Current Baseline scenario. Figure 8**Error! Reference source not found.** displays the distribution of maximum shortfall by trace, where it can be seen that 86% of traces which include the DCP experience a shortfall, and the majority of the shortfalls exceed 1.5 Maf.

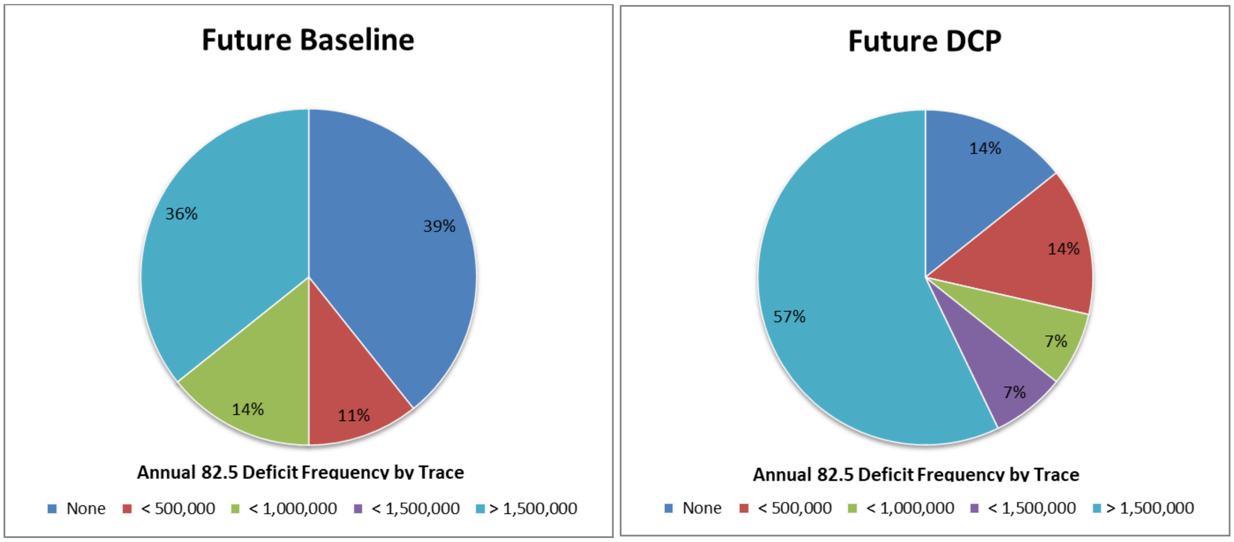

Figure 8. Future Demands Baseline and +DCP Risk Profile for Lee Ferry < 82.5 Maf. The volumes shown are the maximum deficit volumes seen in each trace.

1. Caveat to the Lee Ferry Analysis

As discussed above, the DCPs do a good job of protecting Lake Powell elevations, but actually increase the frequency of 10-year Lee Ferry volumes dropping below 82.5 Maf. When these "deficits" occur, they are often not caused by a lack of water in Powell, but instead by adhering to the policies of the Interim Guidelines. If, as a matter of policy, the Upper Basin decided to ask Reclamation to make additional releases to stay above the 82.5 Maf threshold, it is likely that a significant amount of that deficit could be readily released from Lake Powell. As an example of the intertwined nature of the risks at Lake Powell and Lee Ferry, Figure 9**Error! Reference source not found.** illustrates the simulated pool elevation and 10-year rolling average Compact volume for the hydrologic trace beginning in 2012. The dashed black line in the figure represents both the 82.5 Maf threshold for 10-year flow at Lee Ferry (left y-axis), and elevation 3,525' at Lake Powell (right y-axis). When Powell's elevation crosses the 3525' threshold, both in decline and in recovery, it precedes the 10-year Lee Ferry flow crossing the 82.5 Maf threshold, with a longer lag time between the two events in recovery resulting from the operations dictated by the Interim Guidelines. In this example, by the time the Lee Ferry deficit reaches its maximum in 2029, Powell has approximately 4.0 Maf in storage above minimum power pool.

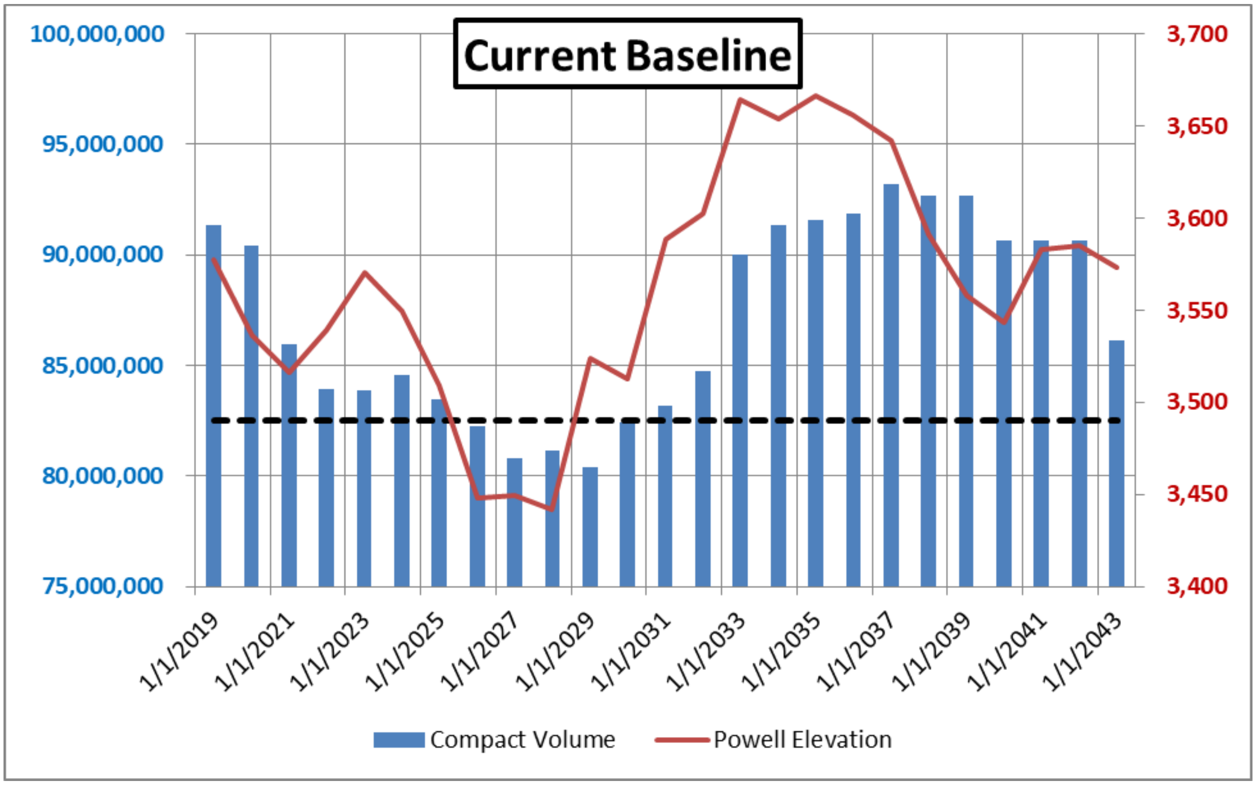

Figure 9. Illustration of the linkage between Powell elevation and Lee Ferry 10-year volumes when operating under the 2007 Interim Guidelines and Drought Contingency Plans

To investigate this phenomenon further, the 82.5 Maf deficit magnitudes were compared to the amount of storage in Lake Powell above minimum power pool (3490') that existed when those deficits occurred. This analysis was carried out as a post-processing step for all four scenarios. The analysis indicates that release of additional water from Lake Powell above the amounts dictated by the Interim Guidelines could eliminate all but one of the Lee Ferry assumed 82.5 Maf shortfalls under the Current Demands Baseline scenario. That single trace would require an additional 1.46 Maf to maintain flows of at least 82.5 Maf. The Current Demands +DCP scenario would also have one scenario in which the existing storage volumes above minimum power pool are unable to eliminate the 82.5 Maf deficit. However, with the DCP in place, the volume of that remaining deficit is only 108,000 AF.

When looking at the Future Demands scenarios, a significant number of the 82.5 Maf deficits can be eliminated by utilizing remaining Powell storage above 3490' elevation. For the Future Demands scenario, use of that water would leave 25% of the traces with a remaining deficit (compared to the original 61%). The maximum remaining deficit from those traces is about 2.1 Maf. The Future Demands +DCP scenario experiences shortfalls remaining in only 29% of traces, as compared to the original deficit frequency of 84%. The maximum volume of those remaining shortfalls is 1.38 Maf.

The exact operational modifications at Powell that would result in release of these additional amounts of water, above or below elevation 3490', were not represented in the modeling, and the development of operational policy that could achieve such deliveries in compliance with existing operational requirements was not considered as part of this analysis.

C. Effectiveness of a 500 Kaf Demand Management Account

The DCP legislation provides for the creation of a 500 Kaf account in one or more of the CRSP Initial Units to be used, if needed, for Compact compliance. Because of uncertainty over the location and operating policy for such an account, we did not attempt to model a comprehensive demand management program in this study. In lieu of that, we analyzed how effective an existing 500 Kaf account would be in offsetting the modeled deficits relative to the 82.5 Maf threshold for compact accounting. This approach greatly simplifies the analysis by assuming that a full 500 Kaf account is available at the onset of each event, and does not reflect the reality that longer term events or events that occur more frequently would reduce the overall effectiveness of the program because of the time needed to refill an account once it has been depleted.

Current Demands Baseline: 8 of 28 traces had at least one instance of the 10 year running total dropping below 82.5 Maf. If a 500,000 AF demand management storage account were available for use at Lake Powell as contemplated in the Upper Basin DCP, it could be used to eliminate the shortfalls in 3 of the 8 traces with deficits. Recall from the previous section that this does not include the possible use of the additional storage below 3525' and above the minimum power pool (3490'). If additional storage above the minimum power pool is used, the deficits in all but one of the traces can be eliminated. The amount of the remaining assumed shortfall at Lee Ferry in the one trace where the shortfall could not be eliminated by release of the remaining water above power pool in Powell would be approximately 962 Kaf.

Current Demands +DCP: 11 of 28 traces had at least one instance of the 10 year running total dropping below 82.5 Maf. (As noted above, the DCP increases the number of traces below 82.5Maf because it generally reduces the average release from Powell). A 500,000 af demand management storage account in Lake Powell would not fully offset the deficit in any of these traces. However, use of remaining storage above minimum power pool would eliminate deficits in all of the traces.

Future Demands Baseline: 17 of 28 traces had at least one instance of the 10 year running total dropping below 82.5 Maf in the future demands baseline. A 500 Kaf demand management storage account would fully eliminate deficits in 3 of these 17 traces. Use of remaining storage above minimum power pool would eliminate deficits in another 9 traces. 5 traces would contain shortfalls after using both the demand management storage account and remaining storage above minimum power pool, with a maximum shortfall of 1.6 Maf. The reduced effectiveness of the demand management storage account in the Future Baseline, as compared to the Current Baseline, is the result of the difference between Future and Current demands greatly exceeding the size of the account when the annual demand difference (and hence reduced Lake Powell inflows) accumulates over a ten year period.

Future Demands +DCP: 24 of 28 traces had at least one instance of the 10 year running total dropping below 82.5 Maf in the future demands plus DCP scenario. A 500,000 af account would eliminate the deficit in 4 of these 24 traces. Use of remaining stored water above minimum power pool would eliminate deficits in all but 5 of the remaining traces. The maximum remaining deficit after use of Powell storage above minimum power pool is about 881 Kaf.

IV. Colorado River Depletion Analysis

The purpose of Tasks B and C was to develop a comprehensive understanding of the linked StateMod model provided by CWCB, and then implement and analyze a variety of potential curtailment scenarios for the Colorado River basins. StateMod represents in detail the water rights, diversion structures, reservoirs, instream flow rights, exchanges, and numerous other processes that characterize water administration in Colorado. Depletions in StateMod are summarized for the structures included in the model, such as diversion ditches and reservoirs, and for aggregations of structures, such as water districts, but depletions are not summarized in model output by water right. Because of this, determination of the amount of depletions that are senior or junior to key dates requires additional careful consideration.

A. Calculating Depletions at Specified Priorities

The methodology applied here for determination of amounts of depletions senior to key dates required modification of the structure of existing StateMod models. An instream flow water requirement was inserted above the downstream-most node of each StateMod model with a decreed flow rate of 9,999,999 cfs, which is a sufficient amount to call out all water use junior to the administration number of the instream flow requirement. Varying the administration number of the instream flow requirement, and analyzing the resulting depletions was carried out to determine amounts of depletions senior to dates of interest. Depletions were calculated using TSTool scripts that retrieve results directly from the StateMod binary output files. Depletions simulated in StateMod include consumptive use, reservoir evaporation, and transit losses.

This method of determining senior depletion amounts was tested by setting the call date to be senior to all water rights on the Western Slope. The administrative date used for this confirmation run was January 1, 1850. The only depletions simulated at this call date resulted from evaporation of stored water that is present as an initial condition for each of the reservoirs in the model.

B. Depletions of Colorado River Water in Colorado

The first analysis undertaken with StateMod was to simply estimate the amount of consumptive use of Colorado River water currently occurring in Colorado. Figure 10 shows minimum, average, and maximum depletion values for the period 1988-2005. Variations in depletions are caused primarily by changing hydrologic conditions from year-to-year, which in turn changes the frequency, timing, and depth of administrative calls in each basin. Total estimated depletions of Colorado River water average just over 2.5 Maf for the simulation period.

Basin	Annual Depletions (acre-feet)		
	Minimum	Average	Maximum
Yampa	173,547	196,982	215,193
White	48,550	62,060	70,397
Colorado	1,117,487	1,220,386	1,345,192
In-Basin	*650,747*	*669,257*	*692,193*
TMDs	*466,740*	*551,129*	*652,999*
Gunnison	480,358	551,150	599,762
Southwest	335,365	500,717	556,627
Total	2,155,307	2,531,296	2,787,171

Figure 10. Depletions of Colorado River water. From the StateMod Baseline model.

C. Pre-Compact Depletions

Of the roughly 2.5 Maf of depletions, we then quantified the proportion that could be attributed to "pre-Compact" water rights. The depletions senior to two possible Compact administration dates were quantified using administration numbers (aka Holt Numbers, developed by the Colorado Division of Water Resources) and appropriation dates. The more senior of the two potential dates of Compact administration is November 24, 1922, which is the date on which six of the seven Basin States signed the Compact. The more junior of the potential dates is June 25, 1929 (administration # 29030), which is the date on which the Boulder Canyon Project act was signed into law by President Hoover. The depletion amounts senior to these dates are displayed in Figure 11Figure 11, using both the administration numbers and appropriation dates of each water right:

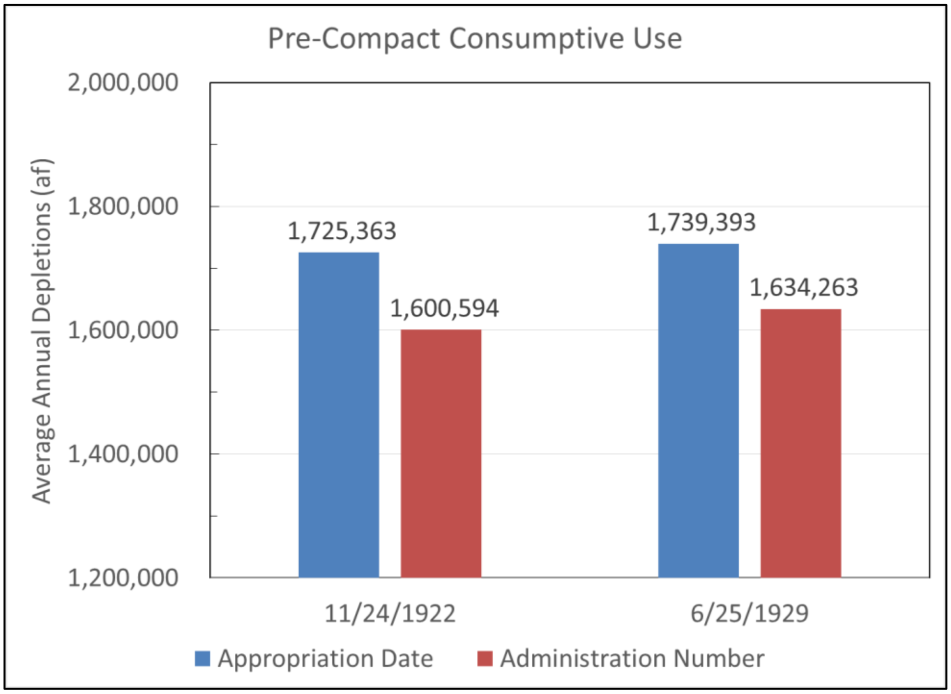

Figure 11. Pre-Compact Depletion Volumes

These depletions are different from the historical depletions associated with water rights senior to the Compact, due to historical use of water rights with priorities both senior and junior to the Compact to irrigate the same lands. These levels of pre-Compact depletions are notably elevated in comparison to some previous estimates, such as the estimate listed in the minutes of the 6th meeting of the Colorado River Commission, where an average total for the State of Colorado's irrigation of lands in production since 1920 was listed as 1,110,000 AF/yr. One of the sources of this difference is the improvement in quantification of potential consumptive use in high altitude irrigation, and another source of the difference is the enhanced efficiency with which pre-Compact water rights are simulated to be used in times of a persistent call.

For the remainder of this report, the term "pre-Compact" will be used to refer to uses with administration numbers senior to the 1922 date. Using the administration number approach will yield the lower of the two volumes of pre-Compact usage, and hence is a conservative assumption for this analysis. The lowest estimate of the amount of pre-Compact use is considered conservative because it corresponds to the highest estimate of the amount of "post-compact" use that would be subject to curtailment under the Compact. The average amounts of pre-Compact depletions by basin for each basin in Colorado are listed in Table 4, along with the proportions each basin represents in terms of total pre-Compact depletions. The Colorado main stem depletions in Table 4 are further differentiated between in-basin uses and trans-mountain diversions (TMDs).[12]

[12] The TMDs referred to in this Report divert water from the Colorado River main stem Basin into the South Platte and Arkansas River Basins. There are a number of smaller post compact trans-mountain diversions that divert from the San Juan and Gunnison Basins into the Rio Grande and Arkansas River Basins. These smaller

Table 4. Pre-Compact Depletions by Basin

Basin	Pre-Compact Depletions (AF/yr)	As Percentage of Statewide Total
Yampa	138,544	8.7%
White	50,173	3.1%
Colorado	594,169	37.2%
In-Basin	574,997	36.0%
TMDs	19,173	1.2%
Gunnison	493,879	30.9%
Southwest	322,561	20.2%
Total	1,599,327	100.0%

D. Post-Compact Depletions

The difference between depletions simulated with and without a Compact call are depletions which rely at least in part on post-Compact rights to meet their consumptive use needs. These depletions are different from the historical depletions associated with post-Compact rights for reasons similar to those that differentiate the pre-Compact depletions described in the previous section from the historical depletions attributable to pre-Compact water rights. Average annual post-Compact depletions for each basin are listed in Table 5, both as volumes and as the percentage they represent of the statewide total. The percentages of total post-Compact use are used as the basis for proportional distribution of curtailment volumes in some of the scenarios evaluated in Section V.

Table 5. Post-Compact Depletions by Basin

Basin	Post-Compact Depletions (AF/yr)	As Percentage of Each Basin's Total Use	As Percentage of Statewide Total
Yampa	58,438	29.7%	6.3%
White	11,887	19.2%	1.3%
Colorado	626,216	51.3%	67.2%
In-Basin	94,260	14.1%	10.1%
TMDs	531,956	96.5%	57.1%
Gunnison	57,271	10.2%	6.1%
Southwest	178,157	35.6%	19.1%
Total	931,969	36.8%	100.0%

trans-mountain diversions were not split from the San Juan and Gunnison Basin values as was done for the Colorado River mainstem.

V. Curtailment Scenario Analysis

The State of Colorado, through the CWCB and AG office, has undertaken a Compact compliance study, which remains confidential. The questions of how and under what conditions a Compact call might be implemented are numerous and highly uncertain. Absent any known path forward if such a situation arose, the WSBRTs wanted to have explored a variety of "what if" scenarios for curtailment. These limited scenarios are not proposals for how to implement a call, but are instead background information across a broad range of possibilities to allow for better understanding of where the impacts may be and how those impacts may vary. The risk analysis presented in the previous section indicates that evaluation of potential curtailment scenarios is a worthwhile step to prepare for future negotiations. It should also be noted that additional potential administrative scenarios are possible, but were beyond the scope of this phase of the modeling effort.

Note also that this analysis of curtailment scenarios is different from and should not be confused with the ongoing discussions and activities related to demand management. Demand management generally refers to the intentional conservation of water to be used to ensure Compact compliance while avoiding the need for water administration to meet the Upper Basin's obligations. A central concept behind any demand management program is that it should be voluntary, temporary, and compensated. The State of Colorado, through the CWCB and AG's office has proceeded with its "2019 Work Plan for Intrastate Demand Management Feasibility Investigations". See http://cwcb.state.co.us/water-management/Pages/DemandManagement.aspx for more details.

A. Scenario Definitions and Rationale

A Compact call is different from a typical administrative call in terms of the time scale associated with the upstream depletions that result in the shortfall addressed by the call, and this difference in time scale suggests that the mechanism for most equitably distributing the cutbacks required by the call could potentially be different for a Compact call, in comparison to a typical real time administrative call. In most cases, for a typical administrative call, the diversions causing the shortfall are occurring upstream of, and at the time of the call, by water users with priority junior to the water user experiencing a shortfall.

A notable exception to this in current administrative practice relates to the administration of out-of-priority upstream storage, which is codified in C.R.S § 37-80-120. Administration of out-of-priority upstream storage is handled by allowing diversions by upstream water users that have a contingency allowing the diversions to be retroactively called out, if the downstream senior right is unfulfilled at a later date. This is conceptually similar to a Compact call, which would result from upstream use junior to the Compact date that occurred at a time prior to the shortfall. The temporal disconnection between the timing of shortfall and the timing of the water use that results in a Compact call is greater than the disconnection involved in out-of-priority upstream storage, which indicates that administration of a Compact call could be based upon long-term patterns of use.

The scenarios evaluated here represent potential methods for distributing the risk of future curtailment inherent in the exercise of rights junior to a right not based upon instantaneous flow availability. Note that these scenarios were developed through multiple meetings and conversations with various BRT groups, and are not intended in any way to represent a full set of "preferred" approaches to possible Compact administration. They are illustrative of a range of possible approaches to reducing consumptive use in an involuntary manner.

1. Direct Priority Administration

One method through which Compact administration might be carried out would be through direct priority administration applied at the same level across all basins. In the direct priority administration scenarios, a single administrative date was determined where uniform application of a call at that date across all basins would result in an average depletion reduction of a specified amount. The most stringent version of this scenario involves application of a call date equal to the date of the Compact, because users senior to the date of the Compact are explicitly exempted from curtailment by Article VIII of the Compact.

2. Basin-Specific Proportional Administration

Another hypothetical scenario for distributing the depletion reductions might be based upon proportional amounts of post-Compact depletions by basin on a long-term average basis. This method is conceptually equivalent to treating each of the basins' group of post-Compact water users as a single entity and assigning equal priorities to the entity representing each basin. So if a particular basin depletes 10% of the State's post-Compact water, it would be responsible for 10% of the state-wide target volume for reduced use.

3. Export-Differentiated Proportional Administration

A second possible variant of the basin-specific method for distributing reductions in depletions was to split the depletion reductions based on percentages of west-slope versus out-of-basin (TMD) depletions. This differentiation groups the trans-basin post-Compact users as an administrative entity separate from the post-Compact water users in the Colorado mainstem, from which the vast majority of post-Compact trans-basin diversions in Colorado occur.

B. Targeted Yield Scenarios

A call amount less than full curtailment could result from a small shortfall at Lee Ferry, or through negotiations that allow for multi-year curtailment which distributes the impacts of the call temporally in a manner similar to the temporal distribution of the depletions that caused the call. These scenarios were compared to the results of a full curtailment scenario, so that the relative reductions in the impact of the call in the targeted scenarios could be assessed. The administrative date of the call for each of the targeted yield scenarios was determined at a monthly resolution, by identifying the month in which the yield of the call switched from yielding less than the targeted amount to more than the targeted amount. Yields exactly matching the targeted amount would require partial curtailment of individual rights, and this analysis focuses on monthly call dates in recognition of the complexity of administration to target yields at single-acre-foot precision. The Targeted Yield Scenarios would result in different impacts to specific water rights compared to a full curtailment, as certain junior rights may be curtailed for longer periods while other more senior post-compact rights might not be impacted at all.

1. Full Curtailment

The most straightforward scenario is that all post-Compact depletions would be curtailed. For this scenario, a call was placed in each of the individual models at an 11/24/1922 priority, and the amount of reduction in depletions compared to a no-call scenario was calculated on an annual basis for each basin. The depletion calculations in the Gunnison were adjusted to remove the simulated depletions associated with evaporation from the Aspinall Unit, which average approximately 23,000 AF/yr. Evaporation from the Aspinall Unit is charged to each of the Upper Basin states on a pro-rata basis of each state's percent of total Upper Basin use, and so should not be counted as part of the Gunnison basin's depletion.

Table 6. Yield of Full Curtailment by Basin

Yield (AF)	Yampa	White	Upper Colorado	In-Basin*	TMD*	Gunnison	Southwest	Total
Minimum	50,440	10,262	527,154	84,234	437,510	42,522	137,840	804,133
Average	58,438	11,887	626,216	94,264	531,952	57,271	178,157	931,969
Maximum	68,468	14,146	722,609	104,681	633,182	87,150	232,037	1,056,021

*Sub-groups of Upper Colorado

The average yield of additional water flowing out of the basin under full curtailment for each basin is essentially equal to the average amount of post-Compact use in each basin (with some minor discrepancies due to evaporative losses, return flows, etc.), and the proportional amounts of post-Compact depletions in each basin to the total were computed for use as the basis of the basin-specific administration scenarios. These proportional amounts are displayed in Figure 12.

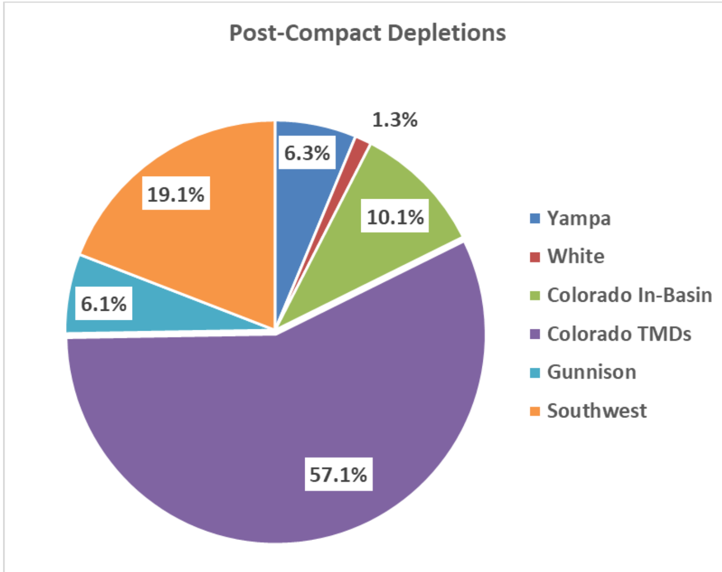

Figure 12. Distribution of Post-Compact Depletions by basin. The total Colorado mainstem portion (67.2%) is split into TMDs and in-basin uses.

2. State-Wide Target Volume Curtailments

As seen in Table 6, a full curtailment of all post-Compact water yields on average about 930 Kaf annually. The next analysis was to look at partial curtailments implemented using single state-wide call dates. For this exercise, we assumed three different target volumes (100 Kaf, 300 Kaf, 600 Kaf), and determined the seniority of the call that would be required, basin-wide, in order to yield that amount of reduced depletions. Using the linked StateMod model, calls were implemented for the duration of the run period, and refined through iteration, until the call dates shown in **Error! Reference source not found.** yielded the target volumes when averaged over 1988-2005. Note that the call dates presented throughout this report are only determined to the month and year, as described above. Refinement to estimate a specific day or even within a day was deemed unnecessary for this level of analysis.

Table 7. State-wide call date to generate a given (average) reduction in annual consumptive use.

Target Volume (acre-feet/yr)	All Colorado River Rights
100,000	Jul 1957
300,000	Sep 1940
600,000	Aug 1935
932,000	**Nov 1922**

Table 8 shows how those volumes would be distributed across the Colorado sub-basins. Note that the distributions change with different target volumes, and are in some cases considerably different than the distribution of all post-Compact rights seen in Figure 12 (and shown in the last rows of this table). This is yet again an indication of how the timing of adjudication and development of water varies across the basins. Basins that have a higher percentage at a given target volume as compared to their Full curtailment percentage developed relatively more slowly than the state-wide average rate of development between the Compact date and the date that produced the target volume, and the converse is true for basins with lower percentages as compared to their Full curtailment percentage. As an example of this type of interpretation of the results, the Gunnison basin developed more quickly than average between November of 1922 and August of 1935, but more slowly than average between November of 1922 and September of 1940.

As before, note that these are average values, and in any given year the volumes and percentages may be higher or lower. The percentage and volume of each sub-basin's post-Compact total water use is also shown for comparison, listed as "Full" in the bottom rows of Table 8.

Table 8. Impact of a state-wide partial call by sub-basin and target volume. Percentages represent the fraction of the target volume that would be curtailed in each sub-basin.

Target Volume (acre-feet/yr)	Yampa	White	Colorado	*In-Basin*	*TMDs*	Gunnison	Southwest
100,000	28%	3%	59%	*22%*	*37%*	6%	8%
(Jul 1957)	27,627	2,753	59,124	*22,309*	*36,815*	5,925	7,528
300,000	16%	2%	59%	*20%*	*39%*	7%	13%
(Sep 1940)	47,987	5,325	177,976	*59,918*	*118,058*	20,862	40,233
600,000	8%	1%	55%	*12%*	*44%*	4%	19%
(Aug 1935)	49,679	8,478	331,556	*69,452*	*262,105*	26,163	113,862
Full	6%	1%	67%	*10%*	*57%*	6%	19%
	58,440	11,888	626,171	*94,403*	*531,834*	57,273	178,163

3. Target Volume Curtailments based on a Pro-Rata Distribution

Another possible approach to curtailing a specific volume annually is to distribute the target volume across the sub-basins based on each sub-basin's share of post-Compact consumptive use. Using the percentages from Figure 12, each sub-basin would be required to curtail the amounts shown in Table 9. For each of these volumes, for each sub-basin, a call date can be developed. Again, these dates represent the call date that would be required across the years 1988-2005 to generate an average annual volume of reduced depletions in the amount shown.

Table 9. Sub-basin target volumes for a given state-wide target, based on pro-rata distribution of post-Compact depletions.

Target Volume (acre-feet/yr)	Yampa	White	Colorado	*In-Basin*	*TMDs*	Gunnison	Southwest
	6.3%	1.3%	67.2%	*10.1%*	*57.1%*	6.1%	19.1%
100,000	6,270	1,276	67,186	*10,129*	*57,064*	6,145	19,116
300,000	18,811	3,827	201,557	*30,387*	*171,191*	18,436	57,348
600,000	37,622	7,653	403,114	*60,774*	*342,382*	36,871	114,697
932,000	58,440	11,888	626,171	*94,403*	*531,834*	57,273	178,163

Results of this exercise are shown in Table 10. Comparing the pro-rata by sub-basin approach to the state-wide curtailment approach reveals significant differences in the impact to individual basins, and is again reflective of the differences in the timing and magnitude of water development across the basins (**Error! Reference source not found.**Figure 13). The dates listed for the 100,000 AF scenario roughly correspond to the date to which 1/9 of that basin's depletions are junior, roughly 1/3 of each basin's depletions are junior to the date listed for the 300,000 AF scenario, and roughly 2/3 are junior to the 600,000 AF dates.

Table 10. Individual Sub-Basin call dates to yield the pro-rata volumes shown. Values shown represent the average reduced depletion over the period of simulation.

Target Volume (acre-feet/yr)	Yampa	White	Colorado	Gunnison	Southwest
	6.3%	1.3%	67.2%	6.1%	19.1%
100,000	6,270	1,276	67,186	6,145	19,116
	Jul 1972	Jul 1962	Jul 1957	Nov 1957	Sep 1940
300,000	18,811	3,827	201,557	18,436	57,348
	Aug 1962	May 1955	Nov 1935	Apr 1955	Sep 1940
600,000	37,622	7,653	403,114	36,871	114,697
	Jun 1952	Jan 1938	Aug 1935	Dec 1933	Nov 1935

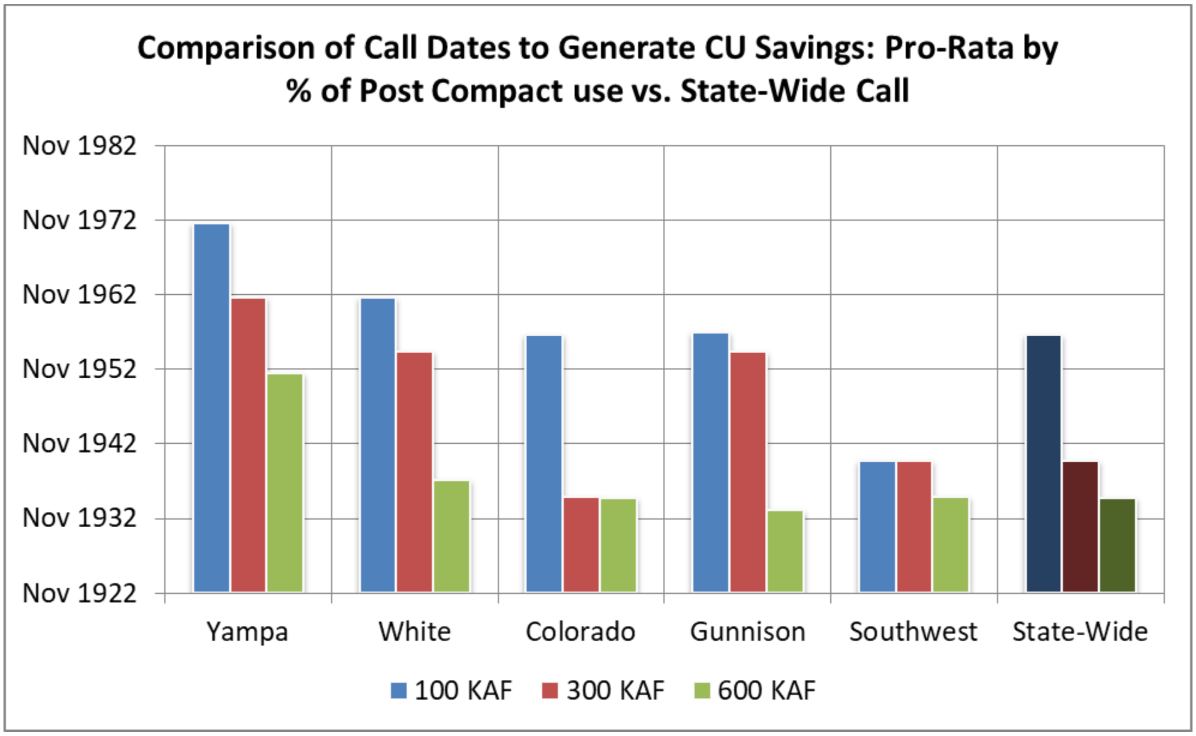

Figure 13. Graphical representation of data from Table 10.

4. Target Volumes on the Colorado Mainstem Pro-rata by in-basin and trans-mountain diversions (TMDs)

The Colorado mainstem accounts for 67.2% of post-Compact depletions, and the necessary call dates to achieve pro-rata curtailment volumes are shown above in Table 10 and Table 11. The timing of development of in-basin uses versus TMDs in this basin vary considerably, and most large TMD developments have rights dating from the mid-1930s to the late 1950s, which puts the pace of proportional development of post-Compact TMDs significantly ahead of the pace of development for in-basin post-Compact uses. For this analysis the target volume obligation of the Colorado mainstem is split into pro-rata volumes based on in-basin and TMD percentages of post-Compact use. This approach does not significantly change the call dates for the TMDs, but does provide some relief to in-basin users by allowing more of the junior in-basin uses to continue diverting.

Table 11. Required call dates and volumes when splitting the Colorado Mainstem obligation between in-basin and TMD uses.

Target Volume (acre-feet/yr)	Colorado	*In-Basin*	*TMDs*
	67.2%	*10.1%*	*57.1%*
100,000	67,186	*10,129*	*57,064*
	Jul 1957	Jan 1981	Jul 1957
300,000	201,557	*30,387*	*171,191*
	Nov 1935	Jul 1957	Aug 1935
600,000	403,114	*60,774*	*342,382*
	Aug 1935	Jul 1941	Aug 1935

Note that due to the large volumes diverted by the TMDs, one of those rights is typically the swing right during these targeted volumetric calls (i.e. it is partially called out in order to yield the target volume).

5. State Wide Target Volumes and call dates split by in-basin and trans-mountain diversions

This last analysis examines how a pro-rata distribution of curtailment would occur if the total volume of Colorado River water use is split between all in-basin uses – regardless of sub-basin – and all TMDs. Recalling that TMDs use 57.1% of all post-Compact water, the remaining 42.9% is consumed by in-basin post-Compact users.

Table 12. Required call dates and volumes when splitting total state-wide post-Compact obligations between in-basin and TMD uses.

Target Volume (acre-feet/yr)	West Slope	TMDs
	42.9%	57.1%
100,000	42,900	57,100
	Nov 1957	Jul 1957
300,000	128,700	171,300
	Jul 1952	Aug 1935
600,000	257,400	342,600
	Nov 1935	Aug 1935

The TMD call dates to yield their target volumes remain the same as when allocating volumes just within the Colorado mainstem (because their percent of the total does not change). The in-basin users are now all aggregated back together. As compared to the Colorado mainstem split above, the in-basin call would be deeper for mainstem users. Compare these in-basin call dates to the individual sub-basin call dates in Table 10 to see how this state-wide in-basin call compares to pro-rata calls. Basins that have more junior call dates in Table 10 than the West Slope call dates in Table 12 developed proportionally more slowly than the rest of the West Slope from the Compact date through the date listed in Table 12.

VI. Summary

This work refines and expands on previous Phases of the Risk Study. The results are intended to inform and support ongoing conversations regarding risk management opportunities in the Colorado River basin. The specific scenarios evaluated should not be viewed as the preferred or only approaches to a possible curtailment or any type of voluntary demand management allocation.

VII. Technical Appendices

A. Model Comparisons

As a first step towards developing the methodology for linking StateMod and CRSS, a series of comparisons between the demand and hydrology datasets of each model was made. Comparisons were also made between the Linked StateMod west-slope model and the individual basin models, to ensure that model results for the Linked Model were sufficiently representative of the individual model results.

1. StateMod Linked Model vs. Individual Basin Models

The Linked Model contains the vast majority of the components of each of the individual basin models, but array size limitations for inputs to StateMod required that some of the reservoir nodes, free river rights, and instream flow rights in the individual basin models be removed during the process of model linkage. Additionally, there were numerous undocumented differences apparent between the input settings of structures in the Linked Model as compared to the individual basin models, such as altered return flow percentages and locations. Rather than attempting to assess the impact of the individual differences between the models, the basin-wide results for simulated depletions were compared to assess the results of the aggregation of all differences in model input settings.

Average percent differences in depletions were found to be small, and the differences reflected higher levels of depletions in the individual models in most cases. Higher depletions in the individual models were expected, due to the removal of numerous reservoir nodes that was a documented part of the linkage process. The percent differences between the Linked Model and the individual models are listed in Table A- 1, where it can be seen that depletions in the individual Gunnison and Southwest models were sometimes lower than the depletions for those basins in the linked model. It was considered possible that these differences resulted from altered return flow percentages and locations. All of the other differences between the Linked Model and the individual models reflected higher depletions in the individual models, but the magnitude of the differences was low enough on average that the linked model was determined to be sufficiently similar to the individual models for use in analysis of state-wide calls. The changes made in support of linking the models were not considered to be improvements, so the individual model results are used in this study for all analyses not involving state-wide calls.

Table A- 1. Percent Differences in Depletions between Linked and Individual Models

Year	Yampa	White	Upper Colorado	Gunnison	Southwest	Total
1988	-1.4%	-2.1%	-1.0%	-0.3%	-2.3%	**-1.2%**
1989	-1.5%	-1.9%	-1.0%	-0.4%	-1.6%	**-1.1%**
1990	-1.7%	-2.0%	-1.1%	-0.5%	-6.1%	**-2.0%**
1991	-1.2%	-2.3%	-1.0%	-0.6%	-4.0%	**-1.6%**
1992	-1.5%	-2.2%	-1.1%	-0.5%	-0.7%	**-0.9%**
1993	-1.2%	-2.1%	-1.1%	-0.5%	0.3%	**-0.7%**
1994	-1.1%	-1.9%	-1.1%	-0.1%	-0.7%	**-0.8%**
1995	-1.6%	-2.5%	-1.1%	-0.5%	0.8%	**-0.6%**
1996	-1.5%	-2.1%	-1.3%	-0.2%	-2.0%	**-1.2%**
1997	-1.5%	-2.7%	-1.1%	-0.5%	0.2%	**-0.7%**
1998	-1.3%	-2.1%	-1.2%	0.1%	-2.1%	**-1.1%**
1999	-1.5%	-2.3%	-1.3%	-0.5%	-0.1%	**-0.9%**
2000	-1.6%	-2.0%	-1.2%	-0.4%	-5.5%	**-1.9%**
2001	-1.6%	-2.1%	-1.0%	-0.5%	-4.5%	**-1.7%**
2002	-2.9%	-2.0%	-0.9%	0.4%	4.3%	**-0.1%**
2003	-1.5%	-2.1%	-1.3%	-0.4%	-7.7%	**-2.3%**
2004	-1.3%	-2.1%	-1.2%	-0.5%	-7.1%	**-2.2%**
2005	-2.3%	-2.2%	-1.5%	-0.5%	0.2%	**-0.9%**
Minimum	-2.9%	-2.7%	-1.5%	-0.6%	-7.7%	**-2.3%**
Average	-1.6%	-2.2%	-1.2%	-0.3%	-2.2%	**-1.2%**
Maximum	-1.1%	-1.9%	-0.9%	0.4%	4.3%	**-0.1%**

2. StateMod vs. CRSS

Comparisons made between StateMod and CRSS consisted of both comparisons of simulated depletions by basin and comparison of simulated basin outflows. The CRSS results were summarized by basin for a model run carried out using the 2019 UCRC demand schedule for each year in an ISM simulation covering the years 1988-2015. Depletions in CRSS were slightly higher than those in StateMod, with an average difference of 112 Kaf/yr, as evident in Table A- 2, which compares the average annual depletions from the StateMod individual basin models to the average annual depletions from CRSS.

Table A- 2. StateMod vs CRSS Depletions (1988-2015, average, AF/yr)

Basin	StateMod	CRSS	% Difference
Yampa	196,982	214,908	9%
White	62,060	40,289	-35%
Upper Colorado	669,397	668,459	0%
Front Range	550,989	757,643	38%
Gunnison	575,267	616,105	7%
Southwest	500,717	383,259	-23%
StateWide	2,555,413	2,667,671	4%

Comparison of the basin outflows between the models revealed greater differences, and the differences in basin outflow have a more direct impact on the risk profile at Lake Powell, so tracking down the source of those differences was considered an important step in development of the model linkage. As a first step in tracking down the source of the differences, the model-simulated inflows to Powell for the Baseline Current Conditions simulation were compared to the CRSS model run that used repeating 2019 UCRC scheduled demands. Both sets of model-simulated inflows to Powell were compared to historical observations, which are calculated by USBR based upon releases from Powell and changes in storage. Exceedance frequencies for historical and simulated annual inflow to Lake Powell are presented in Figure A- 1.

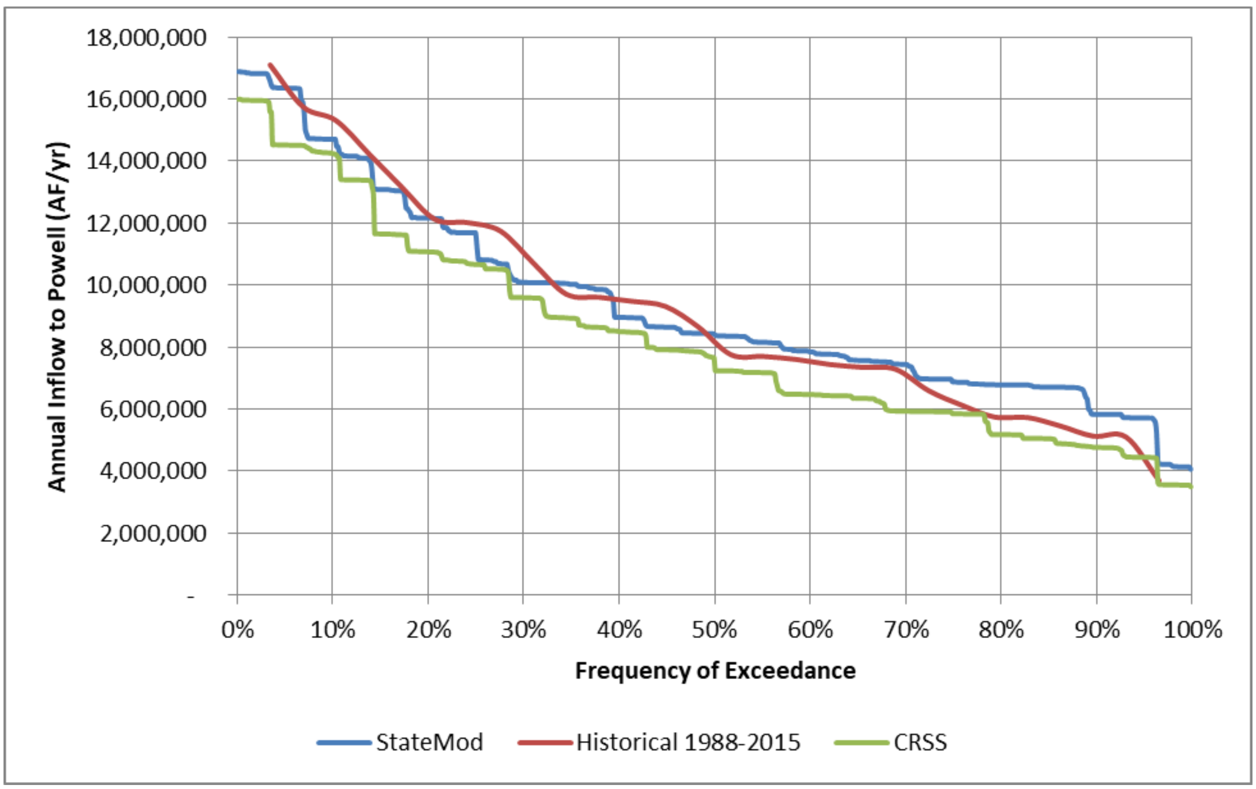

Figure A- 1. Exceedance Frequencies for Annual Powell Inflows, 1988-2015

The historical record includes higher high flows and lower low flows than the StateMod flows, and the flows from the CRSS simulation are consistently lower than both the historical observations and StateMod. The average annual inflows to Powell in the StateMod-linked Baseline Current Conditions simulation exceeded historical observations by 1.8% on average, while the inflows simulated through CRSS alone were 9.7% lower on average than historical observations. The StateMod and CRSS flows both include the CRSS representations of all components of the Upper Basin outside of the State of Colorado, but suitable modeling platforms to represent the other states of the Upper Basin other than CRSS were not available, so the remainder of the comparative analysis of basin outflows focused on gages at or near the Colorado State Line. Comparison of gage flow for the Southwest basins other than the Dolores was carried out through comparison at the San Juan near Bluff gage, which is outside of the state of Colorado, but was chosen for this analysis because its location downstream of the confluence of all seven major tributaries to the San Juan simplified the analysis significantly. Modeled CRSS depletions by New Mexico and Utah in the San Juan basin were subtracted from the gage data before comparing the gage data to StateMod simulation of state line flows.

Differences between historical observations and StateMod-simulated flows are listed in Table A- 3, where it can be seen that some basins have higher outflow in the simulations than historically observed flow, and some basins have lower simulated outflow than historical observations, with total simulated outflows from the State falling below historical observations by an average of 3%. The CRSS model tends to underestimate flows into Lake Powell when looking at the recent historical period. By using StateMod results for the State of Colorado's depletions, and CRSS for the other basin states, we are able to more closely replicate historical flows into Lake Powell. *Given the current data available for both models*, using them in this linked method appears to produce the most realistic results for Powell inflows, and hence is likely a better approach for basin-wide risk analysis.

Table A- 3. Historical Observed and Simulated State-Line Gage Flows (1988-2015, average, AF/yr)

Basin	Historical Gage	StateMod	% Difference
Yampa	1,380,056	1,317,973	-4%
White	465,817	502,395	8%
Upper Colorado	4,139,701	4,089,025	-1%
Dolores	399,015	416,278	4%
San Juan	1,292,928	1,139,437	-12%
Total	**7,677,516**	**7,465,108**	**-3%**

B. Index of Model versions, Website links, and Datasets

The modeling platforms used for this study include the following:

- Colorado River Simulation System RiverWare Model (CRSS)

- CRSS version dcp_cmb_20171031
    - Version 2.9.0 of CRSS, modified to include the DCP
    - Modified as described below in Section **Error! Reference source not found.**
- RiverWare version 7.4.3
- Latest CRSS Model and Datasets Available Here:
    - http://bor.colorado.edu/Public_web/CRSTMWG/CRSS/

- CRDSS Linked Water Rights Allocation Model (StateMod Linked Model)
    - StateMod version 15.001
        - https://www.colorado.gov/pacific/cdss/statemod
- Individual West-Slope Basin Water Rights Allocation Models (StateMod Individual Models)
    - StateMod version 15.001
    - Baseline 2015 models for Yampa, White, Gunnison, and San Juan
        - https://www.colorado.gov/pacific/cdss/surface-water-statemod
    - Baseline 2009 CRWAS model for Upper Colorado
        - http://cwcb.state.co.us/technical-resources/colorado-river-water-availability-study/Pages/CRWASSupportingDocuments.aspx

C. Future Demands Dataset Development

Demands for the "future conditions" scenarios were developed through cooperation with Basin Roundtable technical representatives and the staff from the two Conservation Districts. The purpose of the future condition demands was solely to examine how an increment of additional depletions could impact the risk profiles at Lake Powell and Lee Ferry. The identified increases in consumptive use were a combination of additional use of existing rights/projects as well as new uses. When available, Programmatic Biological Opinion (PBO) studies formed the basis for "allowable" growth that could be achieved without any Federal re-consultation requirements. PBO data were used to develop future demand data for the Yampa, Gunnison, and Colorado mainstem basins. The southwest basin (San Juan, Dolores, and various tributaries), and the White basin future demands were developed primarily by in-basin BRT representatives with input from River District and Southwestern District staff. A total of 26 future uses were identified, consisting of agricultural, municipal, and industrial uses. The total increase in demands across all Colorado basins under the future growth scenario total 384 Kaf, or an increase of 13.7% over current demand levels. Actual modeled depletions from these demands averaged 11.5%. Note that Upper Basin and Colorado's consumptive uses have remained relatively flat for the last 25+ years. The demands identified for the future conditions scenario are not an endorsement of, or proposal for, any specific future use. They are simply illustrative of a range of possible future use scenarios and are intended to illustrate the risks associated with increased consumptive use. Actual growth in demand should it occur, and the timing of that development, may look very different than the future demands postulated for this modelling exercise.

The demand for these future use depletions was not always fully satisfied, resulting in shortages in some cases, and some of the future depletions resulted in shortages to existing uses, where the future uses corresponded to conditional water rights with senior priorities relative to some existing uses. The average depletions simulated for these future uses, and the average change in depletions by basin are listed in Table C- 1**Error! Reference source not found.**, along with the corresponding input demands, for the years 1988-2015.

Table C- 1. Future Use Demands and Depletions

StateMod Linked Model	Future Use Depletions (AF/yr)		
	Average Yield of New Depletions	Average Increase in Basin Depletions	Input Demand
Yampa	29,506	29,485	30,104
White	61,839	61,787	65,000
Upper Colorado & Front Range	86,077	82,425	120,450
Gunnison	31,053	31,100	37,900
Southwest	81,104	82,355	130,084
StateWide	**289,578**	**287,153**	**383,538**

The input demand of these future uses represents a 13.8% increase over current demands, and the resulting depletions averaged 11.4% higher than current levels over the years 1988-2015. Refinements in implementation of the future demands could raise the simulated depletions closer to the increase in demand, but the simulated increase in depletions of 287,153 AF already exceeds the maximum increase from 2019 demands included in the 2007 UCRC demand schedule by 170,000 AF, so further refinement was considered to be beyond the scope of Phase III and unnecessary for this analysis.

1. Future Demand Monthly Distributions

Depletion amounts specified by the PBOs and by BRT/District representatives were provided in annual amounts, which were disaggregated through application of typical monthly patterns to develop realistic model inputs for StateMod. Future demands in each basin were categorized as one of the following classifications, and a unique monthly disaggregation pattern was developed for each classification:

1. **Industrial Direct Diversion**
2. **Agricultural Direct Diversion**
3. **Municipal Direct Diversion**
4. **Trans-Basin Export**

The pattern of monthly demands used to disaggregate annual demands for Type 1, Industrial Direct Diversion demands, was a uniform monthly pattern that reflects typical diversions for industrial uses such as power production and manufacturing. This uniform monthly distribution of demands also reflects the uncertainty associated with the water use patterns of industrial uses, which do not necessarily follow a predictable seasonal pattern.

The pattern of monthly demand for Type 2, Agricultural Direct Diversion demands, was developed through analysis of diversion records for the Red Top Valley Ditch, which has a long and continuous record of direct diversions for irrigation of pasture grass from the Upper Colorado basin. Diversions by the Red Top Valley Ditch have historically spanned the months of May – August, with an average of 9.1% of the annual diversions occurring in May, 52.2% occurring in June, 38.3% occurring in July, and 0.3% occurring in August, and those percentages were used to disaggregate annual demands for the future uses classified as Type 2), Agricultural Direct Diversion demands.

The pattern of monthly demand for Type 3), Municipal Direct Diversion Demands, was set using a combination of the Type 1) and Type 2) demand patterns, to represent the conceptual understanding that municipal demands consist of both relatively-steady indoor demands, and seasonally-varying demand for outdoor water use. The total amounts of indoor and outdoor water use were assumed to be equal on an annual basis.

Monthly demands for future uses associated with trans-basin diversions were all set according to a uniform pattern extending only across the months of April-July. The pattern for these demands did not correspond with the eventual use, as did the direct diversion demands for types 1-3, because the trans-basin diversion demands include significant regulation through storage in East-Slope reservoirs. The uniform pattern across the months of May-July was selected in recognition of the typically higher flows in those months, during runoff.

2. Basin-Specific Future Demand Details

The future demands in each basin are listed in Table C- 2 through Table C- 6. The total annual demand for each future use is listed, along with the use type, priority date, and notes about implementation in StateMod, including the node on which the future use demand was placed. Some future use demands were implemented on nodes that were added to the river network, and these additional nodes are identified by asterisks, which reference table footnotes that describe the location of the new node in the river network of that basin.

Table C- 2. Yampa Basin Future Use Demand Details

Use Type	Annual Demand (AF)	Priority Date	Notes
Municipal	9,899	10/1/2013	District 44 Future Depletions (44_FDP001) node
Industrial	15,403	9/30/1961	Hayden Station (440522) node
Agriculture	4,802	9/30/1961	Oxbow Agriculture (44_Oxbow*) node
Total	30,104		Future Uses based upon PBO

* 44_Oxbow is a direct diversion node that was added between the 442214 and 440694 nodes of the Linked Model

Table C- 3. White Basin Future Use Demand Details

Use Type	Annual Demand (AF)	Priority Date	Notes
Municipal	2,707	10/1/2013	District 43 Future Depletions (FUD001) node
Industrial	62,293	10/1/2013	District 43 Oil Shale Direct (43_OilDem) node
Total	65,000		Future Uses based upon YWG-BRT Modeling

Table C- 4. Upper Colorado Basin Future Use Demand Details

Use Type	Annual Demand (AF)	Priority Date	Notes
Trans-mountain	28,500	6/24/1946	Roberts Tunnel (364684) node: Denver Water Blue River System Buildout
Trans-mountain	25,500	6/6/1969	Adams Tunnel (514634) node: Windy Gap Firming Project
Trans-mountain	14,450	7/9/1934	Moffat Tunnel (514655) node: Denver Water Moffat System Expansion
Trans-mountain	14,000	2/7/1956	Homestake Tunnel (374614) node: Eagle River MOU Project (Homestake Partners)
Municipal	7,000	12/14/1987	New WS_FDaGS* node: W.S. depletions above Glenwood Springs
Municipal	28,000	7/29/1957	New WS_FDbSP** node: W.S. M&I depletions below Shoshone
Trans-mountain	3,000	6/24/1946	Roberts Tunnel (364684) node: CRCA Next Steps Project
Total	120,450		Future Uses Estimated by Colorado River District Staff

*WS_FDaGS is a direct diversion node that was added between the 09070500 and 950500 nodes of the Linked Model

** WS_FDbSP is a direct diversion node that was added between the 530584 and 09072500 nodes of the Linked Model

Table C- 5. Gunnison Basin Future Use Demand Details

Use Type	Annual Demand (AF)	Priority Date	Notes
Agriculture	12,200	11/1/1905	East Canal (410520) node: Dallas Creek Project
Municipal	22,200	11/12/1957	District 62 Subordination (62USUB_M) node: Upper Gunnison Subordination
Municipal	3,500	10/1/2013	District 62 Yield (62U_MY) node: New Depletions
Total	37,900		Future Uses from Gunnison PBO

Table C- 6. Southwest Basins Future Use Demand Details

Use Type	Annual Demand (AF)	Priority Date	Notes
Municipal	1,100	4/19/1962	(WS_SJRHP*) node: San Juan River Headwaters Project
Municipal[12]	1,856	10/1/2013	(78_ADS004) node: Piedra Basin Incremental Development
Municipal[12]	14,597	10/1/2013	(31_ADS006) node: Pine Basin Incremental Development
Municipal	8,205	3/21/1966	(CO_ALP) node: Animas La Plata Project Future Uses
Municipal	16,234	12/31/2006	(WS_ARiD**) node: Animas Recreational In-channel Diversion
Agriculture	24,226	3/21/1966	(WS_SWCD***) node: SWCD Project Water Rights
Municipal[12]	26,976	10/1/2013	(71_ADS019) node: Dolores Basin Incremental Development and Reservoir Expansion
Agriculture	21,250	1/16/1967	(WS_SMP****) node: San Miguel Project
Agriculture	4,502	1/1/1985	(34_UMU) node: 2060 Scenario A Demands[13]
Agriculture	11,138	3/2/1868	(31_SUIT) node: 2060 Scenario A Demands[13]
Total	130,084		Future Uses Estimated by Southwest District Staff

* WS_SJRHP is a direct diversion node that was added between the 29_ADS002 and 09342500 nodes of the Linked Model
** WS_ARiD is a direct diversion node that was added between the 301902_Dwn and 30_ADS007 nodes of the Linked Model
*** WS_SWCD is a direct diversion node that was added between the four upstream nodes (09357500, 304662, 09359000, and 300523) and downstream node 09359500 of the Linked Model
**** WS_SMP is a direct diversion node that was added between the 601381 and 601381_Dwn nodes of the Linked Model

3. Other Upper Basin Future Demands

It was also necessary to develop future demands data for Wyoming, Utah, and New Mexico for use in CRSS. The intent was to increase those states' demands by the same percentage that those in Colorado were increased within the StateMod Model. To achieve this, the percentage increase in demands computed for Colorado and used in StateMod (13.8%) was compared to the increases in demands over current conditions from the 2007 UCRC demand schedule for Wyoming, Utah, and New Mexico. Forecast demands from that schedule show an increase of 13.6% for 2037. The 2037

[13] These demands were modeled using uniform monthly demand across April-July, which was found through calibration to increase yield in comparison to the typical municipal pattern
[14] Demands for the Southern Ute and Ute Mountain Ute nodes were set as the difference between Current and 2060 Scenario A demands from the Colorado River Basin Ten Tribes Partnership Tribal Water Study (https://www.usbr.gov/lc/region/programs/crbstudy/tribalwaterstudy.html)

demands for those States were then fixed for all simulations in CRSS as the "future demands" condition.

D. 2006-2015 Data Extension for StateMod

In order to fill in the years 2006-15, annual flow at the Colorado-Utah state line in the mainstem of the Colorado River was compared to the years 1909-2005, and the year with the closest total annual volume was selected. Table 2 lists the years and percent differences in flow, calculated by subtracting the observed flow in the recent year from flow in the surrogate year.

Table 13. Surrogate Years for StateMod Extended Stress Test Simulation

Recent Year	Surrogate Year	% Difference in Flow
2006	1925	-0.7%
2007	1991	0.5%
2008	1938	-0.9%
2009	1971	-0.1%
2010	1991	0.3%
2011	1917	0.0%
2012	1981	3.0%
2013	1940	0.1%
2014	1948	-0.2%
2015	1944	0.1%

The data from each surrogate year was then appended to the linked model input datasets, using a script developed in the R computing language. The following files were extended in this manner:

- Wslope.ddm
- Wslope.iwr
- Wslope.ifm
- Wslope.tar
- Wslope.rim
- Wslope.ipy

From:	John Malenich
To:	Gross Reservoir SI-20-0003
Subject:	Opposition to Gross Reservoir Expansion
Date:	Tuesday, December 15, 2020 11:59:25 AM

Dear Boulder County Commissioners:

As a resident of Boulder County, I would like to express my opposition to Denver Water's plans to expand and raise the dam at Gross Reservoir. It is my understanding that before Denver Water can begin construction on this project, Boulder County must issue a 1041 permit to Denver Water. I would strongly urge Boulder County to deny Denver Water the necessary permits for this dam expansion project due to serious problems with Denver Water's plans for expanding Gross Reservoir outlined below.

First and foremost, the plan for the expansion of Gross Reservoir is environmentally unsound. The plan will draw additional water out of the Colorado River Basin that is necessary for healthy stream flows and rivers that support fish and wildlife. This plan would lead to further draining of the most dammed and diverted river on the planet. If this plan moves forward, creeks and rivers in multiple states will see up to 80% of their water drained. This project would be the largest construction project in a specifically designated ecologically sensitive area in the County's history. Given our County's history and reputation of strongly protecting our ecologically sensitive areas and being at the forefront of responsible environmental practices, this project simply doesn't fit the values and ideals of the Boulder County community.

In addition to the degradation of the Colorado River and its tributaries, this project will cause the decimation of the area around the reservoir with the destruction of over 200,000 trees, the destruction of important wildlife habitat, significant noise and air pollution from major truck traffic on small roads, load blasting in the construction areas and it will diminish the value of homes in the area of the reservoir. Denver Water's mitigation plans for these issues are completely inadequate.

In addition, the ultimate goal of the project--to store more water--is also misguided. Denver Water could easily use the estimated $350 million budgeted for this project on water conservation efforts instead of this misguided project, which would benefit everyone instead of undertaking a massive water grab. Instead, it seems Denver Water wants to move forward with this project for water that will largely be used on irrigating Kentucky bluegrass lawns in Denver that have no business being planted in our semi-arid climate. This is simply a poor use of our extremely limited water resources in the Western US and fails to consider all users. In addition, there are numerous better alternatives to the Gross Reservoir expansion, such as significant conservation efforts, South Platte River diversions or other water storage facilities that will not have as large an environmental impact. Additionally, Denver Water's own statistics show that as the the Denver population rose 10%, water usage decreased 20%. This clearly shows conservation efforts work and that there is no need for this environmentally unsound and destructive project. This is simply not the least environmentally destructive way to store more water, but in fact one of the most environmentally destructive.

Accordingly, I urge Boulder County to oppose this project and deny Denver Water a 1041 permit and maintain Boulder County as a strong leader on environmental issues. Thank you for considering my concerns.

Regards,

John Malenich

2111 Spruce St.

Boulder, CO

303-359-9456

From:	Will Welch
To:	Gross Reservoir SI-20-0003
Subject:	Public comment on Gross Reservoir Dam expansion project
Date:	Monday, December 14, 2020 8:02:35 AM

Please stop the Gross Reservoir Dam expansion project. There are alternatives that will work and won't further damage the environment or impact Boulder County communities. We don't need this expansion. Put the people and the environment first.

Thanks,
Will

William Welch, M.S. | A-CFHC | NBC-HWC
Board-Certified Functional Health Coach &
Leadership Development Coach
Welch.Will@gmail.com
310-824-6306

From:	Alberta & Don Montgomery
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, December 11, 2020 3:53:52 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Alberta & Don Montgomery
185 Wellington Ave.

Lafayette, CO 80026
303-258-7503

From:	Beryl Beauchamp
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, December 11, 2020 1:34:46 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
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- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
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- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Beryl Beauchamp

,

From:	Ric Rawlins
To:	Gross Reservoir SI-20-0003
Subject:	Please DONT this project go thru.
Date:	Friday, December 11, 2020 1:13:34 PM

The people of our canyon will suffer for years. The Colorado river will suffer. Related animals will suffer. The environment will suffer . The air will suffer , The roads we all pay for will suffer.
There are other underground options . This project is insanity. Please stop...

Sent iPhone

From:	Gary Wockner
To:	Churchill, Jennifer; Gross Reservoir SI-20-0003
Subject:	Fwd: Comment letter and Exhibits-Gross Reservoir
Date:	Friday, December 11, 2020 12:24:24 PM

Hi Jennifer,

Back on Nov. 13, our attorney John Barth, sent the County a comment letter along with 27 exhibits (see below). We asked that we get a confirmed receipt, but we never got one.

Can you please confirm that the County received this comment letter?

Thank you

Gary

--
Gary Wockner, PhD, Director
Save the Colorado: Colorado River Waterkeeper Network
Author: "River Warrior: Fighting to Protect the World's Rivers" (2016)
PO Box 1066, Fort Collins, CO 80522
http://savethecolorado.org
http://www.facebook.com/savethecolorado
https://twitter.com/savethecolorado
970-218-8310

The mission of Save The Colorado is to protect and restore the Colorado River and its tributaries from the source to the sea. Save The Colorado focuses on fighting irresponsible water projects, supporting alternatives to dams and diversions, fighting and adapting to climate change, supporting river and fish species restoration, and removing deadbeat dams. Save The Colorado has thousands of supporters throughout the Southwest U.S. from Denver to Los Angeles and beyond.

-------- Forwarded Message --------
Subject: Comment letter and Exhibits-Gross Reservoir
Date: Fri, 13 Nov 2020 14:11:04 -0700
From: John Barth <barthlawoffice@gmail.com>
To: grossreservoir@bouldercounty.org
CC: Gary Wockner <gary@savethecolorado.org>, Timothy Guenthner <tjguenthner@gmail.com>

Hello Boulder County Land Use:

On behalf of The Environmental Group and Save the Colorado, attached please find a comment letter and 27 exhibits regarding the proposed Gross Reservoir and dam expansion. Please confirm receipt. I will be sending the 27 exhibits in a series of emails. The comment letter and exhibits 1-16 are attached to this email.

--
John Barth
Attorney at Law
P.O. Box 409
Hygiene, CO 80533
(303) 774-8868
barthlawoffice@gmail.com

From:	Fred Peck
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir Expansion
Date:	Thursday, December 10, 2020 3:18:46 PM

I am writing in response to a message I received from Jennifer Chruchill concerning upcoming hearings on the Denver Water proposed expansion of Gross Reservoir by Boulder County. I want to express my complete opposition to any expansion of the Gross Reservoir. I do not feel that Denver Water has done anywhere near enough in the way of conservation by its customers. The lawn watering alone is way out of hand. In my county, outside use of water is prohibited and we seem to get by just fine with this restriction. Until Denver Water and its customers can prove that they have exhausted all other means of conservation available to them, I don't think I can support any expansion of Gross Reservoir.

Thank you,

Fred Peck, Gilpin County

From:	Betsy Armstrong
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reseroir
Date:	Thursday, December 10, 2020 1:45:31 PM

As a citizen of Boulder County, I am writing to oppose Denver Water's application to expand Gross Reservoir. Denver Water's application does not comply with the Boulder Valley Comprehensive Plan, and in addition it violates several of Boulder County Land Use codes.

As a scientist and knowledgable about water usage, I've learned that this expansion is not at all necessary to provide water to downslope users. Nor does the Army Corps of Engineers' EIS take into consideration cumulative impacts, climate change or the influences on the Colorado River.

Approval of this expansion would be destructive to the Boulder County environment and I encourage the Boulder County commissioners to reject this application.

Kind regards,

Betsy R. Armstrong

Betsy Armstrong
Armstrong & Associates
ArmstrongCommunications1@gmail.com
www.BetsyArmstrongArt.com

From:	Jim Disinger
To:	Gross Reservoir SI-20-0003
Subject:	Gross Dam Expansion
Date:	Thursday, December 10, 2020 1:33:13 PM

Of course the Gross Dam Expansion project has many more far-reaching detriments than the obvious power pool area and no benefits for Boulder County.
The destruction of forests above the lake is being funded by Denver Water as well. Their idea is that by thinning, clear cutting and burning Boulder County forests, Denver Water will be able to divert our water to Denver to be sold for more massive housing developments. These clear-cutting projects are ostensibly designed for fire mitigation but, as all forest ecologists know, actually dry and kill our forests making them much more likely to be subject to the types of mega-fires that may destroy our lives and property.

Let’s keep Boulder County’s soil, forests and water in Boulder County!

From:	John Bradin
To:	Gross Reservoir SI-20-0003
Subject:	The West is out of water
Date:	Thursday, December 10, 2020 12:53:31 PM

Reservoirs don't create water; they just divert it. See the example of the Hoover Dam and Lake Mead. Global climate change will very likely make things worse. People in Colorado, Denver in this case, just need to face up to the conservation needs instead.

From:	Liz Morgan
To:	Gross Reservoir SI-20-0003; Churchill, Jennifer
Cc:	Stop Gross Dam Expansion; info@savebouldercounty.org
Subject:	It"s time for FINAL NO on Gross Dam
Date:	Thursday, December 10, 2020 10:21:46 AM

Dear Boulder County Commissioners,

Doesn't there come a time when a community can just say "NO" to a bad actor, acting in bad faith, trying to ram through a destructive project? For over a decade, Denver Water has submitted messy, incomplete applications, has sued the county, and in every manner imaginable has resisted complying with even the most basic requirements of the application process.

How long must we allow this organization to drain the funds, both private and public, of the Boulder community? Enough is enough already.

Let's not fool ourselves that Denver Water will ever be able to remedy the problems with their proposed project by fixing their own errors in their own proposal. Why does Boulder County and the hard working citizen activists of the community have to continue to spend so much time begging Denver Water to fix their own mistakes in their own applications? The project itself is bad and should be denied.

Enough is enough already. This must end.

I urge Boulder County to say a resounding and FINAL "NO" to the misguided Gross Dam expansion proposal. We know all we need to know by now. The end. Let's put this ridiculous discussion to rest once and for all.

Thank you,
Liz

Liz Morgan, MA, FNTP, RWS, JD
Functional Nutritional Therapy Practitioner
Liz Morgan Nutrition
The Mindful Omnivore Blog
The Nourish + Flow Program
719-966-9837

From:	Kimberly Beck
To:	Gross Reservoir SI-20-0003
Subject:	Dam Project
Date:	Wednesday, December 9, 2020 10:48:16 PM

To Whom it May Concern,

I am writing to submit a comment of strong opposition on the proposed Gross Dam Reservoir Extension project for the following summary of reasons:

- The increased traffic, decline in air quality, decline in road conditions, increased noise, increased taxes, and decreased river water are unwanted by county and colorado residents
- The Colorado River is over-drained and overwhelmed already with agriculture and endless suburban growth diversions
- The anticipated water shortages that initiated this project did not come to fruition. The assumptions made for the justification of the project in the EIS are incorrect
- Denver Water customers have been and are willing to implement water conservation efforts
- The project will have severe negative environmental impacts through the release of massive amounts of carbon into the atmosphere, contributing to ongoing declining local air quality and to the whole of existing climate pressures
- The project and EIS does not consider the impacts of climate change on the future streamflows which will likely leave the large reservoir unfilled
- The systemic status quo of endless growth, extraction and consumption for short-sighted and unnecessary resource use must be challenged

I request that approval of this project be denied.

Thank you,
Kimberly Beck, M.Ed.

--
Kimberly Beck, M.Ed.

I don't know exactly what a prayer is.
But I do know how to pay attention, how to fall down
into the grass, how to kneel down in the grass,
how to be idle and blessed, how to stroll through the fields,
which is what I have been doing all day.
Tell me, what else should I have done?
--Mary Oliver

From:	Boulder Flycasters
To:	Gross Reservoir SI-20-0003
Cc:	David Nickum; kirkklancke@gmail.com
Subject:	Gross Reservoir Dam Expansion Proposal 1041 Application Review Process
Date:	Wednesday, December 9, 2020 12:44:09 PM
Attachments:	TU_BFC_GrossDamExpan_1041Comments.pdf

Boulder County Commissioners and Staff,

Attached please find comments from Trout Unlimited in support of the Boulder County 1041 application review process for the Gross Reservoir Dam Expansion Proposal.

Thank you,

Brendan Besetzny
President, Boulder Flycasters

RE: Gross Reservoir Dam Expansion Proposal 1041 Application Review Process
TO: Boulder County Commissioners and Staff

This letter provides comments from Trout Unlimited in support of the Boulder County 1041 application review process for the Gross Reservoir Dam Expansion Proposal. Trout Unlimited participated in providing comments on previous federal and state permitting actions with several positive outcomes, as discussed below. The 1041 application review process will allow Boulder County to consider the potential project impacts on Boulder County, identify actions needed to mitigate damage and disruption, AND improve the South Boulder Creek watershed. Trout Unlimited's interest and expertise is related to cold water fisheries and watershed restoration. So, our 1041 application review comments are limited to actions that could positively impact the South Boulder Creek watershed if the application receives Boulder County approval.

Under the current federal and state permitting, and negotiated compacts between Denver Water and Grand County, as well as between Denver Water, Boulder and Lafayette, there are significant environmental benefits, including some benefits to Boulder County. The most important of which is the resulting 5,000 AF Environmental Pool to provide in-stream minimum flows for South Boulder Creek during our dry winter months. South Boulder Creek is desperately in need of more flow to support watershed health, preserve native species and support recreation. Denver Water has committed between $4m and $6m to this part of the project. This important component of the expansion should, we believe, be weighed as a positive in evaluating the 1041 application.

Beyond the obvious needs to mitigate transportation, environmental and life style disruptions and damage, there is an opportunity to negotiate for more complete watershed mitigation and enhancement. The Environmental Pool is a critical element of this. Denver Water's other environmental commitments to date have focused primarily (and understandably) on addressing impacts in the basin of origin. The 1041 review process now will allow Boulder County to address the South Boulder Creek watershed as well.

The environmental benefits negotiated with Denver Water by Trout Unlimited are critical to the future health of the basin of origin. Fraser Valley residents and Grand County visitors are, and will continue to, benefit from these negotiations. A large percent of Grand County visitors and second homeowners are Boulder County residents. Proper watershed mitigation through the 1041 process can benefit the residents of Boulder County and ensure hard-won environmental benefits continue to accrue in Grand County.

Denver Water has helped and is continuing to support local restoration and mitigation for specific projects. This includes a Trout Unlimited project, led by the Boulder Flycasters Chapter of Trout Unlimited, to develop a State funded Stream Management Plan for lower South Boulder Creek, as well as contributing more than 50% of the cost of building the Environmental Pool storage capability into the expansion. As part of the Army Corps of Engineers 404 permit mitigation requirements Denver Water funded $715,000 for mitigation on lower South Boulder Creek in City of Boulder Open Space. Denver Water will also be required to monitor and remediate associated environmental degradation resulting from the expansion. We see this as an important step forward in having more scientific data to support long term watershed improvement.

Other than the Environmental Pool commitment, Denver Water's remaining mitigation commitments do not physically improve the South Boulder Creek watershed. Part of the requirements for approving the 1041 could include more collaborative investment and efforts to improve the watershed, consistent with Boulder County's overall goals and objectives.

Examples of opportunities for collaborative improvement might include:

- Stream and riparian habitat improvements, including native and listed species
- Fish stocking programs, including native and listed species
- Reservoir access improvements and on-going trail maintenance
- Coordination with other water right holders on cooperative operations to benefit stream health

Additionally, there are concerns that the dam expansion will negatively impact the existing downstream fishery due to potentially lower water temperatures at certain times of the year. The reaches known locally as "Kayak Run" and "Walker Ranch" are the only reasonable public fishing access in the canyon. In an effort to ensure longevity of, and potentially improve, the fishery we suggest Denver Water also commit to collaborative efforts with fisheries biologists and watershed improvement organizations to look at the potential for dam release and other operational changes to benefit the watershed. Potential objectives might be to help ensure necessary in-stream flows during low water periods and to identify other ways to ensure water conditions are suitable for sustainable trout habitat.

Trout Unlimited, through our local Boulder Flycasters Trout Unlimited Chapter and Colorado Trout Unlimited, are ready to help develop a working list of potential improvement actions through our ongoing Stream Management Plan development. We would also enthusiastically help Boulder County understand and perhaps adopt a program similar to "Learning by Doing," a promising partnership among Denver Water, Grand County, Trout Unlimited, Colorado Parks & Wildlife and other watershed improvement organizations working to improve the Fraser River watershed.

Learning by Doing is a collaborative, consensus-based effort for adaptive management of mitigation and enhancement efforts in Grand County. Denver Water, working with its partners, looks for opportunities to use its operational flexibility to benefit stream health, as well as pledging funds that can then be leveraged through cash and in-kind support from other partners. An active monitoring program helps track results and allow for adaptation of strategies to advance efforts that are working and adjust those that are not working.

We are ready to work with Boulder County on a similar initiative. There are likely other local watershed improvement organizations also ready to help.

In closing, we ask Boulder County to elevate watershed improvement as an important area for consideration in the review process. Trout Unlimited is offering to work collaboratively with Boulder County, and other stakeholders, to define an adaptive watershed improvement process and program components as part of the 1041 application approval review.

Sincerely,

Brendan Besetzny
President, Boulder Flycasters Chapter
PO Box 541
Boulder, CO 80306
boulderflycasters@gmail.com
www.boulderflycasters.org

Kirk Klancke
President, Colorado River Headwaters Chapter
PO Box 325
Fraser, CO 80442-325
kirkklancke@gmail.com
www.coheadwaters.org

David Nickum
Executive Director, Colorado Trout Unlimited
1536 Wynkoop Street, Suite 320
Denver, CO 80202
david.nickum@tu.org
www.coloradotu.org

From:	Phil Armstrong
To:	Gross Reservoir SI-20-0003
Subject:	Public Comment - Cost/Benefit Analysis
Date:	Wednesday, December 9, 2020 10:44:07 AM

Dear Boulder County Staff,

Denver Water's 1041 application states a project **cost** of $380 million (the additional $113 million in carrying costs will largely be offset by third-party participants). The stated quantifiable **benefits** include 18,000 acre-feet of annual additional delivered water, and 77,000 acre-feet of additional storage.

If Denver Water were to spend $380 million on water conservation, demand reduction, and paying users to use less water, would they be able to reach or surpass the same 18,000 annual acre-foot goal? Would those programs obviate the need for an additional 77,000 acre-feet of storage?

Thank you for taking the time to read and review my comment.

Regards,
Phil Armstrong
Boulder County Resident
Contact Info: laminar.energy@gmail.com

From:	Alexander Mendoza
To:	Gross Reservoir SI-20-0003; A Google User
Subject:	Docket# SI-20-0003 Gross Reservoir Dam Expansion
Date:	Tuesday, December 8, 2020 5:32:03 PM

To whom it may concern,

On docket SI-20-0003 Gross Reservoir Dam Expansion. If this developement is approved there are many animals that will be affected and or killed. With large trucks driving up highway 72 these animals will be hit and die. I live less than a half a mile away from Hwy 72. Please see attached picture. Just this morning you will see 16 deer grazing on my property. I live at 11715 Ranch Elsie Road. By allowing large trucks in our area will disturb the habitat of deer and many other animal such as foxes, bobcats, coyotes, moose, bears, wild turkeys, and weasels just to name a few. Please respect our area. We already have a flight path over the area that we had nothing to say about.

I Sincerely hope that this email makes a difference. Boulder of all counties should respect the entirety of the environment. I guess its ok unless its not your area that is effected. Not a smart way to think.

Please consider my concerns and others like me in the Coal Creek residence.

Thank you with kind regards,

Alex Mendoza
11715 Ranch Elsie Road
Golden, CO 80403

From:	Lynn
To:	Gross Reservoir SI-20-0003
Subject:	Comment
Date:	Tuesday, December 8, 2020 2:07:40 PM

I 100% oppose the construction of the Gross Reservoir expansion.

The expansion will kill thousands of trees and wildlife, and put thousands of construction trucks on our Boulder County Roads.

There are no restrictions currently on water use. The wasted water to keep grasses green in our dry climate is obscene. For example, the large homes in areas such as Greenwood Village have acres of property that is watered daily. No planting restriction of drought resistant plants are even required.

It is my understanding that Denver is selling water already to other municipalities.

This expansion needs to be stopped.

Thanks so much for your consideration.

Mark and Lynn Shader
lblshader@gmail.com

Sent from my iPhone

From:	Jeremy King
To:	Gross Reservoir SI-20-0003; summerfrederick@bouldercounty.org
Subject:	RE: Gross Damn Expansion Project
Date:	Tuesday, December 8, 2020 10:46:39 AM

Hi Summer, My name is Jeremy King and I am the current President of the Coal Creek Canyon Parks and Recreation District. I am writing to inquire more information on the Gross Damn Reservoir Project and inquire about the possible benefits to our community and organization. Please give me a call at your earliest convenience. Talk to you soon! Thanks

Jeremy King
CCCPRD – President
PO Box 7411
Golden, CO, 80403
303-249-8800

Sent from Mail for Windows 10

From:	Eileen Kintsch
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Sunday, December 6, 2020 11:02:25 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
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- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Eileen Kintsch
435 College Ave.

Boulder, CO 80302
303-443-1203

From:	Mary Hughes
To:	Gross Reservoir SI-20-0003
Subject:	Docket#Docket # SI-20-0003:Gross Reservoir &Dam expansion
Date:	Sunday, December 6, 2020 8:09:27 AM

Dear Board of County Commissioners,

As a 38 yr long resident of Western Boulder County I'm writing to say I vehemently oppose the expansion to Gross Reservoir. This boondoggle being proposed by Denver Water violates many of the land Use Codes put forth in Boulder County's Land Use permit application. This project will affect the forests, flora, fauna, rocks, air and citizens in a profoundly negative way for many many years to come.

Taking water from the already depleted and overused Colorado River must stop. There are so many critical issues due to climate change and the loss of critical snow mass which feeds this beautiful river that this project will alter it and our lives for centuries to come.

The only solution is to educate and implement strict regulations to the public and municipalities that live along the Front Range. Significant fines need to be legislated to the extent that the practice of water conservation is the #1 priority of our citizens, state and local governments.

Please heed my cry for conservation and education for the sake of the Colorado River.

Thank you,
Mary Hughes
31 Wildewood Dr
Nederland, Colorado 80466

From:	Stacie Goffin
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, December 5, 2020 8:11:56 PM

Dear Boulder County Commissioners and Staff,

I just learned of this issue from a neighbor and given the link to a site explaining the issues. I endorse the comments that follow.

The Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous

errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
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- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Stacie Goffin

Boulder, CO 80303

From:	Gail Storey
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, December 5, 2020 4:22:19 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Gail Storey
5290 Euclid Ave.

Boulder, CO 80303

From: dipdeee
To: Gross Reservoir SI-20-0003
Subject: etc
Date: Thursday, December 3, 2020 6:36:41 PM

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to Boulder County Commisioners

on Gross Dam expansion:
DITTO - NEDERLAND TOWN BOARD of TRUSTEES

Jane Cohen
700 Walnut St., Apt. 217
Boulder, CO 80302

From:	Mickie Courtney
To:	Gross Reservoir SI-20-0003
Subject:	Gross Dam Expansion
Date:	Thursday, December 3, 2020 6:54:14 AM

Dear Boulder County Commissioners,

Please do allow Denver Water to expand the Gross Dam Reservoir. I live in Coal Creek Canyon and do not want the disruption to my roads, community and way of life disrupted by Denver Water when an expansion isn't truly necessary. Water conservation is the future, not expensive, destructive dam expansions. Denver Water should know better.

Thank you,

Michelle Courtney
29354 Spruce Canyon Dr.
Golden, CO 80403

From:	Barbara Comstock
To:	Gross Reservoir SI-20-0003
Subject:	Gross reservior
Date:	Wednesday, December 2, 2020 9:17:36 PM

Dear Boulder County Commissioners,

Please do what ever you can to stop the expansion of Gross Reservoir. Environmentally it makes no sense and the disruption to the lives and well being of Boulder County residents and wildlife is in excusable. Thanks

Barbara Comstock
8116 Dry Creek Circle
Niwot CO 80503

From:	Mara Kuczun
To:	Gross Reservoir SI-20-0003
Subject:	please deny Denver Water"s proposed expansion of Gross reservoir
Date:	Wednesday, December 2, 2020 7:25:11 PM

Dear Boulder County Commissioners,

We support and appreciate your application of the 1041 regulations to Denver Water's proposed expansion of Gross Reservoir. We agree that it is critical that the project be thoroughly and carefully reviewed under Boulder County's land use and environmental regulations.

We have concluded because of data provided that the proposed expansion is unnecessary and that the installation of water conservation low flow devices and more efficient toilets, as well as xeriscaping in homes within Denver Water's service area would achieve the same conservation goals, while providing more jobs and no negative environmental impacts.

The expansion project will have severe negative environmental impacts by releasing massive amounts of carbon into the atmosphere. The expansion will require the removal of 200,000 trees, that are badly needed for carbon sequestration. It will require millions of tons of cement that also releases massive amounts of carbon when processed. There will be tens of thousands of trucks traveling on Boulder County roads damaging them severely with unrecoverable costs that will be passed on to taxpayers. The truck traffic will also have a very negative impact on our already deteriorating air quality. This project is completely inappropriate in the middle of a climate crisis. Climate change makes it extremely unlikely that the reservoir will ever be filled because of decreasing moisture and increasing temperatures and evaporation rates.

The Colorado River is overwhelmed with two many states demanding water. A project planning to withdraw water from the river is a very shortsighted, misguided idea.

We oppose the project and respectfully request that you deny it.

From:	Chris Rigatuso
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, December 2, 2020 4:18:42 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Chris Rigatuso
1702 Terrace Dr

Belmont, CA

From:	shurlock
To:	Gross Reservoir SI-20-0003
Subject:	comment on gross res development/enlargment
Date:	Wednesday, December 2, 2020 2:33:01 PM

To Whom It May Concern,
My husband and I, both long time resident citizens of Boulder would like to protest the enlargement of Gross Res. Denver Water, needs to do much more to educate Denvers citizens to manage water, also Denvers leadership needs to create a sustainable model for future planning that understands the sustainability of our environment. For instance, inviting Amazon to Denver a few years ago, and creating a need for 50,000 new houses and water -without first having water and land to develop, speaks to serious mismanagement of leadership.

Once the Colorado River is impacted and the dam enlarged the environmental losses are permanent. Citizens are requested to reduce, conserve, tread lightly, close the loop, support the environment locally, etc. We expect our leadership to do likewise, and respect and reflect the values held by citizens and residents.

Please vote no to stop the enlargement of Gross Reservoir.

regards
Caron Trout

From:	Sarah Koniewicz
To:	Gross Reservoir SI-20-0003
Subject:	No Gross Reservoir Dam Expansion
Date:	Wednesday, December 2, 2020 1:04:06 PM
Attachments:	image001.png image002.png image003.png image004.png image005.png image006.png

Please listen to your citizens and deny Denver Water's permit for expanding Gross Reservoir. This is an unnecessary expansion with large ecological damage to Boulder County.

Thank you,

-Sarah

Sarah Koniewicz
Patent Attorney, Holland & Hart LLP
1800 Broadway, Suite 300, Boulder, CO 80302-5234
T 303.473.4818 F 303.416.8811 M 952.607.8210

HOLLAND&HART

From:	Carol Pittman
To:	Gross Reservoir SI-20-0003
Subject:	Gross Dam Expansion Docket SI-20-0003
Date:	Wednesday, December 2, 2020 12:34:01 PM

Dear Powers That Be:

I can't begin to imagine a more selfish, as well as unnecessary, project than the dam you are proposing. At a time when all the southwestern region of the United States is, and will be, suffering the results of water shortages you propose to grab as much for yourselves alone as you possibly can. Putting in place more stringent conservation measures would be a far better plan, and a plan more in line with the goal of providing adequate water to the entire region that depends on Colorado River water. New Mexico, particularly Albuquerque, has shown that conservation can work, that people are willing to make the called-for sacrifices in order that all may benefit.

I ask you please: don't expand the Gross Dam.

Thank you,
Carol Pittman
Datil, New Mexico

From:	Will S.
To:	Gross Reservoir SI-20-0003
Subject:	Reject Gross Reservoir proposed expansion
Date:	Wednesday, December 2, 2020 12:18:44 PM

The Gross Reservoir expansion proposal should be soundly rejected by the Boulder County Commissioners for numerous reasons. I agree with the following statement to the commissioners made by Nederland Board:

"Nederland Town Board letter to Boulder County:

Dear Boulder County Commissioners,

We support and appreciate your application of the 1041 regulations to Denver Water's proposed expansion of Gross Reservoir. We agree that it is critical that the project be thoroughly and carefully reviewed under Boulder County's land use and environmental regulations.

We have concluded because of data provided that the proposed expansion is unnecessary and that the installation of water conservation low flow devices and more efficient toilets, as well as xeriscaping in homes within Denver Water's service area would achieve the same conservation goals, while providing more jobs and no negative environmental impacts.

The expansion project will have severe negative environmental impacts by releasing massive amounts of carbon into the atmosphere. The expansion will require the removal of 200,000 trees, that are badly needed for carbon sequestration. It will require millions of tons of cement that also releases massive amounts of carbon when processed. There will be tens of thousands of trucks traveling on Boulder County roads damaging them severely with unrecoverable costs that will be passed on to taxpayers. The truck traffic will also have a very negative impact on our already deteriorating air quality. This project is completely inappropriate in the middle of a climate crisis. Climate change makes it extremely unlikely that the reservoir will ever be filled because of decreasing moisture and increasing temperatures and evaporation rates.

The Colorado River is overwhelmed with two many states demanding water. A project planning to withdraw water from the river is a very shortsighted, misguided idea.

We oppose the project and respectfully request that you deny it."

From:	Steve Spry
To:	Gross Reservoir SI-20-0003
Subject:	Gross dam
Date:	Wednesday, December 2, 2020 12:14:02 PM

Dear Boulder County Commissioners,

I support and appreciate your application of the 1041 regulations to Denver Water’s proposed expansion of Gross Reservoir. I agree that it is critical that the project be thoroughly and carefully reviewed under Boulder County’s land use and environmental regulations.

I have concluded because of data provided that the proposed expansion is unnecessary and that the installation of water conservation low flow devices and more efficient toilets, as well as xeriscaping in homes within Denver Water’s service area would achieve the same conservation goals, while providing more jobs and no negative environmental impacts.

The expansion project will have severe negative environmental impacts by releasing massive amounts of carbon into the atmosphere. The expansion will require the removal of 200,000 trees, that are badly needed for carbon sequestration. It will require millions of tons of cement that also releases massive amounts of carbon when processed. There will be tens of thousands of trucks traveling on Boulder County roads damaging them severely with unrecoverable costs that will be passed on to taxpayers. The truck traffic will also have a very negative impact on our already deteriorating air quality. This project is completely inappropriate in the middle of a climate crisis. Climate change makes it extremely unlikely that the reservoir will ever be filled because of decreasing moisture and increasing temperatures and evaporation rates.

The Colorado River is overwhelmed with too many states demanding water. A project planning to withdraw water from the river is a very shortsighted, misguided idea.

In short, this is an environmental disaster!

I oppose the project and respectfully request that you deny it.

Thanks,

Steve Spry

199 Broken Fence Rd.

Boulder, CO

From:	cr rig
To:	Gross Reservoir SI-20-0003
Subject:	Timeline Effect
Date:	Wednesday, December 2, 2020 11:33:27 AM

HI

What is the best estimate for start of Dam project and the finishing?

Do you know how traffic congestion will be mitigated to allow residential traffic from Gross Dam to Chute Rd in your county?

Will this involve hiring of local construction workers that reduce the supply of building industry people in boulder county?

Thanks much, urgently
Chris Rigatuso

From:	Ann Tagawa
To:	Gross Reservoir SI-20-0003
Subject:	dam expansion
Date:	Wednesday, December 2, 2020 10:46:47 AM

NO on the plan to expand the Gross Reservoir Dam!
Ann, Boulder County resident

From:	Layna Melvin
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, December 2, 2020 6:19:09 AM

Dear Boulder County Commissioners and Staff,

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Layna Melvin
415 Highland Drive

Longmont, Colorado 80504
720-617-2090

From: Allen Brown
To: Gross Reservoir SI-20-0003
Subject: SI-20-003
Date: Wednesday, November 25, 2020 9:38:10 AM

I am 100% against all measures of this proposal.
-Allen Brown, property owner
11903 hillcrest rd
Golden

From:	john welsch
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir comments
Date:	Monday, November 23, 2020 4:44:28 PM

Greetings!
I'm very concerned about the proposed Gross Reservoir expansion. Environmentally issues, traffic and safety issues, pollution and noise issues are all concerning to me. Has there been any thought about an alternative plan? It seems to me that there are quite a few reservoirs here on the plains that could accommodate additional water for our future Colorado residents. Boulder Reservoir, Baseline Reservoir, Marshall Lake, Standley Lake, Ralston Reservoir and Chatfield Reservoir are all reservoirs that are relatively easy to get to and could accommodate the additional water that is proposed for the Gross Reservoir expansion. By focusing on dividing this big project to these different reservoirs, it seems to me you would alleviate the environmental, traffic, safety, pollution and noise concerns that you would have with the Gross Reservoir project.
Thank you!
John Welsch

From:	Anita Carrick
To:	Gross Reservoir SI-20-0003
Subject:	Gross Dam Road
Date:	Monday, November 23, 2020 10:51:39 AM
Attachments:	Gross Dam Road.msg

Denver water moved one big rig, two days after Boulder County grated and rolled Gross Dam Road. This picture shows the damage to the road after one vehicle was moved. Denver water CEO promised not to have vehicles on this road during rush hour, they moved this rig between 7:30 - 8:00 AM.
It is not working out and they have just begun.
How can we get this CEO to do as told and follow rules, he would not adhere to Boulder County rules during covid at the boat launch area either.
Thank you.

From:	Laurie Dameron
To:	Gross Reservoir SI-20-0003
Subject:	Fwd: my comments
Date:	Thursday, November 19, 2020 10:47:38 AM

Hi

Following up here - should I expect a reply?

Happy Holidays!

YOU ARE A PART OF THE SOLUTION!!!

Laurie D

Laurie Dameron

Windchime Productions

www.LaurieDameron.com
303-449-3529
Windchimel@aol.com
Chair of Environmental and Sustainable Development
Business and Professional Women since 2015 (BPW Colorado)
Past Chair of Environment 2016-2020 (NFBPWC)

-----Original Message-----
From: Laurie Dameron <windchimel@aol.com>
To: grossreservoir@bouldercounty.org <grossreservoir@bouldercounty.org>
Sent: Wed, Nov 11, 2020 5:02 pm
Subject: my comments

To whom it may concern,

I am against the expansion of Gross Reservoir. It would require cutting down thousands of trees. Trucks and tractors would need to drive miles every day putting out enormous amounts of CO2. Plus it will disturb residents that live near the highways where they will need to pass and hones that are near the reservoir. The project will use enormous amounts of energy.

Instead I think we need to address our lifestyles and make some changes and be more conservative with water. Folks can get toilets that use less water for reasonable prices these days. I got mine for free from the city of Boulder a few years ago. (I paid $25 for delivery). Also "If it's clear, leave it here, if it's brown flush it down" is a motto at my house. Turning off the faucet while brushing your teeth and being conscious of how much water we use to do dishes, water the garden. Perhaps people should be considering xeriscape instead of grass lawns. It may be time for fewer golf courses. In the 1970's here in Boulder, when it was a low snow year, restaurants would only give you water if you asked for it. We need to strive for zero waste. The Environmental Protection Agency states that over 40% of our greenhouse gases come from the way products are extracted from the earth, produced, transported and even to get rid of uses energy and that striving for zero waste is one of the easiest and quickest ways to fight climate change. Folks also need to educate themselves on what is recyclable and compostable as contamination continues to be the biggest problem with zero waste (contamination means putting the wrong items in the wrong bins and if a bin is too contaminated it ends up in the landfill.) We all share this planet and we ALL need to be fighting climate change every day to ensure a future for our children!

thank you,

Laurie Dameron
2635 Mapleton Ave
Boulder, CO 80304

Happy Holidays!

YOU ARE A PART OF THE SOLUTION!!!

Laurie D

Laurie Dameron
Windchime Productions
www.LaurieDameron.com
303-449-3529
Windchimel@aol.com
Chair of Environmental and Sustainable Development
Business and Professional Women since 2015 (BPW Colorado)
Past Chair of Environment 2016-2020 (NFBPWC)

From:	Lindy Lewis
To:	Gross Reservoir SI-20-0003
Subject:	Docket # SI-20-003: Gross Reservoir and Dam Expansion
Date:	Tuesday, November 17, 2020 10:41:12 PM

I wish to submit these comments opposing approval of the Gross Reservoir proposed expansion project.

- When initially permitted, there was no provision for future expansion of the dam and reservoir. Expansion is not needed simply because Denver Water wants to serve additional prospective customers.

- Water reservoir is not a generally permitted use for a property zoned "Forestry", except as provided for in the original construction.

- The proposed expansion has adverse significant environmental impact on Boulder County lands and Boulder County residents. There is not infrastructure support of roads and facilities to handle this project. Construction of additional infrastructure to support construction activities for the project will adversely and permanently alter scenic areas of Boulder County and Coal Creek Canyon.

- Boulder County must oppose a proposed project to draw more water from the already over-allocated resource of the Colorado River system.

Lindy Lewis

Boulder County Resident

11 Leon Ln

Golden, CO 80403

--
Lindy Lewis

From:	Steve
To:	Gross Reservoir SI-20-0003
Subject:	Docket # SI-20-003: Gross Reservoir and Dam Expansion
Date:	Tuesday, November 17, 2020 1:40:05 PM

I wish to submit these comments opposing approval of the Gross Reservoir proposed expansion project.

- When initially permitted, there was no provision for future expansion of the dam and reservoir. Expansion is not needed simply because Denver Water wants to serve additional prospective customers.

- Water reservoir is not a generally permitted use for a property zoned "Forestry", except as provided for in the original construction.

- The proposed expansion has adverse significant environmental impact on Boulder County lands and Boulder County residents. There is not infrastructure support of roads and facilities to handle this project. Construction of additional infrastructure to support construction activities for the project will adversely and permanently alter scenic areas of Boulder County and Coal Creek Canyon.

- Boulder County must oppose a proposed project to draw more water from the already over-allocated resource of the Colorado River system.

Steve Lewis

Boulder County Resident

11 Leon Ln

Golden, CO 80403

From: mrgem@aol.com
To: Gross Reservoir SI-20-0003
Subject: Possible Benefits of Gross Reservoir Expansion?
Date: Tuesday, November 17, 2020 8:53:28 AM

What are the possible benefits to me and other residents living nearby? I cannot think of a single benefit to me and the other folks in this neighborhood.

Not only will there be no discernible benefit to us, there are almost certain to be substantial liabilities in the form of:

- increased traffic on our little, narrow two-lane
- Increased noise pollution
- increased air pollution
- infringement on wildlife habitat

On the other hand, I see major benefit to the proponents of this project - who are hoping to expand development opportunities in the NW metro Denver area. More available acre-feet means more building permits.

Thanks but no thanks.

GE Morgan
Coal Creek Canyon

From:	Elizabeth Mahon
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 17, 2020 8:43:14 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Elizabeth Mahon
1280 Chambers drive

Boulder, CO 80305
3032483408

From:	Omar Zubaedi
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Please Reject Denver Water"s 1041 Application Until Complete
Date:	Monday, November 16, 2020 6:43:45 PM

- FROM: Omar Farouk Zubaedi 3335 Darley Avenue Boulder CO 80305
-
- Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.
-
-
- **Specific issues with the application:**
- **First:** The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.
    - Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

  Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

    - Tree Removal Plan
    - Quarry Operation Plan
    - Pit Development and Reclamation Plan
    - Stormwater Management Plan
    - Erosion Control Reclamation Plan
    - Invasive Plant and Noxious Weed Species Management Plan
    - Fire Management and Response Plan
    - Special Status Plants Relocation Plan
    - Aquatic Invasive Species Monitoring Plan
    - Traffic Management Plan
    - Fugitive Dust Control Plan
    - Road Maintenance Plan
    - Recreation Management Plan
    - Visual Resources Protection Plan
    - Historic Properties Management Plan
    - South Boulder Creek Channel Stability and Monitoring Plan
    - Road Management Plan (USFS)
    - Road Maintenance Plan
    - Restoration and Revegetation Plans
    - Special Status Plants Relocation Plan
    - Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
    - Emergency Action Plan

- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
  - The “Purpose and Need” in the EIS is not accurate and must be redone.
  - The “Alternatives” analysis in the EIS is not accurate and must be redone.
  - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
  - The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
  - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Omar Farouk Zubaedi 3335 Darley Avenue Boulder CO 80305

From:	Jill Powers
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Monday, November 16, 2020 2:24:07 PM

Dear Boulder County Commissioners,

Please reject the Denver Water application for the expansion of Gross Dam!

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
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- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
   - The "Purpose and Need" in the EIS is not accurate and must be redone.

- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Jill Powers

Jill Powers
1702 Sumac Ave
jpowersstudio@gmail.com
Boulder, Colorado 80304
3032470013

From:	Annie Seidman
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Monday, November 16, 2020 1:34:50 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Annie Seidman
1040 Lehigh St.
annieseidman@gmail.com
Boulder, CO 80305
510-289-9560

From:	Annie Seidman
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Monday, November 16, 2020 1:34:37 PM

Dear Boulder County Commissioners and Staff,

My name is Annie Seidman and I am a Colorado native, born and raised on the western slope in Parachute. The beautiful Colorado River runs through my home town and below the edge of the mesa where I grew up. My parents still live there. I cringe to think about what this dam extension would do to the Colorado River- diverting water to the eastern slope and thereby harming the plants, animals and humans that already rely on it. I also worry about the destruction that will be caused by raising the level of Gross Reservoir.

I wish humans and the people in charge of 'development' could make choices based on the health and sustainability of the entire ecosystem. Expanding Gross Dam and taking away important water resources from those in need is a short-term, detrimental solution. The Gross Dam expansion is another example of how humans harm and change the environment in order to accommodate our growing population and carbon footprint which adds to the global warming crisis. This is a short sited plan that will cause more harm than good.

Thank you for hearing my thoughts on the matter and taking them into consideration.

Truly,
Annie

Additionally...

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Annie Seidman
1040 Lehigh St.
annieseidman@gmail.com
Boulder, CO 80305
510-289-9560

From:	Greg Thomas
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Monday, November 16, 2020 11:42:00 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Greg Thomas

,

From: marta lindrose
To: Gross Reservoir SI-20-0003
Subject: Gross Reservoir
Date: Monday, November 16, 2020 11:23:34 AM

To whom it may concern:

Expanding Gross Reservoir is a bad idea. The idea of expanding is worse or equivalent to fracking. The removal of valuable trees, disrupting wildlife, creating road damage, noise pollution, air pollution, visual pollution and possible flooding through accidents are only a few of the problems and damages that we can expect. We live in a fragile environment so protect our resources and stop this expansion.

Denver Water doesn't care about wildlife or fish or people. I live on South Boulder Creek (40+ years) and I have observed that frequently they shut the flow of water off to a dribble and the fish have nowhere to swim and there is very little water for the wildlife to drink. We have been told by them that they are in the water moving business not the protection of the environment or people business.

If Denver were more conservative they would realize there is adequate water for everyone - don't waste. My question is who is or will be benefiting (not the city but person) from this expansion - that should be investigated, it's obvious they don't care about the environment.

Marta Lindrose
1225 Gapter Rd
Boulder

From:	Caroline Zug
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Monday, November 16, 2020 9:29:05 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
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- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely, Caroline Zug

Caroline Zug
1799 Twin Sisters Rd

Nederland, Colorado 80466
303-748-0359

From: Jodie Simon
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Monday, November 16, 2020 9:05:55 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Jodie Simon
3885 Orange Ct

Boulder, CO 80304
7202892086

From:	Judith Strahota
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Monday, November 16, 2020 8:09:44 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Judi Strahota

Judith Strahota
1496 Alpine Ave

Boulder, CO 80304
3039933390

From:	Kevan Krasnoff
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Monday, November 16, 2020 7:59:48 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Kevan Krasnoff
636 marine st

Boulder, Colorado 80302
3034440693

From:	Arden Buck
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Monday, November 16, 2020 2:04:43 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Arden Buck
38 Navajo
POB 1685
Nederland, co 80466
3032583056

From:	Robert Wilkinson
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Sunday, November 15, 2020 9:18:47 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Robert Wilkinson
1195 Hancock Dr

Boulder, Colorado 80303
3034404530

From:	David Papuga
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Sunday, November 15, 2020 5:08:01 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

David Papuga
11986 twilight st

Longmont, CO 80503
7203415596

From:	Bob Bartusiak
To:	Gross Reservoir SI-20-0003
Subject:	Traffic Impact Analysis
Date:	Sunday, November 15, 2020 3:51:27 PM

As an owner of property on Crescent Park Drive I am highly concerned about the workers that would be traveling to and from the worksite daily using Crescent park drive instead of the same route that the trucks will take.

I think the project should require workers/personal vehicles to take Gross Dam road from HWY 72 instead of coming up Crescent Park Drive. There needs to be monitoring of the traffic count on Crescent Park Drive for the expansion project. We will already be negatively impacted on HWY 72, I do not want the safety and road noise to negatively impact our neighborhood.

Regards,

Bob Bartusiak,
720-891-3418
bobbartusiak@gmail.com

From:	thomas moore
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Sunday, November 15, 2020 2:33:17 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
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- South Boulder Creek Channel Stability and Monitoring Plan
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- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

thomas moore
15550 kingfirld drive apt 1202

houston, texas 77084
8328820293

From:	andy dieringer
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Sunday, November 15, 2020 11:17:15 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

andy dieringer
2548 6th St.

Boulder, CO 80304
3034194676

From: SUE FALLS
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Saturday, November 14, 2020 6:17:13 PM

Dear Boulder County Commissioners and Staff,

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First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

SUE FALLS
1155 OAKDALE PLACE

Boulder, Co 80304
7209030251

From:	Roberta Koeppe
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 4:35:50 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

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Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Roberta Koeppe
3212 Cripple Creek Trail

Boulder, CO 80305
3039188026

From:	Vicki Lemmon
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir Expansion
Date:	Saturday, November 14, 2020 1:21:48 PM

To Whom It May Concern:
I and my husband live just off County Road 68, about a mile from Gross Reservoir. We are adamantly opposed to the expansion of the reservoir for a number of reasons, and we hope these add to the body of others' concerns.

There will never be enough water to fill the expanded reservoir. Climate scientists have presented facts over and over that support this.

The watershed feeding the reservoir is already seriously depleted. Increasing demand on the water provided in this watershed, as well as climate change and dwindling rain/snow to replenish it, are only going to deplete it further. This further reduces the likelihood of Gross ever filling past present capacity and only further ransacks the watershed.

The dangers presented by this enormous construction project are almost too numerous to mention. The roads are not adequate for the logging trucks and heavy equipment that will be required. I have been run off the road twice by Denver Water Board trucks that were too big and moving way too fast down County Road 68. The wildlife that live here will be seriously impacted by the noise and disruption of their habitat. The people that live here will be seriously impacted by the same. Helicopter logging over our house, which has been described as a years-long project, will be a daily stressor for all of us living nearby.

We all know that Denver Water Board is a corporate entity that is only interested in expanding Gross in order to profit from the water sales that will supply Denver lawns and golf courses. This is an obscene project that benefits no one but them. Do you know that homes in the mountains are not allowed to have outdoor water faucets? and yet this corporation wants to profit from the very water that we must conserve every day.

Please consider the many negatives against the non-existent positives and do not allow this project to continue.

Thank you,
John & Vicki Lemmon
154 Cumberland Gap Road
Nederland

From:	LAURIE HALEE
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 12:13:47 PM

Dear Boulder County Commissioners and Staff,

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First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

LAURIE HALEE
61 MEADOWLAND CT

NEDERLAND, CO 80466
303-588-1288

From:	Margaret LeCompte
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 11:44:03 AM

Dear Boulder County Commissioners and Staff,

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Margaret LeCompte
290 Pawnee Drive

,

From:	Beverly Kurtz
To:	Clark R Chapman
Cc:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners; Y Chapman
Subject:	Re: Analysis of Denver Water 1041 Application (Gross Reservoir)
Date:	Saturday, November 14, 2020 10:20:00 AM

Dearest Clark and Y,

As usual you have done an outstanding job in documenting issues with the project. I can't thank you enough for taking the time to write all this up (again!) Your support is so appreciated.

Thanks,
Bev

On Fri, Nov 13, 2020 at 1:45 PM Clark R Chapman <cchapman@boulder.swri.edu> wrote:

> Dear Commissioners Deb Gardner, Elise Jones, and Matt Jones:
>
> We hope that you and your staff will consider our lengthy, detailed analysis *(attached Word document)* and reject the 1041 Permit Application of Denver Water (Docket SI-20-0003) for a six-year long construction project to expand Gross Reservoir. Thank you!
>
> Clark and Y Chapman
>
> --
>
> Clark R. Chapman and Y (LMC) Chapman
> 2083 Lazy Z Rd.
> Nederland CO 80466

From:	Mark Shader
To:	Gross Reservoir SI-20-0003
Subject:	Fwd: Comments on Denver Water"s 1041 Application to Boulder County Due November 13th!
Date:	Saturday, November 14, 2020 9:59:13 AM

Sent from my iPad

Begin forwarded message:

> **From:** Mark Shader <markshader1@gmail.com>
> **Date:** November 10, 2020 at 6:40:27 PM MST
> **To:** commissioners@bouldercounty.org
> **Subject: Comments on Denver Water's 1041 Application to Boulder County Due November 13th!**
>
> Long time residence of Boulder County,
> Mark Shader
> 720-352-1614
>
> This project in many ways makes very little sense. I think if Denver etc had water restrictions and green lawn limits etc that water would not be the problem. Also, on limits of how much they can charge selling it to other municipalities. This project is a very slippery slope being publicized as a need for water. Without proper restrictions on its use how can you pass such an outrageous plan.
> Thank you
>
> https://www.saveboulder county.org/how-you-can-help
>
> Sent from my iPad

From: Adrienne Bielak
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Saturday, November 14, 2020 9:59:10 AM

Dear Boulder County Commissioners and Staff,

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- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Adrienne Bielak
31056 Burland Rd

Golden, CO 80403

From:	Gretchen Bach
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 9:59:08 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
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- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The “Alternatives” analysis in the EIS is not accurate and must be redone.
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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Gretchen Bach
2279 Spruce St

Boulder, CO 80302
3038299828

From:	Brittany Olson
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 9:59:08 AM

Dear Boulder County Commissioners and Staff,

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First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Brittany Olson
687 Crescent Lake Rd

Golden, Colorado 80403
3039319860

From:	Cynthia Berginc
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 9:59:07 AM

Dear Boulder County Commissioners and Staff,

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Cynthia Berginc
11933 Coal Creek Heights Dr.

Golden, CO 80403
602 399 0633

From:	Justin Shaffer
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 9:59:07 AM

Dear Boulder County Commissioners and Staff,

We live in Coal Creek Canyon and do not want to see our beautiful canyon destroyed because of the Gross Dam expansion! Please reject their application!

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Justin Shaffer

Justin Shaffer
911 Divide View Drive

Golden, CO 80403

From:	Gwendy Haas
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 9:59:06 AM

Dear Boulder County Commissioners and Staff,

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.
There is another way to provide water and still protect our beautiful state without this project.
Please reject this application.

Thank you!
Sincerely,

Gwendy Haas
3580 Cloverleaf Drive

Boulder, CO 80304
3034494106

From:	Ted Baker
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 9:58:16 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Ted Baker

Ted Baker
11563 Lillis Lane

Golden, CO 80403
720 340 9636

From:	Nicole Faurot
To:	"undisclosed-recipients:"@IMSVA1.BOULDERCOUNTY.ORG
Subject:	Denver Water"s Gross Reservoir Expansion Project
Date:	Saturday, November 14, 2020 9:58:14 AM

To Whom It May Concern,

I live on Flagstaff mountain overlooking Gross Reservoir. I would like to express my concern about this project and have listed specific details below.

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code.

Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Kindly,
Nicole Faurot

From:	Ursula Treves
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 9:58:14 AM

Dear Boulder County Commissioners and Staff,

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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Ursula Treves
12002 spruce canyon circle

Golden, Co 80403
8433424999

From:	Mary Maxwell
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 9:58:13 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Mary Maxwell
8585 Flagstaff Rd.

Boulder, Co 80302
303-915-3074

From: Bruce Doenecke
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Saturday, November 14, 2020 9:58:11 AM

Dear Boulder County Commissioners and Staff,

I am a resident of Coal Creek Canyon and live near the Gross Dam Resevoir.

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

I strongly urge you to reject this application.

Thank you!
Sincerely,
Bruce Doenecke

Bruce Doenecke
PO Box 7028

Golden, CO 80403
3036423993

From:	Eileen Kintsch
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 9:58:11 AM

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First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Eileen Kintsch
435 College Ave.

Boulder, CO 80302
303-443-1203

From:	Brice Johnson
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 9:58:09 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

I cannot imagine 7 years of traffic, noise, and pollution on County Road 68 which runs right behind my home/property for a project that has been proven to not be needed and would cause irreversible damage to the environment, ecology, forestation, animal habitats, recreation opportunities, river flow (the math doesn't work), and property use and value.

Please reject this application.

Thank you!

Sincerely,

Brice Johnson

Brice Johnson
48 Wildflower Ct

Nederland, CO 80466
317-370-0714

From:	Ronald Brown
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Gross reservoir expansion
Date:	Saturday, November 14, 2020 9:58:07 AM

Leading statement to the Boulder County Commissioners: Denver Water's 1041 application is incomplete. Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all the deficiencies below, Boulder County should not consider this application and should return it to Denver Water for clarification and completion.

Specific problems with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

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Boulder County cannot consider this application because these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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Make a difference locally by acting NOW!

We need EVERYONE to send in comments - the important focus right now is the NUMBER and PASSION of commenters. YOU can help right now with a simple E-mail!

Contact us at info@SaveBoulderCounty.org with questions.

Follow us on Facebook at https://www.facebook.com/tegcolorado

Keep informed at SaveBoulderCounty.org

Denver Water has submitted its 1041 Permit Application to expand Gross Reservoir to Boulder County. Even though the application is 354 pages long, it does not address many important issues. Please ask Boulder County to refuse the application until it is complete. Some useful links:

- Boulder County 1041 Regulations
- Denver Water's 1041 Application

Comments should be emailed to Boulder County at grossreservoir@bouldercounty.org AND at commissioners@bouldercounty.org. Feel free to cut and paste from the talking points below - or do your own research looking through the links above and write what inspires you.

We need as many people as possible to write, letting the commissioners know that their constituents are paying attention to this and want the county to apply the county's 1041 regulations to Denver Water’s plan. Every response is important. The talking points below are specific to the actual application but feel free to add your own stories about why this matters to you.

Here are your talking points - please write today!

This looks like a LOT of information to wade through but please read through it - it's really pretty simple to understand.

Leading statement to the Boulder County Commissioners: Denver Water's 1041 application is incomplete. Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all the deficiencies below, Boulder County should not consider this application and should return it to Denver Water for clarification and completion.

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Sierra Club Indian Peaks Group

From:	Maggie Boyer
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Saturday, November 14, 2020 9:58:07 AM

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- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Maggie Boyer

Maggie Boyer
635 S 44th Street

Boulder, Colorado 80305

From:	Amy Fortunato
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 11:44:39 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
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- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
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- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Amy Fortunato
Po box 174

Ward, CO 80481
3034431859

From:	Maria Michael
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 10:03:07 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Maria Michael
2225 Parkview Drive

Longmont, CO 80504
303915-3080

From:	Patrick Mullin
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 8:06:04 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Patrick Mullin
305 Laurel Ave

Kenwood, California 95452

From:	john Ainsworth
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 6:12:46 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

john Ainsworth
3 Ronnie rd

golden, co 80403
3039315218

From:	Gordon McCurry
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application
Date:	Friday, November 13, 2020 5:50:48 PM

Dear Boulder County Commissioners and Staff,

As you are aware, Denver Water has submitted its 1041 application for the expansion of Gross Dam. As a professional hydrologist with more than 35 years of experience in hydrology including water supply planning in Colorado and elsewhere, I request that this application be rejected.

Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS (FEIS) and Record of Decision. I have reviewed the FEIS and find that it has numerous errors, which are under dispute and litigation in federal district court in Denver. Most of the deficiencies in the FEIS are due to the outdated nature of many of the technical elements upon which it is based. These items render the FEIS to be invalid and are sufficient for your Board to deny the 1041 application. To me, the most serious of the deficiencies of the FEIS are as follows:

(1) the "Purpose and Need" section in the Final EIS is not valid and must be rejected. Denver Water's own water use information shows that there is approximately 130,000 acre-ft/year of excess capacity in Denver Water's current supply system. This is far above the projected increase in demand by 2032 (the FEIS's projected timeline) of 100,000 acre-ft, and renders the Purpose and Need for an addition 34,000 acre-ft/year by 2032 invalid. The Final EIS should be rejected on those grounds.

(2) The screening process of potential water supply sources and infrastructure components that was used in the EIS appears to be in conflict with both Council on Environmental Quality (CEQ) and Army Corps regulatory requirements. As stated in Section 2.0 of the FEIS, CEQ regulations include the requirement to rigorously explore and objectively evaluate all reasonable alternatives (40 CFR 1502.14[a]). However, the selection process appears to have been biased so as to only retain items that were desirable from the standpoint of the applicant, Denver Water.

The FEIS identified 303 potential water supply sources and infrastructure components that could potentially become part of alternatives to meet the project's Purpose and Need. Although a multiphase process was used to screen and assemble these components into five alternatives, there were many decisions made to retain or reject certain components that appear to be in violation of the applicable regulations.

(3) Clean Water Act Section 404(b)(1) require "that no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant environmental consequences" (40 CFR 230.10[a]). This is commonly referred to as the Least Environmentally Damaging Practicable Alternative, or LEDPA requirement for the proposed alternative. Many of the potential water supply sources and infrastructure components that were eliminated from further consideration would have much

lower environmental impacts to the aquatic environment than does Denver Waters' proposed alternative. Even amongst the five alternatives (other than the No Action alternative) that were retained for consideration by the Corps, the proposed alternative has the following environmental impacts, as presented in Final EIS Table 5.22-1:

- Greatest loss of rare vegetation communities,
- Second greatest loss of vegetation,
- Second highest permanent loss of wetlands,
- Greatest direct impacts to other waters of the U.S.,
- Greatest direct impacts to riparian habitats,
- Largest permanent loss of crucial seasonal habitats for elk,
- Greatest loss of non-crucial habitat for other big game species such as deer, black bears and mountain lions,
- Largest impacts regarding fragmentation of habitat,
- Largest permanent loss of USFS wildlife habitats, including effective habitats, forested corridors, open corridors, interior forest, existing old growth forest and old growth redevelopment areas,
- Greatest loss of sensitive habitats, including the Wininger Gulch Potential Conservation Area and the Wininger Ridge Environmental Conservation Area, and
- Largest loss of habitat for, and displacement of, USFS Region 2 sensitive species including northern goshawk, flammulated owl and several other bird and bat species.

It is inconceivable that the proposed alternative, with this range and magnitude of permanent environmental impacts, could be considered the least environmentally damaging practicable alternative as is required by the Corps. Based on the above analyses presented in the FEIS, the proposed alternative appears to be inconsistent with the legal requirements under the Clean Water Act and NEPA.

There are many other reasons to deny the 1041 application, including (1) its failure to provide numerous plans, (2) its failure to comply with the Boulder Valley Comprehensive Plan, (3) its violation of Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies, (4) its violation of Boulder County Land Use Code 8-511.I.2 since it is not compatible with resource preservation and does not minimize resource damage, and (5) its violation of Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

For the reasons stated above you have ample reason to reject Denver Water's 1041 application and I request that you do so.

Sincerely,

Gordon McCurry, Ph.D., P.G.

1200 Albion Rd
Boulder, CO 80305
303-520-1349
gmccurry@mccurryhydro.com

From:	billhogrewe@gmail.com
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Please DENY the Gross Reservoir Expansion application
Date:	Friday, November 13, 2020 5:36:29 PM

Commissioners,
I urge you to deny the application from Denver Water to expand Gross Reservoir. The application glosses over many of the requirements in Article 8, Section 511 of the Boulder County Land Use Code including conservation and full utilization of existing municipal water supplies, minimization of resource damage, public health and safety, and compatibility with existing traffic volumes. In addition, the application relies on the Army Corps of Engineers' Environmental Impact Statement and Record of Decision which does not adequately address alternatives, does not include cumulative impacts, and does not adequately consider impacts on global climate disruption.

As a drinking water engineer, it is my opinion that Denver water has not exhausted other options that would eliminate the need for more storage capacity such as water conservation, restrictions on water-intensive landscaping, and limiting growth. In fact, growth is a large, if not the largest, driver behind this project. In the words of former Director of Planning at Denver Water, Dave Little, " Everything is going to be sacrificed for growth and I don't know how to stop that." He made this comment at a Two Forks Retrospective conference in Denver in 2019.

Thank you for your consideration,

Bill Hogrewe, PhD., P.E.
611 Concord Ave.
Boulder, CO

From:	Bill Merline
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	STOP Gross Dam project
Date:	Friday, November 13, 2020 5:33:36 PM

Dear Boulder County Commissioners:

I urge you in the strongest terms to reject any attempt by Denver Water to continue with the Gross Reservoir expansion project.

I and my wife are property owners in Boulder County, and my wife makes a commute into Boulder every day. The risks on the highway of these huge rock trucks is not close to being acceptable.

Some issues:

1) draining more water from the Colorado River will have severe consequences, not only locally, but for Colorado and all interests downstream. It may even lead to lawsuits from other interests downstream for reckless use of a scarce resource.

2) Denver has made very little effort to promote water conservation. People continue to water lawns, golf courses, and many other wasteful applications.

3) Denver and its surrounding communities continue to expand and build and build more, seemingly without any limits. They seem to think there will always be plenty of water for any amount of expansion. This is not sustainable and must be restricted.

4) The burden for this unlimited expansion in the Denver area should NOT be on Boulder County. Why is it that Boulder is supposed to provide water, a reservoir, and all of the associated negative aspects of this project? It should be rejected outright.

5) There are many disastrous effects of this project, all of them put on Boulder County:

a) loss of recreation areas
b) a large loss of trees (some 200,000). In a time of climate change, we cannot afford to lose even a single tree because of its contribution as a carbon sink. A very simple calculation, giving a minimal value to each tree, over a 100-yr life span (we know most of these trees are older than that), yields a loss of value in the trees ALONE of over $2 billion! That clearly exceeds the value of this water to Denver and we should not allow such theft of the County's

resources. It is an OUTRAGE.

c) loss of wildlife habitat

d) This is a construction project that will go on for an unbelievable 5 years (!!), with all of the associated noise, dust, lights, traffic hazards, traffic jams, etc. The projected cost to the County is immeasurable. And what does the County get out of it? Nothing, except these problems.

I urge you to find every possible means to stop this project in its tracks. Lawsuits from Denver Water or not, we cannot be expected to promote Denver's expansionism, when Boulder County itself has been extremely responsible and careful in development. To have this now dumped on County residents when they have struggled themselves to be responsible, is really beyond belief.

Dr. William J. Merline
Staff Scientist
Southwest Research Institute
Boulder CO 80302

merline@boulder.swri.edu
303.582.9691
720.878.7858

From:	Diane Merline
To:	Gross Reservoir SI-20-0003
Subject:	Opposition to Gross Reservoir Expansion Project
Date:	Friday, November 13, 2020 5:33:34 PM

I am writing to express my sincere opposition to the Gross Reservoir expansion project.

Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

Failed to use an adequate alternatives analysis.
Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Denver has made very little effort to promote water conservation. People continue to water lawns, golf courses, and many other wasteful applications.

Draining more water from the Colorado River will have severe consequences, not only locally, but for Colorado and all interests downstream. It may even lead to lawsuits from other interests downstream for reckless use of a scarce resource.

Thank you for your consideration.

Diane Merline
Black Hawk, Colorado

From:	Liz Vaillancourt
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 5:16:33 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Liz Vaillancourt
3120 fremont

Boulder, Co 80304
3039381312

From:	adaline jyurovat
To:	Gross Reservoir SI-20-0003
Subject:	Gross Res.
Date:	Friday, November 13, 2020 4:55:15 PM

Dear Boulder County officials:
To keep it simple, Denver WAter's application regarding Gross Res. is not complete. After it is complete, it is still unsustainable. We cannot afford the environmental disaster that the expansion will bring.

M Adaline Jyurovat
550 Marine St.
Boulder, CO 80302
3034431392

From:	Barbara Hofmann
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 4:40:26 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Barbara Hofmann
2890 Kalmia Ave Apt 203
barb1110hofmann@gmail.com
Boulder, CO 80301
3034492759

From:	MBL
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir Expansion Plan
Date:	Friday, November 13, 2020 4:23:20 PM

Denver Water's 1041 application is incomplete. The application refers to plans that do NOT exist. Please submit the application when it complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. These need to be addressed.

Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors.

The application fails to comply with the Boulder Valley Comprehensive Plan.

Please do not approve this plan until the problems have been addressed!

Sincerely,

Maureen Lawry

From:	Catherine Grace
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 4:17:30 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Catherine H Grace
Concerned Gross Reservoir neighbor

Catherine Grace
78 Aspen Grove Ct
catherinehgrace@gmail.com
Nederland, CO 80466
7203520212

From:	Leslie Faurot
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Cc:	Leslie Faurot
Subject:	Reject Denver Water"s 1041 Application
Date:	Friday, November 13, 2020 4:17:22 PM

Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

First Name (required)
Leslie

Last Name (required)

Faurot

Your Email (required)

lfaurot@wispertel.net

Address

281 Lakeshore Park RD

City

Boulder

State/Region/Province

CO

Postal/Zip Code

80302

Phone

3036423273

Subject:: Denver Water's 1041 Gross Dam Expansion Application is 'Incomplete' and Must Be Rejected

Dear Boulder County Commissioners and Staff,

I thank you for your good work for Boulder County people!

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

This would be the largest construction project in Boulder County!

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

The corps reliance on data from over 10 years ago makes it's work inaccurate for now and the future.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Our Boulder County Commissioners and staff continuously work very hard for our people and our lands.

Please reject this application.

Thank you!

Sincerely,

Leslie Faurot

From:	Steve Juedes Jr
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 3:13:26 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Steve Juedes Jr

Lafayette, Co 80026

From: Diego Olaya
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Friday, November 13, 2020 2:52:32 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is incomplete and must be rejected given the following reasoning:

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application, Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failure to use an adequate alternatives analysis.
- Failure to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Given these shortcomings, please reject this application.

Sincerely,

Diego Olaya

,

From:	Clark R Chapman
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Cc:	Y Chapman
Subject:	Analysis of Denver Water 1041 Application (Gross Reservoir)
Date:	Friday, November 13, 2020 2:33:48 PM
Attachments:	grcrcy20.docx

Dear Commissioners Deb Gardner, Elise Jones, and Matt Jones:

We hope that you and your staff will consider our lengthy, detailed analysis *(attached Word document)* and reject the 1041 Permit Application of Denver Water (Docket SI-20-0003) for a six-year long construction project to expand Gross Reservoir. Thank you!

Clark and Y Chapman

--

Clark R. Chapman and Y (LMC) Chapman
2083 Lazy Z Rd.
Nederland CO 80466

★ **Dr. Clark & "Y" (LMC) Chapman** ★

Rancho Europa

2083 Lazy Z Road

Nederland, CO 80466

(303) 642-1913

13 November 2020

Commissioners of Boulder County
Boulder County Courthouse, 1325 Pearl St.
Boulder, Colorado 80302

Dear Commissioners Deb Gardner, Elise Jones, and Matt Jones:

We hope that you and your staff will consider our lengthy, detailed analysis below and **reject** the 1041 Permit Application of Denver Water (Docket SI-20-0003) for a six-year long construction project to expand Gross Reservoir.

Introduction

We have been following Denver Water's (DW's) desires to expand Gross Reservoir for about sixteen years. In its current 1041 Application, many pages are devoted to explaining DW's extensive outreach to stakeholders. It has indeed been extensive and we have probably attended two dozen such meetings. But from the perspective of citizens who live in the regions that would be affected by this project, DW rarely has "listened" to or meaningfully responded to our input. DW's representations to the Army Corps, the EPA, FERC, the State of Colorado, the Boulder County Commissioners, etc. have been badly erroneous in many ways and they are hardly ever corrected nor do they seriously address our suggestions and complaints.

We note that throughout this Application and its Exhibits, many important issues are not directly addressed but instead simply reference (or copy) earlier DW submittals to government agencies. There are innumerable references to earlier approvals by the Army Corps and FERC, but those approvals were based on totally fallacious materials submitted by DW and faulty judgments by those agencies that did not take into account issues affecting residents of Boulder County. Much of that uncorrected DW material was erroneous at the time and thus remains so. We reference at the end of this letter our previously submitted critiques of these DW documents because most of our analysis and objections remain valid. In addition to deferring to these earlier, erroneous, and sometimes obsolete, submissions, DW often states that certain vital studies will be done in the **future** and hence aren't included in this Application. One common phrase in this Application is:

"To be submitted after final design element is released from design team."

In many cases, the issue is vital and the details should have been included in the Application. The Boulder County Commissioners should, in our view, reject this Application or defer its consideration until these studies have been completed and submitted for review and public comment. As just one example, dealing with traffic and roadways, the Application (in Exhibit E) provides great detail about redesigning the intersection of SH 72 (Coal Creek Canyon) with Gross Dam Road. But what must surely be a much more complex and expensive construction project – constructing a proposed connector road between FS359 and Lazy Z Rd. – is not even given one complete sentence! And the Application states that design of the intersection of CR 132 (Magnolia Rd.) with SH 119 (Peak-to-Peak Hwy.) is not yet completed, so there is zero discussion of its new design in Exhibit 4 other than a brief section about why State Highway Access Codes don't require auxiliary lanes. We find that deference to earlier fallacious submissions and deference to future studies not yet completed or submitted renders this Application fatally flawed.

There is no way that in two short months we can study the thousands of pages in this Application and associated Exhibits. So we concentrate on a few topics about which we are especially knowledgeable. We find that DW's Application is unprofessionally sloppy and erroneous in addressing these topics, from which we surmise that other parts of the Application are likely to be equally unacceptable.

We do want to state, however, that we share our neighbors' concerns about many other general aspects of the proposed expansion of Gross Reservoir. Here we list a few:

* Astonishing incompatibility with the County's Comprehensive Plan. It is on its face a project totally incompatible.

* Incompatibility with the USFS Arapaho Roosevelt National Forest plans for the part of the forest surrounding Gross Reservoir.

* Destruction for many years of the reasons the Reservoir region is valued by recreationists. DW states:
"Past Denver Water surveys indicate that Gross Reservoir's most desirable attributes are its feeling of remoteness, the lack of man-made structures and human intervention, and other scenery-related attributes and activities such as sightseeing and wildlife viewing." [pg 252].
Clearly, this 6- to 7-year-long project will totally eradicate the values of the Reservoir and widely surrounding regions for recreationists during an appreciable fraction of a human lifetime. To say that these impacts are only "temporary" is a joke. And the major modifications to the shorelines, the destruction of Forsythe Falls, the re-constructed roadways, and so on will actually be permanent.

* Radical interference with the major elk migration corridor mapped in this region and the elk wintering habitat around the Reservoir.

* Further strain on the diminishing water in the Colorado River Basin, affecting residents of half-a-dozen states during an epoch of increasing drought due to climate change.

* Major impacts during the 6- to 7-year project on traffic driving on roads connecting the Foothills with Boulder and Golden. Residents are just completing over two years of major stoppages and detours due to major road construction in Coal Creek and Boulder Canyons to repair damage caused by the 2013 flood.

* Social inequity of DW's attempt to mitigate short-term effects of droughts on Denver bluegrass lawns by greatly intruding on the lives of Foothills residents who, by State law, cannot legally use a drop of even their own well water outside their homes. Metro Denver has a near-desert climate ("desert" is

defined as having <10 inches annual rainfall; Denver averages just 14 inches and in 2018 had 8.5 inches). Denver should conserve water accordingly, like other southwestern cities are doing.

* Noise levels will increase drastically. The Application states that construction noise levels at nearby homes "are not likely to be intrusive" and that noise levels off-site will be "minor and temporary." Wrong! Gross Reservoir and exurban/rural communities within many miles through which trucks would pass several times per hour currently have ambient noise levels (e.g. 25 dBA) far below noise levels of the "quiet urban community," which the Application says will typify construction noise levels. The County and State noise regulations listed in Tables 68 and 70 are generic, applicable to developed urban and suburban locations. In no way do they represent existing or desired conditions in areas devoted to wildlife preservation and undeveloped recreation, like most of the open space, national forest, and Environmental Conservation Areas surrounding the Reservoir. And to describe excess construction noises as "temporary", when they may last for six years (and probably much longer due to normal delays of projects), is a cruel joke for senior citizens like ourselves in our 70s.

* An amazing variety of birds live in the vicinity of the Reservoir, including endangered raptors. While the Application lists lots of bird species, it proposes to do little that would actually protect their habitats from adverse effects.

In what follows, we delve into topics concerning which we are especially knowledgeable. We first address a portion of Exhibit E concerning traffic and roadways west of the reservoir. The two of us are authors of the Transportation section of the Magnolia Environmental Preservation Plan (MEPP), which -- as described on pg. 65 of DW's Application -- is referenced in Boulder County's Comprehensive Plan. Later we address a vital attribute of local weather conditions that DW has continually ignored throughout the past decade. Dr. Clark Chapman holds a Master's Degree in Meteorology and a PhD in Planetary Science from M.I.T. and is competent to address weather. Both of us have lived about two miles from Gross Reservoir since 1997 and thus are thoroughly familiar with the Reservoir and surrounding neighborhoods and forest lands.

<u>Comments on: Exhibit 4 "Traffic Impact Analysis"</u>

The Exhibit 4 analysis follows a cookie-cooker approach that is wholly inapplicable to the rural/exurban/foothills region studied. Many pages are devoted to analyzing issues that are irrelevant while the real issues are wholly ignored. The technical sloppiness and outright mistakes are typical of the studies that Denver Water has been submitting to Federal agencies and Boulder County during the past decade. We offer below some general comments, then concentrate on one topic addressed in this Exhibit (roads to be used for truck traffic west of the construction) that illustrate the gross deficiencies that presumably pervade the entire Exhibit and Application.

Most of the truck traffic considered here involves cement and fly ash deliveries and the hauling away of cut trees and timber waste from the site at various times during the 6- to 7-year project. The Exhibit says that it uses the intersection of SH 72 and SH 93 as the starting point for traffic studies to the west because "this is the point where the larger multiple-lane roads change into a single lane in each direction." This is absolutely false! All four roads emanating from this intersection are **two-lane** roads (SH 72 to the northwest toward Gross Dam, SH 72 to the southeast toward Denver, SH 93 to the south toward Golden, and SH 93 to the north toward Boulder). There are a few sections of SH 93 N&S that have a third lane for passing on steep grades, but they are basically two-lane roads, one lane in each direction.

The implication of using this "starting point" is that there is no problem with routes to Longmont beyond this intersection to the east. Wrong! Besides not being a "multiple-lane road," SH 93 has very high traffic volumes, being a major commuter route to and from Boulder. There is zero analysis of traffic volumes for SH 93 in this Exhibit. Moreover SH 93, especially to the north, is subject to some of the strongest hurricane-force winds in the United States and is frequently closed due to high-wind warnings and snow drifts. This feature of SH 93, and the potential for project trucks to be blown over or forced to detour, is nowhere mentioned in this report (we address winds in our next Section).

The Exhibit provides zero analysis of how trucks will get from the SH 93/SH 72 intersection through Boulder County or the City of Boulder to Longmont. Table 3-1 says that trucks going to or from Longmont will take SH 93 or I-70. But SH 93 doesn't get closer than 15 miles to Longmont (through downtown Boulder) and I-70 doesn't get closer than twice that distance. Since the Exhibit estimates that up to 288 trucks will travel **weekly** from Longmont, surely DW should advise Boulder County Commissioners about proposed routes through the County or City that will be used so that adverse effects can be analyzed and mitigated.

Let us now focus on Denver Water's proposals for tree and timber slash removal **west** of the construction project. This is a grossly incompetent analysis, as we will show. Most important, it totally fails to address the nature and location of the local roads proposed to be used to haul materials out of the project area. The nature of most roads west of Gross Reservoir, narrow dirt/gravel residential roads, makes them generally unsuitable for heavy truck traffic. The Exhibit spends many pages analyzing traffic "delays" (found to be minor) due to anticipated truck traffic. That is not the issue for these roads. The roads, while used by people driving out from, or returning to, their large-lot homes, are more typically used by bicyclists, runners, dog-walkers, equestrians, children playing games, and so on. Although bicycle safety is considered in Exhibit 4 for paved roads (SH 72 and SH 119), there is zero analysis of bicycle safety on Lazy Z or Magnolia Roads, proposed as the main route west of the project.

Consider Lazy Z Rd. About 200 people live along the two-mile public section of Lazy Z, or along tributary roads off Lazy Z. A number of people ride their horses on the public section of Lazy Z and then on the private and USFS sections beyond the closed gate (closed to protect wildlife). Their activities would be foreclosed by logging trucks passing by every 15 minutes. There would be major impacts on bicyclists riding along Lazy Z, which is an officially mapped bicycle route; the impacts are wholly ignored in the analysis. The rural ambience of the neighborhood would be destroyed. We point out that nowhere does the report show any awareness of the fact that the public road ends, with a locked gate, two miles west of Denver Water's Gross property (2.2 miles east from Magnolia Rd.).

Consider Magnolia Rd. (CR 132). This road is used on an almost daily basis during certain seasons by runners from around the world (e.g. Africa and Asia), practicing at high elevation for foot races at somewhat lower elevations in Colorado. It is a world-class training road. There is zero acknowledgement of this feature of Magnolia Road in Exhibit 4. Indeed, the document totally fails to even mention a ~4-mile-long stretch of Magnolia in its description of the route from Gross Reservoir to Peak-to-Peak Hwy. (SH 119):

“For tree removal from the west side of the Gross Reservoir, the proposed route includes approximately 3.2 miles of travel on Lazy Z Road (CR 97E) to County Road (CR) 132 and approximately 24 miles of travel on SH 119 between US 6 and CR 132. Transport of these materials will result in increased traffic on the west side access routes, however the existing traffic volumes on these roadways is very low and impacts to the traveling public will not be significant.” [pg. v]

Note that the stretch of Magnolia from the intersection of Lazy Z with CR 132 to the intersection of CR 132 with SH 119 is omitted. And the hundreds of residents who live along these dirt/gravel roads, and “travel” by bicycle, horse, or by walking/running would beg to differ with the bogus statement – which also appears in the main text of the Application -- that “impacts to the traveling public will not be significant.” Not only would they be “significant”, they might largely banish these activities. Why weren’t these impacts analyzed? It seems as though the Design Engineer for this study must live in an urban area where people “travel” only by cars or on sidewalks.

One attribute of the FS 359/Lazy Z route that is mentioned in the Application but given no consideration is the fact that FS 359 and the eastern half of Lazy Z have, for decades, been closed to the public by the USFS for many months in the winter and spring to protect wildlife habitat. There have been good reasons for those closures. Yet there is no discussion in Exhibit 4 about how these sensitive lands will be similarly protected when used for hauling away timber.

Moreover, the engineering analysis seems to be technically incompetent. The major feature of the proposed truck route involves construction of a new 0.15-mile-long road to connect FS 359 to Lazy Z Rd. Unfortunately, nobody looked at the feasibility of doing that. Had the engineers visited the site, or just looked at a topographic map, they would have realized that there is a >200 foot drop along the 0.15-mile (790 ft.) distance. All kinds of measurements of grades along various roads in the area are reported in this study, but they ignore the >25% grade along their proposed new road connector. Not only can logging trucks not climb or descend such a grade, even four-wheel-drive jeeps and ATV’s often got stuck down on Lazy Z Road (hemmed in by the locked gate), unable to climb back up to FS 359 in the years before the USFS permanently closed the dirt road that connected the two. What are Stantek Consultants thinking???

Indeed, the study proposes to build a short, nearly straight road, not a much longer, winding road to enable truckers to ascend or descend the grade:

“PLAN TO BE CONSTRUCTED” above refers to approx. 0.15 miles of new roadway that is planned to be constructed to connect FS 359 to Lazy Z Road to allow for tree removal traffic to travel between these two roads.” [Caption to Fig. 2-2]

Actually, Fig. 3-1 shows a slightly longer route for the proposed connector, but it would still have an average grade of ~20%. Lazy Z Rd. simply cannot be used as a route to truck out materials from lands around FS 359. There are alternate routes, not analyzed in the report, but they present equally challenging (if different) issues.

There is a lengthy section of Exhibit 4 dealing with the intersection of SH 72 with Gross Dam Road, in which a newly constructed intersection is recommended and the design is presented. But there is zero description of the enormously difficult project that would be required to connect FS 359 with Lazy

Z. Beyond that, there is zero analysis of the complex intersection of CR 132 (Magnolia Rd.) with SH 119 (Peak-to-Peak):

"A detailed analysis for access from the SH 119 & CR 132 intersection to the GRE site from the west has not been completed. Additional analysis is required to determine if the roadways along this access route need to be improved to accommodate the large trucks needed for tree removal."

This intersection has limited sight distance. Moreover, directly across SH 119 to the west is West Magnolia Rd. which often is crowded with recreationists who park right there. Analysis of this intersection should have been completed prior to submittal of this Application.

In short summary, the analysis of roadways west of Gross Reservoir, where logging trucks are proposed to travel up to four times an hour, is oblivious to the drastic impacts the trucks would have on the rural nature of the neighborhood and on the actual uses of the roads (by runners, equestrians, bicyclists, etc.). And its major design feature ignores the impossibility of the 25% grade of the new road it proposes to construct. If this kind of incompetent analysis is typical of the rest of Exhibit 4, or the rest of Denver Water's 1041 Application, the proposal should be rejected out-of-hand. The Boulder County Commissioners should also demand analysis of potentially problematical routes east of the intersection of SH 72 and SH 93, not analyzed at all in this Exhibit, that would cross the County (and City?) on the way to Longmont.

Comments on Gross Reservoir Being in an Exceptionally Windy Corridor

One searches in vain in this Application for a competent discussion of the exceptional weather at Gross Reservoir, or even for an acknowledgement that it is different from almost anywhere else in the country. So the consultants who prepared this Application applied cookie-cutter templates to relevant parts of this report, which could be applied almost anywhere, with zero recognition of the frequent extreme hurricane-force Chinook winds that are characteristic of the corridor from Caribou and Nederland down through the Reservoir and extending out onto the Rocky Flats plains. (A word-search of the Application finds zero occasions of "Chinook".) These dangerous winds near Gross Reservoir are not rare. Indeed, as we write this on the day input to the Commissioners is due, the Gross Reservoir region is under an official National Weather Service "High Wind Watch" for gusts to 75 mph beginning this evening.

These high winds are vital to project design in several ways that are missing from this Application. There is a Fugitive Dust Control Plan that is promised, but not until the future. It isn't here for evaluation by experts or consideration by the public. In previous submissions, including this one, there is no awareness that frequent strong winds, often in the autumn and spring, create enormously greater dust problems than in most places in the United States. (Gusts in excess of 120 mph have been recorded in the adjacent town of Wondervu.)

Another high-wind factor affecting this project is danger from wildfires. One of the largest wildfires in Boulder County in recent decades occurred on the east edge of Gross Reservoir in September 2000; fortunately, it was not especially windy on those days. But other recent fires in Boulder County and Arapaho Roosevelt National Forest have been extremely destructive because they were driven by extreme Chinook winds; these include the Fourmile Canyon fire in September 2010 and the very recent East Troublesome Fire in October 2020. So where is the Fire Management Plan in this 1041 Application?

Apparently it is for the future and is not available for review by the public or the Commissioners:

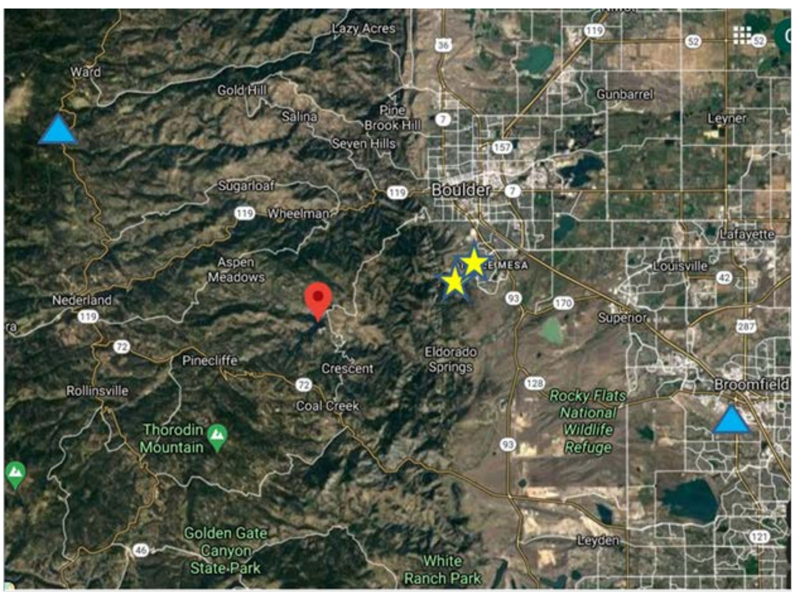
“Denver Water will develop a new Fire Management and Response Plan to reduce the risk of wildfires at and near Gross Reservoir.”

The Application further states that it will apply usual “standards” to fire dangers instead of evaluating the unusual local situation:

“…the Project will not be subject to significant risk from floods, fires, earthquakes or other disasters or natural hazards and therefore Denver Water believes that the Standard has been attained.” [pg. 333]

Yet another high-wind issue totally ignored in the Application is the effect of hurricane-force winds on vehicular travel near the intersection of SH 72 and SH 93, and especially on SH 93 extending north and south from that intersection (perpendicular to the wind direction) toward Boulder and Golden. Trucks and high-profile vehicles are frequently blown over on SH 93, the U.S. Weather Bureau often issues high-wind warnings for this highway, and SH 93 is sometimes closed to prevent blow-overs or because of high snow drifts. These winds might affect dam construction or forestry operations. But who knows because the preparers of the Application are oblivious to these highly unusual wind conditions.

The Application actually mentions wildfires many times. And it even shows wind data. But incompetency reigns! The consultants actually write:

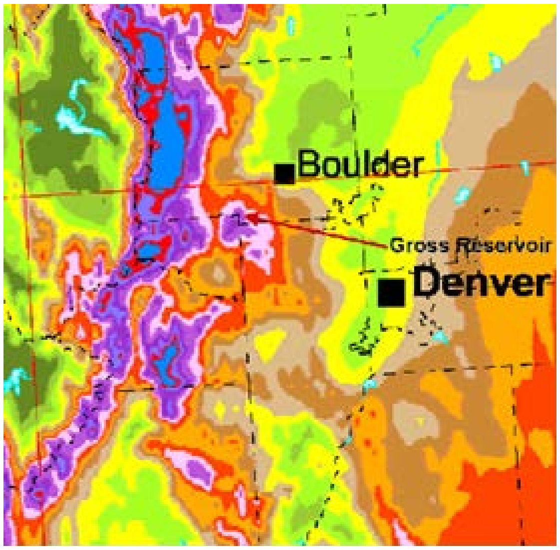


“Wind data are not as available as the other meteorological data; wind data for the years 2004 through 2007 for two sites near the Project vicinity, Broomfield Jefferson County Airport (KBJC) and Mountain Research Station (Boulder 14W) are provided in Table 62 (CISL 2010, NOAA 1998).”

Those two sites, far from the wind corridor, are shown by blue triangles on our first map. The red marker locates Gross Reservoir. Nationally renowned meteorology institutions, with their own weather stations, are located much closer to Gross (about 5 miles), as shown by the yellow stars (the nearby Boulder/Denver Weather Bureau, National Center for Atmospheric Research [NCAR], and National Oceanic and Atmospheric Administration [NOAA]). Their archives contain abundant wind data. We discussed this matter in our critiques of earlier DW submittals to the Army Corps and to FERC, but DW – as usual – ignored our input and the new consultants apparently based their irrelevant, sparse wind data on the faulty report of the earlier consultants.

In our 2010 critique of DW’s Draft Environmental Impact Statement, we presented a map (reproduced here as our second map) showing extreme wind conditions in the Gross Reservoir region. The Final Environmental Impact Statement released in 2014 continued to ignore the frequent hurricane-force Chinook and Bora winds. Indeed they answered our objection to the Draft EIS this way:

"A site-specific analysis of wind conditions in the Gross Reservoir area has been added to FEIS Section 3.13."



That was actually a lie. There was zero analysis in that Section. Indeed the same wording about inadequate availability of wind data, later copied by the new consultants into the current 1041 Application, was there, along with the same data from the two remote weather stations. DW just doesn't care to correct its mistakes, even after ten years!

NOAA's Earth Systems Research Laboratory in Boulder has a whole website devoted to wind records for Boulder: http://www.esrl.noaa.gov/psd/boulder/wind.html where an introductory sentence reads: "Boulder has some of the highest peak winds of any city in the US." The Boulder County Commissioners should demand that, after ten years, DW address the high-wind issue in the competent and serious way it deserves.

Comments on Need and Conclusions

Denver Water's proposal to expand Gross Reservoir violates NEPA in some profound ways, as we describe below. DW established its "need" around 2004, based on data available at the time, as 18,000 AF/yr. Now, in 2020, it continues to say that exactly 18,000 AF/yr remains its "need". This is after many kinds of developments in the last sixteen years, which obviously could not be foreseen in 2004, which would surely affect such a calculation. One of the most obvious is the effect of water conservation efforts in the City of Denver and other suburbs served by Denver Water. In fact, these relatively modest efforts have been much more successful than were predicted in 2004, so why haven't they reduced the "need"? The second development has been the widespread recognition that climate change ("global warming") is increasing more rapidly than predicted and is seriously affecting Colorado such that the Colorado River has periodically averaged at lower levels during the subsequent 16 years and is further threatened in the future. Whatever Denver's historical water rights might be, it is irresponsible to assert them in the current epoch when the river's water does not even reach the Gulf of California in Mexico and promises extreme shortages in Arizona, Nevada, and California…and even threatens agriculture in the Western Slope of Colorado. It would violate the environmental ethos of citizens of Boulder County to facilitate this irresponsible project.

Throughout this decade-and-a-half-long process, DW has consistently stated that "development of 18,000 AF/yr of new firm yield is the only action" to be thoroughly analyzed in its Environmental Impact Statements, thus restricting analysis to engineering options and illegally ignoring proactive options including conservation that would enable Denver Water's customers to use water sustainably.

The obsolete models that arrived at the 18,000 AF/yr "requirement" did not consider probabilities that those old assumptions might be wrong or that the projections would be off. Yet they based the purported "need" on a probability that sometime in future decades there may be a drought that, were the water not available, would require a temporary ban on watering of lawns (and similar restrictions). DW considered it "unacceptable" in its EIS for DW to be unprepared for even an unlikely, "extraordinary" drought that might require Stage 3 or Stage 4 watering restrictions, such as temporarily prohibiting lawn watering. Compare this to the circumstances of the citizens of Boulder, Jefferson, and Gilpin County foothills neighborhoods, who would be most impacted by the Gross Reservoir project, who are already prohibited by Colorado State law from any outdoors watering 24 hours a day/365 days per year. This 18,000 AF/yr "need" is an unjust, biased, and socially unjust "requirement."

DW has never evaluated whether Denver's current and projected uses of water are ultimately sustainable, which should be required before approving an augmented water supply to provide for future perceived "need". In fact, Denver uses more water per capita than many cities in the dry American West and it fails to employ steeply tiered water rate structures used in some other Western cities to curtail wasteful usage. Furthermore, other Americans who do not benefit from Denver Water help subsidize Denver rate payers in many ways. In particular, when DW provides only partial mitigation or no mitigation for adverse impacts of the project to citizens not customers of Denver Water (like in Boulder County), those citizens thereby subsidize artificially low water rates in Denver. This is an unfair and untenable long-term stance on the part of Denver Water.

DW has not only avoided consideration of alternative options for addressing the adopted criteria of reliability, vulnerability, flexibility, and firm yield (e.g. water usage conservation, upgrading existing plants) but also has failed to evaluate its own *on-going* strategies that are *currently being implemented*! (These ongoing measures include (1) conservation, (2) non-potable recycling, (3) system refinements, (4) cooperative projects, and (5) new supply projects.) NEPA requires that all "reasonable" alternatives be examined, so exclusion of such alternatives appears to be illegal. At a minimum, since such alternatives are widely advocated by the public, NGO's, and media commentators, it must somewhere be demonstrated that they are "unreasonable" and require no further consideration. Where is this demonstrated? The basis for this project should be a *demonstration* that the project meets "requirements" and that negative consequences of the project would be less severe than the projected consequences for Denver Water users if the requirements aren't met. That this demonstration is absent from this 1041 Application is a major failure.

There should be an up-to-date analysis of how well various measures to conserve water (fixing leaks, installing water-efficient appliances, promoting xeriscaping, adopting a more steeply tiered water rate structure, stopping wasteful watering of medians, etc.) -- beyond the modest, tentative measures currently in place – would suffice without requiring more water storage.

NEPA requires an evaluation of a "No Action Alternative." On pg. 313 of the Application, three short paragraphs summarily dismiss such an alternative. Previously, DW eliminated evaluation of a No Action Alternative because it did not meet the "Purpose and Need." In other words, because the "need" had been defined to be an additional 18,000 AF/year, DW refused to evaluate proactive alternatives that would eliminate the need for the extra water...an extreme example of tautology and circular reasoning. DW seems to have avoided such wording in this Application, but the Commissioners should be aware of the ridiculous argument that in the past has been made to support DW's failure to study actions that would not require this reservoir expansion project.

In short, it violates the law for DW to fail to consider more sustainable measures for an arid-climate metropolitan area to conserve water in the face of a global climate crisis by sticking to an obsolete calculation of an 18,000 AF/yr "need" and failing to consider reasonable alternatives to this largest-ever construction project in Boulder County history.

The impact of the proposed project on thousands of Boulder County residents for a large fraction of the rest of their lives would destroy the very attributes of their communities that originally attracted them to live in the Boulder County foothills. It would be intolerable to authorize this project, which is so antithetical to long-standing land-use plans of Boulder County and the Boulder Ranger District of the A.R. National Forest, based on such a technically incompetent and incomplete Application. Its promises to provide studies only in the **future,** thus giving the County and its citizens no opportunity to critique what might well be a continuation of DW's unresponsive and inadequate consideration of citizen interests. We urge the Boulder County Commissioners to reject this 1041 Application. Thank you!

Our previous analyses of DW's submissions about this project over the last few years may be found in the archives of this project:

* 16 March 2010: "Critique of Draft Environmental Impact Statement for 'Moffat Collection System Project' (Enlargement of Gross Reservoir)"

* 9 June 2014: "Critique of Final Environmental Impact Statement for 'Moffat Collection System Project' (Enlargement of Gross Reservoir)"

* 9 April 2018: Letter to Federal Energy Regulatory Commission Re: Docket # P-2035-099

Yours truly and thank you for staying safe,

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November 13, 2020

By email at: grossreservoir@bouldercounty.org
Dale Case, Director
Boulder County Community Planning and Permitting
P.O. Box 471
Boulder, CO 80306

Re: Denver Water's Gross Reservoir Expansion 1041 permit application, Docket SI-20-0003

Dear Mr. Case:

On behalf of The Environmental Group and Save the Colorado ("local community groups") and their numerous Boulder County members living near the proposed expansion of the Gross Reservoir and related dam, we submit these preliminary comments on the current 1041 application materials posted by the County to its website.[1]

Members of the local community groups will be significantly and adversely affected by the proposed construction and operation of the dam and reservoir expansion. These adverse impacts include noise, dust, heavy equipment operations, traffic, air pollution, loss of property, loss of enjoyment of property, seismic and/or vibrational disturbance to property and well being, as well as other impacts. The purpose of the County's 1041 regulations is to:

- "protect the beauty of the landscape
- regulate projects that would otherwise cause excessive noise, water, and/or air pollution, or which would otherwise degrade or threaten existing environmental quality within the County
- avoid direct conflict with adopted County land use plans
- protect the public health, safety, and welfare and the environment.

Boulder County Land Use Code ("Code" or "LUC") § 8-202 (B).

[1] *See,* https://landuse.boco.solutions/boco.lu.docketlistings/app/detail.html?docket=SI-20-0003 (as of November 13, 2020).

As will be discussed herein and in our potential future comments, the significant adverse impacts of Denver Water's expansion project cannot be mitigated. As such, Boulder County must ultimately deny Denver Water's 1041 application and prevent the construction and operation of the most destructive project ever proposed in Boulder County.

Denver Water's September 21, 2020 cover letter to the 1041 application requests "expeditious review and consideration" of the application. Denver Water's request should be denied because the Code does not provide any provision authorizing such a request. Further, any delay in the 1041 process has been a direct result of Denver Water's own actions. More specifically, Denver Water filed an applicability petition with the County on October 12, 2018 arguing that it was not subject to the 1041 regulations. Boulder County disagreed finding that Denver Water must submit a 1041 application to the County. Denver Water then proceeded to litigate Boulder County's finding; first administratively, then in Boulder County District Court, and ultimately in the Colorado Court of Appeals. Denver Water failed to prevail in each stage of its litigation. Ultimately, Denver Water voluntarily dismissed its appeal on July 29, 2020. Denver Water's own litigious actions resulted in a 21-month delay in processing a 1041 permit application. Given its own history of litigation and delay, the County should not expedite a 1041 process for one of the largest and most destructive projects in the County's history. Instead, the County should undertake a careful, comprehensive, and cautious review of the application that ensures robust public input at every stage of the process.

Moreover, for the reasons stated below, Denver Water's 1041 is significantly incomplete. Section 8-507 of the Code states, "[b]efore any request for County approval under these regulations may be processed, a complete application…must be filed with the Land Use Department." Further, the County will not commence the public hearing process until a complete application is submitted. LUC § 8-509.B. Because Denver Water's 1041 application is incomplete, the Director must issue a written finding of incompleteness and hold the application in abeyance until all deficiencies have been remedied and made available for public review of a new completeness determination on the amended application.

Section 8-302 of the Code also states, "no person shall engage in any development in such area, and no activity shall be conducted, until…a permit has been issued…" For the reasons stated below, Denver Water is in violation of Section 8-302. As outlined in the attached affidavits, Denver Water has undertaken development and activities in furtherance of the project before a 1041 permit has been issued. We request that the Director make a written finding that Denver Water's has violated the moratorium provision of Section 8-302 of the Code. We also request that the Director issue a "stop work" order to Denver Water and decline to process any 1041 application until such time that Denver Water has restored to their original condition all development and activities it has undertaken without a 1041 permit.

Our additional preliminary comments on Denver Water's current application, and its incompleteness, are provided below.

1. Denver Water is in violation of the moratorium provision of the Code.

Section 8-302 of the Code also states, "no person shall engage in any development in such area, and no activity shall be conducted, until…a permit has been issued…" As stated in the attached affidavit of Tim Guenthner, Denver Water has undertaken construction or activity activities related to the project. Exhibit 1 hereto. These construction activities include:

- constructing a staging area on the south end of the dam.
- Widening of the road from Osprey Point to the south end of the dam and on Gross Dam Road.
- Tree removal
- Installation of a satellite internet connection ground station.

Denver Water's construction and/or activities have changed the basic character of the land. Denver Water did not possess a 1041 permit at the time it undertook this construction and/or activity. As such, Denver Water is in violation of the Section 8-302 moratorium in the Land Use Code. We request that the Director issue a "stop work" order to Denver Water and decline to process any 1041 application until such time that Denver Water has restored to their original condition all development and activities it has undertaken without a 1041 permit.

2. Denver Water's waiver request must be denied.

Claiming that the term "major facility of a public utility" does not apply to its facility, Denver Water is requesting a waiver from the following sections of the Code: §8-308.A.4.; 8-507.D.3.; and, 8-511.E. Each of these sections of the Code impose requirements for "major facilities of a public utility." The term "major facility of a public utility" is defined in the Code to include "transmission lines, power plants, and substations …" LUC § 8-210.AG. Exhibit 5e to Denver Water's 1041 application is the FERC Supplemental EA. In Exhibit 5e, Denver Water describes its facility as including:

> "…a powerhouse located 440 feet downstream of the valve
> house containing two 3,799-kilowatt (kW) horizontal Francis turbines connected to two 4,050-kW synchronous generators for a total installed capacity of 7,598 kW; (5) a 580-foot-long, 60-inch-diameter buried penstock; (6) a concrete tailrace structure, integral with the powerhouse outlet works building; (7) a switchyard containing project transformers; (8) a 1-mile-long, 25-kilovolt project transmission line; and (9) appurtenant facilities…"

1041 Application, Exhibit 5e, p. 2.

By Denver Water's own admission, its facility includes ""transmission lines, power plants, and substations …" as defined in LUC § 8-210.AG. Further, Denver Water is a "public utility" as defined by LUC § 8-210.AS. As such, Denver Water's waiver request must be denied.

The local community groups request that the County issue a written finding denying Denver Water's waiver request. The County staff has correctly found that provisions of the Code apply to this proposed project. Given its litigious history, Denver Water may attempt to appeal the County's waiver determination under Section 8-501(F) of the Code. Therefore, we ask that the County decline to process Denver Water's 1041 application until the 30-day appeal period has expired. If Denver Water does appeal the Director's waiver determination, we likewise request that the County decline to process Denver Water's application until the appeals process is complete, including any interlocutory judicial review Denver Water may seek. If Denver Water's waiver request is ultimately denied as to any provision of the Code, we request that the County find that Denver Water's 1041 application is incomplete until such time as Denver Water complies with all 1041 application requirements associated with its denied waiver request and that the County decline to process the 1041 application until the application is determined complete by the County.

3. Denver Water's 1041 application is incomplete.

a. Denver Water's "capacity" and "need" analyses are incomplete.

Boulder County's 1041 regulations impose additional standards on "major facilities of a public utility," which includes Denver Water's Gross Reservoir expansion. LUC §8-511. Among those additional standards is the requirement to show that "[e]xisting facilities and associated systems servicing the area must be at or near operational capacity." LUC §8-511.E.3. For purposes of its 1041 application, Denver Water must show that its entire water system is at or near operational capacity.

As outlined in the expert report from Peter Mayer, P.E. of Water DM dated November 9, 2020 and submitted on behalf of PLAN-Boulder County, Denver Water's 1041 application is incomplete because it has completely failed to justify the need for the dam and reservoir expansion. Exhibit 2 hereto (Mayer Report).[2]

As noted in Mr. Mayer's expert report, Denver Water's 1041 application relies on an Integrated Water Resource Plan from 2002 (updated in 2004 and 2012) to justify that its existing facilities and associated systems servicing the area are at or near operational capacity. As Mr. Mayer notes:

- the water demands considered by the Corps and included in Denver's Water's analysis and projections have failed to materialize. p. 2.;
- Denver Water's analysis is an outdated and highly inaccurate demand forecast. p. 2;

[2] On October 7, 2015 a coalition of conservation organizations also submitted comments to the Army Corps on the deficient demand analysis. Exhibit 3 hereto. This comment letter is incorporated herein by reference.

- Denver Water's analysis significantly overstates future demand and is no longer a reasonable representation of likely future demand. P. 2;
- The need for expanding the Gross Reservoir no longer exists. p.2;
- The existing Gross Reservoir and capacity and reliability it already provides along Denver Water's large integrated system appears sufficient to meet future build-out demand. p. 2;

Exhibit 2 hereto (Mayer Report).

In summary, Denver Water's 1041 application is incomplete because it fails to present current and accurate information that the "[e]xisting facilities and associated systems servicing the area must be at or near operational capacity" as required by LUC §8-511.E.3.

In addition Denver Water's application does not comply with LUC §, 8-507.D.7.a. because it includes conflicting information on the "need" for the project.[3] The need for the Moffat project is substantially over-estimated in the 1041 permit application as shown in the IRP, Exhibit 2 of the 1041 permit Figure III-4. The IRP demand forecast was produced in 2002. The Corps updated the forecast in 2010 for the Moffat FEIS.[4] Per page 44 of the IRP,

> "Staff plans a routine review of demand forecast, making necessary adjustments at least every 5 years in the future."

If the above statement is correct then there should be forecast revisions in 2007, 2012, and 2017. Water use by Denver Water has declined since 2002, not increased yet the demand forecast has not been revised to reflect these declines.[5] Current trends in Denver Water's actual water use show that Denver Water does not need the additional firm yield to adequately serve its customer base. Below are graphic representations of Denver Water's inaccurate projections of water "need" compared to the actual reductions of water demand over time:

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[3] On April 6, 2018 Save the Colorado also submitted comments on the FERC license challenging the Statement of Need and Alternatives analysis, which is incorporated herein by reference. *See,* Exhibit 4 hereto (McCurry Report).

[4] On December 3, 2018 Save the Colorado requested a supplemental NEPA review due to the inaccuracies in Denver Water's water demand forecast. Exhibit 5 hereto. Save the Colorado also submitted new information to the Corps on Denver Water's demand analysis on December 20, 2016, which is attached hereto as Exhibit 6 and incorporated herein by reference.

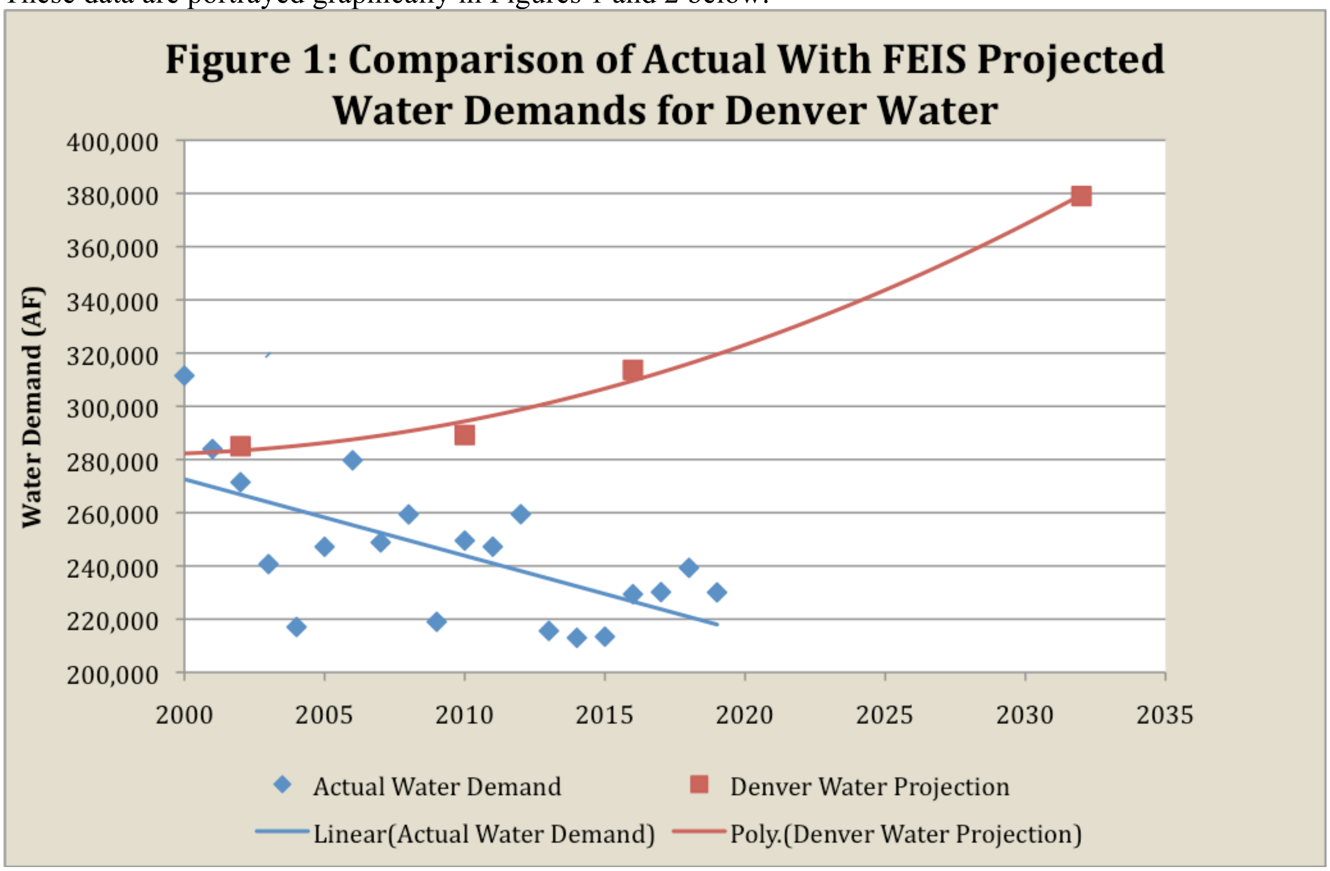
[5] Save the Colorado previously submitted a comment letter to the Army Corps on August 31, 2016 proving the economic "decoupling" of population growth and water demand concluding that "growth of population and economic activity is no longer necessarily linked to growing water use…" Exhibit 7 hereto, p. 3.

Specifically, water use in 2017, 2018, and 2019 are included in this update (See Table 1).[6]

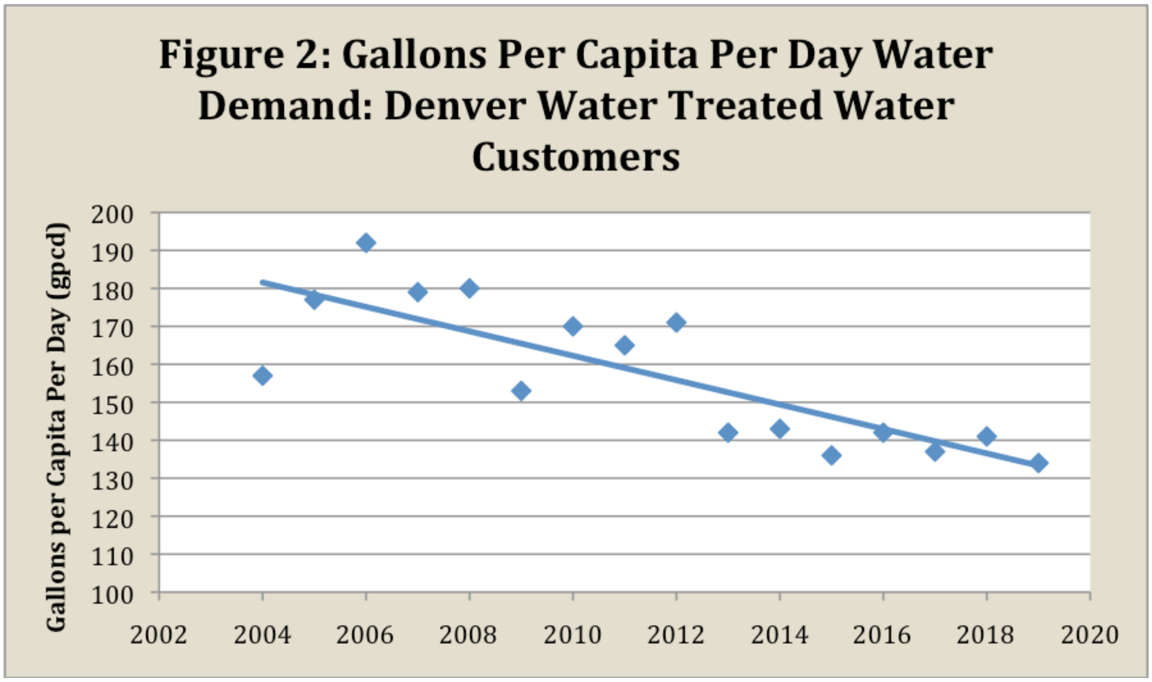
Table 1: Update of Actual Water Use by Denver Water Customers					
Year	Treated Water (AF)	Non-Potable Water (AF)	Total Water (AF)	Non-Revenue Water (%)	Gallons Per Capita Per Day
2017	195,822	34,341	230,162	2.18	137
2018	206,074	33,215	239,289	2.18	141
2019	198,826	31,222	230,048	4.25	137

Sources: Comprehensive Annual Financial Reports for Denver Water, 2017, 2018, and 2019. Non Potable water amounts found on pages III-21 for 2018 and 2019 and on page III-20 in the 2019 annual report.

These data are portrayed graphically in Figures 1 and 2 below.



[6] The information presented herein is an update to LRB Hydrology and Analytics April 3, 2018 water demand analysis. *See,* Exhibit 8 hereto which is incorporated herein by reference.



Note that the total water use is well below that projected for 2016 with conservation – 313,690 AF (shown in Table 3 of the earlier report). Also, gallons per capita per day (gpcd) for treated water use remains low at 134 in 2019. GPCD is combined with estimates of population growth to determine projected water demands.

The following quote from the IRP page 52 also undercuts Denver Water's statement of "need" for the reservoir and dam expansion:

> "Denver Water will not be able to reliably meet demands in the north system during some dry periods due to water availability problems at the Moffat Water Treatment Plant. The cause of this problem is not lack of overall water supply available to Denver Water's system during dry periods but an unequal distribution of available water. That is, Denver Water currently has adequate water in its supply system but not enough is available for treatment at the Moffat plant."

This statement in the IRP relates to the 1041 permit requirement under LUC §§ 8-507.D.b.ix.A and B. The Moffat project is certainly not the Least Environmentally Damaging Project Alternative (LEDPA) since a simple solution to the north/south imbalance would be to bring raw water supplies from the south to the north system for treatment at the Moffat Water Treatment Facility.[7]

b. Denver Water has not submitted a CIP or master plan.

---

[7] Save the Colorado also submitted a comment letter to the Army Corp on March 2, 2016 explaining why the proposed project would not help "balance" Denver Water's system. A copy of the March 2, 2016 letter is attached hereto as Exhibit 9 and is incorporated herein by reference.

The Land Use Code requires a 1041 applicant to submit a "capital improvements plan, facilities master plan, or other acceptable master planning document." LUC §§ 8-501.D. and 8-507.D.7. The purpose of this requirement is to "avoid piecemeal analysis of applications, and to allow for a comprehensive consideration of the cumulative impacts of development under these Regulations." LUC § 8-501.D.

The undersigned have been unable to locate Denver Water's CIP or master plan for the Moffat Dam, Gross Reservoir, and related facilities. The County should find that Denver Water's 1041 application is incomplete for failure to submit the necessary future planning documents. Such documents are important for the County and the public to understand whether Denver Water has any future plans for development of the site. We request that you require Denver Water to submit all current CIPs and/or master plans through the entire life of the dam and reservoir to understand whether Denver Water has any future undisclosed development plans for the facilities and whether it is proceeding in a piecemeal fashion.

c. Denver Water has not analyzed impacts to all surface waters affected.

Sections 8-507.D.7.b.ii.B and C of the Land Use Code requires Denver water to map and describe "all surface waters, including applicable state water quality standards, to be affected by the project."

Save the Colorado previously submitted comments identifying deficiencies with assessment of aquatic resources impacted by the project. Exhibit 10 hereto (Woodling Aquatic Resource Assessment). Save the Colorado has also submitted comments on the draft 401 Certification identifying deficiencies in both the South Boulder Creek and West Slope watersheds. Exhibit 11 hereto. The deficiencies identified in both the Woodling Report and 401 Certification comment letter are incorporated herein by reference

Further, the 1041 application does not discuss in detail source waters on the western slope in the Fraser and Williams Fork basins. It does not adequately describe immediate and long-term impact and net effects on these source water streams. Except for providing a map of the western slope watersheds that lie above the Moffat Collection System, discussions in the 1041 permit focus primarily on anticipated impacts or benefits to South Boulder Creek on the eastern slope. The 1041 application is also deficient in its failure to analyze impacts to wetlands and related resources in Grand County. Save the Colorado previously submitted comments identifying deficiencies with Denver Water's aquatic species assessment. *See*, Exhibit 12 hereto (Elliot aquatic resource report). The deficiencies identified in the Elliot report are included herein by reference.

The Moffat project would increase storage capacity of Gross Reservoir by 3 times. Source waters in the Fraser and Williams Fork have already been depleted from pre-Moffat flows by between 65 and 80 percent in the irrigation season between May and July, the primary period of additional diversions for the expanded reservoir. The impact of this additional storage on source streams would be substantial. Withdrawing additional water from the western slope also increases the risk of a "compact call" in the

Colorado River Basin. Storage levels in both Lake Powell and Lake Mead and inflow to Lake Powell have declined during the 2000s drought period, so much so, that the risk of a compact call has increased - a development that would affect trans-mountain diversions including those through the Moffat Tunnel. Save the Colorado submitted a letter on September 8, 2016 concerning the "Joint West Slope Risk Study" describing the risk associated with a compact call on trans-mountain diversion, which is incorporated herein by reference. Exhibit 13 hereto.

Denver Water must submit an antidegradation analysis for temperature and other water quality standards and requirements for these west slope streams to inform the Board of impacts. Denver Water must also provide an analysis of whether the statewide narrative sediment water quality standard (Colorado Water Quality Control Commission Regulation 31.11(1)(a)(i), 5 CCR 1002-31.11(1)(a)(i)) will be violated in both west slope streams as well as South Boulder Creek and streams on the east slope. Removing water from streams reduces the "flushing flows" needed to remove sedimentation from the stream bed.[8] Buildup of sediment in a streambed can adversely affect spawning of fish and survival of macrobenthic organisms.

d. Denver Water fails to analyze impacts from climate change.

The accuracy of Denver Water's assessment of impacts to water resources (flow, volume, temperature, etc.) over the life of the project (in perpetuity) is dependent on factoring in the effects of climate change on the proposed actions. Denver Water's 1041 application is incomplete because it does not address climate change impacts. The PACSM model used by Denver Water to assess the yield of its water system utilizes the 1953 to 1957 critical drought within the 1947 to 1991 period of record. Since then temperatures have steadily increased and the state has been in an extended drought in the 2000s. Denver Water models its water supply system under an outdated assumption that the "hydrologic and climatological cycle similar to that of water years 1947 to 1991" (page 14 of 2002 IRP, Exhibit 2 to the permit application) would repeat into the future. By 2014, when the FEIS was submitted, it was clear that climate change was changing hydrologic conditions from those between 1947 and 1991. Yet all impact analyses reported in the Moffat Project FEIS, particularly in the western streams, relied on this outdated model. In the FEIS, page ES-12 it states:

> "Climate change and global warming may be considered reasonably foreseeable, but currently there is no accepted scientific method for taking the general concepts associated with climate change and transforming them into incremental changes in stream flow or reservoir levels."

[8] *See,* Exhibit 14 (Bestgen, et al.), Exhibit 15 (Bestgen and Poff, et al.), and Exhibit 16 (Poff, et al.).

To the contrary, there are a number of recent studies employing various methodologies to predict the future impacts of climate change on hydrology.[9] The science of climate change has expanded exponentially in recent years with several water supply vulnerability studies completed using results of downscaled Global Climate Models. At a minimum, the hydrologic and temperature records from the mid-1980s through 2020 provide a record of how climate change has impacted streams in Colorado up to the present. The FEIS and this 1041 permit application ignore impacts of climate change on stream health, particularly in the western slope, and the efficacy of the expanded Gross Reservoir.

In addition, on June 18, 2015 a coalition of conservation groups also submitted comments to the Army Corps of Engineers during the NEPA process highlighting the importance of consideration of climate change. Exhibit 21 hereto. The June 18, 2015 comments are incorporated herein by reference and highlight the failure of the NEPA process to consider impacts from climate change.

In summary, Denver Water's 1041 application is incomplete for failure to analyze impacts from climate change.

e. Denver Water fails to analyze impacts to water wells.

Section 8-507.D.7.b.ii.D of the LUC requires Denver Water to analyze "the impacts and net effect of the activity on groundwater" including "seasonal water levels…artesian pressure…groundwater flows directions and levels…[and existing groundwater quality and classification." The 1041 permit application identified 50 wells located within 0.3 miles to the north of and others that are 1.5 miles south of Gross Reservoir. Figure 16 in Exhibit 1 of the permit application provides a map with locations of these domestic wells. Not included are required maps of seasonal water levels (1), artesian pressure in aquifers (2), groundwater flow directions and levels (3), and existing groundwater quality and classification (7). The application identified the number of wells that draw domestic water from this fractured bedrock aquifer;

3 wells with water level below ground surface of 20 to 40 feet
42 wells with water levels below ground surface of 7 to 280 feet
8 wells with water levels below ground surface of 15 to 100 feet
1 well with water levels below ground surface of 79 feet
2 wells with water levels below ground surface of 80 feet.

This does not begin to evaluate how these domestic water wells may be impacted by an increase in water level in Gross Reservoir of 142 feet. One cannot discern from this information the "impact and net effect of the activity on groundwater." Since the ground surface varies for each well, both current and anticipated future water elevations are, at a minimum, required to assess these impacts. In addition, there is no discussion on

[9] *See,* Exhibit 17 (Udall and Overpeck); Exhibit 18 (Colorado Water Conservation Board); Exhibit 19 (DiNatale); and, Exhibit 20 (Joint Front Range Climate Vulnerability Study).

how seepage losses would change due to increased head in the expanded Gross Reservoir. The only statement in the 1041 application is that "the Project would not impact water wells." This is not substantiated by data included in the permit application.

f. Denver Water's tree removal plan is deficient.

Save the Colorado previously submitted comments on deficiencies with Denver Water's vegetation removal plan. *See,* Exhibit 22 hereto (Smith vegetation removal report). The deficiencies noted in the Smith report are incorporated herein by reference.

g. Important documents are missing from the application.

Important documents are missing from Denver Water's 1041 application. Instead, Denver Water has inserted "placeholders" that simply state "This page is intentionally left blank." For example, the following FEIS Appendices are missing from application Exhibit 5d2 and have been replaced with "placeholders": Appendices A-2; A-3; A-5; B-3 through B-32; Appendix C (Figures C-1 through C-5); Appendix J (all documents); Appendix L. This is not intended to be an exhaustive list of documents missing from the FEIS Appendices found at Exhibit 5d2. In addition, we were unable to find a list of all Appendices to the FEIS. If Denver Water intends to rely on the FEIS and its Appendices for purposes of the 1041 application, it must submit all such documents into the record or explain why documents are missing.

h. Numerous "plans" are missing from the application.

Several plans are promised but not included in the 1041 application. In all cases, these plans would be finalized per requirements in the FERC approval process and approved by agencies other than Boulder County, including the Forest Service, the Federal Energy Commission (FERC), and the Water Quality Control Division. These outstanding and un-submitted plans identified in the FERC approval of the project include:

- Revision to South Boulder Creek Channel Stability Monitoring Plan Upstream of Gross Reservoir: Forest Service
- Storm Water Management Plan
- Erosion Control and Reclamation Plan; filed with the Commission's San Francisco Regional Office for approval.
- Quarry Operation Plan
- Quarry Reclamation Plan
- Pit Development and Reclamation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials
- Dissolved Oxygen and Temperature Monitoring Plan
- Tree Removal Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan

- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Road Maintenance Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Restoration and Revegetation Plans
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

The FERC review stated that because of these plans, water quality impacts would be minimized and/or controlled. However, since these plans have not been finalized prior to Boulder County review of the 1041 permit application, the Boulder county commissioners cannot be assured that the promised plans will be adequate to protect streams in the South Boulder Creek drainage during and after construction.

Without the plans, the application does not comply with the requirement to submit a complete 1041 application.

i. The FEIS is deficient and cannot be relied upon.

Throughout the 1041 application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision. These documents have significant legal and technical deficiencies and are being challenged in litigation in federal district court in Denver.

For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
    - The "Purpose and Need" in the EIS is not accurate and must be redone.
    - The "Alternatives" analysis in the EIS is not accurate and must be redone.
    - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.[10]

[10] *See*, Exhibit 23 hereto, Conservation Organizations' August 27, 2015 letter to the Army Corps regarding the possibility of a "compact call", which is incorporated herein by reference.

- The Corps Record of Decision violated the Clean Water Act:

    - The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
    - The full cost of the project was not considered in choosing the LEDPA.

- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Attached hereto are EIS comment letters substantiating these legal and technical deficiencies with the FEIS.[11] We request that Boulder County refuse to rely on the FEIS and ROD until all litigation challenging these documents is completed.

j. The FERC Supplemental EA analysis is inadequate.

Denver Water's 1041 application also relies on the FERC Environmental Assessment. 1041 permit application Exhibit 5e. Save the Colorado submitted comments on the FERC EA identifying significant deficiencies with the analysis. *See,* Exhibit 26 hereto (April 9, 2018 FERC comment letter). The deficiencies with the FERC EA are incorporated herein by reference.

k. There are less environmentally damaging alternatives.

In a June 14, 2016 report entitled, "The Colorado River Protection Alternative," Save the Colorado identified an array of less damaging alternatives to the Gross Reservoir and dam expansion.[12] These alternatives include:

- Improving raw water connection between Denver Water's North and South Systems.
- A bypass of Strontia Springs Reservoir.
- Aquifer or gravel pit storage.
- Shared operations with other water providers.
- Construction of additional water treatment.
- Buyback or restructure of raw water contracts.

[11] Including, but not limited to Exhibit 24 hereto (Save the Colorado's DEIS comment letter dated June 9, 2014 and Exhibit 25 hereto (Save the Colorado's August 24, 2018 request for supplemental NEPA review).
[12] Exhibit 27 hereto.

Boulder County has the legal authority to require Denver Water to analyze and present these alternatives for consideration in the 1041 permitting process. *See,* LUC § 8-507.D.b.ix. The Director should find that Denver Water's 1041 application is incomplete for failure to present information on these and other alternatives to the environmentally harmful Gross Reservoir and dam expansion. The Director should order Denver Water to submit a full range of alternatives that could be employed to avoid the harmful affects of the project.

Thank you for the opportunity to comment on the incompleteness of Denver Water's 1041 application for the Gross Reservoir and dam expansion. For the reasons stated herein, we request that you make a finding that the 1041 application is incomplete and direct Denver Water correct these deficiencies as outlined in this letter.

Please include Save the Colorado and The Environmental Group on all further correspondence and public notices for this project.

Sincerely,

s/ John Barth

List of Exhibits

1. Affidavit of Tim Guenthner.
2. Mayer Report 11/9/2020.
3. 10/9/15 comment letter to Corps.
4. McCurry Report.
5. 12/3/18 NEPA comment letter.
6. 12/20/16 NEPA comment letter.
7. 8/31/16 NEPA comment letter.
8. LRB 4/3/18 demand analysis.
9. 3/1/16 NEPA comment letter.
10. Woodling Report.
11. 401 Certification comment letter.
12. Elliot aquatic report.
13. 9/18/16 Joint West Slope Risk Study.
14. Bestgen.
15. Bestgen & Poff.
16. Poff.
17. Udall & Overpeck.
18. CWCB climate report.
19. DiNatale.
20. Joint Front Range Climate Report.
21. 6/18/15 NEPA comment letter.
22. Smith vegetation study.
23. 8/27/15 NEPA comment letter.

24. 6/9/14 DEIS NEPA comment letter.
25. 8/24/19 NEPA comment letter.
26. 4/9/18 FERC comment letter.
27. Colorado River Protective Alternative.

Affidavit of Tim Guenthner

I, Tim Guenthner, have personal knowledge and do hereby swear under penalty of perjury of the following:

My name is Timothy Guenthner. I reside at 546 Lakeshore Drive, Boulder Colorado, 80302. I have been a resident here since 2001. I live near the north shore of Gross Reservoir and within easy walking distance to the North Shore Parking Lot. I have followed Denver Water's proposed Gross Reservoir Expansion Project starting with public reviews of the U.S. Army Corps of Engineers (USACE) Final Environmental Impact Study (FIES). I have participated in reviews and approvals of the FEIS, the issuance of the USACE 404 Permit, the approval of the Federal Energy Regulatory (FERC) Hydropower Final License Amendment Application, the review of the FERC Environmental Assessment (EA) and the recent issuance of the FERC order amending the license and extending the license term for the Gross Dam Hydro Electric Project. As such, I am very familiar with the proposed project.

Over the past several years, I, along with other residents around Gross Reservoir, have noticed an increase in construction and development activities performed by Denver Water and its contractors related to the proposed Gross Dam Expansion Project. We are aware of the terms and conditions Denver Water agreed to in the USACE FEIS and 404 Permit, the FERC Supplemental EA and order amending the HydroPower License agreement to expand the dam and reservoir, along with other related documents. These conditions include the requirement that no construction related activities shall commence until Denver Water has complied with all necessary Federal, State, and local regulations and obtained all necessary permits. To date, Denver Water has not completed the Boulder County 1041 process and has not receive authorization to proceed with the project.

Despite signing off on these requirements and agreeing to comply, Denver Water has been engaged in numerous construction activities in and around Gross Dam and reservoir and along the roads both within the Gross property boundary and beyond. Some examples are listed below. The intent of this affidavit is to provide documentation and evidence of Denver Water's failure to comply with the conditions stipulated for construction activities requiring permits and Boulder County's 1041 moratorium.

Construction Activities for Support Facilities, Staging Areas and Temporary Road Construction

Quoting from the Denver Water 1041 Application, *Construction Activities Affecting Land Use,* pp 12-13:

> **Temporary Support Facilities/Staging Areas**
>
> Denver Water has identified several temporary staging areas at the reservoir site, including areas near the hydroelectric plant along South Boulder Creek downstream from the dam and one area at the southwestern end of the dam (Figure 1-2). Final location of staging areas will be determined in the final design phase.

Temporary Construction Roadways and Facilities/Staging Areas

Denver Water would obtain construction access using existing roads or the previously described relocations. In addition, Denver Water would construct temporary access roads to provide hauling access between the quarry, stockpile areas, and the dam site. These roads include (1) temporary widening of the Gross Dam Road from the Osprey Point Quarry to the dam and (2) an access road from the Gross Dam Road to the saddle dam site. The additional disturbance width would be 30–50 feet, and the roads would have a gravel surface.

If the Final EIS Quarry is developed instead of the Osprey Point Quarry, temporary access roads would include a haul road between the Final EIS Quarry site/stockpile area and the stockpile area located west of the dam.

Construction for the staging area on the south end of the dam along with widening of the road from Osprey Point to the south end of the dam has been under way for several years. During the summer months of the last two or three years, there was a significant amount of dump truck hauling being done on the roads into the south end of the dam. Road base and fill was being hauled in and distributed at the south end of the dam and along the access roads. When residents talked to the work crews and personnel working in the area, we were told that the road and staging area were being expanded to provide space for work on the dam and to stockpile road base and other materials for use in construction activities. Some of the results are shown below in figures one through four.

Figure 1 Expanded staging area at south end of dam, viewed from the North Shore. Also visible is the new terracing on the face of old quarry used for the original dam construction.

Figure 2 Staging area viewed from the south end of the dam.

Figure 3 Expanded road from Osprey Point to south end of dam staging area as viewed from the North Shore.

Figure 4 Driving on the newly expanded and resurfaced road connecting Osprey Point to the south end of Gross Dam. The grey road base is new material that was hauled in.

Construction Activities for Permanent Roadway and Trail Improvement Construction

Again, from the Denver Water 1041 Application, *Construction Activities Affecting Land Use,* p 11:

Tree Removal

Pursuant to FERC Order Article 423, within one year of the date of FERC's Order and after conferring with certain governmental stakeholders, including Boulder County, Denver Water must submit a Tree Removal Plan for FERC's review and approval. Denver Water will provide the draft Tree Removal Plan to Boulder County for review and comment in accordance with the terms of FERC's Order.

Denver Water has completed preliminary outreach to agencies and concept development for a Tree Removal Plan. Several options for tree removal and disposal of material were evaluated. This preliminary effort, which included input from Boulder County and the USFS, will be expanded on to develop the final Tree Removal Plan.

Tree removal along Gross Dam Road and along roads within the property boundary has also been conducted over the last several years. Fresh cuts and stumps can be seen along the roads as examples in figures five and six. Many more examples can be found in areas along the road.

Figure 5 Ponderosa pine stumps along Gross Dam Road from tree removal activity.

Figure 6 Stumps left from recent tree cutting along Gross Dam Road for road expansion.

Denver Water states in its 1041 application that access to the dam and construction site will be via Gross Dam Road. During the original dam construction, temporary roads were established to provide access. Some of these temporary roads were no longer in use and were disappearing, being reclaimed by vegetation and erosion. Sometime within the last two years or so, one of these roads was reopened to provide access to the top end of the north shore of the dam. While the cutting of trees and reopening of the road onto Gross Dam Road was under way, residents spoke with the onsite workers who explained that the road was being reopened to provide access to the top end of the north side of the dam. A new gate was installed to block off the access road from Gross Dam road and is shown in figure seven.

Figure 7 Recently re-opened access road from Gross Dam Road to the top of the north end of the dam. Viewed from Gross Dam Road.

Again, from the Denver Water 1041 Application, *Permanent Roadway and Trail Improvements, Gross Dam Road,* pp 11-12:

> Access to the dam would be available using the existing Gross Dam access roads. However, minor road relocations would be necessary at the north and south dam abutments because of future inundation. These two road segments would be abandoned and relocated: approximately 1,500 feet of the north abutment access road would be relocated to the east at an elevation 100 feet higher than the existing access road, and approximately 1,500 feet of the south abutment access road would be relocated south of the existing Gross Dam access roads. Both relocated road segments would be gravel surfaced and approximately 25 feet wide.
>
> Denver Water would design Gross Dam Road for two-way tractor trailer hauling (which would require a 25 mile-per-hour speed limit and a turning radius adequate for semi-trailer trucks). Denver Water would also widen a few curves as shown in the design drawings (Exhibit 1, Figure 26 and Exhibit 4). Denver Water does not plan to pave Gross Dam Road and plans to maintain Gross Dam Road during construction activities and restore the road base to preconstruction conditions.

Road construction for these activities has also started. Road widening has been done along Gross Dam Road, both on the section of the road maintained by Denver Water (Crescent Crossing to Flagstaff Road) and the county section of the road (Crescent Crossing to SH 72). Surveying activity has also been conducted and areas have been marked for road relocation. Residents living along Gross Dam Road have reported receiving letters from Denver Water informing them of plans to relocate sections of the road requiring condemnation of parts of their property for the new road easement. Examples of road widening are shown below in figures seven through 11. Figure eleven shows one example of surveyor stakes on private property where the road is planned to be relocated.

Figure 8 Example of road widening along Gross Dam Road. This type of expansion can be found all along the road.

Figure 9 Example of widening of a curve on Gross Dam Road to accommodate turns by larger hauling trucks.

Figure 10 Widening of curve on Gross Dam Road west of Crescent Crossing on the SH 72 side.

Figure 11 Surveying stakes on private property marking road expansion to straighten the widened curve shown above.

Other activities have also been observed including the installation of a satellite internet connection ground station across from the North Shore parking lot. In response to queries by residents, we were told that the ground station is part of a power line monitoring system for the transmission lines from the Gross Dam Hydro Power station. These lines will be used to transmit power from the modified hydropower station as detailed in the FERC Hydro Power application submitted by Denver Water. See figure 12 below.

Figure 12 New communications satellite installed for monitoring transmission line from the Gross Dam Hydro Power plant.

s/Tim Guenthner

tjguenthner@gmail.com

November 12th 2020

November 9, 2020

PLAN-Boulder County
PO Box 4682
Boulder, CO 80306

Expert opinion and analysis regarding water demands and statement of need for the Gross Reservoir Expansion project

To Whom It May Concern:

At the request of PLAN-Boulder County, I have prepared this expert letter report regarding water demand and statement of need pertaining to Docket SI-20-0003: Gross Reservoir & Dam Expansion. This reservoir expansion was proposed by Denver Water and this expert letter report was prepared in response to Boulder County's Areas and Activities of State Interest (1041) review of this project.

In summary, this letter report concludes that the future water demand forecasts offered by Denver Water in support of the Gross Reservoir & Dam Expansion are no longer accurate or even relevant. Water demand has changed in Denver and across Colorado and the United States. Denver Water's documented demands and production have not increased, even as population has grown.

The Gross Reservoir & Dam Expansion will be the largest construction project in the history of Boulder County and will annually remove an additional 18,000 AF of water from the climate change-impacted Colorado River basin. WaterDM reviewed each aspect of Denver Water's "Project Purpose and Need" statement[1] and reviewed Denver Water's actual demand from 2009 – 2019 and determined that the water demands Denver anticipated when the project was conceived have not occurred. As a result, the supply and reliability concerns used to justify the Gross Reservoir Expansion must be reconsidered.

A statement of need and water demand forecast for a project of this size and scope must be based on sound data, reasonable assumptions, and conservative resource principles to ensure the water will not be wasted and that anticipated impacts to the environment are justified. In this case the demand forecast used to justify the project is no longer reasonable or relevant because demand has changed. Water customers across the Western United States have

[1] 8-507.D.7, Requirements Applicable to All Applicants; 8-507.D.7.a, Project Need, from the "Corps ROD (Section 3.0).

successfully implemented effective water efficiency strategies that today have reduced per capita use.

Denver Water has offered a shifting justification for the Gross Reservoir & Dam Expansion project, but no new analysis of water demands, or a revised demand forecast were included in any of their recent filings. The demand projections for Gross Reservoir are derived from Denver Water's 2002 Integrated Water Resources Plan.[2] The Army Corps of Engineers evaluated Denver Water's demand projections in 2004 and again in 2010 and Denver Water's Final Environmental Impact Statement (FEIS) on the project notes that water conservation has been included in Denver Water's projections.[3]

What is not included in Denver Water's FEIS or its application to Boulder County is that fact that over the past ten years, the water demands considered by the Corps and included in Denver Water's analysis and projections have failed to materialize. The Corps based its analysis on the incorrect assumption of the rapid increase in demand that Denver Water had forecast. Since 2010, Denver Water's total water demand has decreased even as population has grown. The evaluation performed by the Corps in 2004 and 2010 was based on an outdated and highly inaccurate demand forecast. A reevaluation is clearly warranted.

This expert letter report provides a detailed review and evaluation of each of Denver Water's "identified four needs" in light of actual water demands, and an updated water demand forecast that reflects both population growth and the impacts of water efficiency. The analysis in this report shows that Denver Water's water demand forecast significantly overstates future demand and is no longer a reasonable representation of likely future demand.

When replaced with a reasonable future demand forecast based on current production trends and anticipated growth, Denver Water's four identified needs in its application appear far less urgent. Denver Water's use has become more efficient, and the need for expanding this existing reservoir with all the impacts that come with it for Boulder County, not to mention the Colorado River, no longer exist. The existing Gross Reservoir and the capacity and reliability it already provides along Denver Water's large integrated system appears sufficient to meet future build-out demand.

Denver Water should update its demand forecast and statement of Project Need to reflect the last 10 years of production on their system and assure Boulder County that there is a compelling need for the reservoir expansion project.

[2] Denver Water. 2002. Integrated Water Resources Plan. Figure III-4.
[3] U.S. Army Corps of Engineers Omaha Division (USACE). 2009. Moffat Collection System Project Final Environmental Impact Statement (Final EIS). April 25, 2014.

Summary of Qualifications

I am the Principal of Water Demand Management, LLC (WaterDM), based in Boulder, Colorado. WaterDM is a water consulting firm providing expertise and services in the following areas:

- Municipal and industrial water use, research, and analysis
- Demand forecasting
- Water conservation and demand management planning and implementation
- Integrated water resources planning
- Water loss control
- Analysis of municipal water rates and rate structures
- Drought preparedness and response
- Evaluation of changes in demand
- Statistical analysis of water demand and modeling
- Meter technology implementation
- Meter and service line sizing

I have a Master of Science in Engineering (1995) from the University of Colorado, Boulder, and a Bachelor of Arts (1986) from Oberlin College. I am a registered and licensed Professional Engineer in Colorado.

I am a civil engineer and the focus of my career has been on urban water systems and demand management including conservation planning and implementation, rate analysis, water demand research, demand forecasting, drought preparation, utility metering, and water loss control. Since 1995, I have served as a consultant and researcher to urban water providers, US EPA, the Water Research Foundation, the Alliance for Water Efficiency, state governments, and municipal and industrial water users in the US and Canada.

Over my 25-year engineering and consulting career, I have worked with and advised hundreds of water providers and organizations such as the California Department of Water Resources; the Colorado Water Conservation Board; the State of Georgia; the New York City Water Board; the Metropolitan Water District of Southern California; the Marina Coast Water District; Tucson Water; Greeley, CO; Fort Collins, CO; Westminster, CO; Denver, CO; Little Thompson Water District, CO; Security Water and Sanitation District, CO; Scottsdale, AZ; San Antonio, TX; the US EPA; the US Department of Justice; the Alliance for Water Efficiency and many others.

I have served as the principal investigator and lead or co-author of numerous national and state-level water demand research studies including: Residential End Uses of Water (2016, 1999); Assessing Water Demand Patterns to Improve Sizing of Water Meters and Service Lines (2020); Peak Demand Management (2018); Colorado Water Plan and Update (2010, 2018); National Submetering and Allocation Billing Program Study (2004); Water Budgets and Rate Structures (2008); Commercial and Institutional End Uses of Water (2000); and many others.

I am the lead author of the American Water Works Association (AWWA) M22 Sizing Water Service Lines and Meters 3rd. ed. (2014) and 4^{th} ed. (pending). I am co-author of the AWWA G480 Water Conservation Standard (2013 and 2020) and co-author of the Colorado Best Practices Guidebook for Municipal Water Conservation (2010). I served as Trustee of the AWWA Water Conservation Division from 2001-2007 during which time I worked with EPA to create the WaterSense™ program and helped establish the Alliance for Water Efficiency. I have been a Senior Technical Advisor to the Alliance for Water Efficiency since 2007. I am a member of the American Water Works Association, the Alliance for Water Efficiency, the American Water Resources Association, the American Society of Civil Engineers (ASCE), the Colorado Water Congress, and the Colorado River Water Users Association.

In 2016, I testified as an expert witness on municipal and industrial water use at the US Supreme Court (FL v. GA, 142 Original) on behalf of the State of Georgia.

A copy of my curriculum vitae is available at www.waterdm.com.

Gross Reservoir & Dam Expansion Water Demand Forecast

8-507.D7.a, Project Need

Denver Water submitted its Areas and Activities of State Interest (1041) Permit Application to Boulder County for the Gross Reservoir & Dam Expansion Project on September 21, 2020. On page 60 of this application, Section 8-507.D.7.a, addresses the project purpose and need. To justify the reservoir expansion, Denver water presents information from the Final Environmental Impact Statement[4] and from analysis presented by the Army Corps of Engineers[5].

Specifically, Denver Water identifies four needs "in the Moffat Collection system that require resolution." These needs were first presented to the public in 2003 during the National Environmental Policy Act (NEPA) scoping period.[6] The four needs Denver Water identified in its application to Boulder County are:

1. The Reliability Need
2. The Vulnerability Need
3. The Flexibility Need
4. The Firm Yield Need

The fundamental analysis Denver Water presents for all four needs, relies upon the demand forecast prepared for Denver Water's 2002 Integrated Resources Plan as Figure III-4 (reprinted below as Figure 1). The 2002 IRP states that this figure "presents the demand forecast through build-out, along with existing supplies"[7]. This figure shows that Denver Water has an "in-hand" supply of at least 375,000 AF of water. It also forecasts that Denver Water's demand will exceed this available supply in 2028 and possibly in 2014 if a safety factor is considered.

[4] U.S. Army Corps of Engineers Omaha Division (USACE). 2009. Moffat Collection System Project Final Environmental Impact Statement (Final EIS). April 25, 2014.
[5] Army Corps of Engineers. Record of Decision. NWO-2002-80762-DEN, Board of Water Commissioners for the City and County of Denver (Denver Water), Moffat Collection System Project. July 6, 2017.
[6] Denver Water. 2020. Denver Water's Gross Reservoir Expansion Project. Areas and Activities of State Interest (1041) Permit Application
[7] Denver Water. 2002. Integrated Water Resources Plan. Figure III-4.

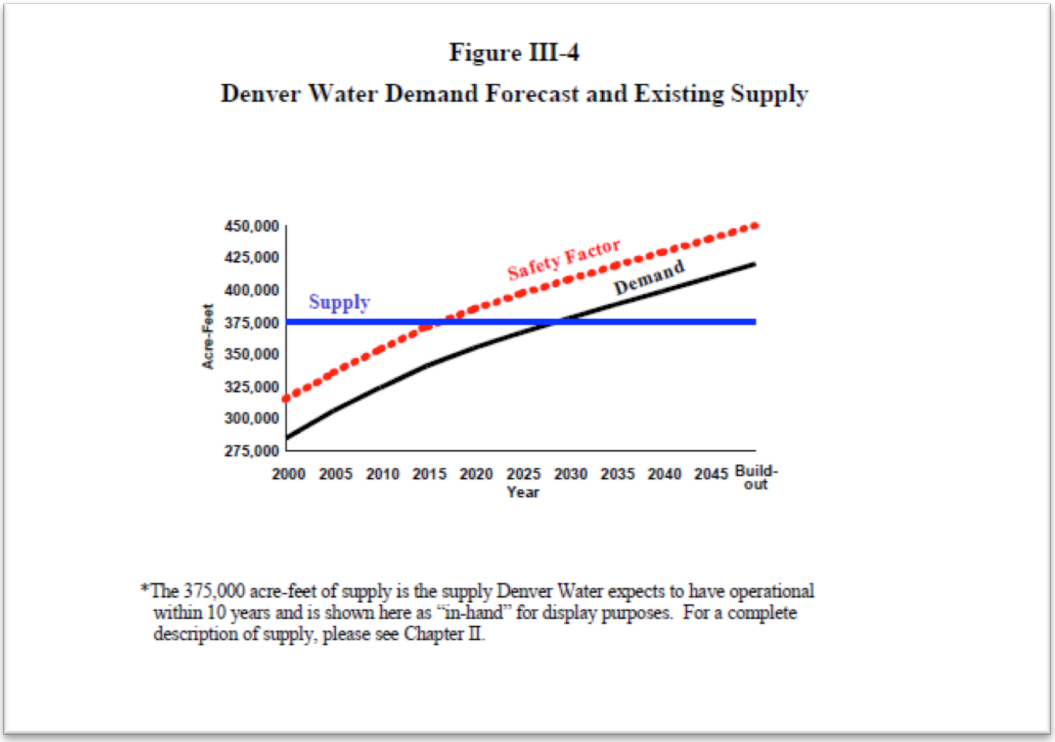


Figure 1: Denver Water Demand Forecast and Existing Supply, 2002 Integrated Water Resources Plan, Figure III-4

Evaluation of Denver Water Demand Forecast

To evaluate the demand forecast Denver Water has relied on to justify the Gross Reservoir & Dam Expansion project, WaterDM obtained Denver Water's Comprehensive Annual Financial Reports (CAFRs) for 2018 and 2019, which include total water production records for 2009 – 2019.[8,9] Denver Water's total production from 2009 – 2019 is shown in Figure 2 along with a usage trend forecast and safety trend forecast.

Denver Water's highest annual water production over the past 10 years occurred in 2012 and was 212,864 AF, which is fully inclusive of all deliveries and non-revenue water. In 2019, Denver Water's total production had reduced to 196,881 AF. Despite all of the growth that has occurred in Denver over the past 10 years, Denver Water's total water use and water production has declined. As a result, in any given year Denver Water may have in excess of 175,000 AF of "in-hand" supply that is not being used to serve its customers. At no point over the last 10 years did Denver Water have less than 150,000 AF of excess supply "in-hand".

To correct for the obvious inaccuracy of Denver Water's 2002 demand forecast, WaterDM developed a simple usage trend forecast based on Denver Water's build-out population growth

[8] Denver Water. 2019. Comprehensive Annual Financial Report For the year ended December 31, 2019 Denver, Colorado

[9] Denver Water. 2018. Comprehensive Annual Financial Report For the year ended December 31, 2019 Denver, Colorado

projection from the 2002 IRP, which is 1,835,000 people in year 2050. WaterDM's forecast does not include any future water efficiency beyond what has occurred to date. The average daily per person use in Denver in 2019 was 131.3 gallons per capita per day (gpcd). WaterDM's Usage Trend Forecast assumes that in 2050 customers use the same 131.3 gpcd on average. In fact, Denver Water customers are going to become even more efficient in the future and use even less water than WaterDM has forecast, but to be conservative GPCD was held at current levels. The Usage Trend Safety Forecast includes a 10% add-on volume as a factor of safety, just as Denver Water did in the 2002 IRP forecast.

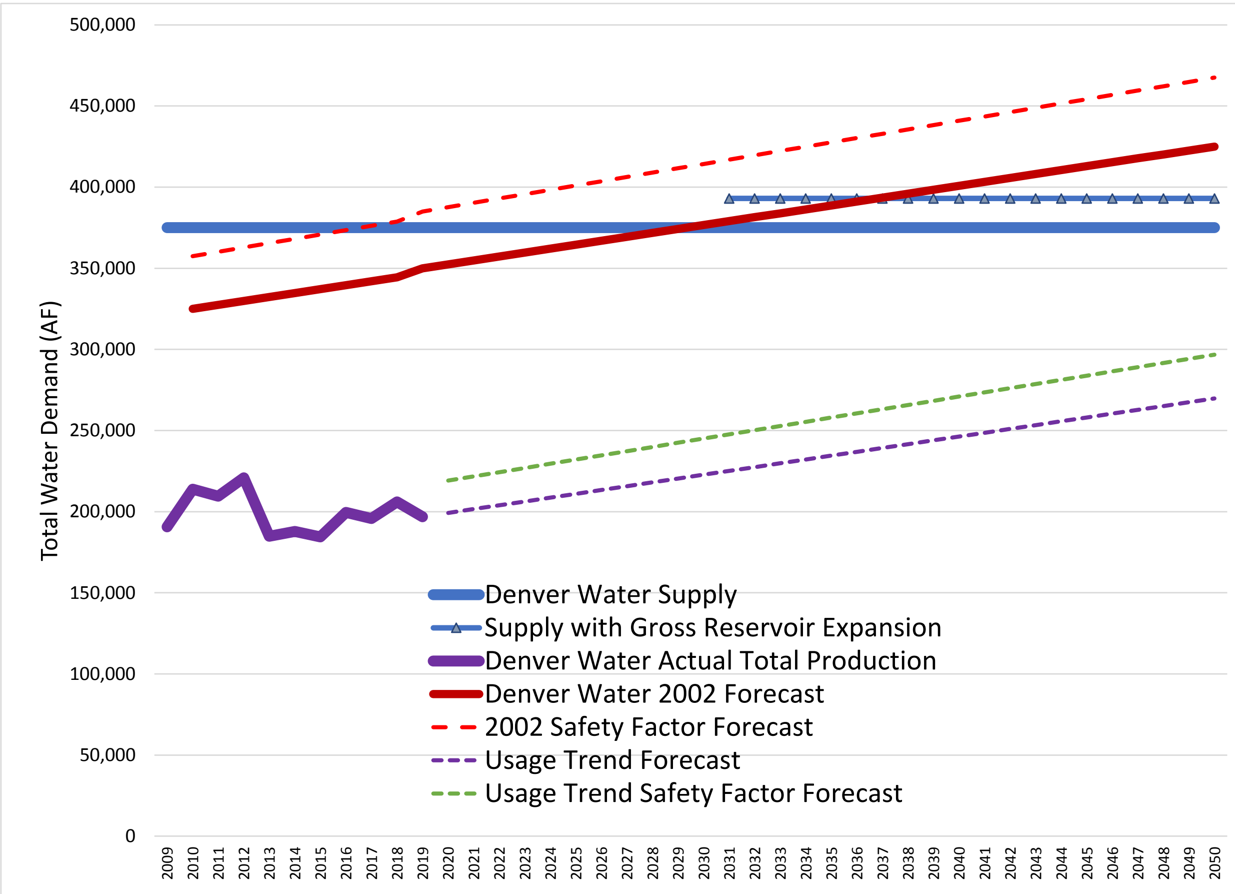


Figure 2: Denver Water Total Production (2009 – 2019) with current usage trend forecast with the 2002 Integrated Water Resources Plan demand forecast

At the buildout population of 1,835,000 using an average of 131.3 gpcd with a 10% safety factor applied, Denver Water is forecast to use 300,000 AF and still has a 75,000 AF buffer – and additional 25%. This would appear to be a comfortable situation for a water supplier in the Front Range.

For comparison, in Denver Water's 2002 forecast, water use was estimated to be 207 gpcd at buildout in 2050. This is 58% higher (75.7 gpcd) than actual in 2019 and an indication of how far off Denver Water's forecast has become. The 2002 forecast is no longer an accurate or reasonable estimate of future demand on the Denver Water system.

Evaluation of Denver Water Needs

WaterDM examined each of Denver Water's "four needs in the Moffat Collection System" that require resolution, in light of the revised demand forecast to determine if they are still legitimate and reasonable. Each need is addressed individually.

The Firm Yield Need

Denver Water's 1041 application to Boulder County states, *"Denver Water's near-term (prior to 2032) water resource strategy and water service obligations, which have occurred since the IRP was developed, have resulted in a need for 18,000 acre-feet per year (AF/yr) of new near-term firm yield. This need was identified after first assuming successful implementation of a conservation program, construction of a non-potable recycling project, and implementation of a system refinement program."*[10]

The Firm Yield Need was what was originally Denver Water's primary rationale for the Gross Reservoir Expansion, when the project was first proposed. As time went by, the Firm Yield Need was deemphasized, as reliability and vulnerability needs were introduced to justify the project. WaterDM's analysis shows exactly why Denver Water chose to deemphasize the Firm Yield Need.

There does not appear to be a reasonable or legitimate need for an additional 18,000 AF of firm yield given actual demand trends. Adding another 18,000 AF through the Gross Reservoir Expansion simply pads what is already an ample water portfolio. As shown in Figure 2, in both the near-term and the long-term, Denver Water has ample water "in-hand" to meet demand even with a 10% factor of safety applied. Denver Water appears to have more "in-hand" water than it needs, somewhere between 75,000 and 175,000 AF available from now until the forecast buildout.

Denver Water should be required to reevaluate and justify the "Firm Yield Need" considering the significant changes in demand that have occurred and the apparent excess supply capacity that it possesses.

The Reliability Need

Denver Water's 1041 application to Boulder County states. *Existing water demands served by Denver Water's Moffat Collection System exceed available supplies from the Moffat Collection System during a drought, causing a water supply reliability problem. In a severe drought, even in*

[10] Denver Water. 2020. Denver Water's Gross Reservoir Expansion Project. Areas and Activities of State Interest (1041) Permit Application (p.60)

a single severe dry year, the Moffat Water Treatment Plant (WTP)—one of three treatment plants in Denver Water's system—is at a significant level of risk of running out of water."[11]

The Reliability Need is what Denver Water has promoted to the top of the list as the rationale for the Gross Reservoir Expansion project, yet the analysis presented in support of this need is remarkably thin. Denver Water's FEIS states that "PACSM modeling" and "2002 operations" indicate that existing water demands would exceed available supplies from the Moffat Collection System during a severe drought, putting the Moffat Water Treatment Plant at a "significant level" of risk of running out of water.[12]

As shown in Figure 2, Denver Water's demand has dramatically changed since 2002 when the modeling and analysis for the risk assessment was conducted. Denver Water must certainly have conducted more recent analysis of its risk assessment that takes into consideration the changes in demand that have occurred.

It is not reasonable to justify a project the size and scope of the Gross Reservoir Expansion based upon an 18-year old reliability analysis, which itself was based on what has become an unrealistic and inflated demand forecast. It is quite likely that the reliability risk to Denver Water's system has changed given the reduced future forecast.

Climate change impacts on the Colorado River basin are also better understood today than they were in 2002. Denver Water's reliability analysis must consider the risk that the 18,000 AF of supply it intends to divert may not be available due to reduced snowpack.

The Boulder County Commissioners should request from Denver Water an updated Reliability Analysis based on current data, an updated demand forecast, and which considers the impacts of climate change.

The Vulnerability Need

Denver Water's 1041 application to Boulder County states, "*Denver Water's Collection System is vulnerable to manmade and natural disasters because 90 percent (%) of available reservoir storage and 80% of available water supplies rely on the unimpeded operation of Strontia Springs Reservoir and other components of Denver's Water's South System.*"[13]

Denver Water reports that their overall water supply system is vulnerable to man-made and natural disasters because 90% of storage and 80% of available water supply is located in their South System. However, a simple analysis shows that storage and supply concerns are hardly changed with the addition of 18,000 AF of firm yield to the North System. Adding the proposed

[11] Denver Water. 2020. Denver Water's Gross Reservoir Expansion Project. Areas and Activities of State Interest (1041) Permit Application (p.60)
[12] USACE. 2003. Scoping Summary – Moffat Collection System Project, p. 3-2. December.
[13] Denver Water. 2020. Denver Water's Gross Reservoir Expansion Project. Areas and Activities of State Interest (1041) Permit Application (p.60)

Moffat Expansion barely decreases Denver Water's reliance on the South System; lowering South System dependence from 81% to 77% of water supply as shown in Table 1. Furthermore, given the changed water demand and revised demand forecast shown in Figure 2, this "vulnerability" needs to be reassessed. How much would increasing the storage capacity of Gross Reservoir and withdrawing an additional 18,000 AF reduce vulnerability – given the existing level of reliability that exists and the likely impacts of climate change.

Table 1: Yield of Denver Water's Systems in AF (adapted from FEIS and Wester Resource Advocates).[14]

	Existing System			*With Moffat Expansion*		
Source	**Supply**	**Percent**	**S. Supply**	**Supply**	**Percent**	**S. Supply**
Roberts Tunnel	93,000	27%	81%	93,000	26%	77%
South Platte	141,000	41%		141,000	39%	
Exchange/Reuse	47,000	14%		47,000	13%	
Moffat Tunnel	64,000	19%		82,000	23%	
TOTAL	**345,000**			**363,000**		

The Boulder County Commissioners should require Denver Water to present an evaluation of the improvements to system vulnerability afforded by the proposed Moffat Expansion <u>and other viable alternatives</u>. For example, if manmade or natural disasters are a concern, one of which might be a tunnel failure (often mentioned by Denver Water), then a greater reliance on one of the tunnel systems would not seem to reduce vulnerability or increase reliability. Improvements to system-wide security (e.g. video cameras, extra patrols), or forest health (because fire is a major concern in the South Platte watershed), may prove to be more economic, and reduce vulnerability more than any of the proposed project alternatives. This analysis has never been presented.

Denver Water has not done an adequate job of presenting the Vulnerability Need in a convincing manner. A revised analysis is warranted before a project of this size and scope and impact is allowed to proceed.

The Flexibility Need

Denver Water's 1041 application to Boulder County states, "*Denver Water's treated water transmission, distribution, and water collection systems are subject to failures and outages caused by routine maintenance, pipe failures, treatment plant problems, and a host of other unpredictable occurrences that are inherent in operating and maintaining a large municipal water supply system. These stresses to Denver Water's ability to meet its customers' water*

[14] Western Resource Advocates. 2010. Comments on the Moffat Collection System Project Draft Environmental Impact Statement (DEIS) and the associated § 404 Permit Application prepared by the U.S. Army Corps of Engineers (USACE).

supply demands require a level of flexibility within system operations that is not presently available."[15]

The analysis Denver Water presents in support of this need is remarkably thin.

Unlike many water providers, Denver Water already has three large, independent water treatment plants, any one of which is capable of meeting the vast majority of Denver Water's customers' water needs during most of the year. In addition, summer-time demands in the entire combined service area can be served by any two plants in times of drought, as evident by operations practiced in 2002.

If the Flexibility Need is in fact real, Denver Water must, at a minimum, provide a quantification of the benefits attributable to the additional flexibility provided by the proposed Moffat Expansion project. Parallel to questions surrounding the vulnerability need, there is not a clear indication that 18,000 AF of additional supply actually provides any substantive benefits to system flexibility.

A helpful starting point would be to determine actual customer service interruptions attributable to the planned and non-planned outages described in Appendix C of the Purpose and Need Report[16] – while there are several listed outages, it is not apparent if any of those outages led to supply interruption at the customer level.

Boulder County deserves to understand how the largest construction project in its history will improve flexibility in Denver Water's system, and what is the actual need for improved flexibility. Denver Water has not provided a convincing argument or analysis to show that this is a legitimate concern. The Boulder County Commissioners should request Denver Water to present substantive analysis on this point.

Conclusions

This letter report concludes that the future water demand forecasts offered by Denver Water in support of the Gross Reservoir & Dam Expansion are no longer accurate or even relevant. Water demand has changed in Denver and across Colorado and the United States. Denver Water's documented demands and production have not increased, even as population has grown over the past 10 years.

The Gross Reservoir & Dam Expansion will be the largest construction project in the history of Boulder County and will annually remove an additional 18,000 AF of water from the climate change-impacted Colorado River basin. WaterDM reviewed each aspect of Denver Water's

[15] Denver Water. 2020. Denver Water's Gross Reservoir Expansion Project. Areas and Activities of State Interest (1041) Permit Application (p.60)

[16] Denver Board of Water Commissioners. 2004. Purpose and Need Statement for the Moffat Collection System Project. April.

“Project Purpose and Need” statement[17] and reviewed Denver Water’s actual demand from 2009 – 2019 and determined that the water demands Denver anticipated when the project was conceived have not occurred. As a result, the supply and reliability concerns used to justify the Gross Reservoir Expansion must be reconsidered.

A statement of need and water demand forecast for a project of this size and scope must be based on sound data, reasonable assumptions, and conservative resource principles to ensure the water will not be wasted and that anticipated impacts to the environment are justified. In this case, the demand forecast used to justify the project is no longer reasonable or relevant because demand has changed. Water customers across the Western United States have successfully implemented effective water efficiency strategies that today have reduced per capita use.

Denver Water has offered a shifting justification for the Gross Reservoir & Dam Expansion project, but no new analysis of water demands, or a revised demand forecast were included in any of their recent filings. The demand projections for Gross Reservoir are derived from Denver Water’s 2002 Integrated Water Resources Plan.[18] The Army Corps of Engineers evaluated Denver Water’s demand projections in 2004 and again in 2010 and Denver Water’s Final Environmental Impact Statement (FEIS) on the project notes that water conservation has been included in Denver Water’s projections.[19]

What is not included in Denver Water’s FEIS or its application to Boulder County is that fact that over the past ten years, the water demands considered by the Corps and included in Denver Water’s analysis and projects have failed to materialize. The Corps based its analysis on the incorrect assumption of a rapid increase in demand, which Denver Water had forecast. Since 2010, Denver Water’s total water demand has decreased even as population has grown. The evaluation performed by the Corps in 2004 and 2010 was based on an outdated and highly inaccurate demand forecast. A reevaluation is clearly warranted.

This report provides a detailed review and evaluation of each of Denver Water’s “identified four needs” in light of actual water demands and an updated water demand forecast that reflects both population growth and the impacts of water efficiency. The analysis in this report shows that Denver Water’s water demand forecast significantly overstates future demand and is no longer a reasonable representation of likely future demand.

When replaced with a reasonable future demand forecast based on current production trends and anticipated growth, Denver Water’s four identified needs in its application appear far less urgent. Denver Water’s use has become more efficient and the need for expanding this existing reservoir, and all that comes with it for Boulder County, not to mention the Colorado River, no

[17] 8-507.D.7, Requirements Applicable to All Applicants; 8-507.D.7.a, Project Need, from the “Corps ROD (Section 3.0).

[18] Denver Water. 2002. Integrated Water Resources Plan. Figure III-4.

[19] U.S. Army Corps of Engineers Omaha Division (USACE). 2009. Moffat Collection System Project Final Environmental Impact Statement (Final EIS). April 25, 2014.

longer exists. The existing Gross Reservoir and capacity and reliability it already provides along the Denver Water's large integrated system appears sufficient to meet future build-out demand.

Denver Water should update its demand forecast and statement of Project Need to reflect the last 10 years of production on their system and assure Boulder County that there is a need for the reservoir expansion project.

Sincerely,

Peter Mayer

Peter Mayer, P.E.
Principal

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SAVE THE COLORADO

Date: October 7, 2015

To: U.S. Army Corps of Engineers

From: Save The Colorado

Re: The Demand Analysis in the Final Environmental Impact Statement for the Moffat Collection System Project is Fatally Flawed and Must Be Redone

Summary: Save the Colorado (STC) submits the following comments on the Final Environmental Impact Statement (FEIS) for the proposed Moffat Collection System Project (Moffat Project) to the US Army Corps of Engineers (Corps). Save The Colorado did a high-level analysis of the data and modeling about the Army Corps projections for Denver Water's "water demand" in the FEIS. Save The Colorado finds the water demand data and modeling in the FEIS to be fatally flawed because:

1. The Corps and Denver Water inappropriately changed the "purposed and need" during the EIS process.
2. The Corps failed to conduct an independent review of Denver Water's water demand, and instead relied on a flawed study presented by a biased source, Harvey Economics, which has a conflict of interest due to its business relationship with Denver Water.
3. The Corps' water demand projections are fatally flawed and absolutely do not reflect Denver Water's water use data in the past, now, nor in the future.

Therefore, the water demand analysis in the FEIS must be redone and the Purpose and Need statement must be re-examined in order to comply with federal law.

1. The FEIS Inappropriately Relies on a Contrived Purpose and Need Statement

Denver Water originally proposed four needs for the Moffat Collection System Project:

- The Reliability Need
- The Vulnerability Need
- The Flexibility Need
- The Firm Yield Need

FEIS at 1-2.

These needs were adapted into a singular Purpose & Need statement for the FEIS[1]:

> The purpose of the Moffat Collection System Project is to develop 18,000 acre-feet per year of new, firm yield to the Moffat Treatment Plant and raw water customers upstream of the Moffat Treatment Plant pursuant to the Board of Water Commissioners' commitment to its customers.

FEIS at 1-4.

This statement is justified by a distillation of Denver Water's original needs into two "major issues":

1. Timeliness: Water Supply Shortage in the Near-Term Timeframe (Prior to 2032)
2. Location: Need for Water to the Moffat Water Treatment Plant and Raw Water Customers

FEIS at 1-4.

During the NEPA process, and contrary to how the proposed project was presented to the public, Denver Water and the Corps have elevated the provision of new water supply (18,000 of new firm yield) from one component of the Moffat Project to the driving force behind the "need" for the project. There is no support for this shift in the record other than a change in priorities for Denver Water. *See*, *e.g.*, "Purpose and Need Statement for the Moffat Collection System Project," Denver Board of Water Commissioners, April 2004 (explaining and attempting to justify the 18,000 firm yield figure but not documenting the shift towards a primary focus on new water supply).

[1] Save the Colorado rejects as unacceptable the Corps' Purpose and Need statement presented in the FEIS. *See* "Re: Moffat Collection System Project – Final Environmental Impact Statement," The Environment Group, Save the Colorado, and Save the Poudre, submitted to the Corps on June 9, 2014 (comments of the FEIS), and forthcoming comments from Save the Colorado.

This is a significant evolution of the project and an approach that has a dramatic effect on the alternatives that are considered. The preliminary alternatives screening process documented in the FEIS was driven by the Purpose and Need statement as written, in particular with the "Purpose and Need" ("PN"), "Logistics – Practicality Issues" ("LP") and "Environmental Consequences" ("EC") screening criteria being based on the firm yield requirement. Any proposed alternative that would not provide at least 15,000 AF of new firm yield in a surface impoundment was immediately removed from consideration, regardless of the ability of that alternative to address the reliability, vulnerability, and flexibility needs of the project. FEIS at 2-4 – 2-7, 2-9.

As will be documented below, the demand projections that underlie the purported "need" for 18,000 AF of new firm yield are fatally flawed. Consequently, the Corps' alternative screening process inappropriately constrains the range of alternative that should be given full consideration in the review of the Moffat Project. The Corps must correct its Purpose and Need statement by eliminating the firm yield need as the driving force behind what thus appears to be a pre-determined outcome, and re-evaluate the full range of alternatives.

2. The Corps Failed to Conduct an Independent Review of Denver Water's Demand Projections

After public review of the Draft EIS and prior to the issuance of the FEIS, the Corps requested updated water demand projections from Denver Water. FEIS at 1-14. These updated projections form the basis for the 18,000 AF firm yield "need" underlying the FEIS. FEIS at 1-14 – 1-18.

Apparently understanding that there was an obvious conflict of interest in having the project proponent be solely responsible for determining the need for a project such as Moffat, the FEIS states that the Corps "evaluated these more recent projections for suitability for the Final EIS." FEIS at 1-14. The updated projections and the Corps' consultant's evaluation of the projections are documented in the FEIS at Appendix A-4 and A-5.

The Corps also retained the same consultants to evaluate the earlier versions of the demand projections and the underlying models (which are retained for the FEIS):

> **An independent review of Denver Water's demand forecast model was completed** for this EIS and concluded that the water demand projections produced from the 2002 IRP offer an acceptable basis for water supply planning purposes.

FEIS at 1-17 (emphasis added).

In a review of this process, however, STC has determined that the Corp's choice of consultant for the evaluation of Denver Water's updated projections and the evaluations of Denver Water's initial projections, itself raises serious concerns about the objectivity of the evaluation and the Corps' diligence in critically examining material from the project applicant.

The evaluation of the updated projections (FEIS Appendix A-5) as well as the earlier evaluations (FEIS Appendices A-1 and A-2) were authored by Harvey Economics, a consulting firm apparently retained by the Corps through contract to complete various work products incorporated into the FEIS. *See* FEIS Appendix A-1, A-2, and A-5. FEIS Appendix A-1, cites Ed Harvey specifically as the author. The documents are described as:

FEIS Appendix A-1 – "Re: Review of Denver Water's IRP," January 15, 2004:

> The primary goal of this review is to determine the validity of the water demand forecasts produced through Denver Water's most recent IRP process as a basis for establishing a need to develop new firm yield supplies.

FEIS Appendix A-1 at 1.

FEIS Appendix A-2 – "Supplemental Evaluation of Denver Water Demand Projections," August 12, 2004:

> This document describes the results of a supplemental evaluation of Denver Water's demand projections, following an initial evaluation that HE conducted in late 2003 and finalized in early 2004.

FEIS Appendix A-2 at 1.

FEIS Appendix A-5 – "Update of Denver Water Demand Projections," April 2, 2012:

> Under the direction of Harvey Economics (HE), one of the third party contractors, the following steps were completed:
>
> 1) Review of the Purpose and Need section of Chapter 1 to determine what information required updating;
> 2) Request to Denver Water to update the water demand projections;
> 3) Review and validation of the Denver Water demand projection update; and

4) Incorporate updated water demand information into the final EIS.

FEIS Appendix A-5 at 1.

> **Based upon HE's determination** that the updated economic demographic projections and the associated water demand projections are reasonable, **the results have been incorporated in the FEIS**.

FEIS Appendix A-5 at 6 (emphasis added).

Even a surficial review of the materials reveals obvious conflicts of interest from having Harvey Economics in general, and Ed Harvey in particular, evaluate Denver Water's projections:

- Ed Harvey founded Harvey Economics in 2003, and that prior to that date he was a Managing Director at BBC Research & Consulting (starting in 1989). Exhibit A.
- Denver Water's demand projections are based on forecasting models developed by BBC Research & Consulting completed in 2001. FEIS Appendix A-1 at 2.
- Denver Water and BBC Research & Consulting worked in close association in the development and implementation of the demand forecasting models. FEIS Appendix A-1 at 4.

Consequently, Harvey Economics evaluated models that were developed by the firm where Mr. Harvey was a Managing Director at the time that these models were developed. Given his purported expertise in these topics, it is a reasonable assumption—that the Corps fails to refute or even address—that Mr. Harvey was at least overseeing, if not directly involved with, the model development work that the Corps subsequently called upon him to evaluate.

If Harvey Economics merely reproduced standard calculations in its evaluation then concerns about objectivity might have been mitigated, but the nature of the evaluation extends far beyond a simple math check. Harvey Economics was relied on by the Corps, for example, to evaluate:

- If "the methodology used to develop those demand projections [was] **appropriate** for the purpose of formulating future water resource development strategies;"
- if "the data sources that drive the water demand forecasts [were] **appropriate** for the purpose of producing water demand projections;"
- If the underlying assumptions in the forecasts [were] **reasonable**;"

- If the demand projections **provide a sufficient basis** for determining future water development requirements."

Appendix A-1 at 1 (emphasis added).

Clearly the tasks conducted for these evaluations required the subjective application of professional expertise. In fact, the evaluations centered on broad assertions without quantifiable and verifiable support and are uniformly supportive of Denver Water's projections. *See*, *in general*, FEIS Appendix A-1, A-2, and A-5. Particularly troubling was Harvey Economics failure to critically evaluate the demand model itself. For this, Harvey Economics relied on a belief in the validity of the model's assumptions rather than any review of its efficacy or any aspect of its actual function:

> HE determined that a re-estimation or new configuration of the water demand models was not needed. The water demand models were originally estimated using 27 years of economic demographic, **data which is believed to be the sufficient historical period** for estimating regression coefficients. **HE concluded** that the structure of the 2002 water demand forecasting **models remained sound and appropriate** for projecting water demands in 2011.

FEIS Appendix A-5 at 2 (emphasis added).

Harvey Economic's "belief" that the model is valid contrasts sharply with the reality of changing water use in the Denver area. The model was derived from data on water use running from 1973 through 1999, a data series that fails to capture the significant shift in water use rates that has occurred since the drought of the early 2000's. *See* http://www.denverwater.org/SupplyPlanning/WaterUse/Population/ (last viewed September 22, 2015 and attached here as Exhibit B, illustrating a marked downward trend in water use). This failure would have been evident in even a simple analysis of readily available multi-year average use data.

Even if Harvey Economics in general and Ed Harvey in particular were professionally qualified[2] to perform an evaluation of Denver Water's demand projections, the apparent involvement of Mr. Harvey in the development and implementation of the underlying models clouded the ability of Harvey Economic and Ed Harvey to provide a reasonably independent evaluation. By employing Harvey Economics for this task, the Corps failed to provide an outside review and rather appears to have

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[2] STC does not stipulate to the adequacy of the qualifications of Harvey Economics and Ed Harvey to perform the work that they report in the described documents.

supplied those responsible for the demand projections another opportunity to justify their approach and results.

The Corps must retain a new and truly independent expert to evaluate Denver Water's demand projections before the Corps can rely on those projections in the FEIS. An independent analysis is needed, given factors including the significant environmental impacts of the proposed project and the level of public controversy regarding environmental and socio-economic impacts.

3. The Corps' Demand Projections Are Fatally Flawed

Denver Water's demand projections were based on three demand sectors:

- Water provided by Denver Water directly to customers
- Fixed-amount contracts with other entities outside of the Combined Service Area
- The 1999 contract with Arvada

FEIS at 1-14, 1-15.

The demand under each of these sectors was projected independently. STC reviews each of these projections below.

<u>The Demand Projection Modeling is Unrealistic and Likely Overstates Future Water Demand</u>

The Demand Projections are Inconsistent with Actual Patterns of Water Demand

The consultant evaluating Denver Water's demand projections took an almost flippant view of the task:

> In truth, there is little opportunity for testing the accuracy of demographic and economic forecasts. Such forecasts are inherently very uncertain.

FEIS Appendix A-1 at 4.

Freed from the burden of a rigorous analysis, the consultants' evaluation of the Denver Water's demand projection model defended it with a variety of lightly described (but not documented) statistical analysis results. *See* FEIS Appendix A-1 at 5, 6. The consultant found, perhaps not surprisingly, that these statistics supported the model, even when the "R^2" results (the proportion of variability in a data set that is accounted for by the model) reported were both high and relatively low. *See* FEIS Appendix A-1 at 5 ("The various models' overall predictive capability predictions are also relatively strong. The single family model has an r2 of 0.65, the commercial model has an r2 of 0.99 and the institutional model has an r2 of 0.92.")

The evaluation also cited "backcasting" – the use of the model to "project" demand during years for which we have historical data as a test of the models predictive ability. FEIS Appendix A-1 at 6. The majority of the years that were the subject of the backcasting analysis (1973 – 1991) were years for which data were incorporated into the model's development.[3] *Compare* FEIS Appendix A-1 at 5 ("Denver Water was tasked with providing water use data for all of the water distributors within its service area from 1973 through 1999") *and* FEIS Appendix A-1 at 6 ("That is, each was used to project historical water use each year from 1973 to the year 2000.") Backcasting these years added nothing to the evaluation gained from the statistical analysis as it merely restates the previously cited error analysis. The few relevant years (1992 – 1999) were discussed in only broad summary so a reviewer is unable to understand what the model's success in projection actually was. It is also not disclosed if the backcasting was performed using actual precipitation, a parameter necessary to adequately assess the model results.[4]

Fortunately, the consultant's assertion that the accuracy of the model couldn't be tested is incorrect. As the model projects forward from 2002, STC was able to perform its own backcasting analysis to independently determine the models results.

At the simplest level, the demand projections appear to produce results that are contrary to empirical evidence of demand over the last decade.

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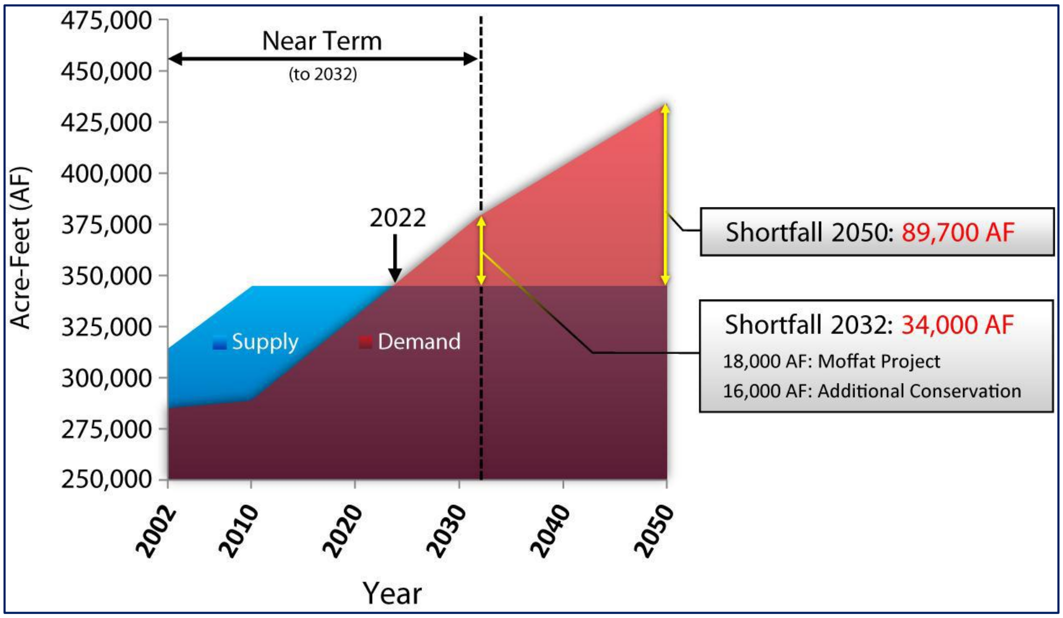
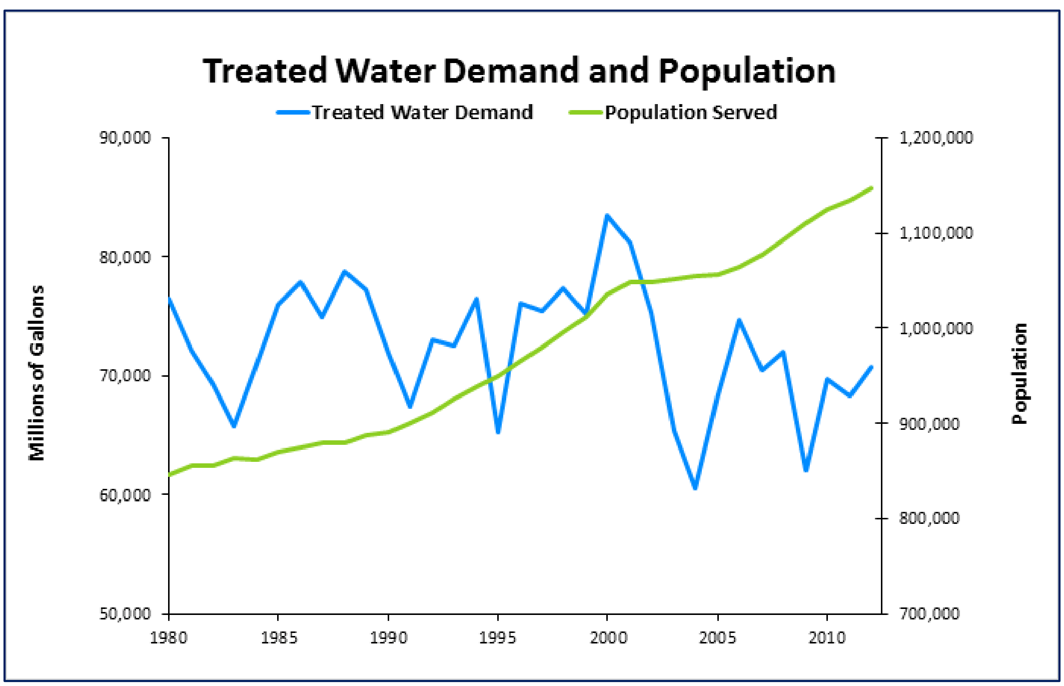
[3] Although, Denver Water was tasked with providing water use data for the years 1973 – 1991, it is not clear from the FEIS and supporting documents which years' data were actually incorporated into the model's development. FEIS Appendix A-1 at 5 ("In fact, only 834 cells of water use information were identified for the single family model, and fewer observations were found for the commercial and institutional water use models.") The inability to acquire all of the desired data is described as "less than ideal," yet the consultant claims that the model's development is "credible." FEIS Appendix A-1 at 5. This justification is based on a successful regression analysis rather than an assertion that a representative range of data was acquired.

[4] As is evident on the graph of treated water demand from Denver Water attached below (and available at http://www.denverwater.org/ SupplyPlanning/WaterUse/Population/ as of September 22, 2015), actual demand in any given year is highly variable. The only independent variable in the model that might reasonably vary to such an extent each year is precipitation. *See* FEIS Appendix A-1 at 3 (listing model independent variables).

STC compared the demand projection for the period 2002 through 2014 as depicted in the FEIS (Figure 1-5) with actual demand data for the same period presented on Denver Water's website:[5]



FEIS Figure 1-5 (Total Annual Denver Water System Demand Versus Supply).



[5] These graphs portray different units (acre-feet and gallons) but are comparable as they both portray linear rates.

Exhibit B.

To even the casual reviewer, it is obvious that the demand projection in Figure 1-5 shows a slight increase each year from 2002 to 2010, and then follows a higher growth rate upward. Contrarily, the actual demand figures, shown in “Treated Water Demand and Population” vary year to year but follow a distinctly downward trend line after approximately 2002. The lower actual demand since 2002 occurred despite steady population increases. Although this is a simple evaluation of the model’s efficacy, it clearly failed to accurately portray even the direction of the demand trend for this substantial period.

Importantly, it casts doubt on one of the fundamental assumptions employed by Denver Water and thus far accepted by the Corps in the FEIS: that “demand”, or actual use, can be expected to rise steadily with population increases. Actual data for the past ten years, since Denver Water began to take conservation at least somewhat seriously, disprove this assumption.

STC also performed a more sophisticated review of the model’s predicative ability, examining the results for the year 2010:[6]

Modeled[7]	**Actual[8]**	**Actual w/ 6% System Loss Amendment[9]**	**Difference between Modeled &Amended Actual**
289,200 AF	238,528 AF	252,840 AF	36,360 AF/12.6%

[6] Although more samples would have been desirable, the modeling results available from the FEIS are only at very large time steps (2010, 2032, 2050) so only 2010 could be tested.
[7] FEIS 1-15, Table 1-1, “Total System Demand.”
[8] STC here uses the figures from the Denver Water 2014 Annual Report (attached here as Exhibit C), “Water Supply, Use, and Storage: 2005-2014,” at III-64. STC combined the figures for “Total Treated Water Delivered” and “Raw Water Deliveries” to derive an actual demand figure. Denver Water’s accounting methods are arguably complex so it was difficult to determine equivalent figures for a valid comparison. This method used was tested on data from 1997 and 2001, as presented in the Denver Water 2001 Annual Report (attached here as Exhibit D), in comparison with system demand figures cited in Denver Water’s Integrated Resource Plan (“water demand of 265,000 acre-feet annually” at 7, “[c]urrent demand on the Denver Water system is now 285,000 acre-feet” at 9; attached here as Exhibit E) and found to be reliably close (263,330 AF and 286,089 AF, respectively) when evaporative losses were added, so losses were approximated and added in the next column.
[9] Following FEIS Appendix A-4 at Attachment 3, a 6% unspecified “system loss” is added for comparison purposes. It is unknown if the model applies a “system loss” to the fixed contract deliveries (as STC does here) so it is possible that the loss in the actual use estimate is overstated. No details were found by STC on how the fixed contract amounts were projected year-to-year other than broad statements that they were increased to the maximum by 2032. Of further note, the FEIS cites a total of 249,000 AF of water use within the Denver Water CSA during 2010, including distribution losses. FEIS at 1-12. This figure is cited to a Denver Water publication on conservation, “Solutions” (attached to the FEIS as Appendix A-3), but STC was unable to locate that figure or any substantial reference to it in the referenced publication.

STC cautions that single-year portrayals of water demand are suspect as indicators of overall demand as there can be great variation year to year; this is evident in the "Total Water Demand and Population" graphic above. A competent projection of water use must incorporate a consideration of a range of probable values. Acknowledging that, however, it should also be noted that our analysis casts significant doubt on the reliability of the model.

2010 fell squarely in the mid-range for demand for the decade 2001-2010, and the model overstates demand at this level by 36,360 AF (12.6%) – twice the new firm yield sought by the Moffat Project. This undercuts the "Purpose and Need" presented by Corps as the premise for the project. The modeling and analysis behind Denver Water's assertions are not reliable when evaluated by reference to actual data.

Over the entire thirty-year period portrayed on Denver Water's "Treated Water Demand and Population" graphic, there does not appear to be any substantial correlation between population growth and water demand increase. In those thirty years, population has increased by roughly 300,000, while the long-term average water demand is approximately flat if not trending downward. This relationship—or lack thereof—directly contradicts the projections of the model which, for single-family residential use, is based on a linear relationship of a demand rate and the number of single family homes, and for commercial and institutional use is based heavily on employment figures.[10] FEIS Appendix A-1 at 3. The model's linear relationship to projected population growth is clear from Denver Water's results. *Compare* FEIS Appendix A-4 at Attachment 1 (projected population growth from 2000 to 2050 is 65%) and Attachment 3 (projected water demand growth from 2000 to 2050 is 62%). Despite the statistical analysis that the consultant uses to justify the validity of the model (Moffat FEIS Appendix A-1 at 5 – 6), the model results are completely inconsistent with over thirty years of actual water demand patterns.

The demand projection model relied on by the Corps for the demand projections and the "need" determination in the FEIS is fatally flawed. The Corps must re-examine future water demand using a

[10] The Corps needs to consider whether models have even considered documented economic trends such as the emergence of internet and service-based sectors in the economy and possible displacement of the water-intensive industrial sector during the 21st century. Denver Water appears to blithely assume that average use statistics from over forty years ago would simply remain constant indefinitely. Assumptions about water use must be re-examined in light of today's economy and lifestyle choices, such as employment patterns and dedication to past landscaping habits (e.g., intensive watering of Kentucky bluegrass yards).

defensible method that can be expected to produce rational demand projections. The Corps must also incorporate a competent consideration of the variable nature of water demand.

Key Components of the Water Demand Projection Model are Improperly Implemented

In addition to being fundamentally flawed, the water demand projection model used by the Corps to inform the FEIS was also hampered by poor execution of key components of the model. If Corps persists in using the current water demand model, the Corps must evaluate and correct the following components.

A key independent variable which informed all of three of the sub-models was precipitation during the growing season. FEIS Appendix A-1 at 3. For the projections, this variable was set to a constant, using an average irrigation value of 9.4 inches. FEIS Appendix A-4 at Attachment 1. STC tested the sensitivity of this variable by reproducing the model projection using a precipitation total of 0.01 inch for 2010. In other words, STC's analysis compared the actual water use projected by the model for an average precipitation year (9.4 inches of rainfall) to a year with effectively zero precipitation. The results do not seem logical.

STC's result from a model run projecting the three sub-models with this precipitation figure (0.01") was only 9% higher than Denver Water's calculation using the average precipitation (9.4"). *Compare* Moffat FEIS Appendix A-4 at Attachment 3 (2010 "Total" demand is 72,573,482 thousand gallons) and Exhibit F (STC's figure of 78,876,357 thousand gallons). Precipitation was the only independent variable in the model that is likely to vary significantly year-to-year. *See* FEIS Appendix A-1 at 3. It is apparent from the Denver Water graphic "Treated Water Demand and Population" that the model fails to capture the true impact of precipitation differences on water demand if such an extreme precipitation variation ("average" to none) generates only a 10% difference in water demand. If the Corps persists in using the current water demand model, the Corps must re-examine the role of precipitation in the water demand model and improve its implementation to more accurately capture its impact on water demand.

Cost was a significant independent variable in the residential sub-model. *See* FEIS Appendix A-1 at 3. Despite this essential role, the model does not appear to have incorporated tiered pricing or any other progressive pricing structure such as that currently utilized by Denver Water. *See*, *generally*, FEIS Appendix A-1 and A-4, and "Inside City 2015 Rates" (available at: http://www.denverwater.org/

BillingRates/RatesCharges/2015rates/insidecity/, last viewed September 29, 2015, and attached here as Exhibit G). The Corps developed a paradigm of unrestricted demand for its modeling (or utilized such a paradigm provided by Denver Water but not objectively evaluated) that fails to incorporate the realities of current water provision systems. FEIS at 1-17.

STC modeled a price increase of $1 per 1,000 gallons for 2050, a much smaller increase than shown in Denver Water's current tiered structure for increasing usage. This increase, independent of any other changes, resulted in a demand reduction of over 13,000 AF. Exhibit H. If the Corps persists in using the current water demand model, it must redevelop the water demand model to more accurately incorporate tiered pricing structures and other consumption disincentives that are integral to water provision and hence separate from conservation techniques.

The figures for number of single family households and multifamily households used in the model are derived from Denver Regional Council of Government's (DRCOG) total number of households, rather than being sourced directly. FEIS Appendix A-4 at 1. The total number of households is split on a 60/40 scale (single family versus multi-family), rather than the 50/50 basis assumed in the original 2002 model data, on the basis of the unsupported statement that this ratio "reflects the current ratio of SF to MF units across the Metro area counties (Adams, Arapahoe, Denver and Jefferson)." FEIS Appendix A-4 at 1. Although it is given little notice in the FEIS, this split is critical to the water demand projections.

Each single family household has a linear demand increase on the residential sub-model; a change of 1% of the total households in 2050 attributed to single family units reduces demand by nearly 3,000 AF. *See* FEIS Appendix A-4 at Attachment 1 (1% of 2050 household total is 7,652) and Exhibit I (STC's modeling of changes in household unit distribution). If fifty percent of the total households are assigned to single family units in 2050 (an historically accurate split according to FEIS Appendix A-1 at 9), then demand at 2050 is reduced by nearly 30,000 AF. Exhibit I. If the Corps persists in using the current water demand model, it must reconsider the distribution of total households in the model between single family and multi-family units and must establish a rigorous defense for its choice of distribution.

Conservation spending, based on a three-year average, was an independent variable in the residential model. FEIS Appendix A-1 at 3. The FEIS states that the source data incorporated into the model comes from Denver Water; the FEIS does not state if the data include expenditures by other providers that use water provided by Denver Water or if they represent only Denver Water's expenditures. FEIS Appendix A-1 at 5. The modeling presented in FEIS used an "updated" figure for conservation spending,

$1,149,949, reportedly the 2010 figure adjusted to a 1983 basis. FEIS Appendix A-4 at Attachment 2. This figure is, however, substantially less than the three-year average for 2008-2010 actual conservation spending—$4,016,833 in a 1983 basis—as presented in the 2011 Denver Water Budget document. Denver Water 2011 Budget, attached here as Exhibit J, at 91; figures adjusted to 1983 basis individually using the Bureau of Labor Statistics CPI Inflation Calculator (http://www.bls.gov/data/inflation_calculator.htm, last viewed October 1, 2015). If the conservation spending as determined from the publicly available data is used in the model, 2050 demand is reduced by nearly 88,000 AF. Exhibit K (STC modeling of conservation spending change). As the raw data is not provided it is impossible for the reviewer to understand the origin of this discrepancy or to rationally accept the figure presented in the FEIS. The Corps must either document the conservation spending figure used or re-model demand using irrefutable data.

The model's method was also critically undermined by holding the conservation spending figure constant throughout the fifty-year span of the model, even though population increases by 65% and the number of households increase by 72% during that time. FEIS Appendix A-4 at Attachment 1. This flat-lined spending situation is justified as holding conservation spending constant (FEIS Appendix A-5 at 4) but actually fails to accurately capture a status quo and rather reflects an active decrease in conservation spending per capita and per household. If spending per capita is held constant, 2050 demand is reduced by nearly 23,000 AF. [11] Exhibit K (STC modeling of conservation spending change). If the Corps persists in using the current water demand model, the Corps must re-examine the assumption of holding conservation spending constant rather than holding conservation spending per capita or per household constant.

<u>The Corps Fails to Provide Any Meaningful Projection of Actual Demand Under the Fixed Contracts</u>

[11] The unsupported assertion of Harvey Economics that there will be diminishing returns on investment in conservation in the future (the statement was written in 2004) needs to be rigorously evaluated against the results of conservation programs to date, the continued development of water efficiency technologies, and the emerging region-wide water consciousness. FEIS Appendix A-1 at 5 ("According to outside experts, the 'low hanging fruit' of conservation savings have already been achieved," with no documentation of those comments or the identities of the experts).

Approximately 24,000 AF[12] of the pending demand cited in the FEIS as "need" apparently derived from fixed contracts under which Denver Water is obligated to provide raw, recycled or treated water to other entities when requested. FEIS Appendix A-1 at 10. The Denver Water Integrated Resource Plan (Exhibit E) clearly states that the perceived shortage of water in the North System is a result of the potential demand from the fixed contract deliveries. Denver Water Integrated Resource Plan (Exhibit C) at 53.

The only disclosures about demand resulting from these contracts are: a second-hand and unsupported reference by the consultant that "these customers have indicated that they intend to take all of the water they are entitled to by 2030"; the consultant's opinion that "[a]lthough the exact timing is dependent upon each entity's own desires, it is reasonable to assume that these commitments will be fulfilled in their entirety by the year 2030"; and an opinion ascribed to a Denver Water official by the consultant that "[a]s of 2000, these customers were receiving approximately 43,000 acre-feet of water, and their calls for additional supplies under their contracts with Denver Water are accelerating more quickly than Denver anticipated." FEIS Appendix A-1 at 11, Appendix A-2 at 8.

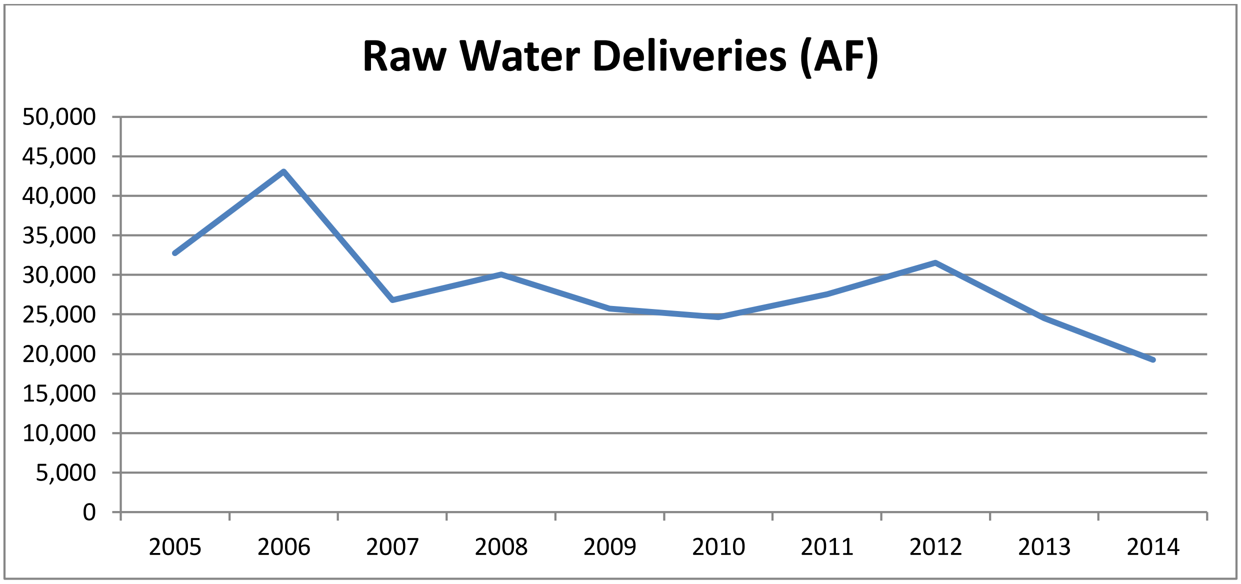
Questions requiring answers in the NEPA analysis that remain unanswered include: 1) who are these entities or customers, 2) how are they using water supplied by Denver Water, 3) what are the nature of the contracts, and 4) are alternatives available to meeting calls for increased supply from Denver Water?

The FEIS does not explicitly describe how the fixed contract demand is incorporated into its demand modeling, leaving the reviewer to assume that it is fully incorporated in the 2032 figure. FEIS at 1-15 (Table 1-1). STC's critique is based on this assumption.

The FEIS utterly fails to provide any type of quantitative support for the assertion that the contracted for water represents an actual need. Readily available data does not support any demonstration of immediate "need" for water by Denver Water to fulfill requests under these contracts. In fact, and contrary to the fear-mongering statement that "calls for additional supplies under their contracts with Denver Water are accelerating more quickly than Denver anticipated (FEIS Appendix A-2 at 8), raw water

[12] "There are approximately 30 entities, including municipalities, water districts, industrial customers, golf courses and power plants, that have agreements with Denver Water to provide up to a certain supply of either treated or raw water each year. In the year 2000, the total water demand from these fixed and special commitments amounted to approximately 43,000 acre-feet. However, Denver Water is committed to providing slightly more than 67,000 acre-feet, suggesting that an additional 24,000 acre-feet of demand be incorporated in the Denver Water demand projections." FEIS Appendix A-1 at 10.

demand has not increased over the last decade.[13] As with total demand, annual use varies but the trend is clearly for demand to be either flat or decreasing:



Data: Denver Water 2014 Annual Report (Exhibit C)

In light of this critical role deliveries under the fixed contracts play in the "need" for the Moffat Project, it is inexcusable that the Corps failed to take a hard look at actual demand. The Corps must undertake an independent analysis of the actual demand anticipated under these contracts within the project time frame, similar to—but more competent than—that conducted for Denver Water's Combined Service Area, and consider how Denver Water might meet that demand without developing additional firm yield in the North System. The Corps should pay particular attention to the role of temporary demand and demand meeting techniques in light of the extremely variable nature of water use in the Denver Water system.

<u>The Arvada Contract is Inappropriately Included in Water Demand Projections</u>

[13] Raw water delivery amount is not a perfect approximation for the amount of water that Denver Water provides under these contracts but provides a reasonable proxy for the general trend. In 2014, deliveries outside the Combined Service Area were split approximately 2/3 raw water and 1/3 treated water. Denver Water 2014 Annual Report (Exhibit C) at III-21 and III-22.

The FEIS incorporates 3,000 AF from the 1999 Arvada Contract into the projected demand beginning in 2032. FEIS at 1-15 (Table 1-1). As Denver Water is only obligated to provide this water if the firm yield from the Moffat Collection System is increased (FEIS at 1-19), it was improper for the Corps to incorporate this amount into the "need" for the project. This 3,000 AF of increased firm yield is a consequence of the project, not an underlying demand that creates a justification for the project. The Corps must re-conduct its demand projections and need analysis without considering the water proposed under the Arvada contract.

This 3,000 AF represents 1/6 or 16.67% of the 18,000 AF new firm yield "need" claimed by Denver Water – a significant percentage of the total. Subtracting the 3,000 AF might significantly increase the attractiveness of various alternatives to the current preferred alternative.

4. Conclusion

In order to comply with the National Environmental Policy Act, Clean Water Act, and Endangered Species Act, the Corps must redo the demand projections in the FEIS. STC's review of the FEIS and comments presented here are not intended to be comprehensive, but STC's comments make a clear case that the demand projections are fatally flawed and must be redone. FThese comments are supplementary to earlier submissions and do not replace previous comments unless specifically noted as doing. STC has confirmed with the Corps that the Corps will accept and consider all substantive comments on the FEIS submitted prior to the publication of the Record of Decision for the Moffat Project[14]. Consequently, these comments – raising major issues of great public interest -- are entitled to full review and response by the Corps

Save The Colorado stands ready and willing to meet with the Corps and Denver Water officials to discuss this crucial and glaring flaw in the current NEPA documents prepared in conjunction with the Moffat project.

Please acknowledge receipt of this letter.

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[14] http://www.dailycamera.com/boulder-county-news/ci_25908721/army-corps-will-take-more-comment-gross-reservoir

Thank you,

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The mission of Save The Colorado is to protect and restore the Colorado River and its tributaries from the source to the sea. Save The Colorado focuses on fighting irresponsible water projects, supporting alternatives to dams and diversions, fighting and adapting to climate change, supporting river and fish species restoration, and removing deadbeat dams. Save The Colorado has thousands of supporters throughout the Southwest U.S. from Denver to Los Angeles and beyond.

McCurry Hydrology, LLC

Memorandum

To: Federal Energy Regulatory Commission
From: Gordon McCurry, Ph.D.
Date: April 6, 2018
Subject: Comments on "Supplemental Environmental Assessment for Amendment of Hydropower License - Gross Reservoir Hydroelectric Project, FERC Project No. 2035-099"

As a professional geologist with more than 30 years of experience in hydrology including water supply planning in Colorado and elsewhere, this memorandum presents my technical review of the Supplemental Environmental Assessment for Amendment of Hydropower License - Gross Reservoir Hydroelectric Project, FERC Project No. 2035-099 (Supplemental EA), dated February 2018, and supporting documents. The Supplemental EA is intended to correct deficiencies in the US Army Corps of Engineers (Corps) Final Environmental Impact Statement (FEIS, Corps, 2014) for the Gross Reservoir project, which was in turn prepared in support of the Corps' permitting process and upon which the Commission relies for the majority of the environmental review required of its licensing process by the National Environmental Protection Act (NEPA).

The Supplemental EA lists eight items in Section 2.3 that were part of the Commission's review of this Supplemental EA. Key among them is item 8, 'effects of Denver Water's compliance with statutory requirements'. As stated in Section 2.0 of the FEIS, the Council on Environmental Quality (CEQ) regulations for implementing NEPA require that an EIS "rigorously explore and objectively evaluate all reasonable alternatives," (40 CFR 1502.14[a] and [d]). Reasonable alternatives, as defined by the CEQ, are those that are practical or feasible from the technical and economic standpoint. In addition, the Corps Section 404(b)(1) Guidelines define practicable alternatives as "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall project purposes" (40 CFR 231.10[a]). It is this reviewer's opinion that the review of this Denver Water proposal has not complied with many aspects of the CEQ and Corps statutory requirements in its FEIS for this project.

As discussed below, the areas in which the FEIS are deficient include the preferred alternative not meeting the Purpose and Need, and not being the least environmentally damaging practicable alternative. Furthermore, the process used to screen potential water supply sources and infrastructure components, to assemble them into alternatives and to evaluate those alternatives was flawed due to the outdated nature of much of the information upon which its decisions were made. The documents that are part of the FERC's review and its regulatory mandates do not appear to support approval of the proposed dam and reservoir project. Therefore, the Commission should deny the relicensing application or require Denver Water to submit a revised EIS that complies with the statutory requirements. Examples of false, erroneous, or misleading information used by Denver Water to select its preferred alternative are given below.

Purpose and Need

The stated purpose and need listed in the FEIS is to develop 18,000 acre-feet per year (AF/yr) of new, firm yield to the Moffat Treatment Plant. The rationale given for this need includes improving system reliability during a drought ('Reliability Need') and addressing a predicted near-term water supply shortage of 34,000 AF/yr by 2032 ('Firm Yield Need'). Of this near-term shortfall, Denver Water will rely on 16,000 AF/yr forthcoming from the implementation of additional conservation efforts.

As presented in the summary of Denver Water's planning estimates (Table 1-1 of the FEIS), Denver Water projected a total system demand of 289,200 AF/yr in 2010 and almost 90,000 AF/yr larger (379,000 AF/yr) in 2032. Although these demand projections were reportedly updated in 2010, Denver Water's own water use information (Figure 1) shows that actual water use was, and remains, far below these demand numbers. For example, 2010 actual water use was approximately 215,000 AF (equivalent to 70,000 million gallons), only 74% of the total system demand given in Table 1-1. Significantly, water use has declined since 2010 to approximately 185,000 AF (60,000 million gallons) even though the population in Denver Water's service area increased by approximately 200,000 during that period.

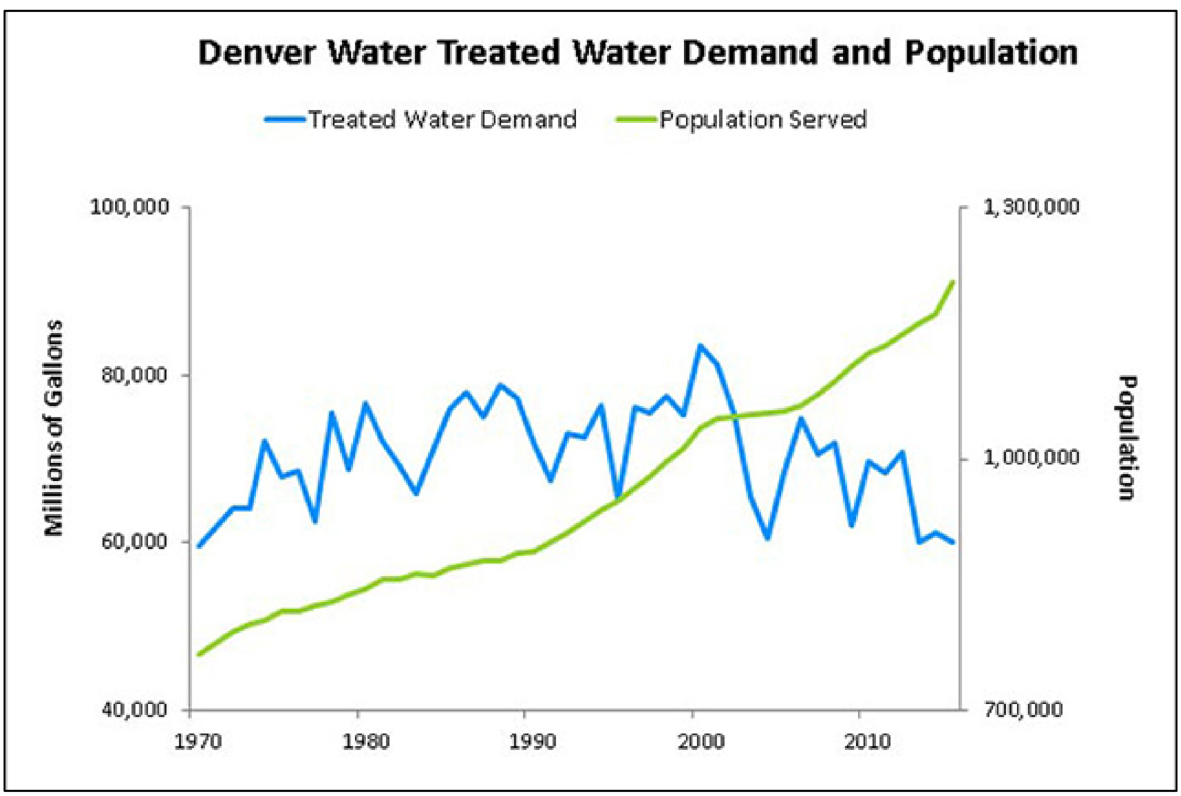

Figure 1. Denver Water Treated Water Demand and Population. Source: https://www.denverwater.org/your-water/water-supply-and-planning/water-use.

The decline in water use is a tribute to water conservation efforts undertaken by Denver Water and its customers. The demand presented on Table 1-1 of the FEIS is for unrestricted demand, defined in footnote 1 of that table as demand that does not include reductions due to drought restrictions, historical conservation or natural replacement of inefficient plumbing that are unrelated to Denver Water's conservation programs. The 'Reliability Need' during a drought can be met with less cost and with less environmental impact if Denver Water were to continue to implement conservation measures. Doing so would further reduce Denver Water's demand and thereby reduce its projected shortfall between supply and demand in future years.

Denver Water's system supply is reported on Table 1-1 of the FEIS as being 315,000 AF/yr. With recent demand at approximately 185,000 AF/yr, there is approximately 130,000 AF/yr of excess capacity in Denver Water's current supply system. This is significantly more than the 100,000 AF/yr of increased demand projected from 2010 to 2032. The excess capacity in Denver Water's system renders its Purpose and Need for an additional 34,000 AF/yr of water by 2032 invalid. Therefore, there asserted basis for expanding Denver Water's water supply and storage system is not supported by usage data that become available after the project permit was initially proposed. The Commission should reject the relicensing application on those grounds.

<u>Screening Process Used in the EIS</u>

Even if the Corps were to revise the Purpose and Need statement in the FEIS in a way that would justify an enlargement of Denver Water's water supply and storage system, the screening process of potential water supply sources and infrastructure components that was used in the EIS appeared to be in conflict with both CEQ and Corps regulatory requirements. As stated in Section 2.0 of the FEIS, CEQ regulations include the requirement to rigorously explore and objectively evaluate all reasonable alternatives (40 CFR 1502.14[a]). However, the selection process appears to have been biased so as to only retain items that were desirable from the standpoint of the applicant.

The EIS identified 303 potential water supply sources and infrastructure components that could potentially become part of alternatives to meet the project's Purpose and Need. A multiphase process was used to screen and assemble these components into five alternatives. Although a phased approach to evaluating system components is appropriate, there were many decisions made to retain or reject certain components that appear to be in violation of the applicable regulations.

For example, in screening phase 1A a set of 16 criteria were used to eliminate potential system components. Of these, the following criteria appear to be misapplied:

- <u>PN2</u> (must supply water to the Moffat Collection System). This criterion is overly restrictive since pipelines connecting Denver Water's Southern and Northern supply systems or pipelines bringing water from locations downstream of the Moffat Treatment Plant would allow the approximately 18 potential components that were screened to be retained for further consideration. Denver Water is in the process of upgrading its Northern supply system. It is appropriate to evaluate the extent to which these upgrades address the concerns Denver Water has regarding the connectivity between the Southern and Northern supply systems and to update the EIS to include the system upgrades before eliminating potential system components.

- PN3 (must produce a solution within the near-term timeframe). The near-term timeframe is not defined in the FEIS, but in the Alternatives Screening Report, Moffat Collection System EIS referenced in Appendix B of the FEIS (Corps, 2007) the near-term delivery date of no later than 2016. This date is presumably based on that being the year of shortfall in water supply and is no longer applicable. The Alternatives Screening Report also mentions a lead time of 11-16 years to implement a water supply alternative due to items such as planning, permitting, design and construction. If we assume that as the time frame, then almost none of the ten storage components (reservoirs) screened in this criterion should have been eliminated since they would have a similar lead time to the preferred alternative. This includes the four existing Front Range reservoirs that are not in the Cache la Poudre basin (component numbers 204, 207, 213 and 229 in FEIS Appendix B, Table B-1).

  This criterion was also used to screen several institutional and water management concepts, including renegotiating agreements (component #304), buying back certain water contract portfolios (#306), land purchases (#307) and converting raw water contracts to treated water contracts (#501). Colorado's water policies and practices have changed considerably since the early 2000's when the information for the Alternatives Screening Report was developed, as suggested by the State Water Plan (CWCB, 2015), so these institutional and water management concepts may now be feasible within an 11-16 year timeframe and warrant further consideration.

  As discussed in the Purpose and Need section above, there is not likely to be a shortfall in the near term and therefore this evaluation criterion does not appear to be applicable to screening of system components.

- ET1 (must use proven technology and management practices). This criterion targeted direct potable reuse (component #401). This component was eliminated, with the Alternatives Screening Report citing a 1998 report and isolated actions regarding use of this technology in California in 1999, 2003 and 2005. In the intervening 12 years, direct potable reuse has seen an increase in use including a 10 million gallon per day (mgd) plant in El Paso, TX, a 7 mgd plant in Wichita Falls, TX, and 1 mgd demonstration plants in San Diego, CA and even in Denver. The EPA developed a compendium of potable and indirect potable reuse systems (EPA, 2017) and other entities such as the Water Environment and Reuse Foundation and the American Water Works Association that are actively working to promote this technology. The technology is proven and its use will increase over time.

This is another example of how water management practices have evolved since this component was eliminated over a decade ago, a decision that is now inappropriate and should be revised.

- ET2 (must not require extreme or extraordinary technical effort to overcome site conditions). One water supply source, Denver Basin brackish groundwater (#802) may have been screened erroneously. The technology for developing brackish drinking water projects has evolved considerably since this component was screening. An example is the San Antonio, Texas, Water System. It includes deep wells that withdraw water from a brackish water aquifer and treat it at a desalination plant that produces 12 mgd (see http://www.saws.org/Your_Water/WaterResources/Projects/desal.cfm). Denver Basin brackish groundwater might be eliminated for other reasons, but criterion ET2 does not appear to be a valid one.

- LG3 (must be outside lands or sites known to be integral to development plans of others). A total of 14 storage and 1 supply management strategy were eliminated using this criterion. These 15 potential components should be re-evaluated to verify that in the past decade none of them have been discarded from plans being developed by other entities.

- LP1 (must be capable of storing at least 15,000 AF in a surface impoundment). This criterion was inappropriate in several aspects and resulted in a large number of the potential system components being eliminated inappropriately from further consideration.

  As stated in FEIS Table 2-1, the 15,000 AF storage requirement could require as many as five new surface storage sites to meet the projected new water storage and that "incorporating that many surface storage sites into an alternative is probably too complex to reasonably implement and manage." Given the complexity of Denver Water's existing water supply, treatment and distribution system portfolio and its successful management of that portfolio, this statement is outrageous and blatantly fails to comply with the CEQ requirement to rigorously explore and objectively evaluate all reasonable alternatives (40 CFR 1502.14[a]). A review of potential system components (FEIS Table B-1) indicates that there are dozens of storage sites with greater than 5,000 AF storage. There is little doubt that a rigorous and objective evaluation of the water supply and management components assembled by Denver Water would result in a set of alternatives that include more than five smaller storage sites that, collectively, could satisfy the additional water supply need with lower environmental impact and lower cost.

  The 15,000 AF storage requirement appears to be arbitrary and leads to a biased outcome of system components that are retained for further analysis. The storage requirement is based on a conservative assumption of the need for a storage-to-firm yield ratio of 4:1. The Alternatives Screening Report states, however, that smaller ratios such as 3:1 and thus a smaller storage threshold may be acceptable depending on the source of supply and degree of conservatism used.

The requirement that the component lead to storage in a surface impoundment is another item that biases the outcome of the screening evaluation. The retained groundwater storage components (# 805-807) indicate that surface storage is not a relevant constraint, so the language in this criterion regarding surface storage should be removed. Furthermore, subsurface storage has minimal environmental impacts and results in no evaporative loss of stored supplies, making it an even more attractive storage option.

The bias imparted by this evaluation criterion led to an incomplete and inadequate set of alternatives available for further analysis. The FERC must require Denver Water to reassess the components rejected by this criterion by using a more rigorous and objective approach.

- LP2 (must be available from a sustainable source in amounts sufficient to be practically developed). This criterion eliminates sites if they cannot provide at last 15,000 AF of additional firm yield in at least one year in four. This criterion is also flawed by being biased toward higher storage volumes so that five or fewer storage sites could satisfy the projected need. The component Expanded Non-Potable Reuse (#403) was eliminated with this criterion even though the Alternatives Screening Report notes that Denver Water's recycling plant has excess treatment capacity in the winter. Expanded use of the water recycling plant could free up potable water from the Moffat Treatment Plant that is currently used for non-potable uses and this saved water could be used to meet a portion of the projected need. The evaluation failed to consider water management approaches such as exchanges or expanded non-potable uses that would make expanded non-potable reuse a viable aspect of any alternative. Denver Water's participation in the Prairie Waters project, involving recapture and reuse of treated effluent, is an example of the success and viability of this water management approach.

In the next phase of screening potential system components (Phase 1b), there was one conceptual flaw that resulted in a subsequent error in evaluating several of the retained alternatives. The Phase 1b screening phase included a comparison of candidate storage sites that were located close to each other relative to impacts to aquatic resources. Since there were no impacts to aquifer resources for the five retained storage sites located in shallow aquifers (Box Elder Creek, Lost Creek, Kiowa Creek, Bijou Creek and Badger Creek), the aquifer sites were screened based on their proximity to the Moffat Collection System service area. The Box Elder Creek shallow aquifer (component #805) was retained for further analysis. Colorado water law considers groundwater in the Box Elder Creek and Badger Creek shallow aquifers to be tributary to the South Platte River, and thus is administered according to the prior appropriation doctrine of water rights. In contrast, the Lost Creek, Kiowa Creek and Bijou Creek shallow aquifers are defined as Designated Basins in the Colorado state statutes (CRS 37-90-103) and are administered under different rules. The Designated Basin aquifers are separated hydrologically from the South Platte alluvial aquifer so are natural subsurface reservoirs for storage and recovery of water. This distinction played an important role when the alternatives were evaluated, as discussed below.

The Phase 1b screening process also assembled the retained components into 14 alternatives with sub-alternatives in many cases. Only two alternatives (Alternatives 11 and 12) did not include one or more surface storage reservoirs. A study done by the CWCB on underground water storage in the South Platte and Arkansas River basins showed many aquifer sites have ample storage, including both shallow alluvial and deeper Denver Basin bedrock aquifers (CWCB, 2007). That only 2 of 14 major alternatives were formulated without the presence of surface water reservoirs is a demonstration of the bias inherent in this project and is counter to the CEQ regulations that require a rigorous and objective evaluation of all reasonable alternatives (40 CFR 1502.14[a]).

The third screening phase (Phase 1C) focused on costs of the formulated alternatives. Several alternatives include reusable water supplies (6, 7, 8, 9, 10, 11, 12 and 14). The Alternatives Screening Report, Appendix C, assumed the unit cost for water treatment for reuse water was $5.25 per gallon per day. The Alternatives Screening Report also noted that this cost may be overly conservative and suggests treatment costs could be in the $3.00-$3.75 per gallon per day range. The higher treatment cost resulted in higher costs for those alternatives and contributed to Alternatives 6,7,9, 12 and several sub-alternatives of 10 being screened in this evaluation step. This appears to be another example of bias imparted into the EIS evaluation process. Given the increased use of treated wastewater and improvements in treatment technology since the Alternatives Screening Report was prepared in 2007, the screened alternatives should be re-evaluated using lower costs for water treatment.

Alternative 11a, storage of reusable supplies in deep and shallow aquifers, was a low-cost alternative that met the Screen 1C cost threshold. It was eliminated in this screening step, however, due to the firm yield of the reusable supplies assumed for this alternative not meeting the 18,000 AF/yr volumetric criterion. As discussed above for the Phase 1A screening criterion LP1, a set of alternatives that include more than five smaller storage sites, including deep and shallow aquifers, could satisfy the additional water supply need with lower environmental impact and lower cost. The CWCB study on underground water storage showed many aquifer sites in the South Platte basin, including both shallow alluvial and deeper Denver Basin bedrock aquifers, have available storage in excess of 200,000 AF, with the Upper Lost Creek, Lower Bijou Creek, and Dawson Unconfined West sub-regions each having more than 1,000,000 AF of available storage (CWCB, 2007). Based on the CWCB (2007) study and the lower environmental impacts of using aquifers for water storage, more alternatives should have included subsurface storage.

Alternatives screening step Phase 2 of the FEIS focused on environmental impacts of the 14 remaining alternatives and sub-alternatives. The scoring presented in Table 2-7 of the FEIS is the same as Table 3-2 in the Alternatives Screening Report. Impacts to wetlands was a key discriminator in this phase of the evaluation. The acreage of impacted wetlands used in the Alternatives Screening Report, shown in Appendix D of that report, are different from the acreage of wetlands shown in tables presented in Section 5 of the FEIS (Tables 5.8-1 through

5.8-3, 5.9-1 through 5.9-4 and as summarized in Table 5.22-1). The FEIS gives no explanation for the discrepancies of this important component of the scoring process.

Wetlands impacts presented as part of the Phase 2 screening were also used in the FEIS to make Alternative 13a (agricultural water conversion) appear to be the least attractive due to significant impacts. As shown in Table 5.8-1 of the FEIS, the permanent impacts to wetlands ranged from 1.75 to 6.15 acres for four of the five retained alternatives (1a, 1c, 8a, 10a). In contrast, Alternative 13a is listed as having 83.87 acres of permanently impacted wetland. The basis for this significantly higher area of impacted wetlands is a 2008 study done for the Northern Integrated Supply Project EIS, for a similar area in southern Weld County in which about 2.1 % of the irrigated land in that County is expected to be wetlands (Section 5.8.5, page 5-274). Using such an imprecise basis that resulted in such a significant outcome for Alternative 13a suggests a bias on the part of the EIS that is misleading and inappropriate. The impacts assessment for agricultural water conversion should be redone.

The Phase 2 screening process also resulted in the potential bias of retained Alternative 8a, which included 20,000 AF of shallow aquifer storage. The aquifer storage was originally to be in the Box Elder Creek shallow aquifer. The Alternatives Screening Report, Section 3.3.4, correctly identified limitations of this aquifer including ability to recover stored water due to its hydrologic connection to the South Platte River. A serious oversight was made in the statement that the Box Elder Creek aquifer was assumed to have the same hydrologic characteristics as for the Lost Creek, Kiowa, Bijou and Badger Creek shallow aquifers. The discussion presented previously on the classification of the Lost Creek and the Kiowa-Bijou Creek aquifers as Designated Basins makes them clearly different in hydrologic characteristics and storage capability than the Box Elder Creek aquifer and so those aquifers should not have been rejected as potential storage sites.

As noted in Section 2.1.5 of the FEIS, storage in the Box Elder Creek aquifer was subsequently changed to be 5,000 AF of storage in gravel pits located along the South Platte River. The 5,000 AF of storage volume is questioned, since Section 2.2 of the FEIS states that 7,600 AF of unused return flows would be available, on average, to supply these pits. Section 2.5.2.2 of the FEIS notes the existence of several gravel pits that could be converted into gravel storage pits. This is consistent with Denver Water's Downstream Reservoir Program that includes nine reservoirs with an estimated storage volume of 32,200 AF (see https://www.denverwater.org/ your-water/water-supply-and-planning/downstream-reservoir-program). With such a significant amount of gravel pit storage planned by Denver Water, it is not clear why these downstream reservoirs and their storage were not included fully in any of the alternatives.

Selection of the Least Environmentally Damaging Practicable Alternative

As stated in Section 2.0 of the FEIS, the Corps permit actions should comply with Corps' Clean Water Act Section 404(b)(1) Guidelines, which require "that no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant environmental consequences" (40 CFR 230.10[a]). Many of the potential water supply sources and infrastructure components that were eliminated from further consideration would have much lower environmental impacts to the aquatic environment than does Denver Waters' proposed alternative.

Even amongst the five alternatives (other than the No Action alternative) that were retained for consideration by the Corps, the proposed alternative has the following environmental impacts, as presented in FEIS Table 5.22-1:

- Greatest loss of rare vegetation communities,
- Second greatest loss of vegetation,
- Second highest permanent loss of wetlands,
- Greatest direct impacts to other waters of the U.S.,
- Greatest direct impacts to riparian habitats,
- Largest permanent loss of crucial seasonal habitats for elk,
- Greatest loss of non-crucial habitat for other big game species such as deer, black bears and mountain lions,
- Largest impacts regarding fragmentation of habitat,
- Largest permanent loss of USFS wildlife habitats, including effective habitats, forested corridors, open corridors, interior forest, existing old growth forest and old growth redevelopment areas,
- Greatest loss of sensitive habitats, including the Wininger Gulch Potential Conservation Area and the Wininger Ridge Environmental Conservation Area, and
- Largest loss of habitat for, and displacement of, USFS Region 2 sensitive species including northern goshawk, flammulated owl and several other bird and bat species.

It is inconceivable that the preferred alternative, with this range and magnitude of permanent environmental impacts, could be considered the least environmentally damaging practicable alternative as is required by the Corps. Based on the above analyses presented in the FEIS, the preferred alternative appears to be inconsistent with the legal requirements under the Clean Water Act and NEPA as discussed above.

<u>Conclusion</u>

The responsible federal permitting agencies (the FERC and the Corps) must evaluate the Supplemental EA and associated EIS documents to verify that Denver Water is in compliance with applicable statutory requirements, including those administered by the CEQ and the Corps. In doing so the agencies will identify the numerous errors, omissions and biases present in the FEIS, including those presented in this memorandum, that cause the preferred alternative and the process by which it was selected to be viewed as not being in compliance with the applicable statutory requirements. Most of the deficiencies in the FEIS are due to the outdated nature of many of the technical elements upon which it is based. These include the basis for the project's Purpose and Need, the process of evaluating alternatives, and the assessment of the least environmentally damaging practicable alternative. As a result, the only defensible response for the FERC is to reject the relicensing application in its current form.

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December 3, 2018

<u>Via E-Mail</u>
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Re: Request For Supplemental NEPA Review By The Corps For The Moffat Collection System Project In Light Of Significant New Information Bearing <u>On The Proposed Action</u>

On behalf of the nonprofit organization Save The Colorado, I hereby request that the U.S. Army Copy of Engineers ("Corps") conduct supplemental environmental analysis pursuant to the National Environmental Policy Act ("NEPA"), 42 U.S.C. §§ 4321-4370m, by preparing a supplemental environmental impact statement ("SEIS") or, at bare minimum, a supplemental environmental assessment to address and evaluate new circumstances and significant information relevant to this project and its environmental impacts. As explained below, **we request a response from the Corps by no later than <u>December 17, 2018</u>** informing Save The Colorado whether the Corps intends to conduct any supplemental NEPA review, and, if not, explaining the reasons why the Corps has declined to take this action.

<u>BACKGROUND</u>

I. <u>STATUTORY AND REGULATORY FRAMEWORK</u>

Congress created NEPA more than four decades ago "[t]o declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment . . . ." 42 U.S.C. § 4321. In light of this mandate, the Supreme Court has reasoned that NEPA is "intended to reduce or eliminate environmental damage and to promote 'the understanding of the ecological systems and natural resources important to' the United States." *Dep't of Transp. v. Pub. Citizen*, 541 U.S. 752, 756 (2004) (quoting 42 U.S.C. § 4321).

In achieving NEPA's substantive goals, Congress created two specific mechanisms through which federal agencies must evaluate the environmental and related impacts of a particular federal action—an EIS and an EA. *See* 42 U.S.C. § 4332(c). These procedural mechanisms are designed to inject environmental considerations "in the agency decisionmaking process itself," and to "'help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment.'" *Pub. Citizen*, 541 U.S. at 768-69 (emphasis added) (quoting 40 C.F.R. § 1500.1(c)). Therefore, "NEPA's core focus [is] on improving agency decisionmaking," *Pub. Citizen*, 541 U.S. at 769 n.2, and specifically on ensuring that agencies take a "hard look" at potential environmental impacts and environmentally enhancing alternatives "as part of the agency's process of deciding whether to pursue a particular federal action." *Baltimore Gas and Elec. Co. v. Natural Res. Def. Council*, 462 U.S. 87, 100 (1983). The alternatives analysis "is the heart" of an EIS or EA. 40 C.F.R. § 1502.14. NEPA's implementing regulations require that the agency "present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public." *Id.*

An EIS must be prepared by an agency for every "major Federal action significantly affecting the quality of the human environment." 42 U.S.C. § 4332(c). Under the Council on Environmental Quality's ("CEQ") regulations that implement NEPA, "significance" requires consideration of both context and intensity. Where a significant environmental impact is not expected, the agency must still prepare an EA and a Finding of No Significant Impact ("FONSI"). *Id.* §§ 1508.9, 1501.3. Where an EA or EIS has been previously prepared, NEPA's regulations require an agency to supplement its prior NEPA review when "[t]he agency makes substantial changes in the proposed action that are relevant to environmental concerns," or "[t]here are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts." 40 C.F.R. § 1502.9(c).

II. FACTUAL BACKGROUND

The Corps commenced its decisionmaking and NEPA review process for the Moffat Collection System Project in September 2003. *See* Corps, *Environmental Impact Statement – Moffat Collection System Project*, http://www.nwo.usace.army.mil/Missions/Regulatory-Program/Colorado/EIS-Moffat/. The Corps issued its Final EIS on April 25, 2014, and the agency issued its Record of Decision ("ROD") authorizing this project on July 6, 2017. *Id.*

Save The Colorado sent a letter to the Corps on August 24, 2018 requesting that the agency conduct supplemental NEPA review in light of various significant pieces of new information bearing on environmental concerns related to this project, which post-dated the agency's 2014 Final EIS and the July 2017 ROD. On October 26, 2018, the Corps responded by declining to engage in any further NEPA review in connection with this project.

DISCUSSION

As the Corps is aware, Save The Colorado and many other stakeholders have questioned the adequacy and rigor of Denver Water's outdated water demand projections (and the Corps' purportedly independent verification of them) that are central to the Corps' purpose and need for this federal action. Among the many problems identified by commenters with the project's purpose and need as stated in the Final EIS, Save The Colorado sent the Corps a detailed letter on October 7, 2015, based on information known at that time, explaining that the Corps' retention of Harvey Economics—and in particular Ed Harvey of that firm—raised potential conflicts of interest (and thus questions about the Corps' independent analysis of the purpose and need as required by the agency's own NEPA regulations) because of Mr. Harvey's prior employment as the Managing Director at BBC Research & Consulting ("BBC") during the time frame when Denver Water retained BBC to develop the water demand modeling that BBC used to estimate Denver Water's demand needs as part of its 2002 Integrated Resource Plan ("IRP"). In other words, it appeared at that time that Harvey Economics—and Mr. Harvey in particular—could *not* independently evaluate Denver Water's demand projections and their underlying modeling because Mr. Harvey was almost certainly involved as a hired contractor for Denver Water when those models and projections were developed, meaning that Mr. Harvey had a vested interest in affirming the validity of his own prior work for Denver Water while at BBC.

In an appendix to the Corps' July 2017 ROD, the agency brushed aside these substantial concerns in two brief paragraphs. *See* ROD Attachment B at 16, 20. Specifically, the Corps stated (without providing the public with any evidence of the "no conflict statement[s]"):

> The Corps required all of the contractors on the third-party contractor team, including Harvey Economics, to provide a written no conflict of interest statement that disclosed historic work products as well as the promise of future work from Denver Water. The Harvey Economics staff member who led the model evaluation had never previously worked on the Denver Water demand forecasting model. Harvey Economics was cleared of any potential conflicts in 2003 prior to starting work on the EIS.

Id.

Recently, however, Save The Colorado obtained records from Denver Water through the Colorado Open Records Act concerning Mr. Harvey's involvement in developing the models upon which Denver Water's demand projections in the 2002 IRP rely. Those records clearly show that BBC—and, in particular, the department at BBC that Mr. Harvey supervised—*was*, in fact, heavily involved in developing Denver Water's demand modeling and projections for the 2002 IRP. The first document is a November 1, 2000 "Municipal Demand Forecasting Literature Review," which also summarizes and advises Denver Water as to the pros and cons of utilizing different water demand models. *See* Exhibit A. The detailed report—which BBC characterized as a "comprehensive review"—was submitted by BBC to Denver Water and was authored by three BBC employees, with the *first-named* author listed as "Ed Harvey." The second document is an October 31, 2001 report "describ[ing] the analyses which produced the [Denver Water] water demand-forecasting model." Attachment B. Although this report did not list all authors by name, it was submitted by "BBC" to Denver Water while Ed Harvey was still the Managing Director of the relevant department at BBC. Only a few months later, in February 2002, Denver Water incorporated BBC's model and demand projections into its final IRP.

Later in 2002, Ed Harvey left BBC and opened Harvey Economics to do similar water demand work as he had conducted for clients (including Denver Water) at BBC. In 2003, the Corps hired Harvey Economics to independently verify the models, assumptions, and projections used by Denver Water to conclude that it needed 18,000 acre-feet of firm yield as a result of this federal project, as stated in Denver Water's 2002 IRP. Harvey Economics then proceeded to prepare three technical memoranda for the Corps (i.e., the January 15, 2004, August 12, 2004, and April 2, 2012 memoranda) upon which the Corps relied in the Final EIS as the only "independent" verification of Denver Water's need for this project. *See* Final EIS Appendices A-1, A-2, A-5. Each of those memoranda state that they were prepared by "Harvey Economics"—of which Ed Harvey is the "Principal/Partner" who owns the business—and the January 15, 2004 report specifically lists "Ed Harvey" as the lead author. In those memoranda, Mr. Harvey and his staff validated the same demand modeling and water demand projections that Mr. Harvey developed for Denver Water while serving as the Managing Director at BBC—i.e., he verified his *own* prior work. This is far from an independent inquiry into the validity of the project's purpose and need, especially in light of the many serious concerns raised by various stakeholders with this important aspect of the Final EIS that sets the baseline in determining the feasibility of alternatives that can satisfy the project's purpose and need.

In light of this highly significant new information recently obtained through an open records request, it seems clear that Harvey Economics (and Ed Harvey in particular) has a patent conflict of interest that eliminates, or at least calls into serious question, the independence of the sole contractor upon which the Corps has relied to "exercise *independent judgment* in defining the purpose and need for the project from both the applicant's and the public's perspective," as required by the Corps' own regulations. 33 C.F.R. Part 325 App. B § 9(b)(4) (emphasis added). Whether this is the result of a major oversight on the Corps' part or the Corps was misled by Harvey Economics as to its prior involvement as Denver Water's retained consultant on the subject matter at hand, the Corps' analysis concerning the purpose and need is fatally tainted by an inherent conflict of interest.

While the proper course of action in light of this substantial new information would be for the Corps to redo its purpose and need analysis from scratch based on this grave problem (as well as the remainder of the NEPA review process, such as the alternatives analysis, which necessarily flows from a legally adequate purpose and need statement), at bare minimum this information requires supplemental NEPA review addressing these concerns because it constitutes "significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts," 40 C.F.R. § 1502.9(c)(1). Thus, because lead agencies "shall prepare supplements" to final EISs where this criterion is satisfied, *id.*, the Corps must conduct supplemental NEPA review and issue an SEIS (or at least a supplemental EA) addressing this vitally important issue that is central to the Corps' purpose and need analysis, evaluation of reasonable alternatives that could satisfy the need for this project, and the ultimate decision as to whether the Corps should authorize this project under Section 404 of the Clean Water Act. In conducting supplemental NEPA review, Save The Colorado strongly urges the Corps to subject that document to public comment and input, in light of the controversial nature of this project and the immense public interest in this project shown to date by Colorado residents.

CONCLUSION

For the reasons explained above, Save The Colorado believes that the Corps—as the lead agency for this project—must conduct supplemental NEPA review as directed by the CEQ's NEPA regulations. Please let me know by **no later than December 17, 2018** if the Corps intends to prepare a Supplemental EIS or EA in response to this letter and the significant new information attached hereto. If the Corps decides not to conduct any further NEPA review despite the new information set forth in this letter, please provide a written response by December 17 explaining the reasons why the Corps has declined this request. I look forward to hearing from the Corps about this matter. Please let me know if you would like to schedule a conference call to discuss this matter in person.

Respectfully submitted,

William S. Eubanks II

William S. Eubanks II

SAVE THE COLORADO

Date: December 20, 2016

To: U.S. Army Corps of Engineers

From: Save The Colorado

Re: Recent Public Disclosures by Denver Water on System Water Use

On October 7, 2015, Save the Colorado (STC) submitted a letter to the U.S. Army Corps of Engineers (Corps) entitled, *Re: The Demand Analysis in the Final Environmental Impact Statement for the Moffat Collection System Project is Fatally Flawed and Must Be Redone.* On January 20, 2016, STC submitted a letter to the Corps entitled, *Re: The Demand Analysis in the Final Environmental Impact Statement for the Moffat Collection System Project is Fatally Flawed and Must Be Redone (part 2)*. On August 31, 2016, STC, along with The Environment Group, submitted a letter to the Corps entitled, *Moffat Collection System Project EIS - Decoupling Comment*. Your office has acknowledged receipt of all of these letters.

STC submitted the above letters to the Corps in response to the discovery of new information pertinent to the Moffat Collection System Project which is currently under environmental and permitting review by your office. STC expects the Corps to receive and give proper review and consideration to all information pertinent to the Moffat project up to the time that the agency makes a decision on the permit.

Relatedly, STC now submits to the Corps new information highly pertinent to the Purpose and Need determination for the Moffat project.

On November 15, 2016, the Denver Post published an article entitled *Denver Water users may have to pay more to cover $7 million projects in budget increase*. As of November 29, 2016, this article was available online at: http://www.denverpost.com/2016/11/15/denver-water-user-rate-hikes/. The article documents the intention of Denver Water, supported by agency spokesperson comments, to request a rate increase for 2017, based on reductions in system-wide water use. In particular, the article states:

> Total water use by Denver Water customers, including factories and businesses, has decreased by 20 percent since 2001 despite a 15 percent increase in the number of customers, according to utility data.

> This week, Denver Water officials said they have re-calculated residential water use and determined that their customers use about 90 gallons a day per person. Denver residents used about 120 gallons per person in 2001. Denver has emerged as a leader among western cities pushing conservation to avoid running dry amid a regional boom in population growth and development.

As has been extensively documented in our earlier letters, Denver Water's "need" for the Moffat project is based on demand models developed well over a decade ago. This modeling failed to account for the radical changes in water demand patterns that have emerged in the Denver area and across the west over the last fifteen years.

Denver Water's public statement that residential per capita use has dropped by 25% since 2001, and that total water use has dropped despite a significant increase in customer base during that same period, is a stark indication of just how inaccurate the modeling has proven to be.

According to Figure 1-5 from the Moffat Collection System Project Final Environmental Impact Statement, the modeling showed total system demand for 2015 to be between 300,000 and 325,000 acre-feet, up from 285,000 acre-feet in 2002. The demand modeling used by the Moffat project to establish the project's "need" has clearly failed to capture not only the magnitude of demand changes but more importantly the direction of demand changes. Real world data continues to show that population growth has not led to water demand growth since 2001 – the very rationale for the Moffat project is unsupportable.

STC calls on the Corps to carefully review the Purpose and Need statement and determination in the FEIS in light of the newly available information. Any decision on permitting the project that relies on outdated and discredited data and reasoning will be of necessity suspect and subject to challenge under Federal environmental review laws and regulations.

Please acknowledge receipt of this letter. Thank you,

--
Gary Wockner, PhD, Executive Director
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August 31, 2016

Tim Carey & Kiel Downing
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Submitted via E-mail: moffat.eis@usace.army.mil

Re: Moffat Collection System Project EIS - Decoupling Comment
Documentation Requiring the Corps to Revisit the LEDPA, Preferred Alternative, Purpose and Need Statement, and Water Demand Analysis
Demand & Need Comment Part 3

Dear Mr. Carey & Mr. Downing:

This comment letter supplements previous letters submitted by Save the Colorado and The Environment Group (TEG) by providing information not yet analyzed by the U.S. Army Corps of Engineers (Corps). Prior letters include Draft and Final Environmental Impact Statement (DEIS and FEIS) comment letters submitted by TEG and these recent submissions:

1. Diversions, Climate, Shortages, and Compact Call: *FEIS for Moffat Collection System Project failed to analyze impact of diversions on the Colorado River Compact, climate change, looming "shortages," and increasing the likelihood of a "Compact Call",* Save the Colorado joined by Waterkeeper Alliance, Colorado River Connected, Wildearth Guardians, Living Rivers & TEG (August 27, 2015)
2. Aquatic Resources: *Aquatic Resources Assessment of U.S. Army Corps of Engineers Final Environmental Impact Statement for Denver Water's Proposed Moffat Collection System Project* (John Woodling, Ph.D., Woodling Aquatics) (September 2015)
3. Demand Part 1: *The Demand Analysis in the Final Environmental Impact Statement for the Moffat Collection System Project is Fatally Flawed and Must Be Redone* (October 7, 2015)
4. Demand Part 2: *The Demand Analysis in the Final Environmental Impact Statement for the Moffat Collection System Project is Fatally Flawed and Must Be Redone* (part 2) (January 20, 2016); and
5. The Colorado River Protection Alternative (June 14, 2016)

This comment is submitted on behalf of Save the Colorado and The Environment Group of Coal Creek Canyon (collectively, the Conservation Groups).

Newly available data, documents, reporting, and findings undermine the purpose, need, analysis, and underlying rationale for the action proposed by project proponent Denver Water in the Moffat Collection System Project (Moffat Project) FEIS. New information establishes that the assumptions and projections presented in the FEIS regarding water demand and consumption are unreliable and inaccurate. They were based on outdated information, data, and assumptions. Projections are being disproven. As conservation takes root in the Denver Water service area and across the Southwest, the concept of decoupling—the disconnection between population growth and water demand increases—has supplanted many of the longstanding assumptions of water demand growth trends relied on by Denver Water to justify the project.

The new information indicates that the Least Environmentally Damaging Practicable Alternative (LEDPA) is not the current preferred alternative but rather a program of continued water conservation projects in conjunction with ongoing, planned, and available supplemental strategies. The Record of Decision (ROD) must be informed by a NEPA analysis that takes a hard look at the new scientific and socio-economic information referenced in this letter. FEIS assumptions and projections regarding water demand and consumption were based on outdated information. Recent data and documented trends proves them to be inaccurate.

In light of the new data and findings, the U.S. Army Corps of Engineers (Corps) must either 1) deny the proposed action, or 2) prepare a Supplemental EIS (SEIS) and allow public comment on a Draft SEIS. The SEIS must comply with the National Environmental Policy Act, the Clean Water Act, the Endangered Species Act, and other applicable law.

At this time, the record does not support approving the proposal to expand Moffat Dam, dredge and fill wetlands, and significantly increase trans-mountain diversions through Moffat Tunnel from the already highly stressed Colorado River headwaters streams that would be further depleted by the Project.

1. **Decoupling of population and water consumption is occurring in the Denver Water Service Area and across the Southwest U.S.**

The FEIS purpose and need included providing 18,000 acre-feet per year (AFY) of new, annual firm yield to the Moffat Water Treatment Plant to address a supply gap projected to manifest as early as 2022, at which time Denver Water predicted that "an annual water supply shortage could occur." FEIS at Abstract, ES-6, and 1-23.

Currently available data contradicts the fundamental assumptions and projections advanced by Denver Water to justify the project. As explained below:

- The data is outdated;
- The assumptions are flawed; and

- The projections are inaccurate.

Contrary to what Denver Water's predictions, the proposed Moffat Projects are not needed. Nor are the projects the least environmentally practicable alternative.

The Corps failed to analyze significant recent information, trends, and facts regarding water demand and use in the Denver Water service area and across the region in the FEIS. This new information is publicly available and widely documented by scientific literature, studies, reports, and comprehensive analysis.

a. Decoupling

Trends and conclusions on water demand in the southwestern United States based on compilations of available data were presented by John Fleck at a January 2016 Conference on the Colorado River. Mr. Fleck is the Water Resources Program Director at the University of New Mexico. Fleck is among the premier experts on water issues in the Southwest, and is the author of a new book on the subject to be published in September 2016, *Water Is For Fighting Over*.

Since 2000, water use in the Colorado River Basin and across the Southwest is increasingly characterized by a phenomenon called decoupling. Fleck's Abstract explains:

> Colorado River Basin water use across most sectors and geographies plateaued or began declining in the last two decades. Overall consumptive use of Colorado River water in the U.S. and Mexico peaked in 2002 and has declined by 6 percent since then, even as population and agricultural productivity have risen. Reflecting a phenomenon economists call "decoupling", this pattern suggests growth of population and economic activity is no longer necessarily linked to growing water use, creating opportunities for water managers attempting to cope with declining reservoirs and the threats of long term drought and climate change.

Exhibit 1 at 1 (emphasis added). (We're *Already* Using Less Colorado River Water: Management - Opportunities in the Face of Supply Constraints John Fleck, CLE Law of the Colorado River, January 2016.)

Although increasingly recognized by experts and documented by statistics across the region, the Corps failed to address decoupling in the FEIS. The FEIS lacks a single mention of the term describing the most significant trend in the past two decades for water management and use in the Southwest – a trend that was identified and publicly documented in the time period between publications of the DEIS in 2002 and FEIS in 2014.

The FEIS, relying on an insufficient review of its demand projections,[1] effectively assumed that the so-called "Chinatown Syndrome" (continued growth of water demand in parallel with population growth) would determine Denver Water's long-term needs during the analysis

[1] See *The Demand Analysis in the Final Environmental Impact Statement for the Moffat Collection System Project is Fatally Flawed and Must Be Redone* (October 7, 2015) at 3 - 7.

period. Although once widely accepted, empirical data documented by Fleck's scholarship establishes that the Chinatown Syndrome has not applied in the region for more than a decade.

> When the Los Angeles Department of Water and Power in 2005 laid out its long term water needs, the agency was using in excess of 600,000 acre feet of water per year. It projected that it would need at least 650,000 acre feet of water by 2015, and likely more than 700,000. <u>By 2015, water use was heading in the opposite direction, with use under 500,000 acre feet and declining</u>. Part of the savings came from the extraordinary conservation measures imposed across California in response to unprecedented drought.
>
> But even before the drought, the trend was already apparent - <u>use by the single largest municipal water agency in the Colorado River Basin has been doing down even as population has risen.</u>

<u>Id</u>. at 1 (emphasis added).

Los Angeles is not an outlier, "but rather represents a pattern among the major municipal water agencies in the Colorado River Basin" <u>Id</u>. at 2. The chart at page 2 of Exhibit 1 illustrates how water use has plateaued across the Colorado River Basin since 2002.

Fleck documents the same trends for two areas that rely partly on Colorado River Water via inter-basin transfers: Colorado's Front Range, including the Denver Water service area, and New Mexico's Middle Rio Grande.

> <u>In the Front Range communities of Colorado, the peak in municipal water deliveries came in 2000.</u> In New Mexico's Middle Rio Grande, which uses Colorado Basin water via interbasin transfer, total municipal water deliveries peaked in 2000. <u>These are not simply reductions in *per capita* water use, but rather are reductions in the *total amount of water* being used by these communities despite significant population growth.</u>

<u>Id</u>. at 2 (<u>underlining</u> emphasis added, italics original, notes omitted).

Fleck establishes that decoupling is being documented for agricultural water use in the Southwest as well as municipal and industrial water use. <u>Id</u>.

Upper Basin usage and usage across the Colorado River basin is going in the same direction as that documented for the Denver Water service area.

> Upper Basin water use is more difficult to track in real time, but based on preliminary estimates reflective of recent trends, <u>Upper Basin consumptive use peaked in 1994 and has been at a stable plateau ever since, varying between 3.5 maf and 4.2 maf per year.</u> With Mexican consumption relatively stable at 1.5 maf per year, <u>the total human use of Colorado River Basin main stem water peaked in 2002 at 13.7 maf.</u> Preliminary estimates put 2015 water consumption at 12.8 maf, the lowest since 2002. When reservoir evaporation and other water uses in the system are included, 2015's total water estimated water use of 14.5 maf could be the lowest since 1986.

> These patterns, found in most major municipal and agricultural geographies served with Colorado River water, suggest that the themes of the classic movie *Chinatown* - of the need for ever more water to fuel ever more growth in arid western North America, and of strife and conflict attending to the water's apportionment - need no longer hold true.
>
> Decoupling
>
> <u>Economists call the pattern seen in the basin - decreased use of a natural resource either in per person or absolute terms as populations and economies grow - "decoupling".</u>
>
> It is a common phenomenon seen in energy, land use for food production, and other natural resource categories, where resource use grows as populations rise into affluence, before leveling off or even declining as additional affluence creates opportunities for, and benefits from, more efficient resource use. In the United States as a whole, according to the U.S. Geological Survey's Water Use in the United States reports U.S. water use peaked around 1980 and has been declining since. The finding applies across the United States to all major water use categories - agriculture, municipal and industrial use, and agriculture. David Katz, an economist at the University of Haifa, has found that the pattern generally holds across the developed world.

<u>Id</u>. at 4 (emphasis added, internal notes omitted).

Thus, water use peaked nationally 36 years ago in 1980. In the Upper Colorado, consumptive use peaked 22 years ago in 1994. Like in Denver, populations and jobs have increased nationally and regionally as water use has fallen or remained stable.

These data, analysis and findings qualify as significant new information, and the Corps must take a hard look at them in the Moffat NEPA process. They were not acknowledged or analyzed in the FEIS.

Denver Water has argued that "demand hardening" limits the savings that can be achieved or projected through conservation. *See* FEIS at 2-122. This line of thought may have reflected some of the accepted thinking in 2002 when the DEIS was released, but in 2016, the assumptions underlying the EIS are increasingly belied by at least 16 years of hard data and newly established trends contradicting predictions and projections in both the DEIS and FEIS.

> The demand forecasts developed for the U.S. Bureau of Reclamation's Colorado River Basin Water Supply and Demand Study illustrate the difficulties western water managers have had in incorporating the phenomenon of decoupling in planning scenarios for the future of western water management. <u>The sum of the seven states' projections of their needs suggested significant near term growth in water use and</u>

> continued rising demand. In the years since the study was completed, the trend has moved in the opposite direction.
>
> Significant difficulties attend the task of projecting future water use trends associated with this decoupling. Some argue that the phenomenon of "demand hardening" means that municipalities will at some point exhaust their conservation opportunities, and that water use will then resume its upward trend as population rises. This is a significant issue, but California's experience during 2015 suggests that, for communities across the state, including those that had already achieved significant pre-drought conservation savings, the point of demand hardening has not yet been reached. The most noticeable example is Los Angeles, which despite significant conservation success going back decades cut its water use in 2015 by an additional 16 percent in a single year.
>
> Opportunities for additional agricultural water conservation are even more complex and difficult to project. More than the municipal sector, the agricultural sector is influenced by exogenous factors - the market price of, and demand for, different crops plays a significant role in farmers' planting and irrigation decisions, factors that are extraordinarily difficult to project.
>
> Despite those shortcomings, it is not only possible but essential to incorporate recent trends in water conservation into projections of future water use in the Colorado River Basin. Failure to do that leads us to the problem embodied in the Los Angeles Department of Water and Power's 2005 Urban Water Management Plan - a significant overestimate of how much water that community needs to meet future needs. Such overestimates among water managers are an understandable byproduct of the profession's incentives. It is far riskier to underestimate needs and run out of water than to overestimate needs and have an unused surplus. But the cumulative weight of everyone's continued overestimates has resulted in an unrealistic picture of our future water needs in the West that makes collaborative agreements based on everyone using less water more difficult to achieve.

Id. at 5-6 (emphasis added).

The conclusion reached for the Los Angeles Department of Water and Power (LADWP) appears to apply with equal force for Denver Water, and the demand projections relied on by the Moffat Projects FEIS.

Denver's 2002 IRP appears to be subject to the same problem – and the same inaccurate predictions - embedded in Los Angeles' 2005 Urban Water Management Plan. Over roughly over the same period that the Moffat EIS has been under development, the LADWP released a 2005 plan laying out long term water needs, projecting that 2005 usage of 600,000 AFY would raise to 650,000 by 2016 and likely more than 700,000. But by 2016, LADWP use was under 500,000 acre feet and declining. Only some of that goes to the current California drought: "the trend was already apparent" before the drought. Id. at 1.

Takeaways include: 1) LADWP 2005 projections of increased consumption and demand are analogous to those relied on by Denver Water for the FEIS; 2) the projections have not been realized for either district's service area; 3) in Los Angeles, demand in 2016 was approximately 100,000 AFY – or roughly 16.67% - *lower* in 2016 than in 2005; and 4) by continuing and modestly ramping up conservation efforts and education, there appears to be no reason Denver cannot also significantly *reduce* use.

The failure of the FEIS to mention or address decoupling is a fatal deficiency. The failure to consider trends, data, scientific and socio-economic data that may undercut the proposal cannot be allowed compromise the rigor of the Corp's independent analysis. The Corps bears the burden of proof to demonstrate compliance with applicable CWA guidelines, including the LEDPA requirement. 40 CFR 230.12(a)(3)(iv). Where, as here, insufficient information is provided to determine compliance, the permit must be denied.

b. Pacific Institute Report

Fleck's findings and conclusions are consistent with those of a comprehensive 2014 publication of the Pacific Institute, Municipal Deliveries of Colorado River Basin Water. The Executive Summary of this document states:

> The number of people relying at least in part on water from the Colorado River basin increased by roughly 10 million people from 1990 to 2008, to a total of almost 35 million. Much of this increase occurred in areas experiencing extraordinary population growth: several cities in Arizona and Utah more than tripled in population between 1990 and 2008. The Las Vegas metropolitan area added upwards of a million people, more than doubling in size. Tijuana also roughly doubled in size, adding more than 800,000 people reliant on Colorado River water for an estimated 90 percent of their water supply.
>
> Total water deliveries by these 100 agencies increased from about 6.1 million acre-feet in 1990 to about 6.7 million acre-feet in 2008. The volume of Colorado River basin water deliveries by these agencies also increased by about 0.6 million acre-feet over this period, from 2.8 million acre-feet to 3.4 million acre-feet, rising from 46 percent to 51 percent of total deliveries. The agencies delivering water in southern California actually delivered four percent less water in 2008 than they had in 1990, despite delivering water to almost 3.6 million more people. In fact, 29 water agencies in five different states delivered less water in 2008 than they had in 1990, despite population growth in their service areas.
>
> Almost every one of the water agencies included in the study experienced declines in per capita deliveries from 1990 to 2008. People and business are demanding less water than they did in 1990. This report does not attempt to determine the causes of these declines, but it does quantify these changes over time, giving a picture of trends for municipal water providers. The majority of people receiving water from the Colorado River basin live in areas where per capita deliveries dropped an average of at least one

> percent per year from 1990 to 2008, generating substantial long-term declines. Many of these areas showed substantial reductions in per capita deliveries.

Exhibit 2, Executive Summary at iii-iv (emphasis added).

The Pacific Institute closes by summarizing the analysis and statistics presented throughout the publication:

> Total municipal water deliveries increased by more than 600,000 acre-feet between 1990 and 2008, taking water from a basin that faces a future challenged by diminished supply and continued population growth. Yet the water delivery trends of many of these water agencies, such as those highlighted in Table 29, offer <u>a route forward, where growth can be accommodated within existing supplies and total demands on the basin actually decline over time. The large number of water agencies from many parts of the Colorado River basin states and Mexico that have already achieved substantial declines in per capita deliveries demonstrate what increased water efficiency and conservation can accomplish</u> and should encourage the less successful agencies to promote conservation and efficiency more aggressively in their own service areas.

<u>Id</u>. at 41 (emphasis added).

In other words, the potential for decreasing diversions must be recognized and analyzed. For purposes of the Moffat FEIS and ROD, whether this alternative qualifies as the LEDPA must be analyzed for the Upper Colorado streams targeted by the proposed Moffat Project. If decreasing consumption and increasing conservation allows providers to make do with equal or lesser amounts of water, that approach would surely be the least environmentally damaging practicable alternative.

In the context of documented trends, the Moffat FEIS failed to analyze the fact that many service providers in the Colorado River Basin are serving all-new population centers experiencing significantly greater population growth rates than those documented, projected - or possible - for the Denver Water service area. Denver Water's contained service area is among the oldest and most fully built-out population centers that relies on Colorado River Basin water. The boundaries are established and finite, subject to limited, quantifiable exceptions for contracts outside the core service area (as disclosed in the FEIS). See http://www.denverwater.org/docs/assets/7648BCD2-9E14-7FEC-FFB808AB3925221A/service-area-map-municipalities.pdf

The Pacific Institute documents that several cities in the basin tripled in size in less than two decades, from 1990-2008. Executive Summary at iii. By comparison, the modest population or job-related increases in the Denver Water service area would not appear to require the significant supply increases from trans-mountain diversions in an era of increased efficiency and conservation. Unlike cities in Arizona and Utah where population tripled in the last few decades, there is limited capacity for additional population growth within the Denver Water service area.

Diminished water usage in Denver and new evidence regarding the success of conservation was reported in a February 10, 2015 Denver Post article:

> The low use this winter continues a trend of declining water use despite a growing population. Denver residents use 82 gallons a day per person for all indoor and outdoor purposes, utility data show. That's down from 104 gallons in 2001 and puts Denver ahead of other Western cities that are counting on conservation to avoid running dry.

Exhibit 3 (emphasis added).

According to the Post, “Denver Water leaders last week declared a new target for 1.3 million customers: 30 gallons a day for indoor use.” Id. This target does not appear to have been addressed or disclosed in the FEIS. The fact that conservation is working is a reason to stay the course with conservation at the heart of a reformulated approach that satisfies the “least environmental damaging practicable alternative mandate.

The FEIS relies on Appendix A to support socio-economic analysis, and endorse the approach of relying on pre-2002 data to support the purpose and need. The Appendix A documents, including A-5 (the 2012 Update) are based on water consumption data and assumptions from the last century.

The primary need for new analysis goes to water supply, demand, consumption, per capita use, and trends – in Denver, and across the region. NEPA requires re-calculating and re-formulating the water demand models - contrary to Harvey’s unsupported opinion that such analysis “was not needed.” Appendix A-5 at 4-5.

According to the Harvey 2012 Update:

> HE [Harvey Economics] determined that a re-estimation or new configuration of the water demand models was not needed. The water demand models were originally estimated using 27 years of economic demographic, data which is believed to be the sufficient historical period for estimating regression coefficients. HE concluded that the structure of the 2002 water demand forecasting models remained sound and appropriate for projecting water demands in 2011.

FEIS A-5 at 2.

As explained above, the 2002 data is uninformed by decoupling and the sea change in consumption and demand that has occurred since that date.

In a section titled “Review and Validation of Denver Water’s Updated Projections,” Harvey concludes that “single family water demand projections are about three percent less than the 2032 projections produced in 2002,” and that “demand models point to an increase in water demand projections of more than nine percent” because of increases in employment projections in the service areas. A-5 at 5-6.

Attempting to validate the existing numbers based on 2002 modeling disregards ten-plus years of more recent data and newly established trends. In light of the new information which became available since the 2002 IRP and 1973-2000 data period, the FEIS must be updated to ensure the ROD is informed by current facts and trends.

The “updated” 2014 Harvey Report lacks any meaningful quantitative analysis or charts depicting actual treated water demand and consumption in the Denver Water service area. It does not consider the decoupling trends described above. As such, it is inadequate and unreliable.

The Harvey appendices cannot be relied on to support the proposed action sought by Denver Water. Today’s facts, current data, and updated trends all suggest that the project is not needed at this time. As applicant, Denver water bears the burden of demonstrating compliance with the Clean Water Act, including the LEDPA requirement. 40 CFR 280.12(a)(3)(iv). The burden has not been met.

2. **The Corps cannot rely on Denver Water’s IRP to justify the project or the Purpose and Need.**

Denver Water’s 2002 IRP projected a 75,000 AFY shortfall by 2016.

> To meet that demand, Denver Water currently has 375,000 acre-feet of yield available or in construction. That means a current excess of 90,000 acre-feet of supply over demand; but it also means a shortfall of 75,000 acre-feet to meet the 450,000 acre-feet build-out figure, which includes the 30,000 acre-feet safety factor. Except for its Moffat System problem, Denver Water’s present 375,000 acre-foot yield is sufficient to serve its increasing demand until the year 2016, at which time Denver Water’s demand and supply lines will cross if no further supplies have been added or no further demand reductions have been made.

Exhibit 5 at 69 (2002 IRP).

> Preliminary findings indicate that <u>our treatment and delivery system</u>, while needing continuous rehabilitation and maintenance, <u>has the capacity to meet the near-term peak day demands of our customers.</u> Current treatment plant capacity is 715 million gallons per day (mgd), and distribution system capacity is 550 mgd. Current maximum day water use is approximately 435 mgd. We plan to investigate ways to quickly reduce less crucial water consumption during a system emergency to protect critical uses. Doing so successfully would help avoid building redundant facilities.

Exhibit 6, 2012 IRP Update at 2-3. *See also* Exhibit 4, Denver Water’s Comprehensive Annual Financial Report for the years ended December 31, 2014 and 2013.

The IRP Update establishes that Denver Water's treatment and delivery system is adequate. Denver Water has the capacity to treat 715 mgd, and to distribute 550 mgd – compared to current maximum daily use of 435 mgd (as of 2011 or 2012).

3. **The Colorado River Cooperative Agreement raises issues requiring supplemental analysis.**

NEPA requires taking a hard look at alternatives, including supply side issues, and analyzing new information. But screening, analysis and contradictions in the FEIS appear to be directly contradicted by statements in the Colorado River Cooperative Agreement (CRCA) and other documents.

Dated September 26, 2013, the CRCA commits to make significant quantities of new water available to Denver Water through re-use, including approaches and alternatives screened out or rejected by the Moffat FEIS. The CRCA documents are found at http://www.coloradoriverdistrict.org/supply-planning/colorado-river-cooperative-agreement/. The CRCA is referenced in various places in the FEIS, but the document fails to take the required "hard look". See, e.g. Appx M and N. Before finalizing the FEIS and ROD, the Corps needs to independently conduct a comprehensive analysis of the CRCA pursuant to NEPA.

Two new pieces of new information in the CRCA are:

- "Denver Water will fully construct its recycled water system with the capacity to provide 17,500 acre-feet annually[.]" Appx K at K-8.

- To achieve this level of re-use, Denver Water will complete construction of at least 30,000 acre-feet of gravel pit storage or other functionally equivalent storage." Id.

This would appear to establish that various alternatives screened out for cost, technical, or feasibility reasons are in the process of being implemented. The FEIS currently provides: "In the event that a Section 404 Permit is not issued, Denver Water would continue to develop and implement its conservation, non-potable recycling, system refinements, and cooperative action projects as described in the 2002 IRP[.]" This needs to be updated to account for actions under the CRCA.

As drafted, the FEIS fails to explain how CRCA commitments in 2013 differ from and compliment prior commitments regarding re-use and storage. Either these are new commitments by Denver Water, or what was presented as new commitments in the CRCA were actually longstanding commitments. In either case, clarification and analysis is needed to meet NEPA's requirement of informed decision-making.

At a minimum, the Corps is required to conduct an updated alternatives analysis and LEDPA determination. For instance, regarding purpose and need, this information is directly relevant to all four needs enumerated in FEIS Chapter 1 and Appendix K: the asserted reliability, vulnerability, flexibility, and firm yield needs. FEIS Appx K at K-2. Regarding alternatives and screening, the information requires re-assessing the re-usable water and gravel storage sections at K-7 to K-8, and throughout the FEIS. The LEDPA determination and final ROD must take account of this new information.

The question goes to feasibility. By committing to implementation, Denver Water acknowledges that these alternatives are feasible and cost-effective.[2] Should Denver Water continue to pursue approvals for Moffat, this new information must be analyzed in a comprehensive SEIS. At a minimum, the new analysis must revisit the Purpose and Need, Alternatives, Environmental Impacts, LEDPA, and Conclusion sections.

4. "Natural Conditions During Drought" alternatives component

In addition to the alternatives previously presented, the SEIS should analyze the extent to which a "Natural Conditions During Drought" component could contribute to obviating the "need" for the additional trans-basin diversions proposed by Moffat. All it might require to be the LEDPA is to stop pretending that Denver's climate supports bluegrass lawns and aggressive irrigation of non-native exotics every year, regardless of actual precipitation. Natural Conditions could be analyzed as a component of the Colorado River Protection Alternative submitted by Save the Colorado.

Plant communities survived and thrived for many centuries across the Front Range before outdoor irrigation water transformed urban landscaping. It is more than reasonable to analyze returning to natural vegetation and native species.

The Colorado Constitution provides that domestic uses have priority over all other uses in time of drought. Thus, peoples' needs for indoor water use will be met. Native vegetation is hardy enough to withstand drought. Analyzing a Natural Conditions alternatives component would inform decision-making through the EIS by allowing readers to ascertain and understand the extent to which outdoor water use for non-native vegetation is driving additional proposed diversions at the expense of the West Slope and the Colorado River Basin. The Colorado River is relied on by over 40 million people in seven states and Mexico.

Denver Water's worst case scenario would appear to have little to do with people or businesses having adequate water for domestic purposes. The LEDPA determination must be informed by the extent to which Denver's proposal is a reaction to the introduction of non-native flora from regions with higher precipitation. Native flora and fauna across Colorado are able to withstand droughts based on historical adaptations. Indeed, this geographical reality was among the primary themes of one of the seminal books ever published about the American West: Wallace Stegner's *Beyond the Hundreth Meridian: John Wesley Powell and the Second Opening of the West*.

[2] The circumstances under which Denver Water committed to pursue and is in the process of achieving these alternative supply, storage, and related projects do not relieve the responsible federal agency from fully analyzing this new information under NEPA.

5. Conclusion

New information requires the Corps to choose between 1) denying the project based on the existing FEIS, or 2) preparing an SEIS. Decoupling goes to the heart of the issues addressed by the existing NEPA documents, but the FEIS fails to recognize or analyze decoupling. The current FEIS cannot support a ROD approving the proposed Moffat Projects.

Thank you for considering this comment letter, and incorporating it into the public record for the Moffat Projects EIS process. The Conservation Groups look forward to continuing to participate in public processes related to this project.

Respectfully,

Mike Chiropolos
Attorney for Save the Colorado and The Environment Group

Cc: Philip S. Strobel, Director, US EPA Region 8 NEPA Compliance and Review Program

Exhibit 1	We're *Already* Using Less Colorado River Water: Management - Opportunities in the Face of Supply Constraints John Fleck, CLE Law of the Colorado River, January 2016 (Abstract and Slides)
Exhibit 2	Municipal Deliveries of Colorado River Basin Water (Pacific Institute June 2011)
Exhibit 3	*Denver water use dips to 40-Year low in 2014,* (Bruce Finley, Denver Post, February 10, 2015)
Exhibit 4	Comprehensive Annual Financial Report for the years ended December 31, 2014 and 2013 (Denver Water 2014)
Exhibit 5	Integrated Resource Plan (Denver Water 2002)
Exhibit 6	Integrated Resource Plan Update (Denver Water 2012)

Actual Versus Projected Water Demand
For Denver Water Customers
LRB Hydrology & Analytics
4/3/2018

Denver Water implemented its Tap Smart water conservation effort in 2007 – accelerating its timeline to 2016 from 2050. Per the Water Conservation Plan of 2015;

“In this plan, 39,400 AF of water savings was apportioned in the following manner: 10,000 AF of permanent savings as a result of behavioral and structural changes from the 2002-2004 drought; a 4,400 AF reduction achieved as a result of an inclining block rate structure; and a 25,000 AF reduction from a combination of active and passive savings (WCP, 2015 page 3).”

Water conservation efforts by Denver Water have been successful and are evident in the reduction in actual water demand noted between 2000 and 2016. This report compiles water sales data from yearly comprehensive financial reports - published by Denver Water - to document actual water demand in the 2000s. Potable water use in 10 year increments is summarized in each financial report (page III-16 in 2015 annual financial report). Non-potable raw and reuse water data for individual years are noted in each annual report - included here as pdf files and on pages III-18 and III-21 of the 2015 financial report. Both potable and non-potable water demand is shown in Table 1.

Actual Potable and Non-Potable Water Use

Potable metered water use is presented in a summary table in Section III of the financial reports entitled “Treated Water Sold in Gallons by Type of Customer.” Under “metered general customers” and “other sales to public entities”, customer type is further broken down to inside city, outside city- read and bill, and outside city- total service. “Inside City” includes customers that reside inside the City of Denver and “Outside City” includes customers outside of the City of Denver but within Denver Water’s Combined Service Area (CSA). A map of the CSA is included in Section III of each financial report – page III-13 in the 2015 financial report.

The last category for treated and metered water sales in each summary table - “Sales of Treated Water for Resale” - includes customers on Master Meter contracts who are outside the City of Denver but inside the CSA and those to which Denver Water exports treated water to “Outside the Combined Service Area.” Entities which received treated water via master meter contracts are noted on page III-30 of the 2015 financial report.

Each treated water summary table ends with a “Reconciliation of Water Treated, Delivered, Consumption, Sales, and Non-Revenue Water” in which total water production in Denver Water’s treatment plants is adjusted for any changes in its clear (treated) water storage to calculate the total amount of treated – potable- water that was delivered to customers each year. This amount is noted under the “Total Potable Water” column in Table 1 below. Total sales of water, or metered water, is subtracted from the total amount delivered to calculate non-revenue water that is either lost in the system or not billed. Total metered water equals the sum of water sales to both inside and outside the CSA (columns 2 plus 3 in Table 1 below).

Table 1: Denver Water: Water Use from Financial Reports							
Year	Potable Water Use					Total Non-Potable (Raw and Reuse) Water Use (AF)	Total Potable and Non-Potable Water Use (AF)
	Inside CSA Metered Water (AF)	Exported Outside CSA (AF)	Non-Revenue Water (AF)	Non-Revenue Water (%)	Total Potable Water Delivered (AF)		
2000	249,144	NA	7,369	2.87	256,513	54,997	311,511
2001	232,431	4,650	11,667	4.69	248,737	35,213	283,951
2002	216,669	4,967	8,410	3.64	230,845	40,612	271,457
2003	185,344	8,022	5,387	2.68	200,703	39,979	240,682
2004	174,964	7,553	3,393	1.83	185,909	31,139	217,048
2005	198,444	7,709	3,984	1.90	210,138	37,060	247,198
2006	214,247	9,566	5,509	2.40	229,322	50,373	279,695
2007	200,193	10,686	5,415	2.50	216,294	32,538	248,832
2008	208,065	9,231	3,589	1.62	220,886	38,475	259,361
2009	179,425	8,907	2,267	1.19	190,599	28,396	218,995
2010	196,764	9,272	7,851	3.67	213,887	35,632	249,520
2011	190,448	8,493	10,544	5.03	209,484	37,751	247,236
2012	200,761	10,919	9,183	4.16	220,864	38,576	259,440
2013	169,431	8,419	6,936	3.75	184,785	30,804	215,589
2014	169,786	10,208	7,776	4.14	187,770	25,213	212,983
2015	167,752	9,660	7,077	3.84	184,489	28,930	213,419
2016	191,587	2,543	5,360	2.69	199,489	29,887	229,376

Denver Water plans to build-out its reuse system for irrigation, industrial use, and lakes in parks and golf courses such that, ultimately, over "5 billion gallons" or more than 15,000 AF is reused in the future (WCP,2015 page 6). Though raw and reuse water is differentiated in the financial statements, Table 1 above includes only the total non-potable water use summarized in the statements. Denver Water also entered water use data into the CWCB Water Efficiency database for 2013 through 2016 (Table 2). Non-potable raw and reuse water was differentiated in this database.

Table 2: Denver Water Use from CWCB Water Efficiency Data Portal									
Year	Potable Water Use (AF)			Non-Potable Raw Water Use (AF)			Non-Potable Reuse (AF)		
	Total Produced	Exported Outside CSA	Delivered To CSA System	Total Produced	Exported Outside CSA	Delivered To CSA System	Total Produced	Exported Outside CSA	Delivered To CSA System
2013	184,733	8,419	176,314	24,738	21,370	3,368	4,815	3,115	1,700
2014	187,771	10,208	177,563	16,801	15,195	1,606	3,878	1,980	1,898
2015	184,489	9,660	174,829	24,895	21,487	3,408	3,952	1,951	2,001
2016	199,489	10,230	189,259	24,356	5,266	19,090	5,273	2,457	2,816

Total produced potable water from the CWCB database (Table 2) matches total potable water delivered volumes in Table 1, above, taken from the financial statements for 2013 to 2016. It is unclear why potable water delivered to the CSA system (CWCB database in Table 2) is slightly lower than the sum of metered and exported water from the financial statements (Table 1) that total 177,850 (1,536 AF), 179,994 (2,431 AF), 177,412 (2,583 AF), and 194,130 (4,871 AF) AF in 2013 through 2016, respectively. Numbers in parentheses equal the difference in the two data sources.

Total non-potable water use from the financial statements (Table 1 above) are higher than the sum of total raw and reuse non-potable water in Table 2 above because effluent sales - 1,252, 417, 83, and 257 AF in 2013 through 2016, respectively - noted in the financial statements were not included in the CWCB database. In addition, in 2014, total produced raw water noted in the CWCB database (Table 2) did not include 4,118 AF of exported non-potable raw water listed in the financial statement under "other non-potable water deliveries." This exported water was included in total raw water deliveries every other year. It is unclear why it was omitted in 2014 in the CWCB database.

The total of potable and non-potable actual water use shown in Table 1 was used for comparison to water demand projections.

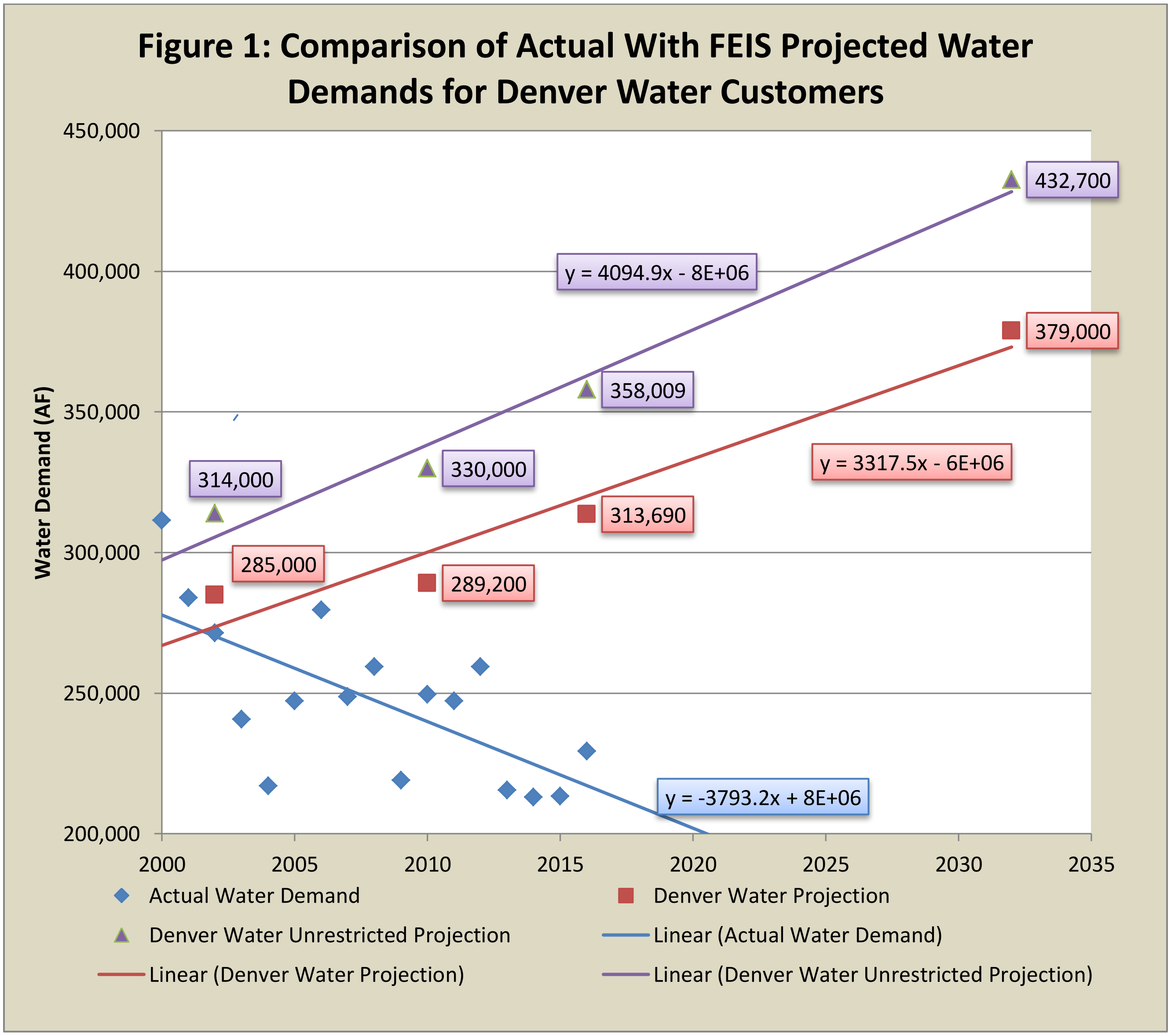
Comparison to Denver Water Demand Projections

Projected water demand for Denver Water customers was evaluated as part of the Moffat Project Environmental Impact Statement. Demand projections are included in Table 1-1 of the FEIS, 2014, for unrestricted demand as well as for system demand reduced by historic conservation and natural replacement savings. Unrestricted demand includes fixed contracts without drought restrictions, historical conservation, or natural replacement. The latter projection includes natural or passive water savings associated with replacement of outdated, inefficient plumbing fixtures with water-efficient fixtures; efforts that are independent of Denver Water's conservation programs. It also includes historic water conservation savings created by conservation efforts between 1980 and 2000 (FEIS, 2014 page 1-16). Demand forecasts from Table 1-1 of the FEIS are shown in Table 3 and graphically in Figure 1 below. Projected demands for 2016 were determined by extrapolating between projected demands in 2010 and 2032.

Table 3: FEIS Projected Demand Compared With Actual Demand

Year	Unrestricted Projected Demand (AF/YR)	Projected Demand with Conservation (AF/YR)	Actual Water Use – Table 1 Above (AF/YR)
2002	314,000	285,000	271,457
2010	330,000	289,200	249,520
2016	358,009	313,690	229,376
2032	432,700	379,000	NA

FEIS projected water demands increase over time though at a lower rate (lower slope of the trend line) for projections that include past and passive conservation savings (Figure 1). This is in contrast to the negative slope of the actual water use trend line indicating that actual water use in the 2000s has decreased over time, likely due to successful water conservation efforts by Denver Water.



The reduction in total gallons per capita per day (gpcd) noted in Figure 2 of the WCP, 2015, from approximately 180 gpcd in 2007/2008 to 142 in 2013 and an average of 160 gpcd between 2009 and 2013 also supports the observation of reduced water demand with time in the 2000s. Total gpcd was also included in statistical summary tables in both the 2013 and 2016 financial reports (page III-3). Total gpcd is displayed graphically in Figure 2. Total per capita use has trended downward between 2004 and 2016.

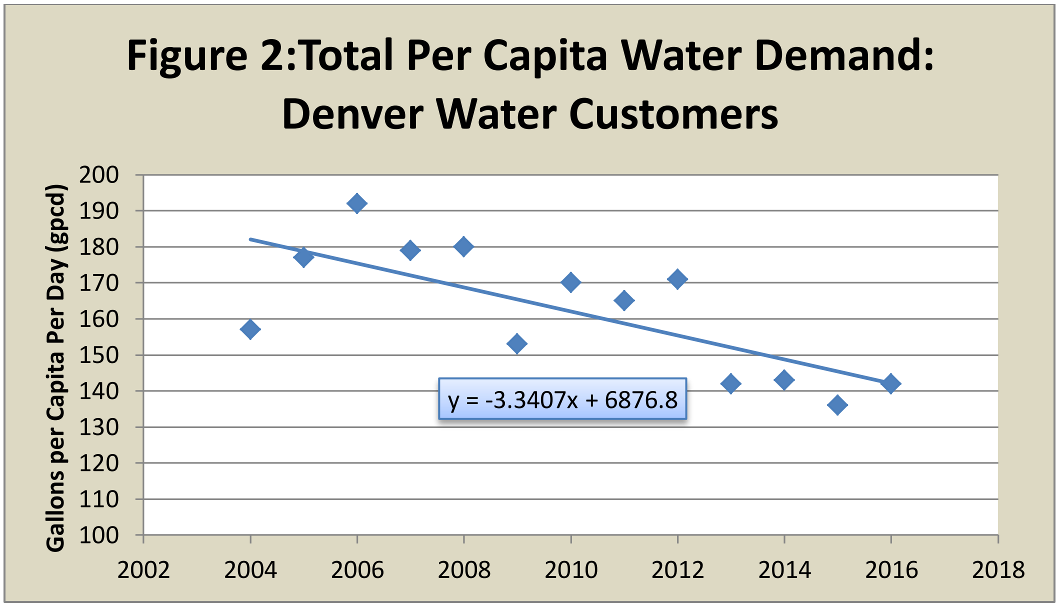


Figure 2:Total Per Capita Water Demand: Denver Water Customers
Gallons per Capita Per Day (gpcd)
200
190
180
170
160
150
140
130
120
110
100
y = -3.3407x + 6876.8
2002
2004
2006
2008
2010
2012
2014
2016
2018

SAVE THE COLORADO

Date: March 2, 2016

To: U.S. Army Corps of Engineers

From: Save The Colorado

Re: The Claims in the Final Environmental Impact Statement for the Moffat Collection System Project that the Project will Help Denver Water "Balance" its System are Inaccurate

Summary: Save the Colorado (STC) submits the following comments on the Final Environmental Impact Statement (FEIS) for the proposed Moffat Collection System Project (Moffat Project) to the US Army Corps of Engineers (Corps). Save The Colorado examined claims made in the FEIS by the Army Corps that the proposed project would help Denver Water "balance" its ability to provide water between its North System (Gross Reservoir and associated facilities) and South System (Dillon Reservoir, South Platte reservoirs, and associated facilities) and finds that:

1. The FEIS provides only broad, unsupported statements that the proposed project will address the identified system "imbalance."
2. The FEIS fails to establish that the proposed project would meaningfully contribute to a balancing of the yields provided by Denver Water's North and South Systems.
3. The FEIS fails to establish that the proposed project would meaningfully address the "location" issue identified in the FEIS as the basis for the project's need, namely the reliability, vulnerability, and flexibility challenges reflected in the asserted North and South System "imbalance."

Therefore, the Corps must reconsider these claims in the FEIS and must either provide meaningful, objective support for these assertions in a supplemental NEPA document or strike them from the

document and accompanying decision making process.

1. **The FEIS Attempts to Identify a Purpose and Need Statement that Calls for a Project that will Balance Denver Water's System**

Denver Water originally proposed four needs for the Moffat Collection System Project:

- The Reliability Need
- The Vulnerability Need
- The Flexibility Need
- The Firm Yield Need

FEIS at 1-2.

These needs were adapted into a singular Purpose & Need statement for the FEIS[1]:

> The purpose of the Moffat Collection System Project is to develop 18,000 acre-feet per year of new, firm yield to the Moffat Treatment Plant and raw water customers upstream of the Moffat Treatment Plant pursuant to the Board of Water Commissioners' commitment to its customers.

FEIS at 1-4.

The FEIS furthers states that two major issues form the basis for the asserted need:

> 1. Timeliness: Water Supply Shortage in the Near-Term Timeframe (Prior to 2032) […]
> 2. Location: Need for Water to the Moffat Water Treatment Plant and Raw Water Customers […]

FEIS at 1-4.

STC has previously submitted comments identifying the fatal flaws in the FEIS's analysis of the "Timeliness" component of the Purpose and Need statement. *See* "The Demand Analysis in the Final Environmental Impact Statement for the Moffat Collection System Project is Fatally Flawed and Must Be Redone," October 7, 2015. These comments established conclusively that the "demand" leg of Denver

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[1] Save the Colorado rejects as unacceptable the Corps' Purpose and Need statement presented in the FEIS. *See* "Re: Moffat Collection System Project – Final Environmental Impact Statement," The Environment Group, Save the Colorado, and Save the Poudre, submitted to the Corps on June 9, 2014 (comments of the FEIS), and forthcoming comments from Save the Colorado.

Water's need for this project was dramatically overstated and that the Corp's could not rely on the FEIS's analysis of this topic for its decision making on this project.

In this comment letter, STC turns to the other issue forming the basis for "need" identified in the FEIS, "location" or, as it is presented in the FEIS narrative, a focus on "balance" for Denver Water's system:

> This imbalance in reservoir storage and water supplies between the North and South systems has created water supply challenges that have resulted in:
>
> 1. **Unreliable** water supply for the Moffat WTP and Moffat Collection System raw water customers
> 2. System-wide **vulnerability** issues
> 3. Limited operational **flexibility** of the treated water system

FEIS at 1-4 (emphasis added).

The FEIS states that this imbalance is a result of Denver Water's system having been historically developed with a reliance on the South System (Blue River and South Platte River supplies) for approximately 90% of the available reservoir storage and 80% of the available water. FEIS at 1-4.

The FEIS makes broad statements that the proposed project will deal with reliability, vulnerability, and flexibility to address these imbalances:

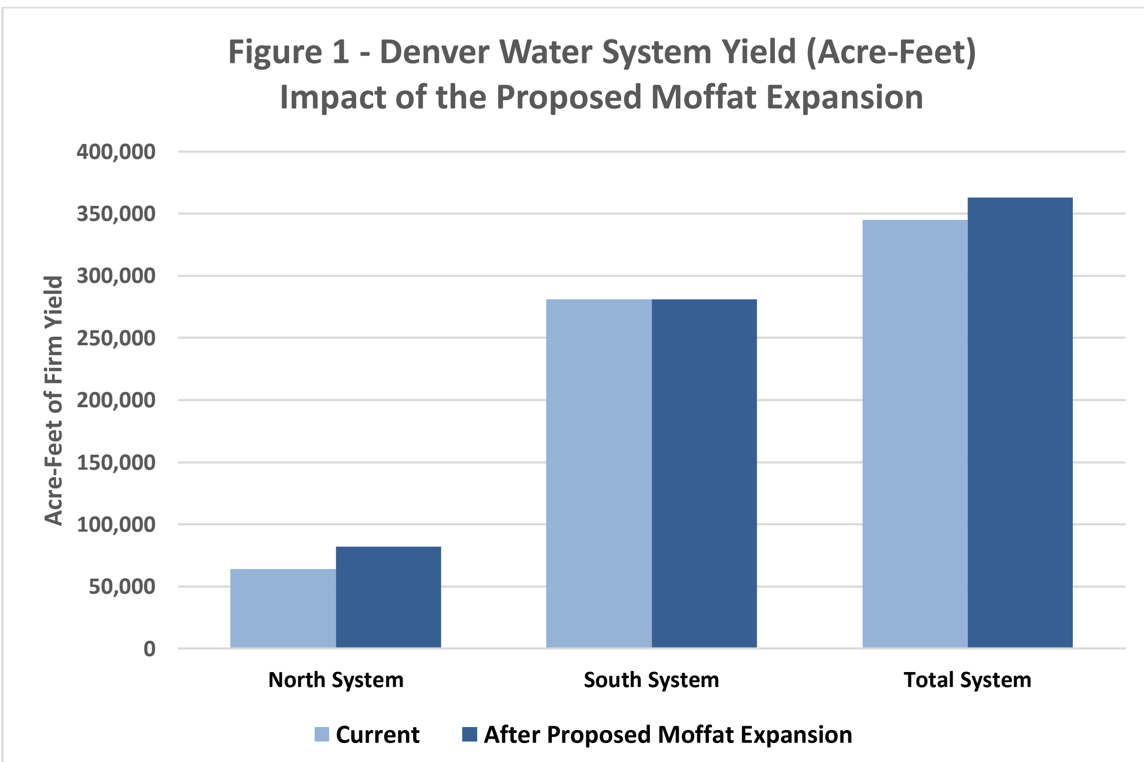
> "will improve reliability"
> "would reduce the current system's vulnerability"
> "would provide more operational flexibility"

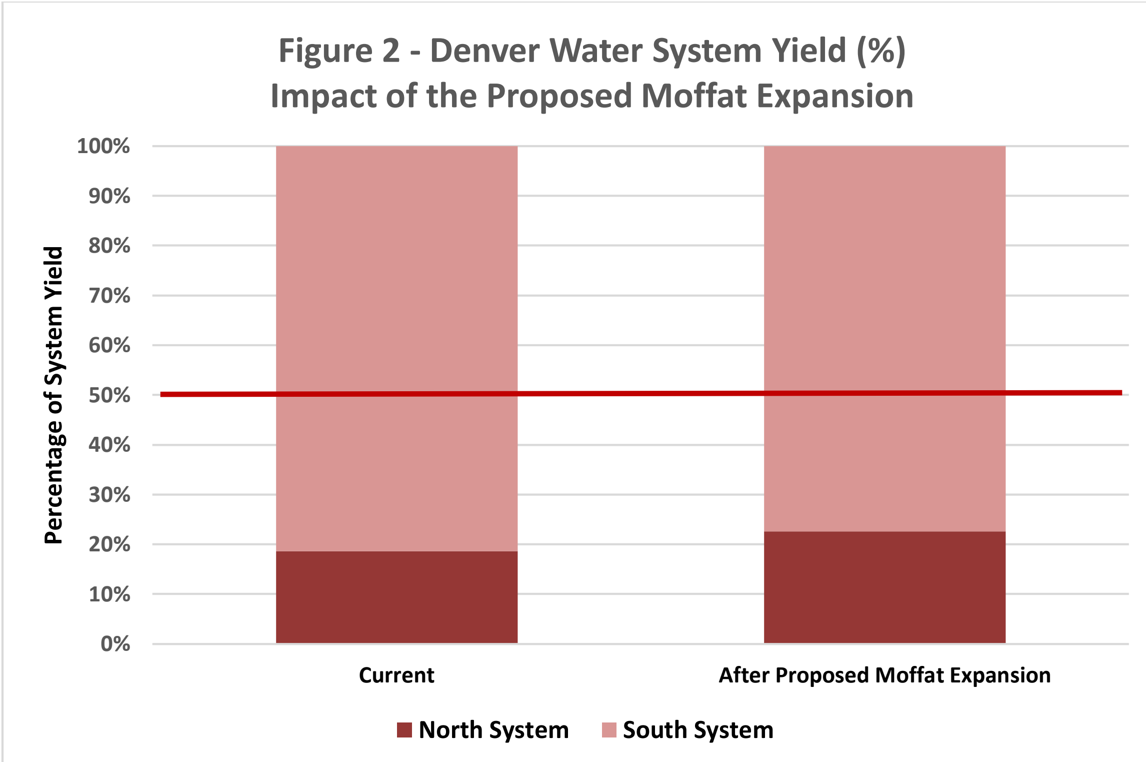
FEIS at 1-27, 1-28.

The FEIS, however, fails to provide meaningful, objective support for these assertions. Rather, data in the FEIS quantitatively demonstrate that the proposed project would do little to address the asserted system imbalances.

2. The Proposed Moffat Expansion Would Do Little to Improve the "Balance" of the Denver Water System

The FEIS cites a current Denver Water system annual yield of 345,000 AF, with 64,000 AF—19% of the total yield—coming from the North System. FEIS Table 1-3. The remainder, 81% of the total yield, is provided by the South System (incorporating the Roberts Tunnel and South Platte Collection Systems and exchange and re-use components). FEIS Table 1-3. The addition of the proposed new Gross Reservoir storage would add a claimed 18,000 AF/year of new yield to the North System, boosting the contribution of the North System to 82,000 AF/year (of a new total of 363,000 AF), which would change the balance to 77% from the South System and 23% from the North System. (This assumes that the new water in the North System reflects an actual growth in consistently available firm yield rather than an as-needed drought response flow, a function that Denver Water does not appear to support, and that the 18,000 AF/year of new yield in North System is obtainable—see below.) Consequently, the Gross Reservoir would only shift the "imbalance" by 4%, offering barely more than rounding error to the current 80%/20% that Denver Water considers problematic. *See* Figures 1 and 2.





If, as the FEIS states, a key basis of the need for the proposed project is to "balance" the North and South Systems of Denver Water's system, then the FEIS demonstrates that the proposed project fails to achieve a meaningful benefit in that regard. **Before the Corps can approve the proposed project or any other alternative to address the need for a Gross Reservoir expansion as identified in the FEIS, the Corps must clearly quantify the firm yield and storage volume in the North System that would allow for an additional strategic reserve to meet the reliability, vulnerability and flexibility needs cited in the FEIS**. FEIS at 1-2, 1-4. Such an analysis must include:

- Probable scenarios for routine maintenance and emergency outages in the South System water treatment plants, reservoirs, and associated facilities based on historical data.
- Probable scenarios, developed with qualified experts, for man-made and natural disasters that could imperil normal operations of the South System. This should include discussion of recent catastrophic wildfires and their impact on South System operations, if any.
- Quantitative discussion of the shortfalls that could be experienced by Denver Water's customers and raw water contracts as a result of the above scenarios.
- Quantitative discussion of Denver Water's ability to modify system operations, both under the proposed project and the No Action Alternative, to maintain that existing strategic reserve.

Further, Denver Water has indicated that the primary purpose of the new storage is to provide water for drought relief when needed, specifically 18,000 AF/year for four years of drought. FEIS at 1-25. These statements suggest that the water is intended to be held in Gross Reservoir as a reserve for the unforeseeable event of a prolonged drought. **The Corps must explain how the reserved water will be available as both drought reserve and to meet ongoing reliability, vulnerability, and flexibility needs.**

In addition, it is not at all clear what the actual additional yield provided by the proposed project through the North System would be. The FEIS suggests that the proposed project would be responsive to the Purpose and Need and provide 18,000 AF/year of new yield. *See*, *e.g.* FEIS at 1-4 ("Denver Water is pursuing the proposed Moffat Project to provide 18,000 AF/yr of new firm yield to the Moffat WTP", emphasis added) and FEIS at 2-35 ("In order to firm this water supply and provide 18,000 AF of new yield, the existing Gross Reservoir would be expanded"). It does not, however, state that the proposed project would actually deliver the 18,000 AF/year of new yield through the North System.

On the contrary, a careful reading of Appendix H-1 demonstrates that on average far less than 18,000 AF/year would be diverted through the Moffat Tunnel and additional diversions occur through the Robert's Tunnel (a component of the South System). *See* FEIS Appendix H-1 at H3-1 (listing a 45-year average annual change in diversion through the Moffat Tunnel of 14.2 cfs, approximately 10,280 AF) at H3-35 (listing a 45-year average annual change in diversion through the Roberts Tunnel of 6.4 cfs, approximately 4,600 AF). The only quantifications of the Moffat Tunnel and South Boulder Creek diversions related to this project in body of the FEIS but are buried in the special status species discussion of impacts, not in any description of the proposed project. *See* FEIS at 5-316 (Moffat Tunnel average annual diversion of 10,285 AF), 5-318 (South Boulder Creek average annual diversion of 985 AF). These figures are supported by a Denver Water letter[2] dated November 13, 2015, listing actual average annual diversions for the project (and including a figure of 4,836 AF for Roberts Tunnel). In the same letter, Denver Water states that "[a] common misconception is that the Moffat Project will reduce flows in the Fraser River basin by 18,000 AF every year, or by 18,000 AF on an average annual basis." Exhibit A at 3.

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[2] See Moffat Collection System Project – Request for Clean Water Act Section 401 Water Quality Certification, June 2015 (Denver Water, November 13, 2015), attached here as Exhibit A, at 4 (referencing FEIS Appendix H-1).

It is difficult to understand how the project can deliver more water than is diverted from the source streams. Consequently, the reviewer is left to wonder how the North System could deliver 18,000 AF/year of new firm yield when only 11,270 AF/year on average are diverted into that system.

The Corps must directly address and clarify the existing confusion regarding the actual firm yield available to the North System through the propose project. The Corps must also explain how the proposed project meets the Purpose and Need set forth in the FEIS if the additional firm yield available to the North System is less than 18,000 AF/year.

The significant existing confusion concerning the yield and diversions described above has apparently misled many readers, commenters and stakeholders to believe that the Moffat Projects as proposed are intended to provide 18,000 AF/year, every year to the Moffat Treatment Plant from the expanded Gross Reservoir. To allow an informed understanding and analysis of the project, the Corps must better explain proposed operations. To the extent the FEIS is vague or imprecise on these central issues, it abjectly fails to satisfy NEPA's requirement of informed decision-making.

3. Year-round Operation of the Moffat Water Treatment Plant May Consume Virtually All of the Additional Firm Yield Resulting from the Proposed Project

The FEIS identifies year-round operation of the Moffat water treatment plant as a key step towards system balance. FEIS at 1-26, 1-27. Currently, the Moffat water treatment plant is shutdown from mid-October through April or May to conserve Gross Reservoir water, leaving Denver Water with only two water treatment plants operational for five and one-half to eight months of the year.[3] FEIS at 2-55. In order for the Moffat water treatment plant to remain in an on-call status (available to quickly come on-line), a minimum operational flow of 30 mgd must be maintained. FEIS at 1-26, 2-55. To accomplish this, Denver Water would utilize the additional yield from the enlarged Gross Reservoir as well as shifting winter treatment to the Moffat water treatment plant. FEIS at 2-55, 2-56. The FEIS does not explicitly state what the extent of that shift and an accompanying summer treatment shift to the South System would be, or what net additional consumption of water from Gross Reservoir would be required. *See*, *e.g.*, FEIS at 2-55, 2-56.

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[3] STC does not, at this time, endorse or dispute the assertion that Denver Water requires three independent water treatment plants to adequately serve its customers.

This is a critical piece of missing data. For the period of October 15 through April 1, 168 days, operation of the Moffat water treatment plant at even the minimal operational level (30 mgd) would require 15,500 AF. Each additional day of minimum operation would result in an additional consumption of 92 AF; if the new operation period stretches from October 15 to May 1, then 18,200 AF would be required which is more than the new storage provided by the Gross Reservoir expansion. STC understands that Denver Water intends to shift operations between treatment plants so that this may not represent new consumption in the system. STC asserts, however, that these operational flows would unquestionably result in annual consumption of the new storage capacity in Gross Reservoir.

If Denver Water is consuming much, if not all, of the new Gross Reservoir storage for these displaced winter operations, that water will not be available for addressing the "system imbalance" concerns of reliability, vulnerability, and flexibility. That new consumption would occur outside the higher-demand months when customers use significantly more water for outdoor purposes. Unfortunately, the FEIS fails to provide the information—namely the extent of shifting of treatment to other plants during the summer—that would allow the reviewer to evaluate if the new storage will actually address these needs. **Before the Corps can approve the proposed project or any other alternative to address the need for a Gross Reservoir expansion as identified in the FEIS, the Corps must clearly quantify Denver Water's ability to operate the Moffat treatment water plant year-round while also addressing the reliability, vulnerability, and flexibility needs and provide a drought response reserve as asserted in the FEIS.** FEIS at 1-2, 1-4, 1-25. Such an analysis must include:

- Quantification of the net gain in firm yield for the North System to meet summer demand needs for treated water and raw water consumers, and to respond to outages of the South System, afforded by the project, as well as gains in long-term storage that would be available for drought response, including:
    - Quantitative assessment of the water intended for winter low-flow operations of the Moffat water treatment plant.
    - Quantitative assessment of the adjustments to summer treatment operations described at FEIS 2-26.
    - Confirmation that the reservoir operations modeling documented in the FEIS incorporated these demand characteristics, or revision of the modeling if the incorporation did not occur.

    - An explicit and accessible discussion of how the Denver Water system would be re-operated to allow for the above.
- Quantification of the extent to which this net gain in firm yield would mitigate North System shortages such as those cited from 2002 (FEIS at 1-11), including:
    - Quantitative assessment of the actual shortfall experienced in 2002.
    - Quantitative assessment of the potential shortfalls cited as likely under the No Action Alternative. *See*, *e.g.*, FEIS at 2-122.
    - Quantitative comparison of the shortfalls assessed above with the net gain in firm yield for the Moffat system afforded by the project.
- Quantification of how winter and summer treatment operations can be modified under the No Action Alternative to allow for year-round operation of the Moffat WTP.

The modeling results presented in the FEIS in Appendix H demonstrate that the Corps believes that Gross Reservoir will maintain a storage level above a minimum of 69,000 AF in average years. *See* Appendix H-1, Table H-1.10. This represents an increase of over 47,000 AF over current conditions and full use scenarios. *See* Appendix H-1., Table H-1.10. These results leave it very unclear to the reviewer of the FEIS how Denver Water will be using the additional 11,270 AF diverted into the North System (on average) while providing the many benefits that the Corps is claiming.

4. Conclusion

In order to comply with the National Environmental Policy Act, Clean Water Act, and Endangered Species Act, the Corps must supplement the FEIS to address the concerns identified above. The FEIS 1) fails to establish that the Preferred Alternative adequately meets the proposed project's Purpose and Need as stated in the FEIS; and 2) fails to support a conclusion that the Proposed Action would be the Least Environmentally Damaging Practicable Alternative under the CWA .

The Corps' would be committing a grievous error if it were to approve the Preferred Alternative without addressing this shortfall. NEPA requires informed decision-making, and CWA requires that the LEDPA be selected. The FEIS fails to satisfy either statute.

These comments are supplementary to earlier submissions and do not replace previous comments unless specifically noted as doing. STC has confirmed with the Corps that the Corps will accept and consider all substantive comments on the FEIS submitted prior to the publication of the Record of Decision for the Moffat Project[4]. Consequently, these comments – raising major issues of great public interest -- are entitled to full review and response by the Corps

Save The Colorado stands ready and willing to meet with the Corps and Denver Water officials to discuss this crucial and glaring flaw in the current NEPA documents prepared in conjunction with the Moffat project.

Please acknowledge receipt of this letter.

Thank you,

--
Gary Wockner, PhD, Executive Director
Save the Colorado
PO Box 1066, Fort Collins, CO 80522
http://savethecolorado.org
http://www.facebook.com/savethecolorado
https://twitter.com/savethecolorado
970-218-8310

The mission of Save The Colorado is to protect and restore the Colorado River and its tributaries from the source to the sea. Save The Colorado focuses on fighting irresponsible water projects, supporting alternatives to dams and diversions, fighting and adapting to climate change, supporting river and fish species restoration, and removing deadbeat dams. Save The Colorado has thousands of supporters throughout the Southwest U.S. from Denver to Los Angeles and beyond.

[4] http://www.dailycamera.com/boulder-county-news/ci_25908721/army-corps-will-take-more-comment-gross-reservoir

Aquatic Resources Assessment
Of
Federal Energy Regulatory Commission
Supplemental Environmental Assessment

For

Gross Reservoir Project & Denver Water's Proposed Moffat Collection System Project

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John Woodling, Ph.D., Woodling Aquatics

April 2018

Executive Summary

Denver Water wants to divert additional water from the Fraser River Basin and the Williams Fork Basin to the South Fork of Boulder Creek on the eastern slope of Colorado. The Federal Energy Regulatory Commission released a Supplemental Environmental Assessment (EA) that is part of the approval process for The Moffat Project. The EA, like the Final Environmental Impact Statement (FEIS) failed to adequately describe the environment that will be potentially impacted, failed to describe and measure the impacts and failed to describe appropriate mitigation measures that would reduce these negative impacts. The failure of the EA to achieve these three objectives occurred due to general issues and specific issues pertaining to aquatic resources.

General Issues

The EA was written in such a manner as to guide the reader to the conclusion that introduction of nonnative flows to South Boulder Creek basin (including Gross Reservoir) from the Fraser River may improve fisheries or have almost no impact. The message was conveyed that artificially increasing the flow regime in the South Boulder Creek basin does not have any long term negative impacts. Another general message was that reducing temperatures in part of South Boulder Creek will likewise have little impact. Aquatic communities develop in response to all environmental factors, including elevated spring flows during the snowmelt period that maintain stream channel integrity. The value of a natural temperature regime was distorted to indicate abnormally low water temperatures in summer months will not have any impact on fisheries. Decreases in stream temperature were minimized.

Specific Issues relating to the EA

The EA failed to accurately describe the aquatic resources in South Boulder Creek. Information presented for each stream reach was limited to a few general claims and the naming of a few species. Potential environmental impacts to the section were presented in a few sentences without any support from the peer reviewed literature, data analysis or support documentation. The EA failed to accurately describe the potential impacts to aquatic resources in the South Boulder Creek basin. The main assessment tool utilized to assess potential impacts to fish population was an interpretation of Weighted Usable Area (WUA). WUA as utilized in the EA, which was not an appropriate tool to assess impacts to fish populations. The observation that WUA failed as an analytical tool is supported by multiple articles in the peer reviewed literature, the review of the draft FEIS by the US EPA, the US BLM EIS and by the authors of the FEIS. The environmental impacts to fish resources in the EA were opinions expressed by the document's authors, not an assessment based on analysis of data.

Other specific issues that contributed to the failure of the EA to accurately assess the aquatic resources in the south Boulder Creek basin included,

1. An assertion in the EA that enlarging Gross Reservoir could result in increased fish diversity in that water. The fish assemblage is comprised of mostly nonnative fish species. Size of the reservoir does not preclude stocking of other fish species. That could be done at any time.
2. An assertion in the EA that fish density in Gross Reservoir would increase as would productivity. Some increased productivity is possible but the level of increased productivity will be reduced by the tree removal program that is also scheduled.
3. The failure of the EA to recognize that mercury levels in fish flesh will continue at existing levels or increase. The 401 certification presented two reasons why mercury may increase in fish tissues if Gross reservoir is enlarged.
4. The failure of the EA to recognize the impact of increased flow levels on fish populations in South Boulder Creek upstream of Gross Reservoir attributable to increased spring flows
5. The failure of the EA to recognize the impact of reduced temperatures on fish populations in South Boulder Creek downstream of Gross Reservoir.

The EA did not accurately describe the aquatic resources in South Boulder Creek basin. The description of aquatic resources in the Study Area was not of sufficient detail and accuracy to serve as a basis of defining and assessing environmental impacts to aquatic resources. As a result the EA failed to identify, quantify or qualitatively measure potential environmental impacts to the waters throughout the South Boulder Creek basin.

Mitigation

The EA listed a series of eight projects and described those projects as mitigation. Six of the eight actions were limited to monitoring. Monitoring is not mitigation. Actual mitigation actions were not described, except for the creation of a 5,000 acre Environmental Pool and removal of trees from the area that would be inundated in an expanded Gross reservoir if the Moffat Project is completed. The 5,000 Environmental Pool may actually make temperature issues in South Boulder Creek worse if the Moffat Project is completed. The tree removal project does not benefit fish populations in Gross Reservoir. The best available mitigation project was not included in the EA. A multi-stage release from Gross Reservoir would eliminate all environmental impacts in South Boulder Creek downstream of Gross Reservoir. Denver Water refuses to consider this option. Denver Water could have earned a lot of respect from the environmental community by agreeing to install and operate a multistage drain system. As written, the mitigation section of EA tries to claim the monitoring projects are actually mitigation projects. The EA, like the FEIS did not assess potential environmental impacts and did not include appropriate mitigation projects.

Federal Energy Regulatory Commission

Analysis of Supplemental Environmental Assessment

Pertaining of Aquatic Resources

Introduction

Denver Water seeks to enlarge Gross Reservoir and transfer additional water from the western slope of Colorado (The Fraser River Basin and the Williams Fork Basin) to the South Fork of Boulder Creek on the eastern slope of Colorado for delivery to customers via the reservoir and South Boulder Creek. The Federal Energy Regulatory Commission prepared a Supplemental Environmental Assessment (EA) that will be part of the basis for the approval process for enlarging Gross Reservoir.

A purpose of the EA is review environmental effects related to a Federal Energy Regulatory Commission approval of Denver Water's proposal to increase the size of Gross Reservoir that were not addressed in the Corps' 2014 Final Environmental Impact Statement. The EA has to describe and measure the impacts and to describe the mitigation measures that will be used to reduce these negative impacts. This EA reflects and addresses comments to FEIS that were received from a wide range of public and private entities.

I have been asked by Mike Chiropolos to review the portions of the EA that deal with aquatic natural resources of South Boulder Creek and Gross Reservoir. However, other waters involved in the Moffat project will be indirectly impacted by actions described in the EA. The other waters that are involved include the Fraser River Basin, the Williams Fork Basin, and the Blue River downstream of Dillon Reservoir, and the mainstem Colorado River to a point downstream of the confluence with the Williams Fork.

I have reviewed the sections of the EA that pertain to aquatic resources within South Boulder Creek and Gross Reservoir and have found several topics that warrant concern. First, the aquatic resources within the project area are not adequately described and assessed. Secondly, the impacts to the aquatic resources within the project area are consistently diminished in scope and magnitude. As a result, the EA underestimates the actual negative environmental impacts of the Denver Water Project and does not provide adequate mitigation measures for some of the actual impacts to aquatic resources.

The following sections of this manuscript describe issues that I found with the EA. My comments are primarily limited to sections of the EA addressing aquatic resources. Other issues that require attention include water quality, water temperature and the interaction of stressors on aquatic resources.

General Comments

Stream and river ecosystems are the result of a complex and millennial-long sets of interactions between geological and climatological factors. Precipitation levels, temperature, and wind interact with local geology to create drainage basins as water flows from areas of higher elevation to lower elevations. In Colorado, the local geology includes the Rocky Mountains, rising to more than 14,000 feet above sea level. Eon- long interactions resulted in the drainage basins that are found along the backbone of the Continental Divide in Colorado.

The resulting stream and river systems support diverse and abundant flora and fauna as the waters flow from the highest mountains to the warmer desert and grassland regions at lower elevations. The highest elevation headwater streams tend to have lower water temperature regimes, a steep gradient (thus faster water velocities) and substrates comprised of mixed materials ranging in size from very large boulders to cobble, gravel sand and silt. Lower elevation streams and rivers increase in size as small tributaries merge with the mainstem. At the same time water temperatures increase, water velocity slows and silt, sand and gravel substrates become more prevalent. River valleys become wider so streams meander back and forth across the floor of these valleys.

Stream and river systems in Colorado continue to be comprised of interactions between water and rock. The larger bed load material (boulders and large cobble) moves downstream during peak flood events such as the one hundred-year and one thousand-year flood events. A hundred-year flood results from a storm event that occurs on the average once every 100 years. On the average the stream becomes bank full once every two years. The bank full events help maintain channel integrity.

Seasonal patterns of flow and temperature exist in the streams and rivers that drain the Rocky Mountains in Colorado. Base (or low flows) are routinely present in late fall and winter months, as most if not all precipitation is in the form of snow that covers the ground until the spring thaw. Stream flows increase in the spring as snow melts. Silt and sand are picked up and borne downstream by the quickly moving, high flow level stream conditions. Snow melt flows reach maximum levels usually in May or early June, every two years on the average reaching bank full levels. Water levels then decline (often quite rapidly) to lower levels in the summer. Late in the summer water levels start down to base flows once again.

Over longer time periods stream flow responds to drought and wet-year cycles. During severe drought, spring snow melt flow levels do not increase stream flows much over the base flow condition. Smaller headwater streams may even be dry. During wet cycles, spring snowmelt levels may reach bank full levels frequently, and over top the river banks. Stream channels are created and maintained by the water regime of the basin over long periods of time.

The stream channels of the Fraser River basin and South Boulder Creek basin were formed and maintained over eons. These channels are now responding to changes in flows that have existed only for decades. The proposed additional diversions of water and the manner in which the water is moved and then used will further alter not only South Boulder Creek but the Fraser River system. The following sections will assess the EA in relation to the interaction of altered flows, stream habitat and aquatic life in the South Boulder Creek basin and some portions of the Fraser River.

Gross Reservoir

The EA included sections concerning Gross Reservoir. Gross Reservoir would be enlarged to store the additional water diverted from the western slope as part of the Moffat Project. Water stored in spring and summer months will be released for use in late fall and winter months. The EA included the following statement concerning fish populations in Gross Reservoir,

> "The Final EIS found that enlargement of the reservoir would cause a short-term, beneficial increase in reservoir productivity that would result in higher fish densities. It also found that the additional shoreline habitat resulting from the enlargement would increase reservoir fish population fish diversity and abundance through increases in available habitat" (Section 5.1.4, first paragraph).

These sentences are misleading and partially incorrect. First, one phrase in the preceding statement from the EA asserts the "additional shoreline habitat resulting from the enlargement would increase reservoir fish population fish diversity." This statement is incorrect in relation to diversity as related to the number of fish species present. The fish populations found in Gross Reservoir are, for the most part, nonnative species that were stocked to produce sport fishing opportunities. Longnose sucker and white sucker are two native fish species found in Gross Reservoir (in large numbers) and neither are target species sought by anglers. The only native fish species sought by anglers is the native cutthroat trout which is mostly extirpated from the South Platte basin and is not found in Gross Reservoir. Other nonnative fish species were stocked to create fishing opportunity, ranging from the lake trout to the rainbow trout. Nothing precludes introduction of other nonnative fish species at the present time to increase diversity. Enlargement of the reservoir is simply not a needed component of a decision to stock additional species. Enlarging the reservoir would likewise not mandate the stocking of additional species to increase diversity.

Similarly, the claim was made that fish numbers would increase "through increases in available habitat," a reference to a larger reservoir. The reservoir will increase seasonally in spring and summer and then decrease as water is released. Fish density is not regulated by the maximum amount of habitat available for a short time periods, but by a complex interaction of fish spawning times, seasonal water levels, amount of critical habitat for emerging fry and fingerlings, food supply, etc. The author of the EA did no analysis to demonstrate that fish populations would increase simply due to a short-term seasonal increase in habitat.

The statement is also made that enlargement of the "reservoir would cause a short-term, beneficial increase in reservoir productivity," leading to increased fish densities. A well accepted fact of fisheries management is that productivity increases as a land mass is first impounded upstream of a filling reservoir. The productivity increase is the result of the decomposition of terrestrial vegetation that is inundated by the rising waters. In the case of Gross Reservoir, the increase in productivity will not be nearly as pronounced, as the terrestrial vegetation will be removed **prior** to impoundment. The vegetation is being removed in an attempt to modulate the mercury levels in the fish populations of Gross Reservoir (see following paragraphs). The claim that fish densities would increase is not supported by literature citations or other examples. Some increase in productivity will result for a few years at a much reduced level. The EA failed to analyze the interaction of vegetation removal and claims of increased reservoir productivity.

Language in the EA likewise asserted that,

> "Raising the maximum reservoir elevation from 7,282 feet to 7,406 feet, would increase the surface area of the reservoir from 418 acres to as much as 842 acres, and increase the total length of the reservoir shoreline from 11 miles to as much as 14 miles. This would result in the development of as much as 3 additional miles of littoral shoreline aquatic habitat, which would benefit those fish species that currently utilize littoral areas. Similarly, increasing the maximum storage capacity of the reservoir from 41,811 acre-feet to 118,811 acre-feet would create additional pelagic habitat, benefiting fish that utilize open-water habitat areas. Overall, the effect of reservoir enlargement on littoral and pelagic species would be long-term and beneficial" (EA page 55).

These statements are also misleading. Water levels in the enlarged Gross Reservoir will fluctuate. The water level is likely to fluctuate to a greater degree than under current conditions (Colorado Water Quality Control Division Rationale for conditional 401 certification of Moffat Collection System Project, page 23). As noted above, fish density is not regulated by the maximum amount of habitat available for a short time period (when the reservoir is filled to capacity) but a complex interaction of fish spawning times, seasonal water levels, amount of critical habitat for emerging fry and fingerlings, food supply, etc. The author of the EA did no analysis to demonstrate that fish populations would increase simply due to a short-term seasonal increase in reservoir volume.

The EA does not provide any proof that fish populations in Gross Reservoir will benefit from a seasonal increase in reservoir size due to the Moffat Project. Productivity would increase for a short time but that benefit does not provide a substantive mitigation for any long term habitat loss due to the project.

Mercury levels in fish flesh is an existing issue in Gross Reservoir. Mercury levels currently warrant a Fish Consumption Advisory. (Colorado Water Quality Control Division Rationale for conditional 401 certification of Moffat Collection System Project, page 23). For example, mercury levels in lake trout routinely exceeded the Colorado Health Department action level of 0.3 ppm from 2011 through 2015 and a large brown trout (18 inches) likewise exceeded the action level in 2011 (Colorado Department of Public Health data). The single tiger muskie sampled (2007) had a mercury level of 0.56 ppm.

The enlargement of Gross Reservoir is likely to create conditions “conducive to the methylation of mercury” (Colorado Water Quality Control Division Rationale for conditional 401 certification of Moffat Collection System Project, page 24). The first condition is the decomposition of newly submerged plain material as the newly enlarged reservoir fills. In addition, the fluctuation of water level may result in additional methylation of mercury as reservoir surface is alternately “exposed and rewetted,” and when volumetric oxygen demand increases as the level of water in the reservoir falls resulting in a smaller hypolimnion. Mercury levels in fish will not diminish but likely increase since the reservoir substrate will alternately experience the recolonization of terrestrial plants during dry years and subsequent inundation when water levels increase. This pattern of plant growth on a dry section of a reservoir substrate during dry years can be seen in reservoirs throughout Colorado and other western states.

Language in the EA asserts that,

> “The Final EIS also found that short-term increases in methylmercury levels would be expected in tissue of fishes in Gross Reservoir,” (page 52),

and

> “Implementation of Denver Water’s tree removal plan and compliance with WQC condition 13 would reduce the likelihood of significant elevations in mercury levels in fish, and would also help to protect human health,” (EA page 55).

The tree removal program will mitigate against the increase in mercury levels in fish, via the food chain, when the enlarged reservoir is first filled. However, fluctuating reservoir levels will result in periodic episodes of terrestrial plant regrowth on the reservoir substrate during drought periods. Mercury levels could increase as enlarged reservoir is refilled and the newly grown plant material begins decomposing. No proof is offered that any increased mercury in fish flesh will be short-term. "Condition 13" refers to a monitoring program and a signing program. The monitoring will measure fish mercury levels and the signs will be a public warning concerning fish consumption. The implementation of Condition 13 in no way will "reduce the likelihood" of an increase in mercury levels in fish in Gross Reservoir if he Moffat Project is completed.

No actual mitigation for increased mercury levels is included in the FEIS, the 401 or this EA. Nothing in either the FIES or EA does anything past the first tree removal program to prevent adverse impacts to the ecosystem and food chain in Gross Reservoir relative to mercury in fish flesh.

South Boulder Creek Moffat Tunnel to Gross Reservoir

The object of the Moffat Project is to move additional waters from the west slope of Colorado for use by Denver Water via Moffat Tunnel. These waters would be diverted to South Boulder Creek during the spring and summer months. The amount of water being diverted is relatively large compared to the existing stream channel of South Boulder Creek. The changes in water flow would be rather dramatic. Mean monthly flows could be up to 25% greater in South Boulder Creek from the Moffat Tunnel to Gross reservoir in the months of June and July (FEIS Chapter 4-514). High flow events would occur more often such that the five year maximum flow event would occur every four years and the ten year event would occur every seven years. As a result increased bank instability (FEIS Chapter 4-514) would occur and erosion rates would increase. The increased bank instability is an expected response to increased flows. The stream bed will begin to be modified by the higher flows until an equilibrium is reached and once again the five year flow event will happen on the average every five years and the ten year event every ten years.

Increased summer flows negatively impact trout reproduction when stream flows reach, or exceed, bank full events. Bank full events are those flows that occur every two years in most Colorado trout streams. Those flows would be more common in this section of South Boulder Creek after the Moffat Project is completed due to increases in June and July. Recently emerged trout fry require habitat with a zero stream flow and a shallow depth to avoid predation by adult trout. These zero flow areas are less abundant as the water volume in a stream increases. Survival of trout fry is negatively correlated to stream flow levels. Ironically, fry survival is high in periods of drought and low in wet years. Fingerling survival is further reduced when stream flows are so high that bank instability leads to bank erosion. The impact of increased June and July flows on fry survival was not specifically included in the FEIS or EA.

The FEIS included language that asserted changes in the Weighted Usable Area[1] for trout would decrease but that the changes would be "negligible for all life stages in all year types (FEIS Chapter 4-5-5). The FEIS included a recommendation that "further 'bank' stabilization could become necessary," but that "no changes is Water quality would occur," while there "would be mostly minimal changes in trout habitat availability," (FEIS Chapter 4-515). The FEIS did not adequately describe the impact of habitat change due to increased water flows in South Boulder Creek upstream of Gross Reservoir. Instead, qualifying words were used such as further bank stabilization "could" become necessary and changes in trout habitat would "mostly" be minimal. The success of bank stabilization is highly questionable. The flow regime in a stream determines stream bed morphology. Permanently higher spring flows will widen and deepen the stream channel over time without regard to human attempts to stabilize a stream bank that is too narrow and too shallow.

The FEIS did not address the impact of the Moffat Project on South Boulder Creek just upstream of Gross Reservoir. The EA attempts to describe the impact of the Moffat Project on the 5,000 feet of South Boulder Creek immediately upstream above Gross Reservoir that would be periodically inundated after reservoir enlargement. The following language was included in the EA,

> "Specifically, water levels in Gross Reservoir after the reservoir enlargement would be lowest in April. The reservoir would then begin to fill in May, and would be highest from June through September. It would then decrease from October through March. Because water levels would be increasing in May through June, when rainbow trout and sucker spawning occurs, spawning areas for these species near the mouths of Winiger Gulch and South Boulder Creek would not likely be affected. Eggs of rainbow trout and suckers require flowing water to provide and replenish oxygen to survive; therefore, already incubating eggs would be deprived of oxygen and likely be lost as lotic habitat transforms into lacustrine habitat. Spawning areas and eggs of brook trout and brown trout, which also require flowing water for oxygenation, would largely be unaffected, because brook and brown trout spawn in October and November when reservoir water levels would generally be decreasing. Surviving trout and sucker fry would move to suitable areas of the tributary to rear," (EA page 54).

This paragraph is incomplete, contains factual errors and is misleading to some degree. Both white sucker and longnose sucker spawn in rivers and streams but both species can spawn in lakes. The presence of both sucker species in Gross Reservoir is independent of flow regimes in South Boulder Creek and Winiger Gulch. Incubating eggs of rainbow trout indeed would likely

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[1] I would assert the WUA is not appropriate and several peer reviewed publications support that contention. The reader is referred to the following section (South Boulder Creek from Gross Reservoir to Boulder Diversion Canal) for a discussion of this issue.

die as water velocity slows over redds and silt covers the stream bed during summer months of increased flow rates.

Brown trout and brook trout are fall spawning species. Fertilized eggs of both species require about 405 degree days to hatch. The recently hatched fry stay submerged in the gravel until the yolk sac is absorbed. The fry then "swimup" into the water column and look like a miniature trout. These fry require waters with a zero flow velocity that are fairly shallow. Brown trout swimup into the water column in late April to May as water levels will rise in South Boulder Creek. The number of brown and brook trout that will survive decreases as the water level in the stream increases (Woodling et al. 2005, Woodling and Rollins, 2008). Despite the claim in the EA, brook trout and brown trout reproduction will be affected by the increased flow regime in South Boulder Creek upstream of Gross Reservoir as spring flows reach bank full levels. Areas of zero flow rate will be relatively rare in most years if a five year flow event occurs every four years.

The last claim in the above quote from the EA is that,

> "Surviving trout and sucker fry would move to suitable areas of the tributary to rear."

Recently emerged trout require zero flow water for shelter immediately upon emerging from the gravel. June and July flows can be up to 25% following enlargement of the reservoir, while five and ten year flood events will become more common. "Suitable" habitat for recently emerged trout, of all species, will be rarer in South Boulder Creek upstream of Gross Reservoir than in most trout streams in Colorado which do not receive an infusion of nonnative stream flows during the snowmelt months.

The description of fish in this section of South Boulder Creek is superficial and incomplete. Some of the observations are in error. The description and analysis would have to be done again in detail, using on-site field studies to actual impacts to trout in South Boulder Creek upstream of Gross Reservoir.

Aquatic macroinvertebrate resources South Boulder Creek, Gross Reservoir to South Boulder Diversion Canal

The FEIS did not address the impact of the Moffat Project on South Boulder Creek just upstream of Gross Reservoir on macroinvertebrates. The EA attempts to describe the aquatic macroinvertebrate impacts attributable to the Moffat Project on the 5,000 feet of South Boulder Creek immediately upstream above Gross Reservoir that would be periodically inundated after reservoir enlargement. The following language was included in the EA,

> “The current benthic macroinvertebrate community supports rearing juvenile trout and suckers. However, when reservoir water levels are increased and inundate tributary streams, the macroinvertebrate communities in those streams would likely shift to species that prefer lentic conditions. When reservoir water levels decrease, rheophilic benthic macroinvertebrates would recolonize previously-inundated areas, displacing those that prefer lentic environments. Therefore, effects of reservoir filling and operations on benthic macroinvertebrates would be temporary and minor,” (EA page 55).

No literature citations, studies or examples were offered to support the statements presented in this paragraph. Many of these ideas appear to be unsupported opinion. Many aquatic macroinvertebrates pass the winter months in a quiescent (non-moving, non-active) stage, such as an egg, or as a pupa. These quiescent lentic species would die as water levels decrease in winter months and flowing waters once again fill the South Boulder Creek stream bed. Many aquatic macroinvertebrates in South Boulder Creek upstream of Gross Reservoir would likewise be in a quiescent life stage in winter months and would not drift into the recently exposed stream bed. Of course many aquatic macroinvertebrates appear to be active through the winter (such as the mayfly genus *Baetis*). Thus, some benthic macroinvertebrates would drift downstream into the previously-inundated areas. Many others would not.

Likewise, lentic species may well colonize the stream bed as water levels increase in the spring and the stream substrate once again becomes the bottom of a reservoir. The rate of colonization will be rather slow. These insects are small and do not move very quickly and 5,000 feet is a long distance.

The EA and the FEIS both fail to describe the habitat of the South Boulder Creek upstream of Gross reservoir. Only superficial level of analysis and comparison was performed. Additional work would be needed to accurately assess both the aquatic habitat and fisheries of this stream reach. This is the same conclusion that could be applied to each section of the EA and FEIS that address aquatic resources.

Gross Reservoir to South Boulder Diversion Canal

South Boulder Creek downstream of Gross Reservoir to South Boulder Diversion Canal is a focal point of impacts that would be attributable to completion of the Moffat Project. The current temperature regime of this stream reach is far colder than would be expected in a stream of the same elevation as South Boulder Creek downstream of Gross Reservoir. Denver Water releases water to South Boulder Creek from outlet structures located deep in the reservoir at the base of the dam that impounds Gross Reservoir. Gross Reservoir stratifies in the summer so that the water when released remains very cold in the depths where the release structures are found. Temperatures do increase downstream of Gross Reservoir in the summer and reach maximum levels in October, only to decrease once again in the fall (WQCD 2016). “The maximum temperature below the reservoir occurs when stratification ends and the fully mixed reservoir is more or less isothermal (WQCD 2016).

This temperature pattern is different than found in most Colorado mountain streams. Warmest waters downstream of Gross reservoir are currently measured in September, not in July or August and range from 13°C to 15°C (WQCD 2016). During summer months, temperatures currently range from 5°C in June to 8°C or 9°C in August (WQCD 2016), far lower than found in streams and rivers at similar elevations in the mountains of Colorado. Fish and aquatic macroinvertebrates are cold-blooded and growth is controlled by temperature. Growth of fish and aquatic macroinvertebrates is lower and slower downstream of Gross Reservoir in relation to waters in streams with warmer temperatures. The temperature of South Boulder Creek upstream of Gross Reservoir is warmer than downstream during the summer months as the sun warms the shallow waters of South Boulder Creek. Water temperatures do not rapidly increase farther downstream in Boulder Creek "as there is little warming of water in this segment" (FEIS Page 4-516-517).

Completion of the Moffat Project will eliminate the early fall period of warming that is currently observed downstream of Gross reservoir (WQCD 2016). More water will be held by the dam and the depth of the hypolimnion will increase so that release of cold water will be of longer duration in the fall. Operation of the reservoir after completion of the Moffat project would result in a 30% decrease "of degree days that are currently available for fish growth" (WQCD 2016).

The FEIS description and analysis of fish habitat in South Boulder Creek was limited to a single analysis of habitat using Weighted Usable Area (WUA). Influences of temperature (or other factors) were not described in any meaningful and in-depth manner. The FEIS presented an analysis of available habitat that concluded,

> "The increases in winter flows would result in large increases in rainbow trout habitat availability and the small decreases in spring runoff flows would decrease conditions that may be stressful to early life stages of this species," (Chapter 4 page 4-517).

As I noted in my analysis of the FEIS (Woodling 2015),

> "The main assessment tool utilized throughout Chapter 4 to assess potential impacts to fish population was an interpretation of Weighted Usable Area (WUA). WUA as utilized in the Final EIS was not an appropriate tool to assess impacts to fish populations. The observation that WUA failed as an analytical tool was supported by multiple articles in the peer reviewed literature, the review of the draft EIS by the US EPA and US BLM EIS and by the authors of the EIS. The environmental impacts to aquatic resources in the Final EIS were opinions

> expressed by the document's authors, not an assessment based on analysis of data," (Woodling).

WUA measures only one aspect of the environment, regardless of how appropriate the method may be. I would assert the WUA is not appropriate and several peer reviewed publications support that contention. However, an analysis of any environment based on a single variable is not adequate when attempting to describe the impacts of a project where factors other than the amount of usable habitat are also being altered.

Fishery resources South Boulder Creek, Gross Reservoir to South Boulder Diversion Canal

Water temperature is a critical component of the environment, especially when the proposed change limits the growing season for trout by 30%. Rainbow trout hatch in the summer months and emerge into the water column. The fry begin feeding and start growing. The fish must grow to a certain length and amass a certain lipid level to survive the winter months (Biro et al. 2004). Growth and lipid levels would differ by water. Salmonids in general do not feed when water temperatures are less than 4°C. Growth of rainbow trout (including fry) will be reduced significantly in South Boulder Creek when summer temperatures range from 5°C (June) to 8°C (August). The impacts of the proposed temperature regime on rainbow trout populations is simply not known and was not explained in the EA.

Impacts of temperature on brown trout populations were likewise not included in the FEIS. Brown trout spawn in Oct, and perhaps the first two weeks of November. The eggs hatch after exposure to about 405 degree days of temperature. Temperatures in South Boulder Creek downstream of Gross Reservoir will be warmer than any other time of year when the brown trout spawn. The eggs may hatch by December. The young sac-fry will remain in the gravel until the yolk sacs are completely utilized. Young brown trout potentially could swimup into the water column when winter flows are still elevated. Swimup fry must find habitat where still water is present, water with no measurable flow rates. Brown trout could potentially swimup during the late winter (February or so) when stream flows would be higher than currently found in South Boulder Creek. The higher the water level the less zero flow habitat available for trout fry. Strangely, the comparatively warmer water temperatures in October and November could negatively influence brown trout reproduction. An analysis of both instream temperature and emergence time would be needed to determine the impact of an altered temperature regime on brown trout.

The FEIS needed a detailed analysis of how the extremely low water temperatures in South Boulder Creek post-project would impact fishery populations, and not just trout. The FEIS did not include a detailed analysis of the impacts of temperature on fish, noting in passing,

> "The cooler temperatures throughout the year would limit trout growth and survival and likely dampen the beneficial effects of greater habitat availability," (Chapter 4 page 4-517).

No proof was presented that changes in habitat would be significant in relation to temperature. A statement cannot be made one way or the other concerning "dampening"

The EA description of impacts to the South Boulder Creek fish assemblage is as follows,

> "Within South Boulder Creek downstream of Gross Dam, the Final EIS determined that the expansion of the Moffat Collection System would overall have minor, beneficial impacts to fisheries and aquatic resources because flows downstream in South Boulder Creek would be higher in winter and peak flows would be reduced. It also found that overall cooler water temperatures would be provided downstream of Gross Dam, which would limit fish growth and survival. The Final EIS determined that certain mitigation measures proposed by Denver Water, including operations of the Environmental Pool, a Fish and Wildlife Mitigation Plan, and a Fish and Wildlife Enhancement Plan would benefit fish and aquatic resources," (EA page 52).

The EA concluded that the listed mitigation measures "would benefit fish and aquatic resources" in South Boulder Creek (see above paragraph). This conclusion is incorrect for two reasons. First, as noted by WQCD 2016, operation of the Environmental pool could make the impact of lower temperatures greater because the volume of the reservoir would be increased. The Environmental Pool would worsen conditions instead of mitigating the issue of colder water downstream of Gross Reservoir. Secondly, as noted above, the FEIS and EA do not adequately describe the fishery resources of South Boulder Creek and how those resources would react when water temperatures are reduced even farther than current conditions. Current mitigation measures as proposed by Denver Water cannot be evaluated against environmental impacts attributable to the Moffat Project because those environmental impacts have yet to be properly described. Decreased temperature and reduced growth rate of fish are two factors that are of paramount importance when analyzing the impact of the Moffat Project on South Boulder Creek. Neither was addressed in the EA or the FEIS.

Aquatic macroinvertebrate resources South Boulder Creek, Gross Reservoir to South Boulder Diversion Canal

The aquatic macroinvertebrates found in Boulder Creek likewise are coldblooded species that are regulated by temperature. Aquatic macroinvertebrates often are found along an altitudinal gradient from higher elevations to lower elevations. Water temperature is the principal environmental factor that influences this elevational distribution. The elevational gradient of aquatic macroinvertebrates was determined in Boulder Creek a long time ago (Dodds and Hisaw, 1925). Further work on elevational zonation was developed for mayflies (Ward and Berner 1980) and stoneflies (Knight and Gaufin 1966). Higher elevation waters are colder than low elevation waters. South Boulder Creek is very similar to Boulder Creek so the species distribution along an elevational gradient should be similar for the two waters.

The temperature regime of South Boulder Creek currently is colder than most trout streams of similar elevation in the area. The temperature regime will decrease even more if the Moffat Project is constructed. Any analysis of aquatic macroinvertebrates in South Boulder Creek would require an analysis of how current and future temperature regimes have influenced the species assemblage in South Boulder Creek downstream of Gross Reservoir. The community may be more like a higher elevation stream than a stream of similar elevation.

The FEIS analysis of aquatic macroinvertebrates was performed using the Multi Metric Index developed by the Colorado Water Quality Control Division. The Division uses this tool to determine if streams and rivers in Colorado are attaining the aquatic life designations that are assigned to stream segments by the Colorado Water Quality Control Commission. The MMI is a useful tool. A MMI score usually increases as the number of taxa of a particular group (such as Mayflies, or predators, or species that "cling" to a rock) increases. The MMI does not indicate much about the ecology of individual species, specifically temperature preferences or temperature requirements. For example, many coldwater obligate species are members of taxonomic groups that contribute to a high MMI score. Other members of the same group may prefer warmer, lower elevation streams and rivers. MMI scores may not increase or decrease as elevation changes and one member of a metric group may be replaced by another that is perhaps more tolerant of higher water temperatures. Therefore MMI scores at a site downstream of Gross Reservoir may not change as cold water obligate species of a sensitive group such as Ephemeroptera replaces a member of the same taxonomic group that does not tolerate cold water.

Sampling aquatic macroinvertebrates in South Boulder Creek appears to require a different approach to determine impact of low water temperatures on the species assemblage. The species assemblage present could be compared to the elevational gradients developed by Dodds and Hisaw (1925), Knight and Gaufin (1966) and Ward and Berner (1980). The water temperature in South Boulder Creek is very cold and will become colder if the Moffat Project in operation. Entities involved in assessing the conditions in South Boulder Creek could use a species ecology based approach to determine if colder temperatures are impacting the aquatic macroinvertebrates of South Boulder Creek downstream of Gross reservoir. More analyses than solely the MMI are needed to determine if colder temperatures alter the benthic community in this stream.

Neither the FEIS nor the EA have described the benthic community of South Boulder Creek adequately. No determination can be made concerning the relationship of aquatic macroinvertebrates and lower stream temperature regimes that would be present if the Moffat Project is completed. More detail is needed to determine if mitigation programs are needed.

Evaluation of proposed mitigation actions.

Several proposed mitigation actions proposed by Denver Water were included in the EA. Six address Water Quality issues and two address Fisheries and Aquatic Resources. These actions are.

1. Finalize a tree removal plan for trees in the inundation area
2. Monitor continuous temperature at four locations in South Boulder Creek
3. Monitor metal concentrations in South Boulder Creek
4. Monitor dissolved oxygen and temperature in Gross Reservoir for 3 years
5. File with FERC a revision to its approved South Boulder Creek Channel Stability Monitoring plan
6. Store a 5,000 acre foot Environmental Pool in Gross Reservoir
7. Develop an Aquatic Nuisance Invasive Species Monitoring Plan
8. Monitor “health” of aquatic macroinvertebrates downstream of Gross Reservoir

Monitoring is not mitigation. Mitigation actions are supposed to lead to an environmentally preferred outcome (Sutley 2011). Monitoring is used to monitor the effectiveness of mitigation, in this case reducing impacts to South Boulder Creek caused by increasing the volume of water flowing through the system and lowering water temperature in South Boulder Creek. Likewise, developing an Aquatic Nuisance Invasive Species Monitoring Plan is not a mitigation program. Aquatic nuisance species issues appear everywhere and entities everywhere have to deal with the problem. Some of the invasive species that could appear in Gross Reservoir could negatively impact treatment costs for Denver. Dealing with an environmental nuisance species that may appear in the future is not mitigation for enlarging Gross Reservoir.

The tree removal program for Gross Reservoir likewise is not entirely mitigation. The trees are being removed to possibly modulate mercury accumulation in fish. However, tree removal will also decrease the magnitude of any post impoundment increase in productivity of Reservoir. The tree removal program does not benefit the natural resources in any manner and should not be considered to mitigate for environmental damage.

The 5,000 acre foot Environmental Pool is not a well thought out mitigation action. The 5,000 acre foot storage will actually make water temperature issues downstream of the reservoir worse (WQCD 2016, Appendix A.

The EA did provide information that leads readers of the EA to the conclusion that two environmental issues will likely develop if the Moffat Project is completed. First, the increased amount of water diverted from the Fraser River may well result in a long-term change in the physical habitat of South Boulder Creek upstream of Gross Reservoir. Bank instability was predicted to increase along with erosion. Higher spring flows and an increased frequency of high flow events will both result in modifications of the stream channel. The stream channel will evolve over time to handle the increased flows. Downstream siltation levels will increase. The EA and the FEIS should address this issue in far more detail and plan appropriate mitigation.

The EA includes a mention that increased bank stability may require bank stabilization. However, bank stabilization is not included as a mitigation program. Efficacy of bank stabilization is questionable in this case. Increased spring snowmelt flows will result in stream channel modification as the geology and artificially altered water regime in South Boulder Creek move to an equilibrium. The stream channel over time will adapt to the new flow levels. Human actions to stabilize existing stream banks will last only a relatively short time.

Secondly, the water temperature regime downstream of Gross Reservoir will remain in the single digits if the Moffat Project is completed. The maximum temperature would be about 9°C in October. Fish growth would be reduced and fish reproduction issues may also result. No mitigation actions for this impact were included in the EA.

The EA did not include any mitigation action in South Boulder Creek that would actually mitigate for the environmental impacts associated with the Moffat Project. A series of monitoring programs was included in the EA and listed as mitigation even though no environmental improvement results from monitoring. One possible project exists. A multi-stage release from Gross Reservoir would eliminate all environmental impacts in South Boulder Creek downstream of Gross Reservoir. Denver Water refuses to consider this option. Thus mitigation like the FEIS and EA is actually an ineffective and empty process.

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November 23, 2016

Tim Carey
Moffat EIS Project Manager
U.S. Army Corps of Engineers, Omaha District
Denver Regulatory Office
9307 S. Wadsworth Blvd.
Littleton, CO 80128

Submitted via E-mail: moffat.eis@usace.army.mil

Re: Moffat Project Environmental Impact Statement
"Conditional 401 Certification" issued by Colorado Water Quality Control Division for the Moffat Collection System Project
Comment submitted on behalf of Save the Colorado, The Environment Group, and WildEarth Guardians

Dear Mr. Carey:

This comment letter summarizes findings and conclusions from the State's Conditional 401 Certification for the Moffat Collection System Project (Moffat Project). In the context of the existing record and previous comments submitted by Save the Colorado, The Environment Group, and other parties, the State's findings further establish that the proposed Moffat Project supported by applicant Denver Water would not be the "Least Environmentally Damaging Practicable Alternative" (LEDPA) under the Clean Water Act. Because it is not the LEDPA, the U.S. Army Corps of Engineers (Corps) cannot approve the current preferred alternative in the pending Record of Decision (ROD).

1. Moffat Project 401 Process and State's Scope of Review

By letter dated June 23, 2016, the Colorado Water Quality Control Division (Division) issued a "Conditional 401 Certification" for the Moffat Collection System Project. That document is attached to this comment.

If approved, the new Gross Reservoir Dam would be raised 131 feet in height, making it the tallest dam in Colorado at approximately 460 feet. The surface area of Gross Reservoir would almost double to 818 acres, inundating adjacent forests, wetlands, wildlife migration corridors, scenic canyons, and Forsythe Falls – one of the great National Forest nature hikes on Colorado's Front Range.[1] The project would almost triple the Reservoir capacity 114,000 acre-feet of water. The Division's review excludes consideration of the allegedly "short-term" construction impacts of the $380 million project, the biggest industrial operation in the history of Boulder County.

The Division's review is limited to the nature and scope of water quality impacts, including those resulting from hydrological modifications (primarily changes in the timing and quantity of flows). Letter at 1. The Division's review was constrained by its perceived lack of legal authority to deny a permit regardless of the extent or severity of impacts to water quality, the only type of impacts considered by the Division's 401 review. Letter at 1.

Specifically, the Division's Letter provides that

> Section 82.5(B)(6) [of Division Regulation 82] provides that "[c]ertification shall not be denied where the imposition of conditions or denial would result in material injury to water rights as prohibited under section 25-8-104 C.R.S." The pertinent part of § 25-8-104(1) states as follows:
>
> > No provision of this article shall be interpreted as to supersede, abrogate, or impair rights to divert water and apply water to beneficial uses in accordance with the provisions of sections 5 and 6 of [state law]. Nothing in this article shall be construed, enforced, or applied so as to cause or result in material injury to water rights.

Letter at 1-2.

In other words, the Division interprets its authority to require certification wherever (as here) denial could in any way impair the exercise of water rights under state law. Leaving aside whether such interpretation is consistent with the Clean Water Act, it triggers full and careful scrutiny of the state decision by federal agencies bound by federal, not state, law.

According to the Conditional Certification (Rationale at 1):

> The proposed Moffat Collection System Project (Moffat Project or project) will provide an additional 18,000 acre-feet per year (AF/y) to meet future demands of the Applicant and its customers. It includes an enlargement of Gross Reservoir and will rely on existing infrastructure to fill the added storage capacity. Expansion of the dam and enlargement of the reservoir will have direct impacts to waters of the United States, including adjacent wetlands. Although the project does not discharge pollutants, it does involve significant "hydrologic modifications." By altering flows on both sides of the Continental Divide, the project directly affects the quantity and

[1] The hike down Forsythe Canyon from the newly constructed Forest Service trailhead to Forsythe Falls is renowned as "a perfect hike for out-of-town visitors" http://www.5280.com/blogs/2012/06/12/outdoors-hiking-forsythe-canyon-trail-gross-reservoir#; and listed among "Top 7 Waterfall Hikes" within about an hour of Denver, http://dayhikesneardenver.com/7-waterfall-hikes-about-1-hour-of-denver/

quality of aquatic habitat, and it indirectly affects water quality by changing contributions to mass balance for all constituents.

The conditional certification does not inquire into how the water would be used or supply and demand trends relevant to the project "purpose and need." These and many other factors outside the scope of the Division's review are relevant to the NEPA analysis and LEDPA determination to be made by the Corps. The 401 review does not address the purpose and need for the Project, including information and data that is essential to the LEDPA determination. Among the many key components of the Project that must be weighed by the Corps, but were outside the scope of the Division's review, are: 1) the fact that recent population and job growth in the Denver Water service area has not increased water demand or consumption in the last decade and a half contrary to Denver Water predictions relied on by the EIS (decoupling); 2) historically low water levels in Lower Colorado reservoirs, the historic drought in California, and the ensuing likelihood of a Compact Call on the Colorado River; 3) impacts to fisheries and evidence of ecosystem collapse in the Colorado River headwaters streams that would be further depleted by Moffat; and 4) the fact that the Moffat Project is largely an "insurance policy" for Denver Water largely as an insurance policy to allow Kentucky bluegrass lawns to be watered during an extended drought

The Division's decision to issue "conditional certification" is subject to its acknowledgement that significant impacts are expected for all streams and water bodies affected by the project, on both sides of the Continental Divide.

- Gross Reservoir impacts include high mercury levels, fish advisories, and a contaminated food chain.
- South Boulder Creek impacts below the dam go to freezing water temperatures, nutrient production, fish habitat, aquatic ecosystem, and copper concentrations.
- Upper Colorado impacts (primarily to the Fraser and Williams Fork Rivers and tributaries) include additional dewatering of headwaters streams during the high runoff season, temperature, copper and other metal concentrations, and aquatic habitat.

The Division considers most of the proposed "mitigation and enhancement" measures to be uncertain and unproven. The West Slope streams are already approximately 65% depleted by existing trans-basin diversions. Depletions would rise to 75-90% in average and wet years, effectively eliminating anything resembling the natural flow regime during the vital May-June-July runoff period.

2. Summary of Division's Findings: Impacts, Mitigation & Conditions

Overall, the Division findings establish significant impacts to the ecology of the Gross Reservoir, South Boulder Creek, and the Upper Colorado River. As for the proposed "Learning by Doing" mitigation plan, the Division's concluded only that the approach "may reduce the impacts." Certification Rationale at 28 (emphasis added).

a. Gross Reservoir Impacts

For Gross Reservoir, the Division found that "[t]he potential impact of the Moffat Project on mercury in fish tissue in Gross Reservoir causes concern because mercury levels already are high enough to warrant a Fish Consumption Advisory (FCA)." Id. at 23. Based on recent scientific literature regarding elevated levels of mercury in fish tissue, "there are good reasons to expect problems[.]" Id. Although the Division recognized that the mercury "makes its way through the food chain over a period of several years," the analysis does not consider impacts on raptors, invertebrates, or other species constituting the web of life in this high-altitude aquatic ecosystem. Because preventing impacts is considered futile, "mitigation" is limited to monitoring and posting Fish Consumption Advisories. Id. at 24.

b. South Boulder Creek Impacts

South Boulder Creek below the dam will be severely impacted by releases of far colder water. Releases come from the bottom of the reservoir, which will be far deeper and colder than for the current smaller dam. Absent any dam (natural regime), water temperatures in the creek would peak in late July at close to 20 degrees centigrade. Rationale at 10-11, A-2 and A-5. With the existing dam, temperature peaks in late September at 13-15 degrees. Id. at A-4. With the new dam, summer water temperatures would "remain relatively constant at 7 or 8 degrees." Id. at A-5.

> In other words, the alteration of the pattern is sufficiently extreme that South Boulder Creek below the reservoir is likely to be in attainment the winter numeric standard throughout the year. That offers little opportunity for fish growth and would suppress productivity of the benthic invertebrates, which are an important food resource for the fish.

Id. at A-5 (emphasis added).

These impacts were the one area where the Division identified a proven mitigation option: Multi-Level Outlet Works (MLOW). Id. at 11-12. "Installation of the MLOW is feasible," but operation of the MLOW would interfere with hydropower generation. Id. at 12. In sum, the MLOW is practicable, and it would make the project significantly less environmentally damaging to South Boulder Creek than Denver Water's preferred alternative, which is only subject to the "monitoring" condition imposed by the Division. However, Denver categorically rejected the MLOW option, primarily on cost grounds, although the Division estimated the full cost to be less than 3% of the overall project cost. This is consistent with Denver rejecting the rail spur alternative for transporting construction materials to the reservoir site, which would vastly reduce transportation impacts including danger to residents and wear on roads.

Gross Dam is approximately five miles above Boulder County's Walker Ranch, which includes a 3.5 mile stretch of South Boulder Creek that could be impacted by colder flows. The County's 1985 Walker Ranch Management Plan cited a 1964 study which found that, after the existing dam was built, "[f]ish are using their energy for sustenance, not growth," and that "[c]old water also slows growth of plant and insect food."[2]

c. Upper Colorado River Impacts

The Division found that the project "directly affects the quantity and quality of aquatic habitat, and it indirectly affects water quality by changing contributions to mass balance for all constituents." Rationale at 1 (emphasis added). That is consistent with the FEIS prepared by the U.S. Army Corps of Engineers, which found that "moderate to major impacts would occur in average to wet years" in the Upper Fraser and Williams Fork Rivers. Moffat FEIS at ES-13.

However, the Division generally failed to analyze impacts to aquatic habitat from the new diversions, except in some instances where specific violations were predicted. Nor did it directly compare the certain impacts of dewatering during peak flows in late spring and early summer against the potential benefits of much smaller timed releases proposed for later in the summer.

The Division's review contains only one passing reference to the Greenback Lineage Cutthroat Trout, one of the most sensitive aquatic resources identified by independent scientists.[3] The Division notes that Denver's Fish and Wildlife Mitigation Plan (FWMP) would commit $72,500 for "restoration" of cutthroat trout habitat, without any analysis. Id. at 19, note 28.[4] The certification lacks any actual analysis or findings going to Greenbacks, a species may necessitate a Supplemental EIS and/or additional public comment opportunities given the abundance of new scientific information regarding the historical range of the Greenback, habitat, and related issues under the Endangered Species Act, NEPA, and other law.

Significant impacts to the Upper Colorado found by the Division include:

> Project diversions in the Fraser River basin will reduce stream flows with the expected impact of causing or contributing to existing impairments for temperature and further erosion of assimilative capacity. [. . .]
>
> Reduction of flow in the Fraser River basin reduces the dilution of wastewater effluent, raising concerns about nutrient levels in the Fraser River, the Colorado River, and the Three Lakes system. According to the FEIS, total nitrogen concentrations at the mouth of the Fraser may increase by more than 40% due to cumulative impacts [all foreseeable diversions].

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2 http://www.colorado.edu/geography/class_homepages/geog_4430_s08/walkerrnachmplan.pdf at 11-12

3 See Aquatic Resources Report, Woodling Aquatics (John Woodling PhD)(2015).

4 The same note provides that $1.5 million, or half of the FWMP funding, would go to projects in the South Platte Basin, absent mention that this Front Range river basin is not impacted by the Gross Moffat Project.

Id. at 7, 15 (emphasis added).

Although the Division regards "nutrient reduction in wastewater effluent as one of the few opportunities for direct mitigation," the "certification" settles for requiring a future plan to address these impacts. Id. at 16.

Denver's mitigation proposal provides for bypass flows of approximately 1,000 acre-feet per year (AFY) to attempt to address water temperature and quality concerns in targeted streams. Id. at 9 note 11. These "mitigation" commitments appear to amount to approximately 6% of the 15,000 to 18,000 AFY in average diversions. *See* Division Letter at 1.[5] Taking almost 20 times as much additional water out of the Upper Colorado tributaries than *could* be released for bypass flows is an enormous difference for aquatic ecosystems already at or near the brink of ecosystem or fisheries collapse according to the FEIS.

The Division noted that because mitigation releases are not tied solely to temperature concerns, "there is no assurance that these flows will be available once the Temperature Mitigation Response and Additional Actions flows have been exhausted." Id. at 9 (emphasis added). As a result, "it is not yet known if the mechanics of the response will yield successful mitigation in a real-life situation." Id.

Ranch Creek, one of three Upper Colorado streams targeted by timed releases, is characterized by a network of beaver dams that casts doubt on the ability of mid- or late-summer releases to mitigate temperature. "Ranch Creek is also a complicated location for a [Voluntary Pilot Project] because of diversions and the potential importance of the many beaver dams." Id. at B-1. This is because each dam "extends the residence time of water in the reach, and it warms the water more than would occur without the dam." Id. The Division did not analyze whether more benefits might accrue from the existing flow regime (not allowing new depletions proposed by the project), let alone augmenting existing flows to emulate the natural flow regime.

As to the monetary commitments for habitat work, the Division first noted that Denver "has not proposed the what-where-and-when details for these habitat modifications" with one Regarding metals, the Division stated concerns regarding impacts related to dissolved iron and copper. "Existing exceedances of standards, chiefly for copper, increase the level of concern about the potential for the project to have water quality impacts." Id. at 25. Initial anti-degradation review identified some exceedances, and "the geographic extent of the exceedances has been expanded during recent assessments by the Division." Id. In other words, the baseline situation is more concerning than originally believed.

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5 Using the alternate figure of 15,000 AFY of average diversions, the 1,000 AFY mitigation amount would be 6.6% of additional water removed from the Upper Colorado Basin.

Copper exceedances occur on four stream segments in the project area: the Williams Fork and Vasquez Creek in Grand County on the West Slope, and South Boulder Creek both above and below Gross Reservoir in Boulder County on the Front Range. Id. at 25-26.

As to the monetary commitments for habitat work, the Division first noted that Denver "has not proposed the what-where- and-when details for these habitat modifications" with one exception that specifies the "general location". Id. at 19. The projects "may" benefit fish and have the "potential" to yield benefits. But absent the essential but missing details, "there is uncertainty about the magnitude and location of the benefit." Id. "There is no way to incorporate the monetary commitments [with one exception] … for unspecified projects into the calculation of net environmental benefits. Id. at 19-20.

Conditions imposed by the Division generally require monitoring, to be followed by developing plans to address any identified problems or violations. See, e.g., id. at 17-18. The Corps should recognize that monitoring alone only results in collecting additional data as to the nature and scope of impacts caused by the project.[6]

It is highly speculative at best whether any future mitigation strategies would be effectively designed, enforced or implemented to effectively avoid, minimize or mitigate the Project's negative impacts. In this context, the LEDPA determination and ROD need to recognize that mitigation would be designed to reduce or mitigate impacts.
Avoiding new negative impacts on both sides of the Divide would require denying the project. The proponent's refusal to fund the MLOW, a proven mitigation approach that would significantly reduce impacts to South Boulder Creek per the Division, establishes that the proposal as currently configured cannot be the LEDPA.

3. Conclusions & Takeaways

Core characteristics of healthy rivers are flow regimes and temperatures within natural ranges, and maintaining habitat functions. See http://www.elkhartriverrestorationassociation.org/river-education/how-healthy-rivers-work/ . The Division's review establishes that Gross Moffat would compromise all three metrics. In Gross Reservoir elevated mercury concentrations would permeate the food chain. In South Boulder Creek freezing flushing flows would compromise nutrient production and trout habitat. In the Upper Colorado diverting flushing flows will inevitably result in higher temperatures, higher concentrations of metals and wastewater effluent, and impacts to fisheries and native cutthroat trout.

Importantly, all these impacts are already occurring from existing diversions and operation of the existing dam and reservoir. The unneeded project would inevitably exacerbate these

[6] See slide 47 at http://ascentenvironmental.com/files/1613/7228/6127/Defensible_Strategies_for_Mitigation_Measures_and_Deferral_of_Details.pdf (Mitigation "Do"s and "Don't"s including: "Don't: Defer adoption of mitigation or formulation of the significant aspects of mitigation until future study • Don't: Rely just on general goals of mitigation • Do: Recognize significant effect, commit to actions"

impacts. Recovering these aquatic ecosystems to re-establish healthy rivers would start by asking the right questions, such as:

- Can we re-establish healthy rivers by better managing these natural systems with existing flows?
- Are additional flows needed to restore these rivers and meet the legal mandates of the Clean Water Act?

The wrong questions include: how can we limit environmental damage if we allow 15,000 to 18,000 AFY of additional diversions on average, and might a monitoring regime supplemented by untested mitigation an acceptable alternative to a restoration strategy designed to get at the root of most of the issues: too much water being diverted already under current practices?

The Division concludes that Gross Moffat could significantly impact these waters. The "Learning By Doing" mitigation proposal resembles a science experiment, untested "in a real-life situation." Id. at 9. Denver rejected proven mitigation techniques that would meaningfully mitigate impacts to South Boulder Creek. Water quality impacts alone are reason to question whether the Moffat project should proceed, before reaching the lack of need for the water (Denver's consumption peaked around 2002 and has been roughly level since then), environmental impacts other than water quality, construction impacts, and recreation and other economic impacts on both sides of the Divide.

The mitigation agreed to by Denver amounts to a small percentage of the total project cost: 3% at most, and approximately 1.2% based on numbers cited by the Division. Although the Division did not attempt to calculate cumulative ecological and economic impacts from diversions, they would be likely to exceed the $380 million project cost, possibly by orders of magnitude. As Save the Colorado comments establish, climate significantly contributes to the risks and overall costs of the proposed project – ranging from current and projected water shortages across the Colorado River system, the potential for a compact call, and new scientific information establishing the climate impacts of reservoirs.

Overall, the Division's conditional certification might be best understood in light of 1) support for the project among certain influential stakeholders who still approach water issues from a civil engineering long after the big dam-building era has become a historical relic; 2) the Division's belief that it lacks authority under state law to either deny a permit or to impose conditions if Denver objects; and 3) state prior appropriation laws dating back to the 19th Century.

The Division's conditional permit leaves unanswered the legal question of whether the State's "primacy" to administer various aspects of the Clean Water Act is in compliance with the federal law where the Division believes that state law has effectively pre-judged that the permit will issue. When the state "right to divert" trumps all environmental concerns, does that clearly violate the federal Clean Water Act passed to "restore and maintain" the Nation's waters, and ensure that water quality provides for the "protection and propagation" of fish and wildlife? See 33 U.S.C. 1251(a) and (a)(2). The Corps should request the legal opinion of the U.S. Environmental Protection Agency on this threshold question, in addition to conducting its own legal review.

On the surface, the untrained eye would not detect dangerous mercury levels in Gross Reservoir, winter temperatures in South Boulder Creek during summer months, and heavy metal or effluent concentrations in what's left of flows in Upper Colorado tributaries. Similarly, a casual reader might construe the Division's Conditional 401 Certification for the Moffat Project as an indication that the environmental impacts are acceptable and the 401 findings indicate that the Project warrants approval. Just like with the affected waters, a closer examination of the conditional certification leads to different conclusions than the untrained eye might reach absent a rigorous examination of the actual findings in light of applicable federal law.

Denver does not need the water. The project threatens the aquatic environment on both sides of the Continental Divide. The Upper Colorado needs the remaining natural flows to retain any semblance of a natural river ecosystem and aspire to its economic potential. Significant socio-economic impacts to residents, quality of life, and recreation- and water quality-related economic drivers would occur on both sides of the Divide, especially in Boulder, Gilpin, and Grand Counties. A Compact Call would have far-ranging and severe impacts to Colorado and neighboring Upper Basin states.

Thank you for considering this comment letter, and incorporating it into the public record for the Moffat Projects EIS process. Based on the above, and other comments, we expect the Corps to deny the Moffat permit as required by federal law. The Conservation Groups look forward to continuing to participate in public processes related to this project.

Respectfully,

Mike Chiropolos
Attorney for the Conservation Groups for the Moffat Project on Comment Letter:
Save the Colorado, The Environment Group, and WildEarth Guardians

Attached: CDPHE Water Quality Control Division "Conditional 401 Certification" for Moffat Collection System Project (June 23, 2016)

Walker Ranch Management Plan (Boulder County 1985)

Cc: Julia McCarthy, Sarah Fowler, and Maggie Pierce, United States Environmental Protection Agency, Denver Regional Office

To: Federal Energy Regulatory Commission
From: Geoff Elliot, Grand Environmental Services
Date: April 8, 2018
Subj: **Gross- Moffat Supplemental EA, Considerations for Special Aquatic Resources**

We have reviewed the February 2018 Federal Energy Regulatory Commission Supplemental Environmental Assessment for Amendment of Hydropower License for the Gross-Moffat expansion (EA, FERC 2018) and, where applicable, the April 2014 Final Environmental Impact Statement for the Moffat Collection System Project (FEIS, Corps 2014) which the EA tiers to, and the Final Mitigation Plan for the Moffat Collection System (Corps 2017A and 2017B). We focus on special aquatic resources including riffle-pool complexes and jurisdictional wetlands and EA question (7) effects of environmental mitigation plans and other mitigation measures Denver Water (DW) proposes (EA page iv). Our conclusions are:

1. Environmental analysis in the EA/FEIS and Final Mitigation Plan is impossible to follow due to complex technical arguments based upon an incomplete environmental baseline. Indeed, the Corps fails to recognize the past, present, and reasonably foreseeable impacts upon special aquatic sites from profound dewatering of the Fraser River headwaters (60-100% depletions depending upon where measured (Buchanan 2015)), focusing instead upon "incremental effects" of the DW proposed action. Likewise in the Boulder Creek drainage where flows have increased for decades, we see complex technical arguments that de-emphasize existing degradation of special aquatic sites.
2. The Corps fails to take a watershed approach to the environmental analysis contrary to their own guidelines and those of sister agencies. Several widely accepted rapid-assessment protocols are available that could have offered a more holistic evaluation of environmental baseline and likely impacts, promoting more interagency, interdisciplinary collaboration with results shared with the public in plain language. Instead, the Corps opts for convoluted, data-choked discussions confuse ecological concerns.
3. Proposed mitigations ignore CEQ guidelines calling for systematic accountability and mechanisms to accomplish goals of NEPA and the Clean Water Act. Rather than taking a comprehensive, watershed approach, the Corps presents mitigations tied to limited actions rather than a transparent path toward predictable, results.

312 Park Avenue, PO Box 857, Grand Lake, CO 80447-0857
Phone: 970-509-0199 geoff@grandenvironmental.com

Based upon the above conclusions, we find the EA/FEIS and Final Mitigation Plan do not support your finding that the DW proposed action is the Least Environmentally Damaging Project Alternative (LEDPA) in terms of special aquatic sites including riffle-pool complexes and adjacent riparian wetlands.

Thank you for this opportunity to comment; please do not hesitate to contact us to discuss.

Sincerely,

Geoffrey S. Elliott
Principal Earth Scientist
Grand Environmental Services

Attached:

- Map 1: Fraser River Headwater Streams with Denver Water Diversions and Diverted Stream Reaches
- Map 2: Fraser River Headwater Streams with 303(d) impairments
- Map 3: Fraser River Headwater Streams with Collapsed Fisheries
- Table 1: Summary of Fraser River Headwater Streams, Diverted Reaches, Collapsed Reaches
- Table 2: Initial Estimate of Affected Riparian Wetlands

Part 1) Applicable Watershed Science

1A) Watershed Approach (EPA 1996) – The US Environmental Protection Agency (EPA) calls for federal agencies to adopt a watershed approach for land and water-resource management including wetland and stream mitigation (EPA 1996, ELI/Natural Conservancy 2014, Corps 2018A). The watershed approach is particularly applicable to the Corps of Engineers, as lead agency on the Gross-Moffat environmental analysis under the National Environmental Policy Act (NEPA) for expansion of Moffat trans-mountain diversions to Gross Reservoir, much of which is on involves lands and waterways on National Forest Service lands (USFS 2011, FERC 2018).

> The Gross-Moffat EA/FEIS and Final Mitigation Plan misinterpret the watershed approach. The Corps does not take comprehensive, holistic look at past, present, and reasonably foreseeable impacts to the Fraser River headwaters and Boulder Creek watershed. Instead, they downplay or substantially ignore existing watershed conditions, natural ecological functions, and significant cumulative impacts to special aquatic sites including riffle-pool complexes and adjacent jurisdictional riparian wetlands. Focusing on proposed incremental increases in trans-mountain diversions and deliveries to Gross Reservoir leads to their significant underestimate of impacts to Waters of the US.

1B) Ground Water and Surface Water – A Single Resource (USGS 1998) – USGS Circular 1139 is a landmark document presenting in plain language the basic concepts in ground water-surface water interactions.

> *"As development of land and water resources increases, it is apparent that development of either of these resources affects the quantity and quality of the other. Nearly all surface-water features (streams, lakes, reservoirs, wetlands, and estuaries) interact with ground water…Thus, effective land and water management requires a clear understanding of the linkages between ground water and surface water as it applies to any given hydrologic setting."* Dr. Robert M. Hirsch, Chief Hydrologist for the US Geological Survey, in USGS 1998).
>
> The Moffat-Gross EA/FEIS and Final Mitigation Plan ignore this fundamental concept in watershed science. Stream-riparian ecosystems are complexly intertwined, with multi-directional conjunctive flow between stream channels and their protective riparian corridors. By oversimplifying ground water-surface water exchange, the Corps misses the profound indirect and cumulative impacts of Moffat diversions of 50-100% of native flows from Fraser River headwater streams as well as increased flows in Boulder Creek.

1C) Proper Functioning Condition (PFC in BLM 1998) – this widely accepted protocol was developed the US Bureau of Land Management (BLM), US Forest Service (USFS), and Natural Resources Conservation Service (NRCS) for rapid assessment of stream-riparian corridors with a watershed perspective. Proper Function Condition includes:

- Hydrology – floodplain above bankfull should be inundated in "relatively frequent" events (every other year (BLM 1998 page 27), with sinuosity, width/depth ratio, and gradient in balance with the landscape setting.
- Riparian Health – riparian-wetland area should be widening or has achieved potential extent, there is a diverse composition of riparian-wetland vegetation for maintenance/recovery, and species present indicate maintenance of soil moisture.
- Hydrogeomorphic Processes – Hydrogeomorphic (HGM) processes should include accessible floodplain, bankfull width, width/depth ratio, sinuosity, gradient, stream power, and hydraulic controls.

The PFC protocol reflects a long-standing trend in watershed science aiming to promote interagency collaboration and better communications with the public, especially land- and water-managing stakeholders.

> The Moffat-Gross EA/FEIS and Final Mitigation plan apparently chose not to use the valuable PFC rapid assessment tool that could have shed better light on watershed conditions in the Fraser River headwaters and Boulder Creek using a protocol familiar to local land-management agencies. Instead, the Corps opts to emphasize detailed hydrologic evaluations of incremental changes between existing conditions and proposed expanded Gross-Moffat operations on a limited number of reference reaches. This leads to a fundamental misunderstanding of direct, indirect, and cumulative impacts to stream corridors including jurisdictional waters of the US while reducing opportunities for interagency collaboration and public involvement.

1D) Hydrogeomorphic Approach – The hydrogeomorphic (HGM) approach is a fundamental concept in watershed science and key to understanding water quality functions of special aquatic sites especially riffle-pool complexes and wetlands. See, for instance:

> A Hydrogeomorphic Classification for Wetlands (Corps 1993)
>
> An Approach for Assessing Wetland Functions Using Hydrogeomorphic Classification, Reference Wetlands, and Functional Indices (Corps 1995)
>
> Hydrogeomorphic Wetland Classification System: An Overview and Modification to Better Meet the Needs of the Natural Resources Conservation Service (NRCS 2008)
>
> Hydrogeomorphic Approach – Assessing Ecosystem Functionality (Corps 2018B)

The HGM approach is systematic, reproducible, and transparent.

> **Hydrology –** Key to productive interrelationships between stream and riparian ecosystems is geomorphology (shape) of channel and floodplains. Regular overbank flows (shallow biennial flooding into adjacent floodplains) are the primary driver for effective HGM functional values as water moves back and forth between streams and their riparian zones.

Overbank flooding reduces flow velocities (flood-flow attenuation) which reduces bank erosion while dropping sediment and nutrient/carbon-rich organic debris onto the floodplain – two key processes improving water quality – and floodwaters soak into floodplain soils, recharging the filtering riparian aquifer.

Geochemistry – Soluble organic and inorganic materials are captured by riparian soils and subsoils, including nutrients, metals, and carbon which feeds the riparian ecosystem and, because the subsurface is generally colder during the runoff season, cools the shallow groundwater before seeping back to the stream channel when flooding subsides. These HGM geochemical processes are key water-quality functions.

Habitat – The surface expression of much of these HGM water-quality functions is the rich array of riparian communities including jurisdictional wetlands. Depending on elevation, valley slope, and floodplain width these riparian habitats offer:

Habitat for large and small mammals as well as migratory songbirds, birds of prey, and waterfowl.

Bank stabilization which shapes fish-friendly stream morphologies while balancing sediment transport and distribution.

Food-chain support as vegetation falls back into the riffle-pool complex.

Timing of Flows – A natural hydrograph is critical to full HGM functional values as most aquatic and riparian species have evolved within ecological parameters shaped by amount and timing of flows.

1E) Other Assessment Protocols – The HGM approach is incorporated into a number of widely accepted watershed analytical tools including:

<u>Channel Evolution Model</u> (Schumm et al 1984) – recognition of predictable changes in channel morphology related to changes in flows and sediment regime.

<u>Applied River Morphology</u> (Rosgen 1996) – the seminal work on stream classification and assessment, channel evolution, and river restoration.

<u>Stream Visual Assessment Protocol Version 2</u> (SVAP2 in NRCS 2009) – the updated work building on PFC, includes more detailed evaluation of HGM-type functions.

<u>Guidance for Stream Restoration</u> (NRCS 2013) – NRCS formally adopts the Rosgen Stream Classification along with other assessment tools and presents standard restoration techniques for interagency and public applications.

<u>Functional Assessment of Colorado Wetlands</u> (FACWet, CSU/EcoMetrics 2011) – Rapid and more in-depth assessment of wetlands developed by Colorado State University and EcoMetrics, sponsored by the Colorado Department of Transportation and Federal Highway Administration.

<u>Functional Assessment of Colorado Streams</u> (FACStream, CSU/EcoMetrics 2016) – the stream-focused companion work to FACWet.

Our own experience is that these assessment tools have been embraced by federal agencies including the Corps, NRCS, Colorado Parks and Wildlife, as well as University and private watershed practitioners. By distancing themselves from these methods, the Corps misses the opportunity to take a truly hard look at stream-riparian conditions in the Gross-Moffat project area. The Gross-Moffat EA/FEIS and Final Mitigation Plan thus stand on at least three weaknesses:

1. Ignorance or perhaps a misunderstanding of Federal guidance including the watershed approach and widely accepted rapid-assessment protocols that could clarify existing watershed conditions to set the stage for transparent interagency collaboration.
2. A significant underestimate of direct, indirect, and cumulative impacts to special aquatic sites in the Fraser River and Boulder Creek drainages, including riffle-pool complexes and adjacent jurisdictional riparian wetlands.
3. No real sense of how stream-riparian systems have been impacted in the analysis area; therefore, no credible baseline upon which to drive successful mitigation measures.

Part 2) Impact Assessment

The technical problems with the Gross-Moffat EA/FEIS and Final Mitigation Plan make impact assessment impossible. That said, we can make some preliminary observations to guide future work.

2A West Side Flow Reductions – Trans-mountain diversions since the 1930s have already impacted some 80 miles of Fraser River headwater streams (See Map 1 attached). The FEIS discloses >50% of headwater flows diverted (FEIS Chapter 4) but flow reductions actually range from 64% at the Fraser River at Winter Park USGS Gage (Buchanan 2015) up to 100% diversions along many streams (Corps 2017A). Impacts to aquatic resources including riffle-pool complexes and adjacent riparian wetlands have not been reasonably documented but certainly include:

> **Profound changes in hydrologic regime in many streams –** from perennial flows to seasonal/intermittent and, in some cases, changes to subterranean flow only. See, for instance FACSteam Table 7 in CSU/EcoMetrics 2016). These changes include a profound loss of overall stream discharge, peak and low flows, and timing of flows critical to aquatic species along these stream corridors:
>
> > Out of 272 miles of headwater stream above Fraser Canyon, some 82 miles of streams are subjected to at least 50% diversions (Map 2, Table 1)
>
> **Changes in conjunctive flow –** Before Moffat diversions, riparian zones would have been flooded on a regular basis. Post-Moffat dewatering, stream channels now drain adjacent riparian aquifers and interdependent jurisdictional wetlands. Assuming a

conservative 10-30 foot wide riparian zone along each sides of Fraser River headwater streams, we can calculate in Table 1:

> 2.5 to 7.5 acres of impacted riparian wetlands per mile of dewatered streams
>
> Total 200 to 600 acres of riparian wetlands impacted by existing diversions in the Fraser Valley headwaters(Table 2)

Hydrogeomorphic Functional Values – This loss of fundamental stream-riparian function includes loss of flood flow attenuation and aquifer recharge, loss of bio-geochemical cycling including nutrient uptake and carbon sequestration, and habitat losses to fish and wildlife. This explains at least part of:

> Existing 303(d) listed stream impairments (Figure 2)
>
> At least 15 streams where aquatic ecosystems have already collapsed or may be past or near passing an ecological tipping point (Figure 3, detail from Corps 2017A).

Stream evolution trajectory – loss of high, and in many cases medium and lower flows forces headwater streams into a quasi-entrenchment where most, if not all flows are contained in the same channel (NRCS 2009). Without natural flows and sediment load and robust HGM processes, it would be impossible to predict how long it will take for these streams to recover naturally into equilibrium systems.

Additional Gross-Moffat Impacts – Without thorough disclosure of the above past and present impacts upon Fraser River headwater streams in plain language, we find it impossible to take a hard look at additional impacts from the "full use of existing system" and proposed Gross Reservoir expansion.

2B East Side – Gross-Moffat operations since the 1930s have already Boulder Creek including Gross Reservoir and stream channels upstream and downstream. Unlike the Fraser River headwaters, changes to the Boulder Creek hydrologic regime include increased flows along with changes in maximum and minimum flows, and timing of discharge. Rapid changes due to ramping upward and downward per Moffat-Gross operations include:

Starting Flow (cfs)	Down Ramp Rate (cfs per hour)	Change
39	20	51%
70	30	43%
100	30	30%
150	50	33%

Flow changes of 30-50% per hour should be expected to confuse instream species adapted to a steady hydrograph. Proposed re-timing of flows (FEIS page 57) further complicates aquatic conditions include increased development of anchor ice downstream from Gross Reservoir.

It's difficult to elaborate on likely impacts to riparian species including jurisdictional wetlands.

Part 3) Mitigation

Memorandum for Heads of Federal Departments and Agencies – Appropriate Use of Mitigation and Monitoring and Clarifying the Appropriate Use of Mitigated Findings of No Significant Impact (CEQ 2011) – The President's Council on Environmental Quality issued this guidance to encourage public participation and accountability in developing agencies' mitigation agreements (including the Corps) (CEQ 2011 page 4). Agencies are directed to develop systematic mechanisms for accountability such as:

- How to ensure that mitigation commitments are implemented
- How to monitor the effectiveness of mitigation commitments
- How to remedy failed mitigation
- How to involve the public in mitigation planning, monitoring, and adaptive management

CEQ reiterates policy requiring agencies to follow a systematic approach to mitigation:

1. Avoiding an impact by not taking a certain action or parts of an action
2. Minimizing an impact by limiting the degree or magnitude of the action
3. Rectifying an impact by repairing, rehabilitating, or restoring the affected environment
4. Reducing or eliminating an impact over time, through preservation and maintenance
5. Compensating for an impact by replacing or providing substitute resources or environments

We understand these mitigation steps are to be followed in order; that is, impacts are to be avoided wherever practicable and, where not practicable impacts should be minimized, etc. Compensation is the last resort, and only when the proponent has documented higher levels of mitigation are not practicable (see for instance Corps 2018C).

Agencies should assure agreements are tied to measurable performance standards or expected results (CEQ 2011 pages 8 and 14), and sufficient funding is committed to assure mitigation success including monitoring and, to remedy ineffective or non-implemented mitigation, adaptive management. Finally, agencies must ensure transparency and openness by making relevant and useful environmental information available to decisionmakers and the public (CEQ 2011 pages 9 and 13).

Final Mitigation Plan for West Side – Mitigation for impacts to Fraser River headwater streams and adjacent riparian zone are difficult to address since the Corps does not recognize the profound indirect and cumulative impacts to these ecosystems including dewatered reaches, 303(d) impairments, and reaches of ecological collapse.

The Final Mitigation Plan addresses only “incremental effects to aquatic resources” (Corps 2014B page 24), apparently denying responsibility for past and present impacts upon the watershed, and focuses limited resources to address public concerns per the Mitigation and Enhancement Coordination Plan (MECP 2013):

a) **Concern: Fine-grained sediment choking stream beds reduces fishery habitat value –** MECP calls for DW to bypass limited periodic “flushing flows” on the Fraser River, Vasquez Creek, Ranch Creek, Cabin Creek, and St. Louis Creek meant to scour sediment from stream beds to improve fishery habitat (Corps 2014B page 36). If the flushing flows are not effective in short distances below diversions, the project proponent makes recommendations and continues monitoring.

   We do not understand how the proposed MECP “flushing flows,” which are less than present flows, would actually meet promised goals in these 5 stream reaches. Furthermore, the Corps assumes flushing silt from gravels would be effective, when actual observed conditions in the field as gravel and cobble choked with an algae + silt mix, locally known as “rock snot.” Our own experience shows that much higher flows are necessary, actually moving stream bed materials to dislodge the rock snot in order to make the bed more suitable to larger macroinvertebrates such as stonefly.

   This is an example of the Corps accepting action-driven, rather than results driven, mitigation contrary to Federal Policy in CEQ (2011).

b) **Concern: High Water Temperatures, potentially lethal to trout, in the Fraser River, Ranch Creek, and St. Louis Creek, including 303(d) listings for elevated water temperatures** (see Map 2 attached). MECP calls for the project proponent to bypass a limited amount of additional water, under limited conditions, on these streams with no commitment to actual results.

   This is another example of the action-driven, rather than results-driven mitigation. Of deeper concern is the language in Condition 5 (Corps 2014B Appendix B page 3) which points DW toward a one-time $1M contribution to the Learn by Doing Committee, of which the proponent is a major player, if the mitigation is unsuccessful and offers no more than “de minimus” improvements in water temperature.

c) **Concern: Loss of native Colorado River Cutthroat Trout in most Fraser River headwater streams –** The MECP calls for DW to make a one-time contribution for establishment of a cutthroat trout in one Grand County stream reach. This is in addition to additional measures to protect and promote greenback lineage trout in Grand County.

   Apparently, the Corps accepts almost complete loss of cutthroat trout in the Fraser River headwaters without disclosing it in the EA/FEIS and Final Mitigation Plan, but does offer off-site compensatory mitigation elsewhere in Grand County, with an only limited cash commitment and no guarantee of success. This is again contrary to Corps Policy (Corps 2018C).

d) **Concern: Loss of high elevation fishery habitat in the Fraser River Headwaters –** The Final Mitigation Plan details River rehabilitation on 1.8 miles of the Williams Fork River immediately upstream and downstream of Williams Fork Reservoir on land owned by DW.

   Again, the Corps apparently accepts almost complete loss of high elevation stream channel habitat including protective riparian corridors in the Fraser River headwaters, without full disclosure in the EA/FEIS and Final Mitigation Plan, and again offers off-site compensatory mitigation elsewhere in Grand County, with an only limited cash commitment and no guarantee of success. Furthermore, the primary habitat losses are on National Forest System lands and certain private and public lands in the Fraser Valley upstream from Fraser Canyon, while DW benefits from the proposed fishery improvements on their own property.

Without disclosure in plain language of past, present, and reasonably foreseeable impacts from diverting 50-100% of native flows from the Fraser River headwaters, it's difficult to understand how the above measures would mitigate for:

- Profound changes to 80 miles of dewatered streams and their riparian corridors including jurisdictional waters of the US.
- Significant impacts to some 200 to 600 acres of riparian wetlands.
- 303(d) listed impaired streams including elevated concentrations of Copper and Arsenic, as well as aquatic life
- Collapse or near-collapse of aquatic habitats in approximately half of the stream reaches listed in the Final Mitigation Plan
- Loss of aquatic resources on National Forest System Lands, to be mitigated on lands owned by the City and County of Denver

East Side – The EA does present a reasonable list of Best Management Practices for controlling direct impacts of erosion and sedimentation during proposed Gross expansion, but fails to offer a reasonable disclosure in plain language of past, present, and reasonably foreseeable impacts to aquatic resources along Bounder Creek including adjacent riparian wetlands. It is thus impossible to gage the likelihood for success of the proposed mitigations:

- Protection of the 539-acre Toll property by conveyance to the USFS
- Off-site stream habitat improvements and stream bank stabilization elsewhere in the South Platte River drainage

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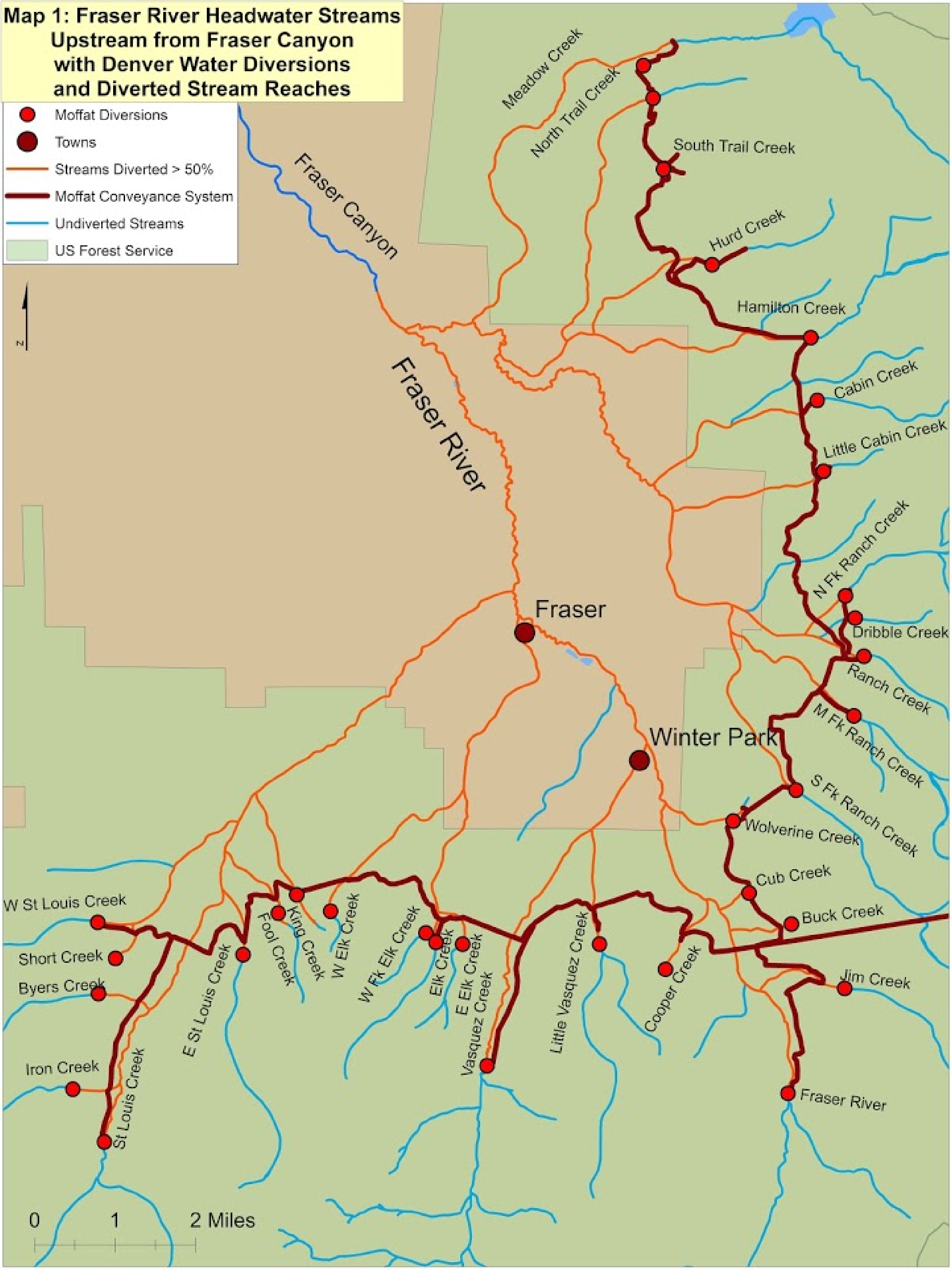
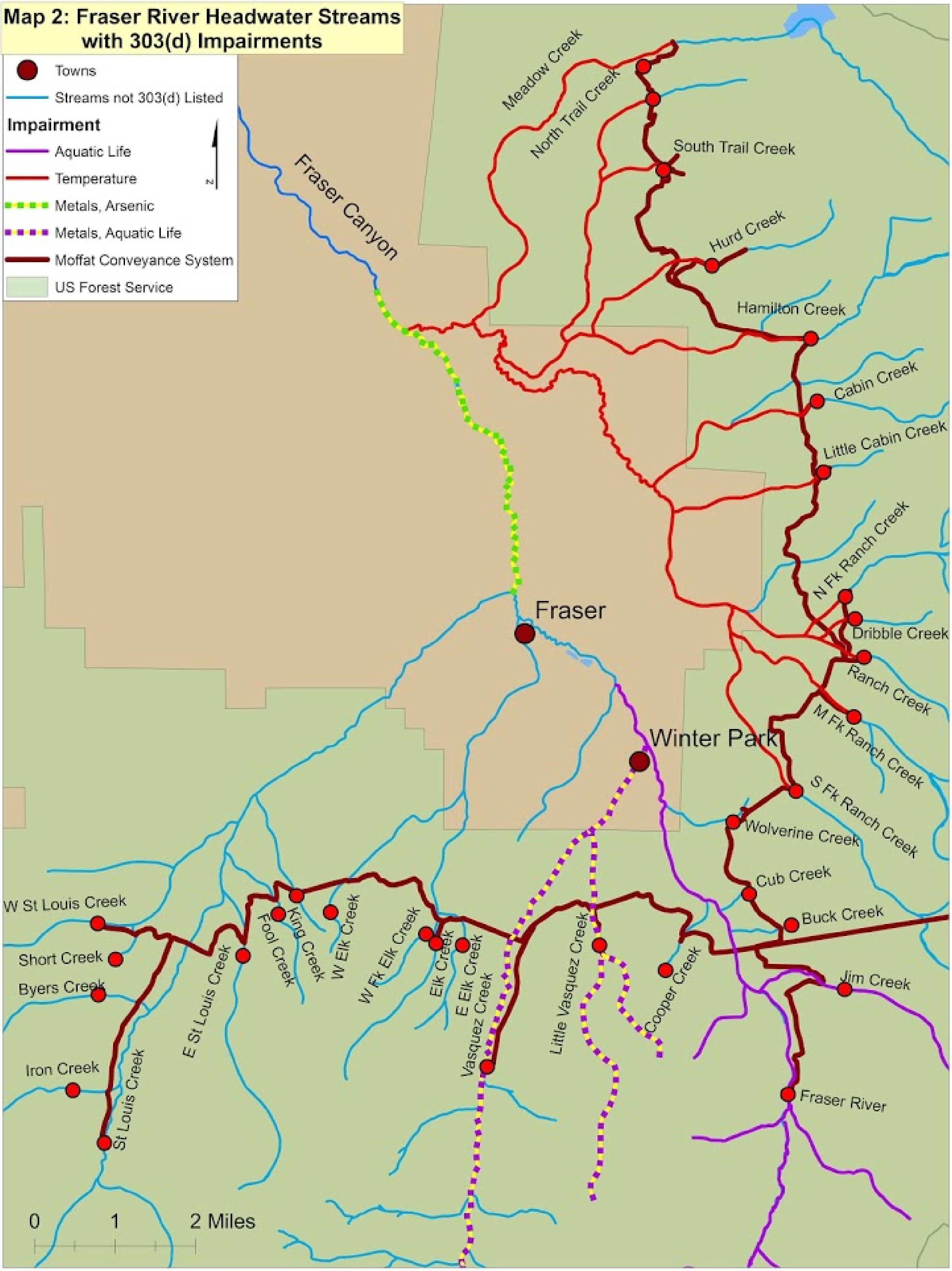


*Grand Environmental Services * 970-509-0199 * April 7, 2018*


Map 2: Fraser River Headwater Streams with 303(d) Impairments
Towns
Streams not 303(d) Listed
Impairment
Aquatic Life
Temperature
Metals, Arsenic
Metals, Aquatic Life
Moffat Conveyance System
US Forest Service
N
Fraser Canyon
Meadow Creek
North Trail Creek
South Trail Creek
Hurd Creek
Hamilton Creek
Cabin Creek
Little Cabin Creek
N Fk Ranch Creek
Dribble Creek
Ranch Creek
M Fk Ranch Creek
S Fk Ranch Creek
Fraser
Winter Park
Wolverine Creek
Cub Creek
Buck Creek
Jim Creek
Fraser River
W St Louis Creek
Short Creek
Byers Creek
Iron Creek
St Louis Creek
E St Louis Creek
Fool Creek
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W Fk Elk Creek
Elk Creek
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Vasquez Creek
Little Vasquez Creek
Cooper Creek
0
1
2 Miles

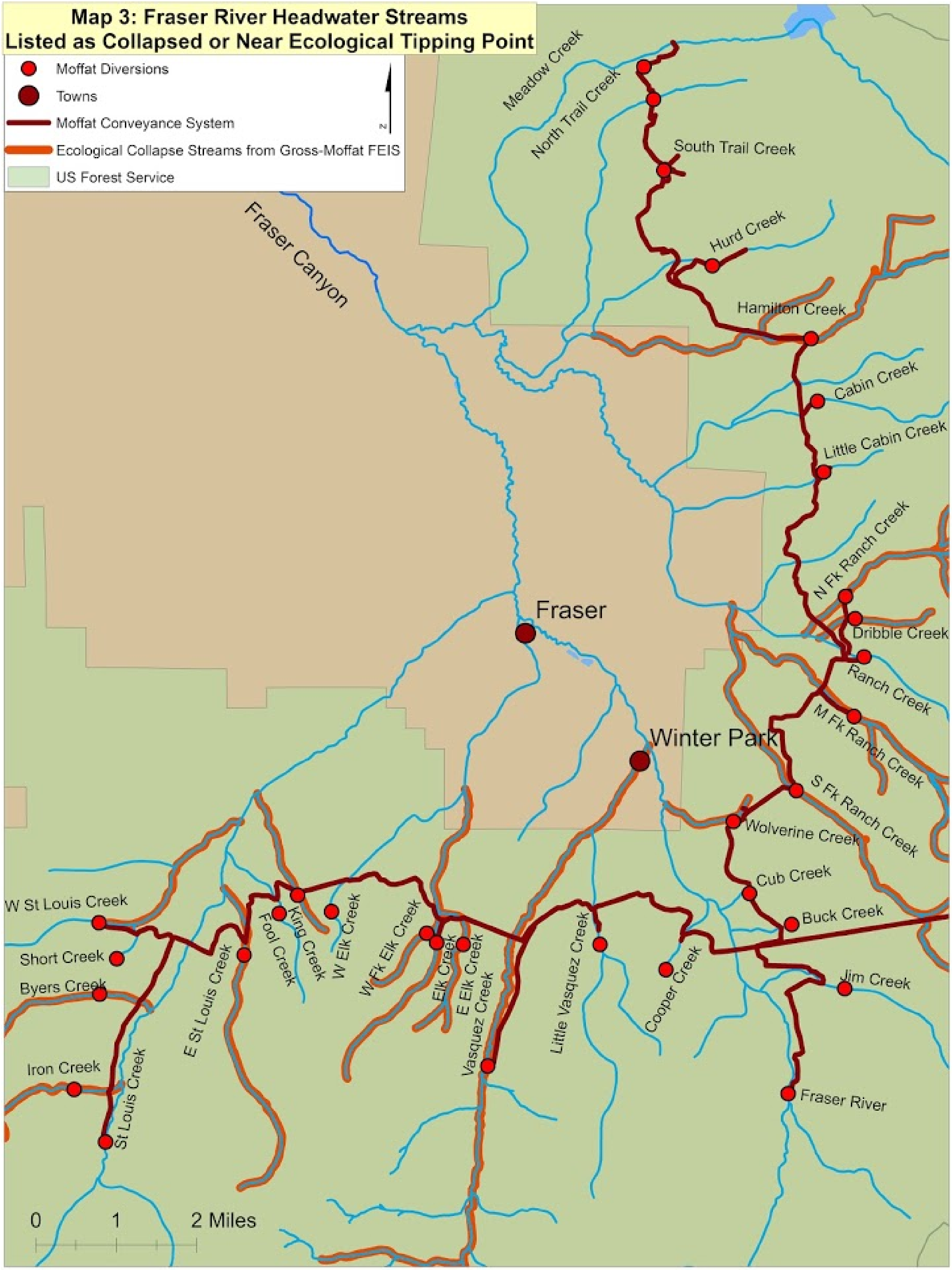
Map 3: Fraser River Headwater Streams
Listed as Collapsed or Near Ecological Tipping Point
Moffat Diversions
Towns
Moffat Conveyance System
Ecological Collapse Streams from Gross-Moffat FEIS
US Forest Service
N
Meadow Creek
North Trail Creek
South Trail Creek
Hurd Creek
Fraser Canyon
Hamilton Creek
Cabin Creek
Little Cabin Creek
N Fk Ranch Creek
Dribble Creek
Ranch Creek
M Fk Ranch Creek
S Fk Ranch Creek
Wolverine Creek
Cub Creek
Buck Creek
Jim Creek
Fraser River
Fraser
Winter Park
W St Louis Creek
Short Creek
Byers Creek
Iron Creek
St Louis Creek
E St Louis Creek
Fool Creek
King Creek
W Elk Creek
W Fk Elk Creek
Elk Creek
E Elk Creek
Vasquez Creek
Little Vasquez Creek
Cooper Creek
0
1
2 Miles

Table 1: Fraser Valley Headwater Streams
Stream lengths from National Hydrography Data Set
Stream diversions >50% from Moffat Final EIS
Streams "collapsed, "near or past ecological tipping point from Moffat FEIS + Final Mitigation Plan

Name	Total Length (miles)	Stream Diverted >50% Length below diversions (Miles)	% Impacted	Past or Near Collapse/Ecological Tipping Point
Meadow Creek	20.4	5.3	26%	
Trail Creek	5.2	3.7	72%	
S Trail Creek	3.2	0.8	25%	
Hurd Creek	4.8	2.1	43%	
Hamilton Creek	9.7	2.3	24%	
Cabin Creek	12.8	2.4	19%	
Little Cabin Creek	3.9	1.8	47%	
N Fk Ranch Creek	5.2	0.8	15%	Past
Dribble Creek	1.6	0.4	27%	Past
Main Ranch Creek	17.0	10.5	62%	
M Fk Ranch Creek	7.2	2.0	28%	
S Fk Ranch Creek	7.7	2.6	34%	Past
Wolverine Creek	1.3	1.0	82%	Past
Cub Creek	0.8	0.5	59%	Past
Buck Creek	2.4	0.6	27%	Past
Jim Creek	9.2	1.3	14%	
Fraser River	43.2	13.7	32%	
Cooper Creek	1.2	0.6	46%	Past
Little Vasquez Creek	7.4	1.6	21%	Near
Vasquez Creek	41.7	5.0	12%	Near
E Elk Creek	2.3	0.6	26%	Past
E Fk Elk Creek	2.4	0.2	8%	Past
Elk Creek	5.7	4.7	83%	Past
W Elk Creek	3.2	2.6	80%	Near
King Creek	2.0	1.5	76%	Near
Fool Creek	2.9	1.2	43%	Past
E St Louis Creek	4.6	0.9	20%	Past
St Louis Creek	30.4	9.6	32%	
Iron Creek	3.7	0.5	14%	Past
Byers Creek	2.4	0.8	33%	Past
Short Creek	0.8	0.6	75%	
W St Louis Creek	5.8	2.4	41%	Past
Grand Total	272.1	84.8	31%	19 total out of 32

Table 2 Initial Estimate of Riparian Wetlands Impacted by Gross-Moffat

Fraser River headwaters only

Model 20 and 60 foot wetland widths including both sides of streams

Wetland Width (Feet)	20	60
Length in one mile (Feet)	5280	5280
Area wetland one mile (Square Feet)	105,600	316,800
Area wetland one mile (Acres Per Mile)	2	7
Length of Streams Diverted >50%	85	85
Acres Impacted to Some Extent	206	617

SAVE THE COLORADO

Date: September 8, 2016

To: U.S. Army Corps of Engineers

From: Save The Colorado

Re: Joint West Slope Risk Study

On August 27, 2015, Save the Colorado (STC), joined by Waterkeeper Alliance, Colorado River Connected, Wildearth Guardians, Living Rivers and TEG, submitted a letter to the U.S. Army Corps of Engineers entitled, *FEIS for Moffat Collection System Project failed to analyze impact of diversions on the Colorado River Compact, climate change, looming "shortages," and increasing the likelihood of a "Compact Call."* Your office acknowledged receipt of this letter ("Compact Call letter") on August 28, 2015.

The Compact Call letter identified the significant risks to the current water management scheme and specifically to Colorado West Slope water users that is posed by a combination of negative hydrological impacts from climate change and increased diversions from the Colorado River and its tributaries. The letter noted that the FEIS for the Moffat Collection System Project failed to take a hard look at the impacts on the Colorado River water users and management system that are likely to result from the additional diversions that would be enabled by the Moffat project. STC and its partners established that the Corps must at a minimum complete additional NEPA analysis and consider these impacts in the Moffat project permitting decision.

New information has now come to light regarding the risks to the Colorado River system identified in the Compact Call letter. *Aspen Daily News* Online reported on August 15, 2016, that Eric Kuhn, general manager of the Colorado River District is undertaking a study "asking if future droughts will drop water levels in Lake Powell so low that Glen Canyon Dam won't be able to produce hydropower or release enough water to meet downstream demands."[1] This study (the Joint West Slope Risk Study) is designed

[1] http://www.aspendailynews.com/section/home/172183

to identify "how much water the upper basin states may have to send to keep Lake Powell above two key elevations" that would avoid a Compact Call.[2]

Importantly, in his explanation of the study results to date, Kuhn noted that even a "relatively moderate drought" could drive shortages in the upper basin.[3] The article (attached here as Exhibit 1) continues:

> Another potential conclusion from the risk study is that any new transmountain diversion would only make it more likely that Powell would go below target levels.
>
> "What we're suggesting is that a new transmountain diversion could still divert, but only if there's enough water in Lake Powell," Kuhn told the board.
>
> Kuhn put it another way during a presentation to the Gunnison River basin roundtable on Aug. 1.
>
> "It is going to be a very high burden to show that a new transmountain diversion won't impact system usages," he said.
>
> In fact, Kuhn said the model is showing that there has only been one year since 2000 that a new transmountain diversion wouldn't have had a negative impact.
>
> "So are you going to build a multi-billion dollar project that is going to operate once in 20 years?" Kuhn said in Gunnison. "I don't think so."[4]

It is clear from Kuhn's summary of the study that even the preliminary results he reported are essential to understanding the feasibility and impacts of the Moffat project. **The Corps is now aware of this study and the findings to date and must consider them in its NEPA analysis and permit decision making for the Moffat project. Further, the Corps must not proceed with permitting any project leading to increased transmountain diversions from the Colorado River basin, including the Moffat project, until this landmark study is completed and reviewed.** If the Corps fails to incorporate this critical piece of information, the prospect of a multi-million dollar boondoggle—wasting public money on a project that will never meet its goal—is clear.

Please acknowledge receipt of this letter. Thank you,

--

Gary Wockner, PhD, Executive Director
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http://www.facebook.com/savethecolorado
https://twitter.com/savethecolorado. 970-218-8310

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[2] Ibid.
[3] Ibid.
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Ecological Applications, 30(1), 2020, e02005

Designing flows to enhance ecosystem functioning in heavily altered rivers

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Citation: Bestgen, K. R., N. L. Poff, D. W. Baker, B. P. Bledsoe, D. M. Merritt, M. Lorie, G. T. Auble, J. S. Sanderson, and B. C. Kondratieff. 2020. Designing flows to enhance ecosystem functioning in heavily altered rivers. Ecological Applications 30(1):e02005. 10.1002/eap.2005

Abstract. More than a century of dam construction and water development in the western United States has led to extensive ecological alteration of rivers. Growing interest in improving river function is compelling practitioners to consider ecological restoration when managing dams and water extraction. We developed an Ecological Response Model (ERM) for the Cache la Poudre River, northern Colorado, USA, to illuminate effects of current and possible future water management and climate change. We used empirical data and modeled interactions among multiple ecosystem components to capture system-wide insights not possible with the unintegrated models commonly used in environmental assessments. The ERM results showed additional flow regime modification would further alter the structure and function of Poudre River aquatic and riparian ecosystems due to multiple and interacting stressors. Model predictions illustrated that specific peak flow magnitudes in spring and early summer are critical for substrate mobilization, dynamic channel morphology, and overbank flows, with strong subsequent effects on instream and riparian biota that varied seasonally and spatially, allowing exploration of nuanced management scenarios. Instream biological indicators benefitted from higher and more stable base flows and high peak flows, but stable base flows with low peak flows were only half as effective to increase indicators. Improving base flows while reducing peak flows, as currently proposed for the Cache la Poudre River, would further reduce ecosystem function. Modeling showed that even presently depleted annual flow volumes can achieve substantially different ecological outcomes in designed flow scenarios, while still supporting social demands. Model predictions demonstrated that implementing designed flows in a natural pattern, with attention to base and peak flows, may be needed to preserve or improve ecosystem function of the Poudre River. Improved regulatory policies would include preservation of ecosystem-level, flow-related processes and adaptive management when water development projects are considered.

Key words: algae; aquatic insects; channel geomorphology; climate change; designed flow regime; fish; hydrology; modeling; NEPA policy change; probabilistic Bayesian Network model; riparian community; water development.

Introduction

Rivers have been heavily modified on a global scale due to hydrologic alteration by dams and water extraction, leading to extensive ecological change (Nilsson et al. 2005, Dudgeon et al. 2006, Vörösmarty et al. 2010). Ongoing demand for municipal and agricultural water will continue to stress river ecosystems, but those uses are countered by growing interest in restoring rivers to sustainable ecosystem conditions, while still accommodating human needs. Providing water for traditional uses while sustaining ecosystem function poses challenges, particularly in semiarid and arid landscapes where water demand is high (Grafton et al. 2013). Thus, restoration practitioners seek to optimize the functional

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impact of limited water to maximize ecological outcomes (Yarnell et al. 2015).

River restoration requires understanding linkages between specific flow conditions and ecosystem attributes to provide clear, quantified management targets (Poff and Schmidt 2016, Webb et al. 2017). In heavily altered systems, restoration to a "natural," pre-development state is generally not an option, particularly when future climate is uncertain (Moyle 2014, Poff 2018). Alternatively, specifying flows to restore functions that are ecologically important and socially desirable may be possible. So-called "designer flows" (sensu Acreman et al. 2014) can, in principle, help meet both ecosystem and human needs for water (e.g., Kiernan et al. 2012, Chen and Olden 2017). For heavily appropriated systems with multiple competing users, it is critical to understand how alternative management interventions will affect existing economic and social benefits provided by the river (Northern Colorado Water Conservancy District 2017). It is also important to understand the biophysical processes needed to promote long-term ecosystem functioning, including dynamic channel features and desirable aquatic and riparian species, which may have different requirements. Appropriate ecosystem modeling that incorporates a variety of future flow conditions is useful for such an evaluation.

The Cache la Poudre River (hereafter, Poudre River) is a southern Rocky Mountains, USA, mountain and plains system in northern Colorado that has been altered by heavy agricultural and urban water use since European settlement in the 1870s. Despite streamflow changes, intensive agricultural and urban land use, and nonnative species establishment, the Poudre River remains a valued amenity both socially and functionally, particularly where it flows through the City of Fort Collins (City). Declining ecological condition of the Poudre River has been documented (City of Fort Collins 2017) but a strong interest has developed among the public and government institutions to restore and promote a dynamic and functioning river that provides amenities. However, extensive dam and diversion infrastructure, proposed additional water development near Fort Collins (U.S. Army Corps of Engineers 2018), and climate change, complicates appropriate management strategies.

Management of arid-land systems such as the Poudre River requires understanding flow-ecology relationships (Poff et al. 2010), as well as anticipating future hydrologic change, to illuminate restoration strategies responsive to likely evolution of the river ecosystem. To accomplish this, we first developed a comprehensive, multi-compartment model informed by empirical data showing how hydrology and other variables (e.g., channel structure, water temperatures, and nutrients) drive important riverine geomorphic processes and associated ecosystem endpoints in the coupled aquatic-riparian system. Thus, our model differs from other strictly flow-driven modeling approaches such as ELOHA (Poff et al. 2010), which is effectively a rapid assessment tool useful for multisite comparisons of potential river degradation. Following model development for the current ecosystem, we evaluated how "scenarios" of future hydrologic conditions, ranging from status quo to expanded water development and climate change, may alter the Poudre River ecosystem. We also designed and modeled hypothetical flow regimes that we thought might achieve acceptable ecosystem outcomes under active flow management. Our aim was to produce a scientifically credible and comprehensive analysis to inform the public and assist water managers interested in sustainable management of the Poudre River ecosystem. Here, we detail model development and implementation to identify aspects of an ecologically effective flow regime that might be attainable through active management of water infrastructure, including proposed development in the Poudre River basin. This modeling effort may also inform predictions and management perspectives for other heavily altered river ecosystems in the western United States and elsewhere.

Methods

Study site

The Poudre River drainage (~2,865 km^2) originates in high-elevation mountains (>4,000 m above sea level) west of Fort Collins, Colorado, USA (U.S. Geological Survey [USGS] gage 06752260, Fig. 1). Above 1,900 m elevation, the river is a moderate to high gradient, high-velocity, cobble-bottomed stream that supports a trout-dominated fish community and diverse aquatic insects in orders Ephemeroptera, Plecoptera, and Trichoptera (EPT taxa). In the study area just downstream, the channel meanders through a lower gradient, less confined transition zone between mountains and prairie (~1,600–1,900 m elevation) and supports cool water tolerant trout, native catostomids and cyprinids, and fewer EPT taxa while adding Diptera (Fausch and Bestgen 1997). Native narrowleaf and plains cottonwood (*Populus angustifolia* James and *P. deltoides* W. Bartram ex Marshall, respectively) and their hybrids, willow (*Salix* spp.) and green ash (*Fraxinus pennsylvanica* Marshall), as well as nonnative species crack willow (*Salix fragilis* L.), Siberian elm (*Ulmus pumila* L.), and Russian olive (*Elaeagnus angustifolia* L.), dominate the riparian zone. Gravel, cobble, sand, and silt predominate in this montane-prairie ecotone. Downstream, the warm-water Poudre River continues another 60 km to the South Platte River, Missouri–Mississippi River watershed.

The 21 km long transition zone reach of the Poudre River, as just described, historically had multiple and sinuous channels and a broad floodplain with oxbows (Fig. 2a). As urbanization and development proceeded, riverbanks were structurally hardened to prevent channel meandering and property destruction during flooding, which resulted in a straighter and mostly confined

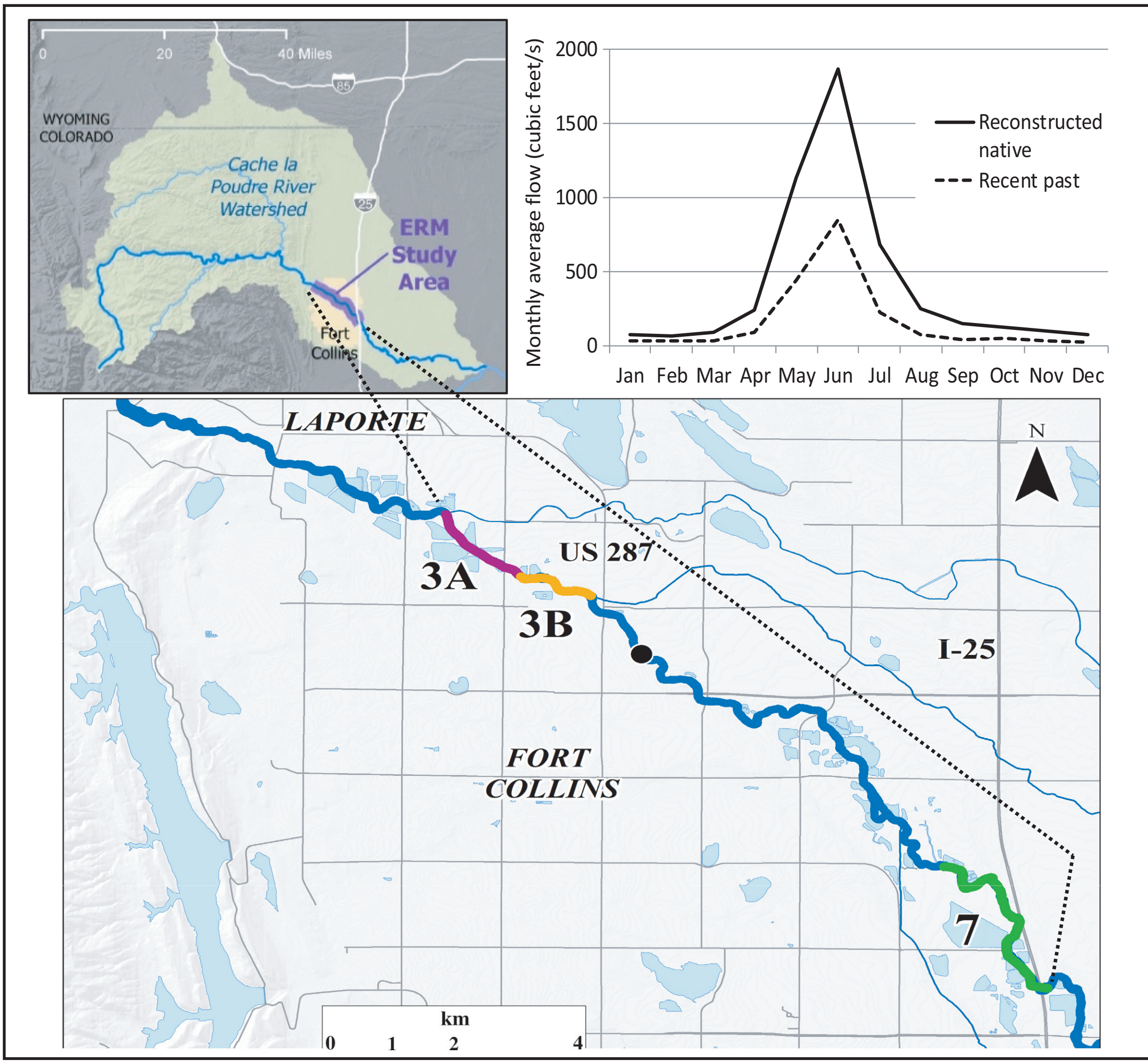

Fig. 1. The Ecosystem Response Model study area in the Cache la Poudre River watershed near Fort Collins, Colorado, USA. The Poudre River Basin map (upper left; 1 mile = 1.61 km) shows the study area segment, which is expanded below to show confined, moderately confined, and least confined reaches (3a, 3b, and 7, respectively) from up to downstream. Reduced mean monthly flow of the Poudre River in Fort Collins (water years 1975–2005) for the altered recent past hydrologic scenario (from flow gage measurements, USGS # 06752260; 1 cubic foot/s = 0.03 m^3/s) is compared to the reconstructed native (pre-development, modeled flows) flow regime (upper right; Shanahan et al. 2014).

single-thread system (Fig. 2b). Native cottonwood and willow dominate the riparian community, although non-native trees are increasing. Three of eight urban to sub-urban river corridor sub-reaches (Fig. 1b) were chosen for modeling because they represented the range of upstream to downstream channel constriction and floodplain connectivity through the 21 km long study area. Reach 3a (confined reach) is highly confined upstream by bank stabilization and has only a few opportunities for floodplain restoration. Just downstream, Reach 3b (moderately confined reach) is partially confined, offering modest restoration opportunity for natural riverine and riparian functions, while downstream Reach 7 (least confined reach) has a mix of armored banks and open floodplain and, potentially, the greatest channel-floodplain restoration opportunities.

Conceptual hydrologic calendar

To illustrate how changes in flows qualitatively affect important geomorphic and biological attributes, we developed a conceptual Poudre River hydrologic calendar (Fig. 3). We developed this model from stream ecology literature (e.g., Allan 1995), regional and Poudre-River-specific ecological and geomorphic traits (Fausch and Bestgen 1997, Merritt and Poff 2010, Wohl et al.

FIG. 2. Cache la Poudre River along a section of the ERM study reach, Fort Collins, Colorado, (a) in 1937 and (b) recently (circa 2005). Panel a shows a meandering channel, with a wide, unimpaired zone of channel movement across the floodplain and presence of cottonwood forests of various ages. Panel b depicts the confined channel after nearly a century of land use changes that simplified and straightened the river, reduced channel migration and the associated rejuvenation of riparian habitat, narrowed the riparian zone, and confined the channel with hardened banks and associated pit ponds following gravel extraction.

2016), as well as from observations and expert judgement based on the authors' extensive field sampling over the last two or more decades. We adopted this river view after discussions that gravitated from a narrowly focused subset of flow-biology relationships to a holistic Poudre River ecosystem model useful to predict responses of geomorphic and biological indicators to flow and changes in management. This model reflects our aim of counterbalancing the unintegrated and few species-specific approaches commonly used in environmental assessments and resource management decision-making.

Strongly seasonal spring and early summer peak flows foundational to a functioning snowmelt river ecosystem set the physical habitat template for the Poudre River. Increased discharge from high-elevation snowmelt recruits streamside wood into the channel, mobilizes fine sediments, and scours algae, gravels, and cobbles to create aerated spawning substrates for fishes, including spring-spawning salmonids. Cool water fishes reproduce and young of spring-spawning salmonids emerge. High magnitude flow peaks maintain channel width and complexity and sometimes connect the river and floodplain, forming seasonal wetlands of variable extent and duration depending on snowmelt volume. Descending limb flows and associated sediment deposits create germination sites and enhance seedling survival for colonizing plant species (e.g., *Populus* and *Salix*) and enable early life stage fish dispersal to complex, secondary-channel backwaters. In summer, relatively stable base flows facilitate rapid growth of tree seedlings as well as reproduction and growth of native fishes, trout, and aquatic insects that require cleansed and oxygenated gravel beds. Stable autumn and winter base flows of appropriate magnitude support spawning fish and enhance survival of trout eggs and insects in shallow riffles.

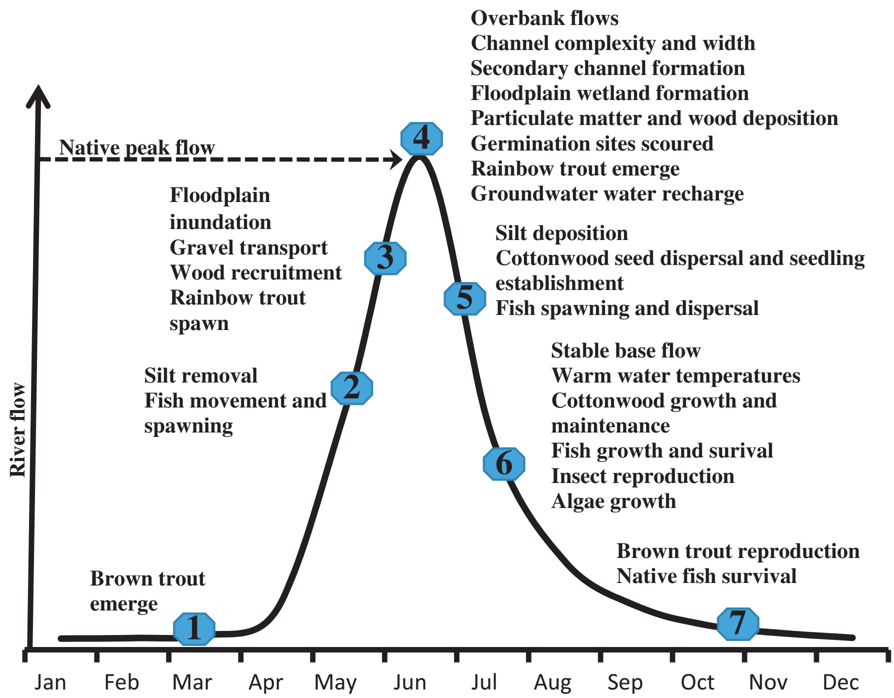

Fig. 3. Poudre River hydrology calendar, which conceptually describes flows and timing of functions those flows support to produce physical, chemical, and biological responses.

In contrast to the historical conditions portrayed by the hydrologic calendar, the contemporary Poudre River is highly altered (Appendix S1: Tables S1, S2). Extensive water storage infrastructure was developed to supply agriculture and municipal use, aggregate mining and urban development resulted in confined channels, and the many diversion dams upstream of the city (Fig. 1, Appendix S1: Table S1) divert a large proportion of river flow for much of the year. Storage and diversions reduce pre-development (native) peak and base flows (flows that would occur in the absence of diversions and other management) by 59% and 57%, respectively (Bartholow 2010, Shanahan et al. 2014). These hydrologic changes reduce sediment flushing and contribute to channel simplification thus reducing river amenities including a quality fishery or native riparian corridor (Wohl et al. 2015).

Model development and structure

Hydrologic alteration induces multiple, linked ecosystem responses, including changes to sediment transport, channel maintenance, and floodplain and wetland inundation, which affect distribution and abundance of in-channel and riparian biota (Nilsson and Svedmark 2002). Thus, we developed a multi-compartment Ecosystem Response Model (ERM) to evaluate future trajectories and complex and interacting biophysical functions under various Poudre River flow regimes, using a probabilistic Bayesian Network model. Here, we describe generalities of ERM development; additional details regarding probability tables and relationships used to calculate responses to flows and other variables are in Shanahan et al. (2014), Supporting Information (SI; Data S1) and City of Fort Collins (2019).

The probabilistic ERM network conceptualizes cause-and-effect relationships between flow regime, sediment, temperature, and ecological states (Fig. 4). Most relationships are based on conditional probabilities such that effects of one driver on a response will vary depending on other driver variables. Use of conditional probabilities leads to complex model parameterization but allows for incorporation of many information types to produce predictions about physical, chemical, and biological resources, and interactions among them. Because hydrology is a known master driver of physical and ecological conditions in streams (Poff et al. 1997, 2010), the ERM can be used to predict outcomes under various conditions including native flows, present altered flows, and future regimes resulting from additional water storage or climate change. The ERM incorporated major ecosystem components and interactions and retained advantages of a Bayesian Network approach (Uusitalo 2007) including (1) integration of various ecosystem functions typically evaluated as independent variables, (2) incorporation of various data types ranging from quantitative empirical analyses to qualitative expert judgment, (3) explicit quantification and incorporation of uncertainty, and (4) flexibility to test an array of scenarios.

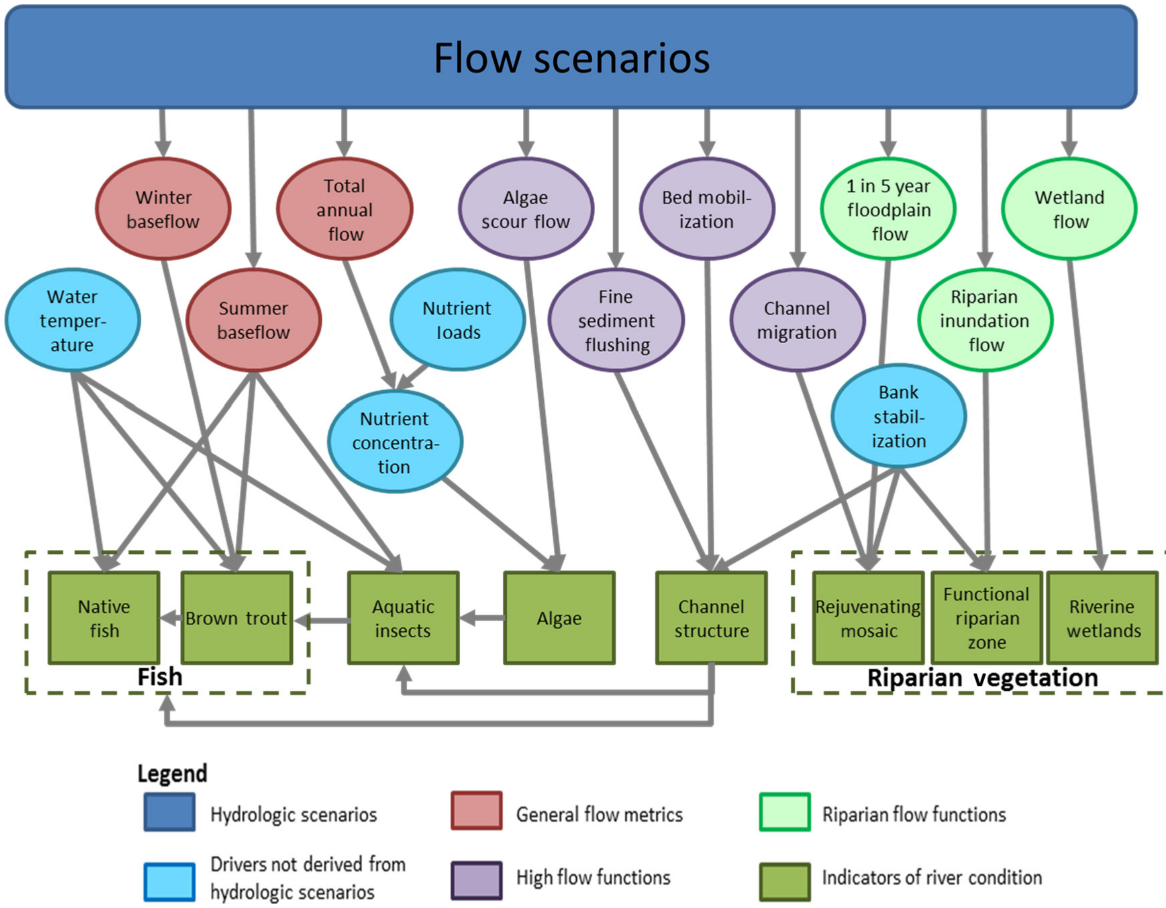

FIG. 4. Structure of the Bayesian network for the Poudre River Ecological Response Model (ERM), which links flow regime drivers, including aspects of magnitude, duration, frequency, and variability, to various flow metrics and functions, and their influence on indicators of river condition, the sum of which form ecosystem responses. Arrows between flow metrics and function nodes to indicators of river condition are predictive relationships in the model. Arrows linking indicators of river condition reflect interactions.

Indicators were formulated using combinations of quantitative channel hydraulics, empirical flow-ecology relationships based on continuous or categorical responses, and interacting effects of flow mediated through various combinations of base and peak flow, temperature, nutrients, and bed stability. Indicators included in the ERM (see Appendix S1: Table S3) were: (1) channel structure (substrate and channel geometry template for physical and ecological processes), (2) algae (basal food web resource, but unaesthetic and detrimental when excessive), (3) aquatic insects (species composition and abundance indicates flow regulation, water quality, and is a critical food web link), (4) native fish (indicates channel condition and flow regulation effects), (5) trout (mainly nonnative brown trout (*Salmo trutta* L.), which have high angler value and are a sensitive indicator of thermal and hydrologic regimes), (6) rejuvenating mosaic forest (width of multistage riparian forest with species adapted to disturbance), (7) functional riparian zone (river-connected area that supports biogeochemical processing, flood peak attenuation, sediment deposition, episodic aquatic habitat, and a productive vegetative community), and (8) riparian wetland (floodplain area inundated with sufficient frequency and duration to support wetland plants). Indicators were grouped into three types, based mainly on the amount of quantitative data available to describe them. The first group, for which quantitative data were available, included channel structure and three indicators of riparian condition, for each of the three separate river reaches. Because quality and quantity of stream habitat are determined by the interaction between flow and the structure of the river channel, the effects of flow changes on the ecosystem must be considered in the context of the current channel structure and its variability along the river (Brewer et al. 2016, McManamay et al. 2016). To quantify the effects of channel structure and associated moderate to high flows on indicators in the ERM (i.e., algae, native fish, trout, aquatic insects, and three riparian vegetation indicators), shear stress and effective discharge analyses were performed at representative locations in each of the three reaches modeled along the Fort Collins river corridor. Hydraulic modeling identified discharges at which critical thresholds of shear stress, associated with riverbed flushing and bed and channel mobilization, were met, based on flow characteristics, channel geometry, and substrate composition in each reach (details in Shanahan et al. 2014; the full channel structure model data and a detailed narrative is in SI, and Data S1; the full Excel spreadsheet is also available from the senior author upon request). An annual high flow pulse capable of flushing surface deposits of fine sediment was assumed needed to ensure ecological functioning, while widespread mobilization of the coarse river bed sediments had a longer, two-year average return interval based on the current management infrastructure, and on interannual flow variability including multi-year dry periods. Descriptions and data sources for cross-sectional geometry were used to perform shear stress and effective discharge analyses, discharge–shear-stress rating curves, the HEC-RAS model (U.S. Army Corps of Engineers 2009), hydraulic model median grain size (d_{50}), and flow records for each of the three reaches, as described in Shanahan et al. (2014), SI (Data S1) and City of Fort Collins (2019).

Geospatial probability modeling was used to determine floodplain area available for the three riparian indicator responses. Reach-specific empirical models related flood flow inundation to riparian forest species and functional group composition. These relationships used detailed riparian plant distributions (Shanahan 2009) and measured presence of the rejuvenating mosaic, functional riparian zone, and riverine wetlands, and were modeled as a function of exceedance probability from a 30-yr flow record (USGS streamflow gages) using logistic regression. Compared to the other two riparian indicators that mainly require floodplain inundation, the rejuvenating mosaic requires higher shear stresses to induce channel migration and to disturb and scour floodplain germination sites for seeds. Exceedance probability was mapped using local rating curves developed with HEC-RAS 1-D hydraulic models (U.S. Army Corps of Engineers 2009), a 1-m^2 digital elevation model, and river flow duration curves. Reconstructed historical flows and future climate change and water development scenarios were used to recalculate and reproject future exceedance probabilities and corresponding distributions and area of vegetation, which informed probabilistic model parameters.

The trout indicator was the sole member of the second indicator group, which was based on an empirical flow-ecology relationship augmented with expert judgement. The trout indicator was based in part on field sampling that related abundance of young brown trout captured in autumn samples (n = 16 yr) as a function of the river flow level in the previous winter when eggs were incubating and hatching. This relationship indicated that higher winter flows of about 1 m^3/s, for example, had a relatively high 0.67 probability of producing a larger number (>20) of young trout per year, while low flows < 0.28 m^3/s had an 80% probability of producing 5 or fewer trout; intermediate flows produced an intermediate number of young trout. The empirical relationships between winter flow categories and young trout abundance were used to describe the probabilities of having a trout fishery in one of four categories, or states (− −,−, 0, +) that reflect the number of age classes present, their abundance, and reproductive success (present state is between − and 0). Several other factors also influenced this indicator (see Fig. 4), and these were assigned independent probabilities (by expert judgement) to place trout into one of the four states in a process similar to that described below for qualitative indicators (see SI; Data S1; City of Fort Collins 2019). We also weighted driving variables for each indicator in the ERM according to their relative importance. Using trout as an example, weights for winter baseflow, summer baseflow and temperature, and channel structure were relatively high and equal (0.27 each, total of 0.81), reflecting that habitat and temperatures are relatively more important, while invertebrates received a lower relative weight (0.19), reflecting that trout can likely obtain ample food even in a relatively degraded system. We also detail the full progression of the trout indicator, including several interacting flow-related metrics and probability tables, across the range of environmental drivers to demonstrate how we arrived at the final reach-specific indicator states (see SI; Data S1).

Expert judgment was used to assign flow-based or other probabilities to a third group of indicators, algae, aquatic insects, and native fish, in the absence of direct flow-ecology relationships. For example, aquatic insects in each reach were assigned to one of three states: + (many EPT, including insects with 2-yr life cycles), 0 (mostly EPT but univoltine and reduced abundance) and − (some EPT but many tolerant taxa as well). Insect community probability state was a function of three designated drivers (see Fig. 4) of community composition and abundance: (1) channel structure (a function of fine sediment flushing, bed mobilization and bank stabilization), (2) summer base flow magnitude and water temperature above or below 23°C as one combined variable, and (3) algae production (a function of nutrient concentration and scouring flow). For example, a clean and diverse streambed had respective probabilities of producing aquatic insect states −/0/+ of 0.0/0.5/0.5. Note total probability sums to 1.0 across the three states. Adequate summer baseflow combined with cool temperatures generated probabilities for aquatic insect states −/0/+ of 0.0/0.5/0.5. For algae, where future abundance was "about the same as today" insect states −/0/+ were assigned probabilities of 0/1/0. Thus, in a river reach, under a given flow scenario that generates a clean and diverse streambed, adequate and cool baseflow, and about the same amount of algae as today, the conditional probability of an aquatic insect state of 0 is calculated from the product of the probabilities of the three controlling variables, i.e., $0.5 \times 0.5 \times 1 = 0.25$. Similar reasoning was followed for other response variables lacking suitable empirical monitoring data. For example, probability tables for the impacts of nutrient enrichment (total nitrogen and dissolved phosphorus) and scouring flows on algal biomass were based on general observations of experts in recent years to generate states of – (less than today), 0 (about the same as today), and + (more than today). Native fish states (––,–, 0, +) were based on expected species richness, abundance, and life stage diversity in response to summer baseflow, temperature, trout predation, aquatic insects, and channel structure (see Shanahan et al. 2014 and SI [Data S1] for further details). Our fish species richness metrics were tailored to the naturally depauperate local assemblage and reduced species richness due to extirpation of specialists more sensitive to flow alterations (e.g., gravel-spawning nest builders, Fausch and Bestgen 1997), but could be easily altered for other geographic areas where fish species richness is higher.

Use of expert judgement, based on research experience and published ecological and hydro-geomorphic principles, is well-established in modeling and decision analysis (von Winterfeldt and Edwards 1986, Otway and von Winterfeldt 1992). Our main effort to reduce uncertainties associated with expert judgement was to assign conservative conditional probabilities, such that only stressor levels in the highest category were coded to cause ecological impairment. This conservatism may lead to less variation in the absolute expected values of each indicator, but the relative differences across the flow scenarios remained robust. While we specified prior distributions for all parameter interactions, we currently lack sufficient empirical data across all flow scenarios and indicators to refine prior distributions. Hence, we proceeded by specifying network linkages (Fig. 4), computing prior distributions from available data, and comparing results for a single flow scenario (recent past) against other scenarios of interest.

The ERM model uses Structural Modeling, Inference, and Learning Engine software running in GeNIe (Graphical Network Interface; Decision Systems Laboratory 2014) and computes conditional probabilities for input data using the general form

$$P(A_i|B) = \frac{P(B|A_i)P(A_i)}{P(B)} = \frac{P(B|A_i)P(A_i)}{\sum_{i=1}^{n} P(B|A_i)P(A_i)}$$

where A and B are possible outcomes and $P(A_i|B)$ is the conditional probability of A_i given B. The eight ERM indicators (model output) measure aspects of ecosystem function and condition and include variables that have regulatory implications, such as Clean Water Act aquatic life criteria, nutrient thresholds, and water temperatures, and biological indicators valued by the community.

Linkages that determined indicator condition were mapped in the final Bayesian network (Fig. 4). Hydrologic drivers including flow magnitude, duration, and frequency influenced physical processes and ecological states directly and interactively and those were altered to create flow regime “scenarios.” Flow attributes had both direct and interacting effects on indicator condition. For example, peak flow conditions directly affected algae via scouring, and channel structure via sediment flushing and bed mobilization. In contrast, aquatic insects, native fish, and trout indicators had only interacting links to peak flow attributes, via changes in channel structure, because direct relationships were not available from existing data or reliably inferred from expert judgement. Although hydrology was the primary driver of ecosystem responses, other important factors were also incorporated including water temperature, nutrients and water chemistry, and bank stabilization interacting with flows (Fausch and Bestgen 1997, Dudgeon et al. 2006, Poff 2018).

Hydrologic scenarios

After finalizing the ERM structure, we developed nine hydrologic scenarios as model inputs (Fig. 5; Appendix S1: Table S4). Scenarios characterized their effects on the Poudre River ecosystem (e.g., peak flow frequency, low flow duration) and spanned a spectrum of past to future conditions including

1) three historical scenarios that included historic unaltered regimes (reconstructed native), recent-past altered flows (recent past), and present, continuing flow alteration (present operations;)
2) two future scenarios with reduced water availability due to additional development (additional water development) or climate change (driest climate); and
3) four designed hydrologic scenarios with combinations of base flow magnitude and consistency, and peak flow magnitude, duration, and frequency to achieve specific ecosystem goals. These we referred to as stable base–low peak, high base–moderate peak, dry base–high peak, and stable base–high peak.

Historical and future hydrologic scenario development.— Hydrologic scenarios were based on gage records, diversion withdrawal data, and outputs from models used by city planners and regional water managers. All historical and future scenarios were founded on the recent past scenario, a spatially discretized record of gaged discharges across the study reach. Native and present operations scenarios remove (or add) the effect of existing reservoir and diversion operations in the Poudre River drainage. Together, these models and streamflow gages produced time series of simulated flow at a daily time step (Fig. 5; Appendix S1: Tables S2, S3). To incorporate climate change impacts, the present operations scenario was modified using predictions from global

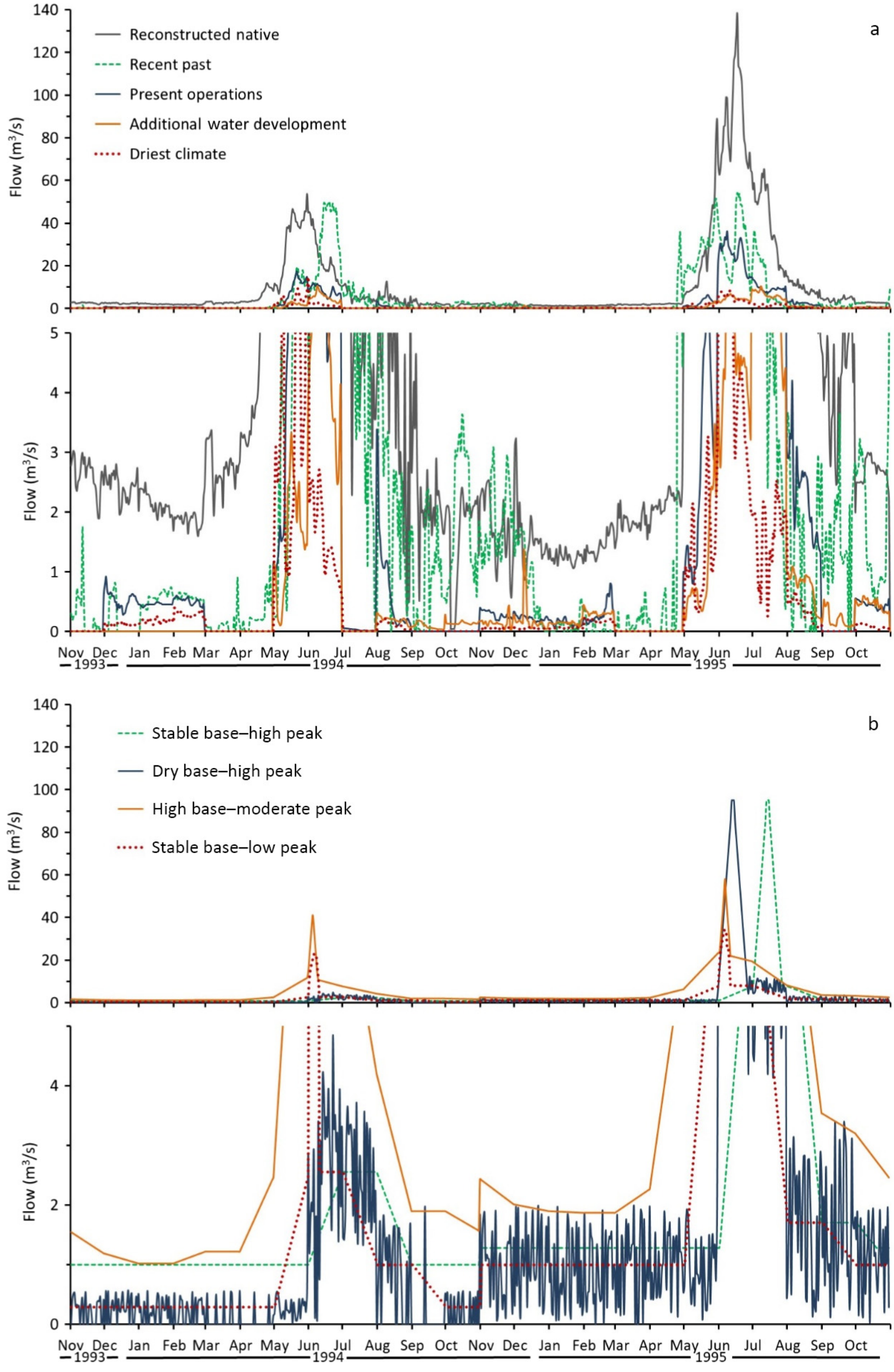

Fig. 5. Dry and wet year hydrographs for the Cache la Poudre River, Fort Collins, Colorado, showing differences in peak (upper) and base (lower panel, expanded for detail) flows for (a) five historical or future flow scenarios and (b) four designed flow scenarios. All are modeled flow scenarios with the exception of the recent past, which is from gage data (U.S. Geological Survey # 06752260).

climate circulation models (Diansky and Volodin 2002) and the Bias Corrected Spatially Downscaled [BCSD], Coupled Model Intercomparison project phase 3 archive (CMIP3, collectively the BCSD-CMIP3) that describes climate-changed hydrologic scenarios for the western United States (Gangopadhyay et al. 2011, U.S. Bureau of Reclamation 2011). Downscaled hydrology data are monthly time series predictions of unit runoff for each circulation model for one-eighth degree (12 × 12 km) latitude-longitude grid cells. Runoff calculations used the CMIP3 scenario with the lowest projected runoff in 2050 (inmcm3_0.1.sresb1) for the grid cell that most overlapped the Poudre River basin, and was the basis for our plausible driest climate scenario. To create the hydrology time series, we first computed the monthly ratio of average runoff under the driest climate scenario to average runoff under current baseline conditions. These ratios were then multiplied by the present operations daily flows to estimate the driest climate hydrologic time series of daily flows used with the ERM.

Designed flow scenario development.—The designed flow scenarios were developed as potential guidelines for water managers with the goal of improving the Poudre River flow regime to achieve certain social-ecological outcomes (Acreman et al. 2014). Designed flow scenarios have combinations of functional characteristics (e.g., Yarnell et al. 2015) that include base flow magnitude and consistency, and peak flow magnitude and duration. Sufficient base flow magnitude supports habitat for fish and aquatic insects, and influences water temperature and nutrient levels, while flow consistency reduces variation due to high diversion extraction or low reservoir releases that presently create disconnected pools and dry reaches detrimental to aquatic life. Although highest magnitude flows depend largely on snowpack levels, proposed water projects would store additional peak flows and further reduce their magnitude and duration, allowing for the possibility of designed flows to achieve downstream ecological targets if reservoir and diversion operators let flows bypass infrastructure. Designed scenarios (e.g., stable base–high peak) also included ascending and descending limb flow rates of change of about 7.1 $m^3 \cdot s^{-1} \cdot d^{-1}$ during the peak runoff period (e.g., Yarnell et al. 2010, 2015, City of Fort Collins 2019); direct effects of limb flows are presumed important but were not modeled. We show two consecutive years of the modeled Poudre River hydrographs for all scenarios (Fig. 5), in consecutive dry (1994) and wet (1995) years, to illustrate differences in base and peak flow magnitude, timing, and variability, among years when snowmelt runoff magnitude differed. Using the ERM relationships between flow and various indicators of river condition, we predicted effects of the four hypothetical designed flow scenarios on Poudre River ecosystem attributes using the same technique as for historical and future flow scenarios.

For each of the three reaches evaluated by the ERM, the ecological response of the eight river indicators under nine hydrologic scenarios was computed as a probability distribution scaled from lower (0) to higher (1) functioning. Each distribution is portrayed as a single mean value, which simplifies data presentation (Table 1; details in Shanahan et al. 2014 and SI). Indicator scores were then plotted (Fig. 6) on a probability scale (0–1) with associated qualitative predictions of condition from lowest (0) to highest (1). For example, channel structure scores were assigned to quartiles of the scale that ranged from an entrenched condition (lowest, score of 0–0.25) to a clean and diverse condition (highest, score 0.76–1). Native fish and trout scores from lowest to highest were assigned relative predictions in four ranked classes (−−,−, 0, +) and lowest to highest riparian indicator scores had relative predictions from minimal to wide areas of inundation, respectively. Indicators with only three categories were similarly assigned, where, for example, aquatic insect predictions ranged from −− (lowest condition, score of 0–0.33) to + (highest condition, score 0.67–1.0). Algae scores represented conditions that were significantly enriched and worse than present conditions (lowest, 0–0.33), similar to current conditions (0.34–0.66), or were significantly improved from present conditions (highest, 0.67–1.0). Differences in indicator scores are appropriately interpreted between flow scenarios in comparative rather than absolute terms as 0–1 scales for each indicator varied with input data and assumptions for each prior distribution.

Results

Modeling showed indicator variable response patterns typical of many flow-regulated systems, but it also revealed lesser-known interactions instructive for ecological understanding and management that varied spatially. Indicator scores were generally highest under the reconstructed native flow regime followed by the two designed flow scenarios with high peaks and the Recent Past regime in the least confined downstream reach (Fig. 6, Table 1). Indicator responses were lowest under future flow scenarios (additional water development or dry climate) in the confined reach. Present operations scenario scores were generally low.

Channel structure and the three Riparian zone indicator response scores were most sensitive (variable) to the array of flow scenarios. Low or zero scores resulted when only low magnitude peak flows were available (e.g., two future scenarios) but channel structure responded strongly to high magnitude flows because key shear stress levels were exceeded (e.g., reconstructed native, two designed flows with high peaks). Among instream biota, algae and trout were most sensitive to flow, responding negatively in the absence of high flows and subsequent impaired channel structure, and positively to presence of higher base flows, especially in winter, and cooler water temperatures in summer. Aquatic insect and native fish scores were the least sensitive to various

Table 1. Index of Poudre River condition for eight indicators in three different river reaches (3a = confined, 3b = moderately confined, 7 = least confined) under nine different hydrologic scenarios.

				Flow scenario					
Indicator and reach	Reconstructed native	Recent past	Present operations	Additional water development	Driest climate	Stable base–low peak	High base–moderate peak	Dry base–high peak	Stable base–high peak
Channel structure									
3a	0.80	0.33	0	0	0	0	0	0.80	0.81
3b	0.80	0.58	0.03	0	0	0	0.38	0.80	0.80
7	0.91	0.91	0.26	0	0	0.35	0.64	0.91	0.91
Algae									
3a	0.80	0.30	0.30	0	0	0	0.45	0.70	0.70
3b	0.80	0.30	0.30	0	0	0	0.45	0.70	0.70
7	0.95	0.30	0.30	0.30	0	0.10	0.60	0.70	0.70
Aquatic insects									
3a	0.46	0.26	0.26	0.21	0.21	0.30	0.41	0.41	0.53
3b	0.46	0.28	0.26	0.21	0.21	0.30	0.41	0.41	0.53
7	0.53	0.38	0.26	0.26	0.21	0.32	0.48	0.45	0.57
Native fish									
3a	0.45	0.37	0.30	0.30	0.30	0.37	0.38	0.43	0.53
3b	0.45	0.40	0.30	0.30	0.30	0.37	0.47	0.43	0.53
7	0.58	0.50	0.36	0.30	0.29	0.47	0.62	0.51	0.75
Trout									
3a	0.61	0.30	0.18	0.18	0.18	0.35	0.52	0.40	0.72
3b	0.60	0.35	0.19	0.18	0.18	0.35	0.60	0.40	0.71
Rejuvenating mosaic forest									
3a	0.62	0.26	0	0	0	0	0	0.23	0.23
3b	0.83	0.43	0.23	0	0	0	0	0.30	0.30
7	0.94	0.83	0.29	0.06	0.06	0	0.06	0.50	0.50
Functional riparian zone									
3a	0.25	0.23	0.13	0	0	0	0	0.21	0.21
3b	0.90	0.82	0.41	0.11	0	0.11	0	0.67	0.67
7	0.93	0.93	0.48	0.27	0.22	0.32	0.22	0.89	0.89
Riparian wetland width									
3a	0.51	0.36	0.30	0	0	0.21	0.30	0.46	0.46
3b	0.98	0.63	0.44	0	0	0.28	0.44	0.89	0.89
7	1	0.94	0.68	0.33	0	0.55	0.77	1	1

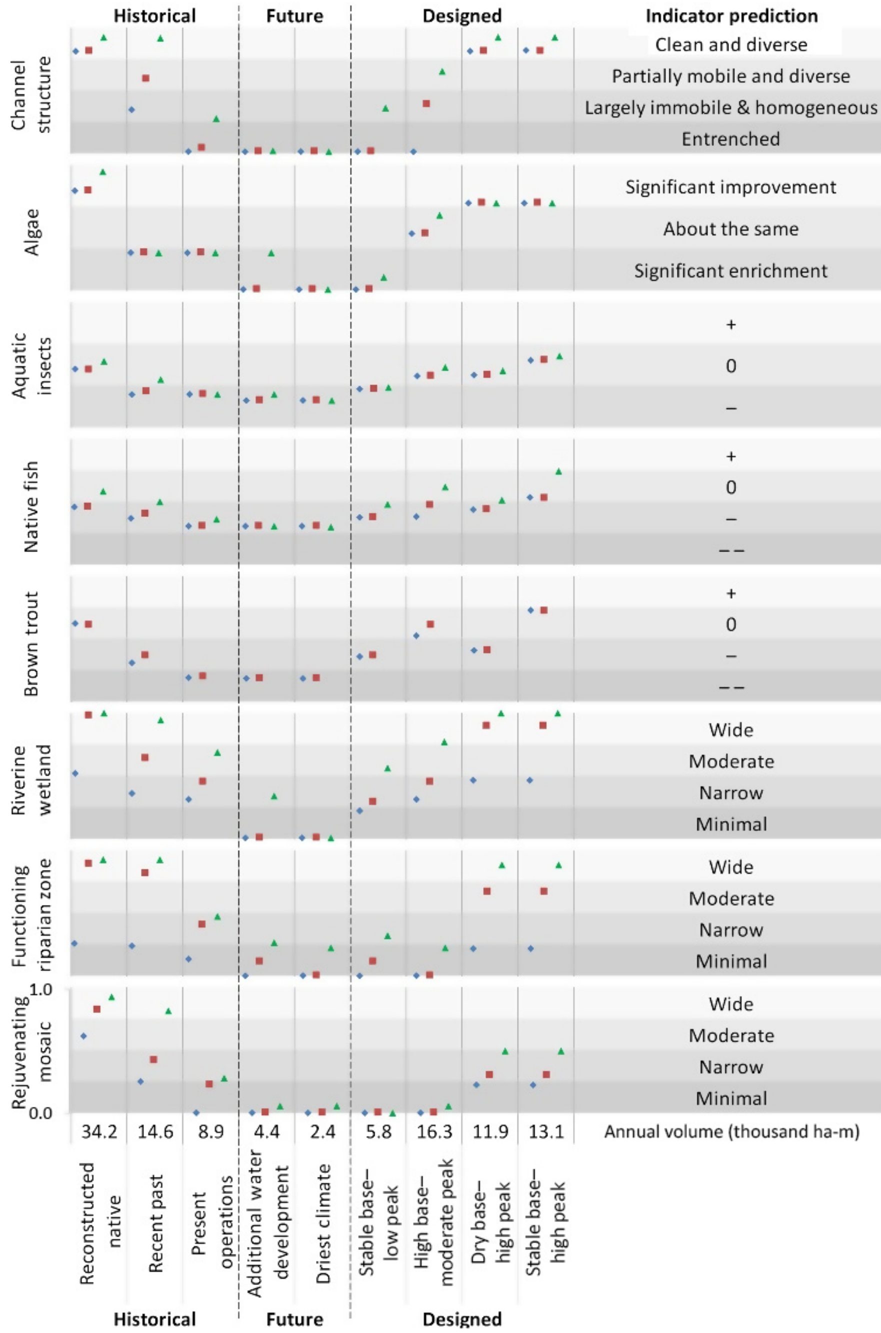

FIG. 6. Indicator predictions for three historical, two future, and four designed hydrologic scenarios for eight indicators of river condition in each of three Poudre River reaches. Each indicator is scaled from 0 to 1, with the four different gray-shaded rows for each indicator showing quartiles of change. From up to downstream, blue diamonds are for the confined reach, red squares for the moderately confined reach, and green triangles for the least confined reach. The annual volume of flow (ha-m) required to achieve each Hydrologic Scenario is portrayed at the bottom of each results column. Scores for river condition indicators for aquatic insects (+, 0, −) and fish (+, 0, −, −−) are arrayed from lowest to highest. No trout scores are presented for the downstream, least confined reach because water was warm, and few trout were present.

scenarios because assigned probabilities for various effects were conservatively estimated, mainly because few specific links to flows and other drivers were apparent (Shanahan et al. 2014). Details for indicator responses to flow scenarios are below.

Channel condition

Channel structure scores declined through the progression from Historical to Future hydrologic scenarios, due to declining peak flows and increased channel simplification, a pattern generally similar for other indicators. Highest channel structure scores (0.80–0.91) under reconstructed native and some designed scenarios resulted from high magnitude flows for a minimum of three consecutive days that provided sediment flushing, coarse substrate mobilization, channel migration, and increased geomorphic complexity. Alternatively, channel structure score was 0 in high base–moderate peak, additional water development, and driest climate scenarios in confined and moderately confined reaches because flow magnitude was inadequate to mobilize substrate and halt channel simplification.

Flows required for substantive geomorphic work varied spatially along the river corridor. Increasing channel structure scores from upstream confined and moderately confined reaches to the downstream least confined reach reflected increased downstream channel migration and complexity. Increased downstream geomorphic work can be achieved, despite identical simulated river flows, because median sediment size decreased more rapidly than channel gradient from upstream to downstream, so the same peak flow magnitudes increased channel structure scores more downstream.

Instream biota

Algae indicator scores were also highest under reconstructed native and designed hydrologic scenarios with high peak flows (score range 0.70–0.95) but lowest in confined reaches with low peak flows because substrate mobilization and scour were minimal. Identical recent past and present operations scores resulted because flow thresholds that altered channel structure were not achieved.

Aquatic insect scores were highest (0.46–0.57) in high peak and higher base flow scenarios (reconstructed native, stable base–high peak) because those conditions increased taxa richness, life history diversity, and abundance and were lower in confined reaches with low peak flows and low or variable base flows. Native fish indicator scores were higher (0.38–0.75) in scenarios with higher peak flows and consistent base flows (reconstructed native and designed scenarios except stable base–low peak) due to higher taxa richness, life stage diversity, abundance, and channel-structure-related habitat diversity, attributes that were reduced in low peak or variable base flow scenarios. Reasons for reduced score ranges over all flow scenarios and reaches for aquatic insects and native fish were discussed above. Native fish scores in the least confined reach were consistently higher, regardless of hydrologic condition, reflecting greater habitat availability and low abundance of predaceous trout in that warmer reach.

Trout reproduction, abundance, and age-class diversity varied with summer and winter base flow levels, summer water temperatures (higher in low flows), aquatic insect abundance, and channel structure. Thus, highest trout scores (0.40—0.72) resulted from higher peak and consistent base flow scenarios (reconstructed native, high base-moderate peak, and stable base-high peak), which was supported by empirical data that linked trout reproductive success with higher winter base flows. Conversely, trout were negatively affected by low base flows in summer (reduced survival) and winter (reduced reproduction), and elevated summer water temperatures that may reduce dissolved oxygen levels. Effects of lower winter base flows are evident by comparing the dry base-high peak score (0.40) to other designed scenarios with higher base and higher peak flows (score range 0.52–0.72).

Riparian zone

Riparian forests responded positively to high peak flows that saturated soils, mobilized sediment, and created channel movement, and they responded negatively to low flows and bank armoring, especially in confined reaches. Among historical flow regimes, reconstructed native and, to a lesser extent, recent past scenarios elicited the strongest positive response by the rejuvenating mosaic indicator, particularly in the least confined reach (0.94 and 0.83, respectively). Designed hydrologic scenarios with high peak flows showed the greatest improvement over those with moderate or lower peaks. Native riparian tree recruitment was negligible with low peak flows (score range 0.00–0.29) because floodplain connections rarely occurred, even in the least confined reach.

Scenarios with high peak flows (reconstructed native, recent past) produced the highest functional riparian zone scores, especially in the least confined reach (scores = 0.93), similar to riparian wetland scores (0.94–1.00). Wetland development was limited in channel-confined reaches under most flow scenarios (confined reach = 0.00–0.51) because high, steep banks and channel entrenchment prevented river–floodplain connections. Similar to the functional riparian zone, wetlands would increase if bank height were reduced and banks were set back and sloped to allow greater river–floodplain connection and a more continuous moisture gradient. Rejuvenating mosaic scores were lower than the other two riparian vegetation scores under the same flow and reach conditions because flow magnitudes and velocities were insufficient to disturb and scour surfaces needed for seed germination sites.

Annual flow volume required to implement the nine ERM flow scenarios varied widely. For example, annual discharge volume in the reconstructed native scenario was more than twice as high (34,246 ha-m; 278,000 acre-feet, Appendix S1: Table S2) as other scenarios and up to 14× greater than low peak flow scenarios, regardless of base flow characteristics. Notably, when compared with the reconstructed native or recent past scenarios, the stable base–high peak scenario produced comparable or higher indicator scores for most metrics with substantially less water (13,117 ha-m;

106,000 acre-feet, Appendix S1: Table S2). Reach differences for indicators reflected prevalence of overbank flooding, or, of differences in channel structure rather than flows, which were identical across reaches.

All indicators were sensitive to changes in assumptions of driving variables; those with linear or continuous responses were relatively more sensitive than categorical driving variables. For example, increased flows and shear stress caused channel structure change, especially when thresholds for bed particle mobility were exceeded. Channel structure changes then cascade interactively through most instream biological indicators. Categorical variables were less sensitive to flow changes, unless they resulted in response category changes, indicating that additional quantitative data that explicitly linked indicators to flows would improve model performance. Additionally, all indicators have assumptions and thresholds that can be changed, to reflect differing local conditions or addition of new or refined flow regimes, which increases model flexibility and utility.

Discussion

Ecological response model outcomes and important drivers

The integrated ERM for the urban Poudre River demonstrated how the structure and function of the coupled aquatic and riparian ecosystem are strongly shaped by flow and illuminated complex interactions between different taxa and trade-offs with different flow regimes. Thus, this model could provide restoration ecologists and managers with a tool to assess effects of potential future flows to target specific, desired processes or ecosystem attributes. Assuming additional changes from new development or climate change will cause further alterations to the urban Poudre River, the ERM would also allow insights into what specific flow components may need to be "designed" as part of any new infrastructure to help sustain or improve ecological integrity.

Our modeling led to three main observations. First, the conceptual hydrologic calendar and ERM predictions increased our understanding of the complex interactions among flows, bed mobilization, channel structure, and biota (e.g., Fig. 4) that contribute to overall ecosystem condition. Second, specific peak flow magnitudes based on geomorphic measurements and hydraulic modeling were critical for substrate cleansing and mobilization, channel morphology, and overbank flows, with strong subsequent effects on riparian and instream biota. Instream biological indicator scores (aquatic insects, native fish, trout) increased in hydrologic scenarios with greater peak flow magnitudes because of improved channel structure, the physical habitat template of the river, even though those indicators were only interactively linked to peak flows. Implicit is that other important ecological processes and communities not modeled by the ERM, including those supported by ascending or descending limb flows, are maintained. Third, an unexpected model result was that designed flows with high peaks resulted in restoration of impaired processes using about the same Poudre River annual water volume available in the flow-depleted recent past scenario. These complex and interacting Poudre River insights demonstrated by the ERM would not be possible with more traditional flow assessments that evaluate only single variables independent of each other (Brewer et al. 2016, McManamay et al. 2016).

Modeling ERM flow effects indicated how river management could be optimized. For example, high flows had the greatest effects in the least confined channel reach, but all reaches may benefit if flow effects were combined with levee or bank modifications. To this point, lowered banks in the downstream portion of the confined reach promoted successful floodplain cottonwood recruitment in recent higher flow years. Stable base flows most effectively increased instream biological indicators such as trout and aquatic insect scores compared to present conditions because periods of stream desiccation and extreme fluctuations were reduced. Indicator scores in low peak flow scenarios were only about 50% of those with high peaks, demonstrating strong links between geomorphic function and biota.

The importance of natural flow regime components (Poff et al. 1997, Postel and Richter 2003) to a higher-functioning Poudre River ecosystem was illustrated by ERM modeling because peak flows scoured riverbed substrate, increased channel complexity, removed excess algae, and promoted a diverse aquatic insect community that supported fish and likely, other ecosystem components such as terrestrial insectivores (e.g., Baxter et al. 2005). Extreme peak flows that may cause channel incision may not be an issue here because discharge magnitudes in designed flows are relatively low. High flows may also increase the quantity of large wood via channel migration (Yarnell et al. 2010, Wohl et al. 2015, 2019), and river connectivity to floodplain wetlands important to backwater-dependent aquatic organisms. Descending limb flows, although not modeled explicitly, likely modified channel morphology, cued reproduction by fishes and other aquatic organisms, and prepared surfaces needed for native seed germination and seedling growth and survival necessary for perpetuating the ecologically important riparian gallery forest (Mahoney and Rood 1998, Yarnell et al. 2010). Base flows supported fish and aquatic insect reproduction and growth, and successful reproduction by trout until the spring hydrologic cycle begins again.

A changing ecosystem

The Poudre River supports functioning remnants of native riparian and aquatic biota, but this urbanizing ecosystem has undergone significant change over the last 150 yr. Examples include channel modification and simplification, diminished native fish populations, and limited recruitment of young trees in stands of senescent narrowleaf and plains cottonwood. Native fish only approached the highest indicator condition once (stable base–high peak in the least confined reach 7) because local extinctions are exacerbated by negative modeled interactions with trout (e.g., predation) and habitat changes (e.g., backwater loss) related to simplified channel structure and, presumably, greater upstream river fragmentation and dewatering by diversion dams. Regardless, and specific to the Poudre River system, dynamic model responses of indicators demonstrated ecosystem decline was not inevitable, and that designed flows using existing and proposed infrastructure could lead to improved conditions. The flexible ERM could model ecosystem responses to additional designed Poudre River flow regimes, or be used as a general assessment approach in other altered systems where managers seek to improve ecosystem conditions, after tailoring geographically relevant indicator information for the model.

Similar to other modified arid-land rivers, the Poudre River ecosystem is a spatially variable patchwork of physical conditions with a changing biological composition whose functioning varied even across the relatively short reaches we evaluated. For example, modeling showed confined reaches had reduced ecosystem complexity and indicator scores compared to the least confined downstream reach, which more typified predevelopment conditions (Fig. 2). Thus, modeled ecosystem responses to flow management varied in a spatial context and may better allow practitioners to align restoration prescriptions with reaches most suited for a particular management action. Extreme low flows presently occur in some Poudre River reaches and result in persistent riverbed desiccation especially in winter, effects that are exacerbated by diversion dams that limit upstream recolonization by downstream biota. Effects of management strategies to enhance river connectivity or bank restoration could be modeled in the ERM to evaluate indicator responses and relative costs and benefits of such actions.

We acknowledge that flows discussed here may benefit some nonnative species. For example, anglers fish for nonnative brown trout, because native cutthroat trout (*Oncorhynchus clarkii* [Richardson]) disappeared decades ago due to competition and hybridization with nonnative trout species (Behnke 1992, Bestgen et al. 2019). Further, predaceous trout may have a negative impact on non-salmonid native fishes, creating a challenge in managing for healthy populations of both. We speculate that flows to benefit nonnative trout would also likely benefit native cutthroat trout that once existed here but flow management would do little to restore native trout because they were extirpated by other mechanisms (Behnke 1992).

Unlike the situation with trout, designed flows, and increased channel and floodplain management, may promote native cottonwoods via increased seedling recruitment (Merritt and Poff 2010). This is important because of limited recruitment of young trees to replace old stands of native cottonwoods, keystone species in western stream ecosystems (Merritt and Bateman 2012) that are being replaced by nonnative taxa. Thus, species-specific responses to flow management and the relative ability to favor native taxa over nonnative ones is a planning consideration, and can be modeled with the ERM.

Strengths and limitations of the Ecosystem Response Model

The ERM was constructed to evaluate linked biophysical responses over a range of possible flow futures, with few constraints on what is likely, affordable, or administratively possible. Decision-makers must ultimately weigh stakeholder interests with the ecological, economic, and societal consequences associated with various policy options. Although ERM predictions are not precise in an absolute sense, the power of this modeling approach lies in its integrative and comparative nature. For example, modeling showed that instream biological indicators (e.g., algae, aquatic insects) benefitted from higher and more stable base flows and high peak flows, but stable base flows with low peak flows were only half as effective to increase indicator scores. A nuance was that trout scores in high peak designed scenarios nearly doubled when base flows changed from low to higher levels, reflecting the important seasonal role of flow on reproductive success. Thus, explicit baseflow management to enhance trout in the absence of peak flows would result in only a modest improvement in scores and at the expense of other indicators dependent on high peak flows.

Modeling also showed the strong positive link between channel structure and riparian indicators with peak flow, reflecting gradient (channel structure) or threshold (riparian) effects as peaks declined from historical flow levels. The ERM provides insight into what magnitudes of designed flows would be minimally sufficient to reestablish higher functioning along the river corridor. Thus, designed flows with high peaks would likely enhance channel and riparian functioning, but if peaks came at the expense of higher and more stable base flows, instream biota indicators would decline, demonstrating the utility of the ERM to evaluate flow scenario trade-offs and to explore nuances that may vary seasonally or spatially.

The interactive and data-driven ERM differs from another flow modeling approach, ELOHA, in several ways. ELOHA is mainly a multisite comparative approach intended for use in situations that are data sparse and where scientific capacity to generate detailed knowledge is lacking. Studies more detailed than ELOHA-type analyses are required for highly valued local ecosystems, where the assumption that streamflow alone drives ecological function cannot be accepted, and where other environmental factors such as water temperature, channel structure, and streambed scour and movement, are important. The ERM for the Poudre River is such a detailed, site-specific model that includes many relationships that are both directly and interactively influenced by flow, directly via flow-linked pathways to indicators, and interactively through indicators. Differences notwithstanding, ERM findings could be placed into an ELOHA-type framework by classifying the Poudre River as a particular flow regime type (in a given geomorphic context) to set expectations for the ecological performance of similar river types.

Indicator response comparisons across a set of diverse and plausible hydrologic scenarios reveal certain futures are likely better than others in terms of a highly functioning ecosystem that provides valued river amenities. Given the altered condition of the present-day Poudre River ecosystem, managers and the public need to consider the vulnerability of the system to further hydrologic alteration and the associated trade-offs. The ERM also illustrates another salient point for river managers to consider: that the same volume of flow can achieve substantially different ecological outcomes, depending on how it is managed.

Thus, the ERM provides a clear framework and useful decision support tool for understanding trade-offs and consequences of various management options on water supply and biota. Indeed, a general, risk-based modeling approach may be more useful than traditional environmental assessments that produce unintegrated measures of resource alteration, especially considering the trajectory of ecosystems under changing environmental conditions including climate warming (Schindler and Hilborn 2015). Application of probabilistic models to other systems will require the system-specific quantification of geomorphic and ecological relationships, which will inform a transparent and science-based process to aid decision-making and clarify the likely trade-offs and consequences of flow management regimes. Modeling approaches that predict ecosystem pathways also allow decision-makers to compare a variety of stakeholder interests and the engineering, ecological, economic, and societal consequences associated with policy options (see Baker et al. 2004).

Futures for flow-altered systems

The ERM analyses confirmed changes in historical Poudre River ecological conditions and indicated additional legacy shifts will occur even if present flow management practices are maintained. Further, ecological changes will be accelerated by additional water development or a drying climate. However, results also indicated carefully managed flows that link key hydro-geomorphic processes with biological responses are likely to enhance ecological functioning of the river ecosystem. Key elements of a designed flow in this and other systems similar to the Poudre River would be peak magnitudes in spring and early summer that meet threshold levels for channel maintenance and riparian vegetation, gradually ascending and descending limb flows, and relatively stable and adequate magnitude base flows, which collectively should improve geomorphic and biological indicators. Because flow requirements differ among biota, maintenance of interannual variability is important to support a more biodiverse ecosystem through time. Although we evaluated only a few designed scenarios, other flow regimes that incorporate additional seasonal or interannual variability in peak or base flows could easily be modeled to better understand those effects.

In any plausible future, the Poudre River will not return to native flows, because annual discharge in the reconstructed native scenario is up to 14× higher than other scenarios. This large gap between natural flow conditions that set the original physical template for the Poudre River and current or future flows suggests that (1) managers of heavily altered river systems may need to set ecological objectives that are not strictly “natural,” and (2) designed flows are needed to achieve specific objectives (e.g., Acreman et al. 2014, Brewer et al. 2016, McManamay et al. 2016). The ERM demonstrated that specific Poudre River objectives could be achieved with about one-half the annual discharge of the reconstructed native scenario, if certain flow targets are met. Social and ecological benefits from designed flows in altered systems are most likely to occur if basin-wide flow management is combined with other actions to promote upstream–downstream and channel–floodplain connectivity along the river corridor.

Additional future depletions of Poudre River flows are possible given an existing proposal to store water in a new off-channel reservoir, which will further diminish already reduced peak flow magnitudes and impact river resources. Proposed project mitigation (Northern Colorado Water Conservancy District 2017) has focused on stabilizing base flow, which is needed to reduce present streambed desiccation. Our modeling indicated water levels to accomplish base flow functions in the stable base–high peak scenario was about 1 m^3/s flow (about 35 cubic feet per second), the required level for successful trout reproduction (Bartholow 2010, Appendix S1: Table S2), and improved functioning of other indicators. However, the proposed base flow would meet this threshold on average only 50% of years and would not benefit river resources downstream of the city because flows will be diverted.

Peak flow frequencies and magnitudes proposed are also inadequate to maintain channel condition and biota because a 3-d peak bypass flow is projected to occur in only 43% of years (Northern Colorado Water Conservancy District 2017; data *available online*).[12] Further, mean peak Poudre River flow magnitudes are unlikely to reach even the 31 m^3/s estimated for the relatively low present operations scenario in most years. As modeled

[12] http://www.northernwater.org/docs/NISP/MapsDocuments/2017FWMEPFinal.pdf

by the ERM and predicted by fundamental principles of river science (Poff et al. 1997, Wohl et al. 2015), changes from proposed additional water development would essentially ensure a general and long-term decline in Poudre River aquatic and riparian ecosystem functions. Thus, the best possibility for maintaining or improving Poudre River ecological conditions with the proposed off-channel storage is designed peak flows that bypass the newly proposed storage reservoir for a minimum of three consecutive days with the predicted highest magnitude flows each year. This scenario also ensures the natural interannual variability in flows needed to sustain ecosystem functioning, effects of which are seen by comparing ERM outcomes of managed scenarios with different peak flow levels.

Ideally, the frequency and magnitude of peak flows in flow-depleted rivers could be partially restored to more closely approximate natural flows, which here are those in the reconstructed native scenario (i.e., ≥3-d peak flows in more than 50% of years that reach 94.9 m^3/s at Fort Collins, to provide the flow magnitude and duration needed for channel maintenance (Andrews and Nankervis 1995, Emmett and Wolman 2001)). Although existing storage reservoirs and diversions have substantially reduced Poudre River peak flows, our analyses show that the estimated “deficit” in peak flow volume and duration could be met with bypasses from existing storage facilities or diversions in the Poudre River basin, which in real time would require adequate flow forecasting. Other studies that have implemented designed flows (Kiernan et al. 2012) or modeled them (Chen and Olden 2017, Sabo et al. 2017) show it is feasible to balance existing human demands while provisioning key ecosystem targets. Adaptive management will be needed to ensure flow scenarios support desired outcomes. Additional details regarding the high flow mitigation specific to the Poudre River are elsewhere (Appendix S2).

As stressors on over-allocated river ecosystems increase from human water demands and climate change, modeling approaches that predict future ecosystem responses to water development and management will play an increasingly important role in informing public debate and choices about management of these resources (Baker et al. 2004, California State Water Resources Control Board. 2017). Ecosystem-based models such as the ERM can identify strategies to achieve firm targets to assist with rehabilitation or mitigation plans in water development scenarios. Unfortunately, no policy requires that integrated, holistic, ecosystem-scale impacts be assessed before new water projects are approved. Rather, requirements for assessing “impact” under NEPA are satisfied when analyses are framed only in traditional single-variable models. Thus, even when river engineers and other scientists not associated with water development interests construct holistic models of “impact” (e.g., the ERM), there is no clear pathway to having those substantively considered in project development, much less adopted. Another fundamental problem with the traditional NEPA-driven “environmental impact” approach is failure to consider ecosystem functions and societal values on par with the economic factors that largely dictate proposed alternatives for development. Typically, impacts of the preferred project alternative are evaluated with a few single-factor analyses that are portrayed as causing minimal environmental alteration. Joint consideration of both long-term ecological issues and short-term economic gain at the project proposal stage may aid development of more environmentally sustainable alternatives, especially in light of new uncertainties posed by climate change (see Poff et al. 2016). This would promote more robust science and more transparent trade-off analyses of alternative development options needed to support more rational societal decisions about river management in a complex and uncertain future.

Acknowledgments

We appreciate the contributions of J. Stokes, B. Anderson, the Northern Colorado Water Conservancy District staff, and especially J. Shanahan for assistance throughout. Comments from S. Brewer, J. Friedman, S. Yarnell, K. Zelasko, and an anonymous reviewer improved the manuscript. M. Haworth assisted with construction of Fig. 1. J. Shanahan, B. Bledsoe, and N. L. Poff conceived the study. D. Baker and M. Lorie conducted modeling. K. Bestgen, B. Kondratieff, B. Bledsoe, J. Shanahan, D. Merritt, and N. L. Poff provided data. K. Bestgen led manuscript writing but all authors contributed.

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Supporting Information

Additional supporting information may be found online at: http://onlinelibrary.wiley.com/doi/10.1002/eap.2005/full

Data Availability

Data are available from the City of Fort Collins Natural Areas Department at https://www.fcgov.com/naturalareas/pdf/erm_report.pdf, https://www.fcgov.com/naturalareas/pdf/erm_appendix.pdf?1421099850, and https://www.fcgov.com/naturalareas/eco-response.php

Ecological Applications, 30(1), 2020, e02005

Designing flows to enhance ecosystem functioning in heavily altered rivers

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Citation: Bestgen, K. R., N. L. Poff, D. W. Baker, B. P. Bledsoe, D. M. Merritt, M. Lorie, G. T. Auble, J. S. Sanderson, and B. C. Kondratieff. 2020. Designing flows to enhance ecosystem functioning in heavily altered rivers. Ecological Applications 30(1):e02005. 10.1002/eap.2005

Abstract. More than a century of dam construction and water development in the western United States has led to extensive ecological alteration of rivers. Growing interest in improving river function is compelling practitioners to consider ecological restoration when managing dams and water extraction. We developed an Ecological Response Model (ERM) for the Cache la Poudre River, northern Colorado, USA, to illuminate effects of current and possible future water management and climate change. We used empirical data and modeled interactions among multiple ecosystem components to capture system-wide insights not possible with the unintegrated models commonly used in environmental assessments. The ERM results showed additional flow regime modification would further alter the structure and function of Poudre River aquatic and riparian ecosystems due to multiple and interacting stressors. Model predictions illustrated that specific peak flow magnitudes in spring and early summer are critical for substrate mobilization, dynamic channel morphology, and overbank flows, with strong subsequent effects on instream and riparian biota that varied seasonally and spatially, allowing exploration of nuanced management scenarios. Instream biological indicators benefitted from higher and more stable base flows and high peak flows, but stable base flows with low peak flows were only half as effective to increase indicators. Improving base flows while reducing peak flows, as currently proposed for the Cache la Poudre River, would further reduce ecosystem function. Modeling showed that even presently depleted annual flow volumes can achieve substantially different ecological outcomes in designed flow scenarios, while still supporting social demands. Model predictions demonstrated that implementing designed flows in a natural pattern, with attention to base and peak flows, may be needed to preserve or improve ecosystem function of the Poudre River. Improved regulatory policies would include preservation of ecosystem-level, flow-related processes and adaptive management when water development projects are considered.

Key words: algae; aquatic insects; channel geomorphology; climate change; designed flow regime; fish; hydrology; modeling; NEPA policy change; probabilistic Bayesian Network model; riparian community; water development.

Introduction

Rivers have been heavily modified on a global scale due to hydrologic alteration by dams and water extraction, leading to extensive ecological change (Nilsson et al. 2005, Dudgeon et al. 2006, Vörösmarty et al. 2010). Ongoing demand for municipal and agricultural water will continue to stress river ecosystems, but those uses are countered by growing interest in restoring rivers to sustainable ecosystem conditions, while still accommodating human needs. Providing water for traditional uses while sustaining ecosystem function poses challenges, particularly in semiarid and arid landscapes where water demand is high (Grafton et al. 2013). Thus, restoration practitioners seek to optimize the functional

Manuscript received 30 November 2018; revised 19 July 2019; accepted 24 July 2019. Corresponding Editor: Ryan S. King.
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impact of limited water to maximize ecological outcomes (Yarnell et al. 2015).

River restoration requires understanding linkages between specific flow conditions and ecosystem attributes to provide clear, quantified management targets (Poff and Schmidt 2016, Webb et al. 2017). In heavily altered systems, restoration to a "natural," pre-development state is generally not an option, particularly when future climate is uncertain (Moyle 2014, Poff 2018). Alternatively, specifying flows to restore functions that are ecologically important and socially desirable may be possible. So-called "designer flows" (sensu Acreman et al. 2014) can, in principle, help meet both ecosystem and human needs for water (e.g., Kiernan et al. 2012, Chen and Olden 2017). For heavily appropriated systems with multiple competing users, it is critical to understand how alternative management interventions will affect existing economic and social benefits provided by the river (Northern Colorado Water Conservancy District 2017). It is also important to understand the biophysical processes needed to promote long-term ecosystem functioning, including dynamic channel features and desirable aquatic and riparian species, which may have different requirements. Appropriate ecosystem modeling that incorporates a variety of future flow conditions is useful for such an evaluation.

The Cache la Poudre River (hereafter, Poudre River) is a southern Rocky Mountains, USA, mountain and plains system in northern Colorado that has been altered by heavy agricultural and urban water use since European settlement in the 1870s. Despite streamflow changes, intensive agricultural and urban land use, and nonnative species establishment, the Poudre River remains a valued amenity both socially and functionally, particularly where it flows through the City of Fort Collins (City). Declining ecological condition of the Poudre River has been documented (City of Fort Collins 2017) but a strong interest has developed among the public and government institutions to restore and promote a dynamic and functioning river that provides amenities. However, extensive dam and diversion infrastructure, proposed additional water development near Fort Collins (U.S. Army Corps of Engineers 2018), and climate change, complicates appropriate management strategies.

Management of arid-land systems such as the Poudre River requires understanding flow-ecology relationships (Poff et al. 2010), as well as anticipating future hydrologic change, to illuminate restoration strategies responsive to likely evolution of the river ecosystem. To accomplish this, we first developed a comprehensive, multi-compartment model informed by empirical data showing how hydrology and other variables (e.g., channel structure, water temperatures, and nutrients) drive important riverine geomorphic processes and associated ecosystem endpoints in the coupled aquatic-riparian system. Thus, our model differs from other strictly flow-driven modeling approaches such as ELOHA (Poff et al. 2010), which is effectively a rapid assessment tool useful for multisite comparisons of potential river degradation. Following model development for the current ecosystem, we evaluated how "scenarios" of future hydrologic conditions, ranging from status quo to expanded water development and climate change, may alter the Poudre River ecosystem. We also designed and modeled hypothetical flow regimes that we thought might achieve acceptable ecosystem outcomes under active flow management. Our aim was to produce a scientifically credible and comprehensive analysis to inform the public and assist water managers interested in sustainable management of the Poudre River ecosystem. Here, we detail model development and implementation to identify aspects of an ecologically effective flow regime that might be attainable through active management of water infrastructure, including proposed development in the Poudre River basin. This modeling effort may also inform predictions and management perspectives for other heavily altered river ecosystems in the western United States and elsewhere.

Methods

Study site

The Poudre River drainage (~2,865 km^2) originates in high-elevation mountains (>4,000 m above sea level) west of Fort Collins, Colorado, USA (U.S. Geological Survey [USGS] gage 06752260, Fig. 1). Above 1,900 m elevation, the river is a moderate to high gradient, high-velocity, cobble-bottomed stream that supports a trout-dominated fish community and diverse aquatic insects in orders Ephemeroptera, Plecoptera, and Trichoptera (EPT taxa). In the study area just downstream, the channel meanders through a lower gradient, less confined transition zone between mountains and prairie (~1,600–1,900 m elevation) and supports cool water tolerant trout, native catostomids and cyprinids, and fewer EPT taxa while adding Diptera (Fausch and Bestgen 1997). Native narrowleaf and plains cottonwood (*Populus angustifolia* James and *P. deltoides* W. Bartram ex Marshall, respectively) and their hybrids, willow (*Salix* spp.) and green ash (*Fraxinus pennsylvanica* Marshall), as well as nonnative species crack willow (*Salix fragilis* L.), Siberian elm (*Ulmus pumila* L.), and Russian olive (*Elaeagnus angustifolia* L.), dominate the riparian zone. Gravel, cobble, sand, and silt predominate in this montane-prairie ecotone. Downstream, the warm-water Poudre River continues another 60 km to the South Platte River, Missouri–Mississippi River watershed.

The 21 km long transition zone reach of the Poudre River, as just described, historically had multiple and sinuous channels and a broad floodplain with oxbows (Fig. 2a). As urbanization and development proceeded, riverbanks were structurally hardened to prevent channel meandering and property destruction during flooding, which resulted in a straighter and mostly confined

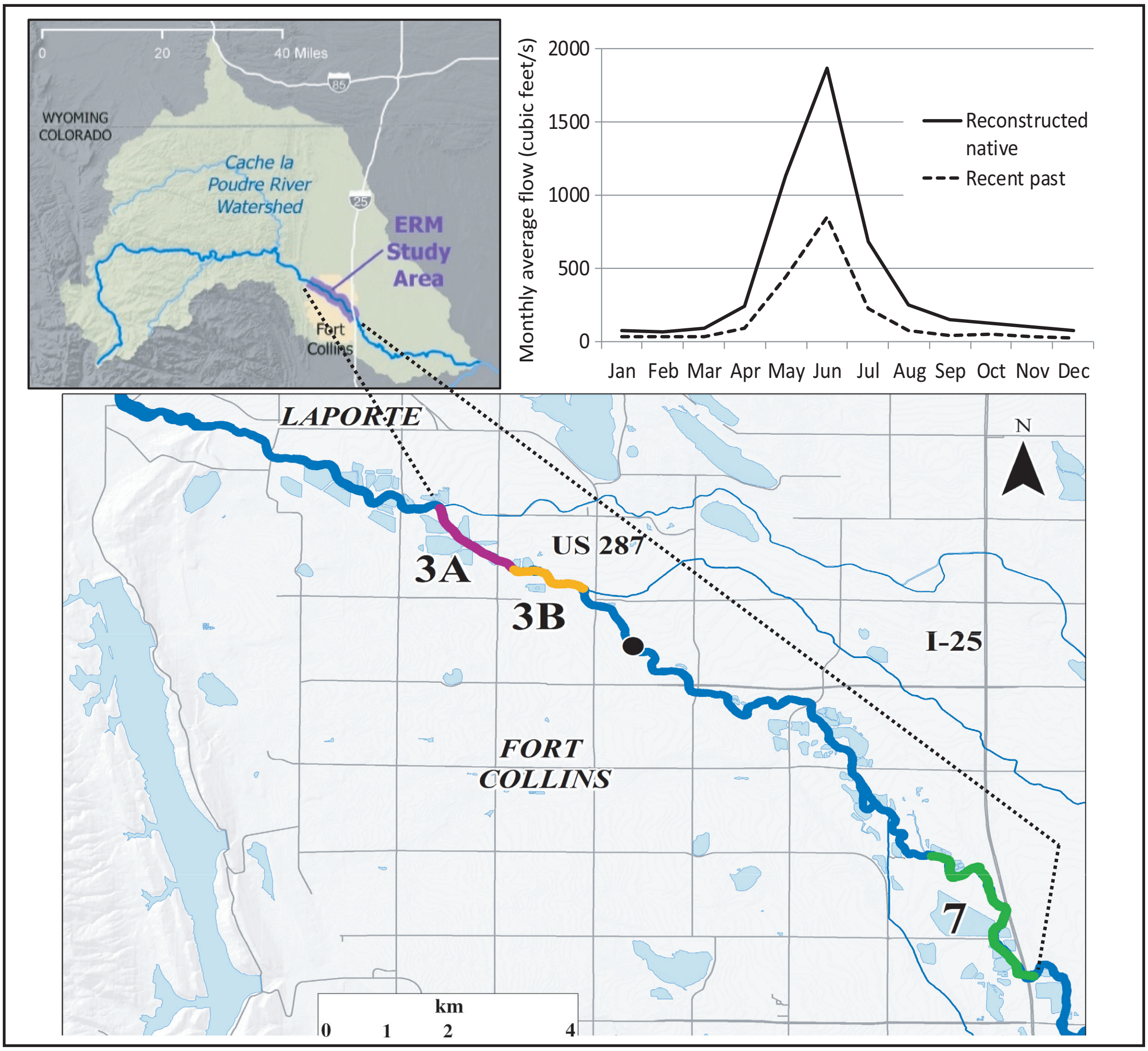

Fig. 1. The Ecosystem Response Model study area in the Cache la Poudre River watershed near Fort Collins, Colorado, USA. The Poudre River Basin map (upper left; 1 mile = 1.61 km) shows the study area segment, which is expanded below to show confined, moderately confined, and least confined reaches (3a, 3b, and 7, respectively) from up to downstream. Reduced mean monthly flow of the Poudre River in Fort Collins (water years 1975–2005) for the altered recent past hydrologic scenario (from flow gage measurements, USGS # 06752260; 1 cubic foot/s = 0.03 m^3/s) is compared to the reconstructed native (pre-development, modeled flows) flow regime (upper right; Shanahan et al. 2014).

single-thread system (Fig. 2b). Native cottonwood and willow dominate the riparian community, although non-native trees are increasing. Three of eight urban to sub-urban river corridor sub-reaches (Fig. 1b) were chosen for modeling because they represented the range of upstream to downstream channel constriction and floodplain connectivity through the 21 km long study area. Reach 3a (confined reach) is highly confined upstream by bank stabilization and has only a few opportunities for floodplain restoration. Just down-stream, Reach 3b (moderately confined reach) is partially confined, offering modest restoration opportunity for natural riverine and riparian functions, while downstream Reach 7 (least confined reach) has a mix of armored banks and open floodplain and, potentially, the greatest channel-floodplain restoration opportunities.

Conceptual hydrologic calendar

To illustrate how changes in flows qualitatively affect important geomorphic and biological attributes, we developed a conceptual Poudre River hydrologic calendar (Fig. 3). We developed this model from stream ecology literature (e.g., Allan 1995), regional and Poudre-River-specific ecological and geomorphic traits (Fausch and Bestgen 1997, Merritt and Poff 2010, Wohl et al.

a) 1937

b) Recent, circa 2005

FIG. 2. Cache la Poudre River along a section of the ERM study reach, Fort Collins, Colorado, (a) in 1937 and (b) recently (circa 2005). Panel a shows a meandering channel, with a wide, unimpaired zone of channel movement across the floodplain and presence of cottonwood forests of various ages. Panel b depicts the confined channel after nearly a century of land use changes that simplified and straightened the river, reduced channel migration and the associated rejuvenation of riparian habitat, narrowed the riparian zone, and confined the channel with hardened banks and associated pit ponds following gravel extraction.

2016), as well as from observations and expert judgement based on the authors' extensive field sampling over the last two or more decades. We adopted this river view after discussions that gravitated from a narrowly focused subset of flow-biology relationships to a holistic Poudre River ecosystem model useful to predict responses of geomorphic and biological indicators to flow and changes in management. This model reflects our aim of counterbalancing the unintegrated and few species-specific approaches commonly used in environmental assessments and resource management decision-making.

Strongly seasonal spring and early summer peak flows foundational to a functioning snowmelt river ecosystem set the physical habitat template for the Poudre River. Increased discharge from high-elevation snowmelt recruits streamside wood into the channel, mobilizes fine sediments, and scours algae, gravels, and cobbles to create aerated spawning substrates for fishes, including spring-spawning salmonids. Cool water fishes reproduce and young of spring-spawning salmonids emerge. High magnitude flow peaks maintain channel width and complexity and sometimes connect the river and floodplain, forming seasonal wetlands of variable extent and duration depending on snowmelt volume. Descending limb flows and associated sediment deposits create germination sites and enhance seedling survival for colonizing plant species (e.g., *Populus* and *Salix*) and enable early life stage fish dispersal to complex, secondary-channel backwaters. In summer, relatively stable base flows facilitate rapid growth of tree seedlings as well as reproduction and growth of native fishes, trout, and aquatic insects that require cleansed and oxygenated gravel beds. Stable autumn and winter base flows of appropriate magnitude support spawning fish and enhance survival of trout eggs and insects in shallow riffles.

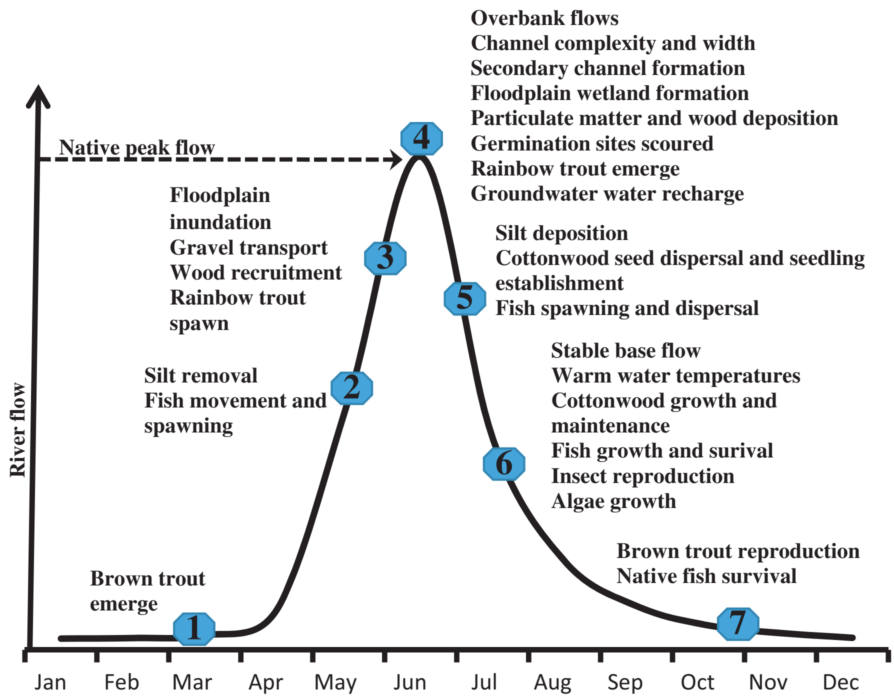

Fig. 3. Poudre River hydrology calendar, which conceptually describes flows and timing of functions those flows support to produce physical, chemical, and biological responses.

In contrast to the historical conditions portrayed by the hydrologic calendar, the contemporary Poudre River is highly altered (Appendix S1: Tables S1, S2). Extensive water storage infrastructure was developed to supply agriculture and municipal use, aggregate mining and urban development resulted in confined channels, and the many diversion dams upstream of the city (Fig. 1, Appendix S1: Table S1) divert a large proportion of river flow for much of the year. Storage and diversions reduce pre-development (native) peak and base flows (flows that would occur in the absence of diversions and other management) by 59% and 57%, respectively (Bartholow 2010, Shanahan et al. 2014). These hydrologic changes reduce sediment flushing and contribute to channel simplification thus reducing river amenities including a quality fishery or native riparian corridor (Wohl et al. 2015).

Model development and structure

Hydrologic alteration induces multiple, linked ecosystem responses, including changes to sediment transport, channel maintenance, and floodplain and wetland inundation, which affect distribution and abundance of in-channel and riparian biota (Nilsson and Svedmark 2002). Thus, we developed a multi-compartment Ecosystem Response Model (ERM) to evaluate future trajectories and complex and interacting biophysical functions under various Poudre River flow regimes, using a probabilistic Bayesian Network model. Here, we describe generalities of ERM development; additional details regarding probability tables and relationships used to calculate responses to flows and other variables are in Shanahan et al. (2014), Supporting Information (SI; Data S1) and City of Fort Collins (2019).

The probabilistic ERM network conceptualizes cause-and-effect relationships between flow regime, sediment, temperature, and ecological states (Fig. 4). Most relationships are based on conditional probabilities such that effects of one driver on a response will vary depending on other driver variables. Use of conditional probabilities leads to complex model parameterization but allows for incorporation of many information types to produce predictions about physical, chemical, and biological resources, and interactions among them. Because hydrology is a known master driver of physical and ecological conditions in streams (Poff et al. 1997, 2010), the ERM can be used to predict outcomes under various conditions including native flows, present altered flows, and future regimes resulting from additional water storage or climate change. The ERM incorporated major ecosystem components and interactions and retained advantages of a Bayesian Network approach (Uusitalo 2007) including (1) integration of various ecosystem functions typically evaluated as independent variables, (2) incorporation of various data types ranging from quantitative empirical analyses to qualitative expert judgment, (3) explicit quantification and incorporation of uncertainty, and (4) flexibility to test an array of scenarios.

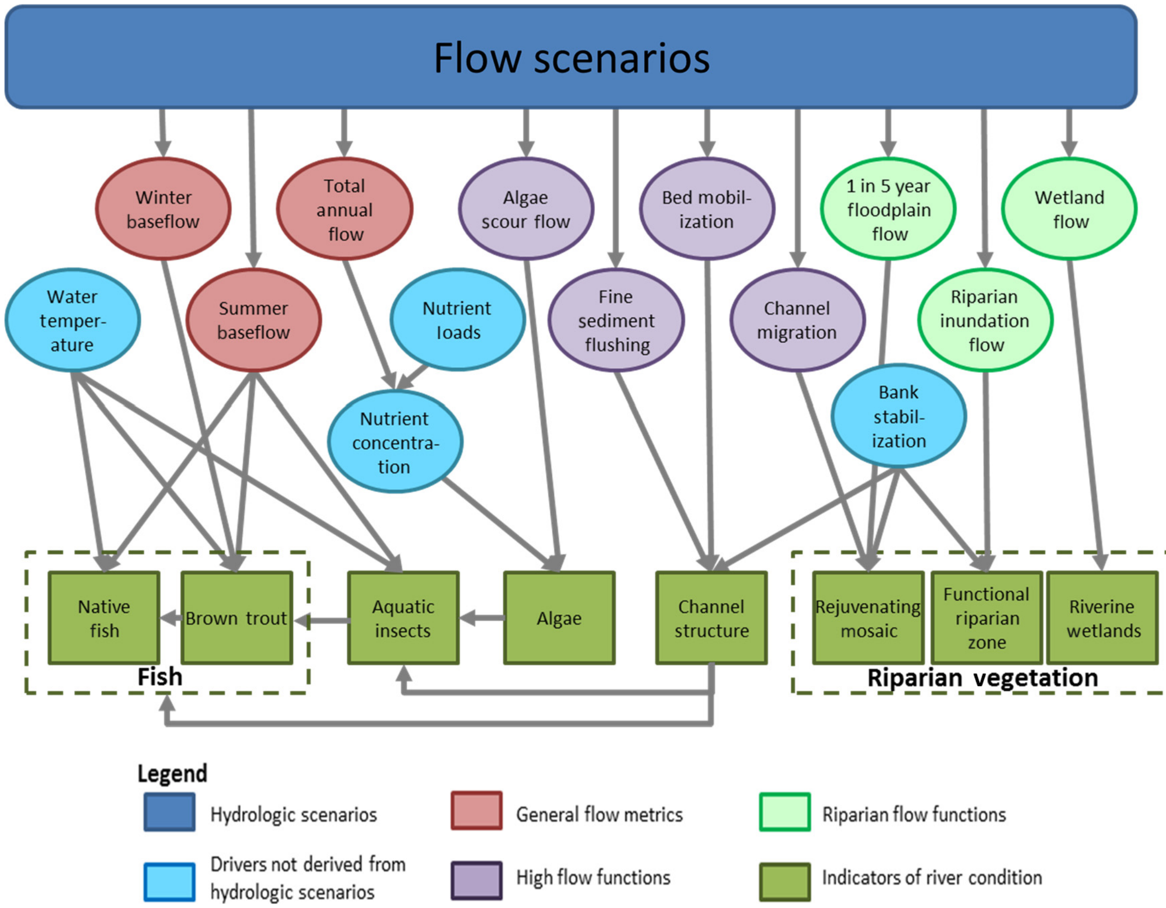

FIG. 4. Structure of the Bayesian network for the Poudre River Ecological Response Model (ERM), which links flow regime drivers, including aspects of magnitude, duration, frequency, and variability, to various flow metrics and functions, and their influence on indicators of river condition, the sum of which form ecosystem responses. Arrows between flow metrics and function nodes to indicators of river condition are predictive relationships in the model. Arrows linking indicators of river condition reflect interactions.

Indicators were formulated using combinations of quantitative channel hydraulics, empirical flow-ecology relationships based on continuous or categorical responses, and interacting effects of flow mediated through various combinations of base and peak flow, temperature, nutrients, and bed stability. Indicators included in the ERM (see Appendix S1: Table S3) were: (1) channel structure (substrate and channel geometry template for physical and ecological processes), (2) algae (basal food web resource, but unaesthetic and detrimental when excessive), (3) aquatic insects (species composition and abundance indicates flow regulation, water quality, and is a critical food web link), (4) native fish (indicates channel condition and flow regulation effects), (5) trout (mainly nonnative brown trout (*Salmo trutta* L.), which have high angler value and are a sensitive indicator of thermal and hydrologic regimes), (6) rejuvenating mosaic forest (width of multistage riparian forest with species adapted to disturbance), (7) functional riparian zone (river-connected area that supports biogeochemical processing, flood peak attenuation, sediment deposition, episodic aquatic habitat, and a productive vegetative community), and (8) riparian wetland (floodplain area inundated with sufficient frequency and duration to support wetland plants). Indicators were grouped into three types, based mainly on the amount of quantitative data available to describe them. The first group, for which quantitative data were available, included channel structure and three indicators of riparian condition, for each of the three separate river reaches. Because quality and quantity of stream habitat are determined by the interaction between flow and the structure of the river channel, the effects of flow changes on the ecosystem must be considered in the context of the current channel structure and its variability along the river (Brewer et al. 2016, McManamay et al. 2016). To quantify the effects of channel structure and associated moderate to high flows on indicators in the ERM (i.e., algae, native fish, trout, aquatic insects, and three riparian vegetation indicators), shear stress and effective discharge analyses were performed at representative locations in each of the three reaches modeled along the Fort Collins river corridor. Hydraulic modeling identified discharges at which critical thresholds of shear stress, associated with riverbed flushing and bed and channel mobilization, were met, based on flow characteristics, channel geometry, and substrate composition in each reach (details in Shanahan et al. 2014; the full channel structure model data and a detailed narrative is in SI, and Data S1; the full Excel spreadsheet is also available from the senior author upon request). An annual high flow pulse capable of flushing surface deposits of fine sediment was assumed needed to ensure ecological functioning, while widespread mobilization of the coarse river bed sediments had a longer, two-year average return interval based on the current management infrastructure, and on interannual flow variability including multi-year dry periods. Descriptions and data sources for cross-sectional geometry were used to perform shear stress and effective discharge analyses, discharge–shear-stress rating curves, the HEC-RAS model (U.S. Army Corps of Engineers 2009), hydraulic model median grain size (d_{50}), and flow records for each of the three reaches, as described in Shanahan et al. (2014), SI (Data S1) and City of Fort Collins (2019).

Geospatial probability modeling was used to determine floodplain area available for the three riparian indicator responses. Reach-specific empirical models related flood flow inundation to riparian forest species and functional group composition. These relationships used detailed riparian plant distributions (Shanahan 2009) and measured presence of the rejuvenating mosaic, functional riparian zone, and riverine wetlands, and were modeled as a function of exceedance probability from a 30-yr flow record (USGS streamflow gages) using logistic regression. Compared to the other two riparian indicators that mainly require floodplain inundation, the rejuvenating mosaic requires higher shear stresses to induce channel migration and to disturb and scour floodplain germination sites for seeds. Exceedance probability was mapped using local rating curves developed with HEC-RAS 1-D hydraulic models (U.S. Army Corps of Engineers 2009), a 1-m^2 digital elevation model, and river flow duration curves. Reconstructed historical flows and future climate change and water development scenarios were used to recalculate and reproject future exceedance probabilities and corresponding distributions and area of vegetation, which informed probabilistic model parameters.

The trout indicator was the sole member of the second indicator group, which was based on an empirical flow-ecology relationship augmented with expert judgement. The trout indicator was based in part on field sampling that related abundance of young brown trout captured in autumn samples (n = 16 yr) as a function of the river flow level in the previous winter when eggs were incubating and hatching. This relationship indicated that higher winter flows of about 1 m^3/s, for example, had a relatively high 0.67 probability of producing a larger number (>20) of young trout per year, while low flows < 0.28 m^3/s had an 80% probability of producing 5 or fewer trout; intermediate flows produced an intermediate number of young trout. The empirical relationships between winter flow categories and young trout abundance were used to describe the probabilities of having a trout fishery in one of four categories, or states (−−,−, 0, +) that reflect the number of age classes present, their abundance, and reproductive success (present state is between − and 0). Several other factors also influenced this indicator (see Fig. 4), and these were assigned independent probabilities (by expert judgement) to place trout into one of the four states in a process similar to that described below for qualitative indicators (see SI; Data S1; City of Fort Collins 2019). We also weighted driving variables for each indicator in the ERM according to their relative importance. Using trout as an example, weights for winter baseflow, summer baseflow and temperature, and channel structure were relatively high and equal (0.27 each, total of 0.81), reflecting that habitat and temperatures are relatively more important, while invertebrates received a lower relative weight (0.19), reflecting that trout can likely obtain ample food even in a relatively degraded system. We also detail the full progression of the trout indicator, including several interacting flow-related metrics and probability tables, across the range of environmental drivers to demonstrate how we arrived at the final reach-specific indicator states (see SI; Data S1).

Expert judgment was used to assign flow-based or other probabilities to a third group of indicators, algae, aquatic insects, and native fish, in the absence of direct flow-ecology relationships. For example, aquatic insects in each reach were assigned to one of three states: + (many EPT, including insects with 2-yr life cycles), 0 (mostly EPT but univoltine and reduced abundance) and − (some EPT but many tolerant taxa as well). Insect community probability state was a function of three designated drivers (see Fig. 4) of community composition and abundance: (1) channel structure (a function of fine sediment flushing, bed mobilization and bank stabilization), (2) summer base flow magnitude and water temperature above or below 23°C as one combined variable, and (3) algae production (a function of nutrient concentration and scouring flow). For example, a clean and diverse streambed had respective probabilities of producing aquatic insect states −/0/+ of 0.0/0.5/0.5. Note total probability sums to 1.0 across the three states. Adequate summer baseflow combined with cool temperatures generated probabilities for aquatic insect states −/0/+ of 0.0/0.5/0.5. For algae, where future abundance was “about the same as today” insect states −/0/+ were assigned probabilities of 0/1/0. Thus, in a river reach, under a given flow scenario that generates a clean and diverse streambed, adequate and cool baseflow, and about the same amount of algae as today, the conditional probability of an aquatic insect state of 0 is calculated from the product of the probabilities of the three controlling variables, i.e., $0.5 \times 0.5 \times 1 = 0.25$. Similar reasoning was followed for other response variables lacking suitable empirical monitoring data. For example, probability tables for the impacts of nutrient enrichment (total nitrogen and dissolved phosphorus) and scouring flows on algal biomass were based on general observations of experts in recent years to generate states of – (less than today), 0 (about the same as today), and + (more than today). Native fish states (−−,−, 0, +) were based on expected species richness, abundance, and life stage diversity in response to summer baseflow, temperature, trout predation, aquatic insects, and channel structure (see Shanahan et al. 2014 and SI [Data S1] for further details). Our fish species richness metrics were tailored to the naturally depauperate local assemblage and reduced species richness due to extirpation of specialists more sensitive to flow alterations (e.g., gravel-spawning nest builders, Fausch and Bestgen 1997), but could be easily altered for other geographic areas where fish species richness is higher.

Use of expert judgement, based on research experience and published ecological and hydro-geomorphic principles, is well-established in modeling and decision analysis (von Winterfeldt and Edwards 1986, Otway and von Winterfeldt 1992). Our main effort to reduce uncertainties associated with expert judgement was to assign conservative conditional probabilities, such that only stressor levels in the highest category were coded to cause ecological impairment. This conservatism may lead to less variation in the absolute expected values of each indicator, but the relative differences across the flow scenarios remained robust. While we specified prior distributions for all parameter interactions, we currently lack sufficient empirical data across all flow scenarios and indicators to refine prior distributions. Hence, we proceeded by specifying network linkages (Fig. 4), computing prior distributions from available data, and comparing results for a single flow scenario (recent past) against other scenarios of interest.

The ERM model uses Structural Modeling, Inference, and Learning Engine software running in GeNIe (Graphical Network Interface; Decision Systems Laboratory 2014) and computes conditional probabilities for input data using the general form

$$P(A_i|B) = \frac{P(B|A_i)P(A_i)}{P(B)} = \frac{P(B|A_i)P(A_i)}{\sum_{i=1}^{n} P(B|A_i)P(A_i)}$$

where A and B are possible outcomes and $P(A_i|B)$ is the conditional probability of A_i given B. The eight ERM indicators (model output) measure aspects of ecosystem function and condition and include variables that have regulatory implications, such as Clean Water Act aquatic life criteria, nutrient thresholds, and water temperatures, and biological indicators valued by the community.

Linkages that determined indicator condition were mapped in the final Bayesian network (Fig. 4). Hydrologic drivers including flow magnitude, duration, and frequency influenced physical processes and ecological states directly and interactively and those were altered to create flow regime “scenarios.” Flow attributes had both direct and interacting effects on indicator condition. For example, peak flow conditions directly affected algae via scouring, and channel structure via sediment flushing and bed mobilization. In contrast, aquatic insects, native fish, and trout indicators had only interacting links to peak flow attributes, via changes in channel structure, because direct relationships were not available from existing data or reliably inferred from expert judgement. Although hydrology was the primary driver of ecosystem responses, other important factors were also incorporated including water temperature, nutrients and water chemistry, and bank stabilization interacting with flows (Fausch and Bestgen 1997, Dudgeon et al. 2006, Poff 2018).

Hydrologic scenarios

After finalizing the ERM structure, we developed nine hydrologic scenarios as model inputs (Fig. 5; Appendix S1: Table S4). Scenarios characterized their effects on the Poudre River ecosystem (e.g., peak flow frequency, low flow duration) and spanned a spectrum of past to future conditions including

1) three historical scenarios that included historic unaltered regimes (reconstructed native), recent-past altered flows (recent past), and present, continuing flow alteration (present operations;)
2) two future scenarios with reduced water availability due to additional development (additional water development) or climate change (driest climate); and
3) four designed hydrologic scenarios with combinations of base flow magnitude and consistency, and peak flow magnitude, duration, and frequency to achieve specific ecosystem goals. These we referred to as stable base–low peak, high base–moderate peak, dry base–high peak, and stable base–high peak.

Historical and future hydrologic scenario development.— Hydrologic scenarios were based on gage records, diversion withdrawal data, and outputs from models used by city planners and regional water managers. All historical and future scenarios were founded on the recent past scenario, a spatially discretized record of gaged discharges across the study reach. Native and present operations scenarios remove (or add) the effect of existing reservoir and diversion operations in the Poudre River drainage. Together, these models and streamflow gages produced time series of simulated flow at a daily time step (Fig. 5; Appendix S1: Tables S2, S3). To incorporate climate change impacts, the present operations scenario was modified using predictions from global

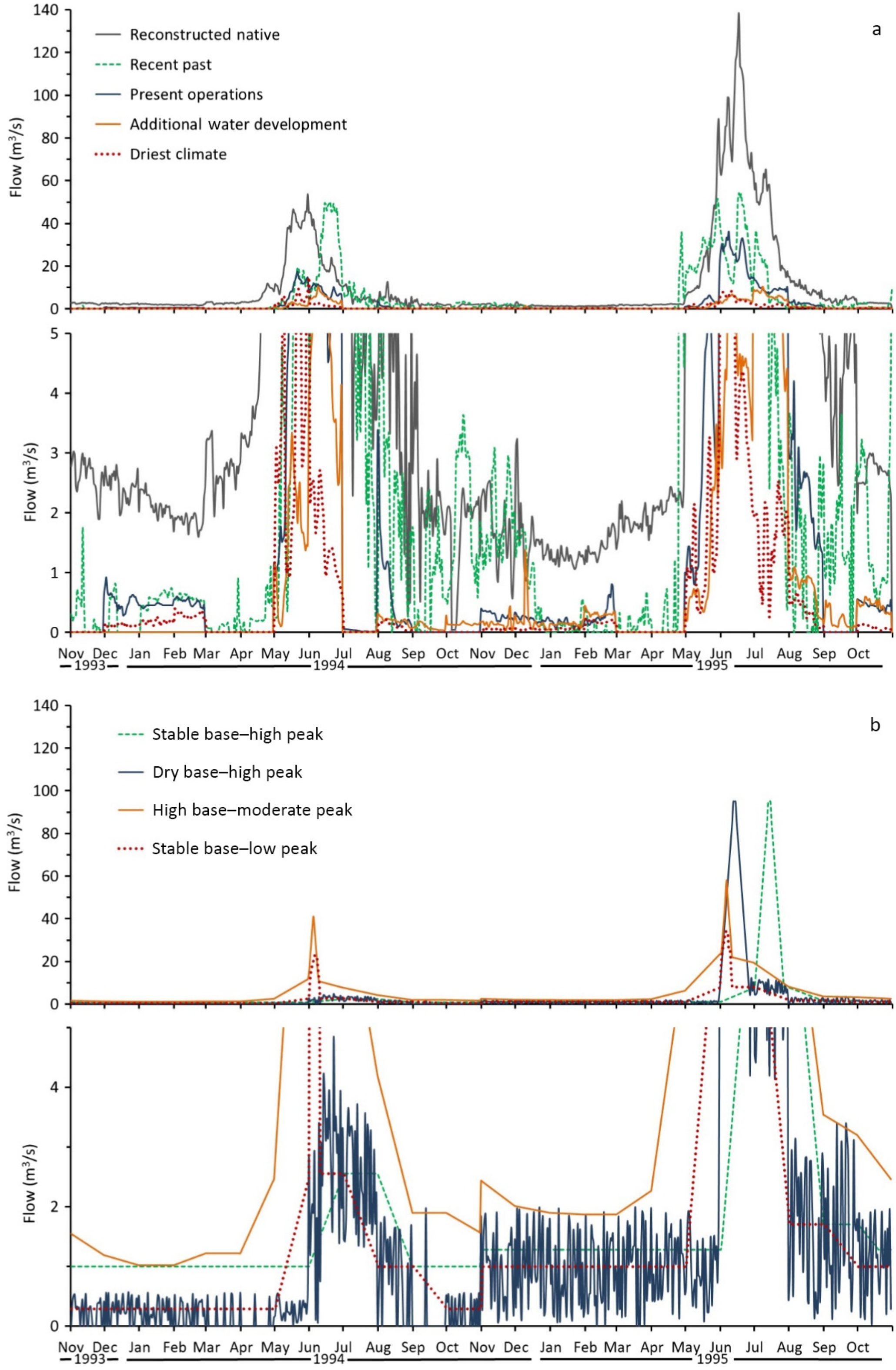

FIG. 5. Dry and wet year hydrographs for the Cache la Poudre River, Fort Collins, Colorado, showing differences in peak (upper) and base (lower panel, expanded for detail) flows for (a) five historical or future flow scenarios and (b) four designed flow scenarios. All are modeled flow scenarios with the exception of the recent past, which is from gage data (U.S. Geological Survey # 06752260).

climate circulation models (Diansky and Volodin 2002) and the Bias Corrected Spatially Downscaled [BCSD], Coupled Model Intercomparison project phase 3 archive (CMIP3, collectively the BCSD-CMIP3) that describes climate-changed hydrologic scenarios for the western United States (Gangopadhyay et al. 2011, U.S. Bureau of Reclamation 2011). Downscaled hydrology data are monthly time series predictions of unit runoff for each circulation model for one-eighth degree (12 × 12 km) latitude-longitude grid cells. Runoff calculations used the CMIP3 scenario with the lowest projected runoff in 2050 (inmcm3_0.1.sresb1) for the grid cell that most overlapped the Poudre River basin, and was the basis for our plausible driest climate scenario. To create the hydrology time series, we first computed the monthly ratio of average runoff under the driest climate scenario to average runoff under current baseline conditions. These ratios were then multiplied by the present operations daily flows to estimate the driest climate hydrologic time series of daily flows used with the ERM.

Designed flow scenario development.—The designed flow scenarios were developed as potential guidelines for water managers with the goal of improving the Poudre River flow regime to achieve certain social-ecological outcomes (Acreman et al. 2014). Designed flow scenarios have combinations of functional characteristics (e.g., Yarnell et al. 2015) that include base flow magnitude and consistency, and peak flow magnitude and duration. Sufficient base flow magnitude supports habitat for fish and aquatic insects, and influences water temperature and nutrient levels, while flow consistency reduces variation due to high diversion extraction or low reservoir releases that presently create disconnected pools and dry reaches detrimental to aquatic life. Although highest magnitude flows depend largely on snowpack levels, proposed water projects would store additional peak flows and further reduce their magnitude and duration, allowing for the possibility of designed flows to achieve downstream ecological targets if reservoir and diversion operators let flows bypass infrastructure. Designed scenarios (e.g., stable base–high peak) also included ascending and descending limb flow rates of change of about 7.1 $m^3 \cdot s^{-1} \cdot d^{-1}$ during the peak runoff period (e.g., Yarnell et al. 2010, 2015, City of Fort Collins 2019); direct effects of limb flows are presumed important but were not modeled. We show two consecutive years of the modeled Poudre River hydrographs for all scenarios (Fig. 5), in consecutive dry (1994) and wet (1995) years, to illustrate differences in base and peak flow magnitude, timing, and variability, among years when snowmelt runoff magnitude differed. Using the ERM relationships between flow and various indicators of river condition, we predicted effects of the four hypothetical designed flow scenarios on Poudre River ecosystem attributes using the same technique as for historical and future flow scenarios.

For each of the three reaches evaluated by the ERM, the ecological response of the eight river indicators under nine hydrologic scenarios was computed as a probability distribution scaled from lower (0) to higher (1) functioning. Each distribution is portrayed as a single mean value, which simplifies data presentation (Table 1; details in Shanahan et al. 2014 and SI). Indicator scores were then plotted (Fig. 6) on a probability scale (0–1) with associated qualitative predictions of condition from lowest (0) to highest (1). For example, channel structure scores were assigned to quartiles of the scale that ranged from an entrenched condition (lowest, score of 0–0.25) to a clean and diverse condition (highest, score 0.76–1). Native fish and trout scores from lowest to highest were assigned relative predictions in four ranked classes (−−,−, 0, +) and lowest to highest riparian indicator scores had relative predictions from minimal to wide areas of inundation, respectively. Indicators with only three categories were similarly assigned, where, for example, aquatic insect predictions ranged from −− (lowest condition, score of 0–0.33) to + (highest condition, score 0.67–1.0). Algae scores represented conditions that were significantly enriched and worse than present conditions (lowest, 0–0.33), similar to current conditions (0.34–0.66), or were significantly improved from present conditions (highest, 0.67–1.0). Differences in indicator scores are appropriately interpreted between flow scenarios in comparative rather than absolute terms as 0–1 scales for each indicator varied with input data and assumptions for each prior distribution.

Results

Modeling showed indicator variable response patterns typical of many flow-regulated systems, but it also revealed lesser-known interactions instructive for ecological understanding and management that varied spatially. Indicator scores were generally highest under the reconstructed native flow regime followed by the two designed flow scenarios with high peaks and the Recent Past regime in the least confined downstream reach (Fig. 6, Table 1). Indicator responses were lowest under future flow scenarios (additional water development or dry climate) in the confined reach. Present operations scenario scores were generally low.

Channel structure and the three Riparian zone indicator response scores were most sensitive (variable) to the array of flow scenarios. Low or zero scores resulted when only low magnitude peak flows were available (e.g., two future scenarios) but channel structure responded strongly to high magnitude flows because key shear stress levels were exceeded (e.g., reconstructed native, two designed flows with high peaks). Among instream biota, algae and trout were most sensitive to flow, responding negatively in the absence of high flows and subsequent impaired channel structure, and positively to presence of higher base flows, especially in winter, and cooler water temperatures in summer. Aquatic insect and native fish scores were the least sensitive to various

TABLE 1. Index of Poudre River condition for eight indicators in three different river reaches (3a = confined, 3b = moderately confined, 7 = least confined) under nine different hydrologic scenarios.

				Flow scenario					
Indicator and reach	Reconstructed native	Recent past	Present operations	Additional water development	Driest climate	Stable base–low peak	High base–moderate peak	Dry base–high peak	Stable base–high peak
Channel structure									
3a	0.80	0.33	0	0	0	0	0	0.80	0.81
3b	0.80	0.58	0.03	0	0	0	0.38	0.80	0.80
7	0.91	0.91	0.26	0	0	0.35	0.64	0.91	0.91
Algae									
3a	0.80	0.30	0.30	0	0	0	0.45	0.70	0.70
3b	0.80	0.30	0.30	0	0	0	0.45	0.70	0.70
7	0.95	0.30	0.30	0.30	0	0.10	0.60	0.70	0.70
Aquatic insects									
3a	0.46	0.26	0.26	0.21	0.21	0.30	0.41	0.41	0.53
3b	0.46	0.28	0.26	0.21	0.21	0.30	0.41	0.41	0.53
7	0.53	0.38	0.26	0.26	0.21	0.32	0.48	0.45	0.57
Native fish									
3a	0.45	0.37	0.30	0.30	0.30	0.37	0.38	0.43	0.53
3b	0.45	0.40	0.30	0.30	0.30	0.37	0.47	0.43	0.53
7	0.58	0.50	0.36	0.30	0.29	0.47	0.62	0.51	0.75
Trout									
3a	0.61	0.30	0.18	0.18	0.18	0.35	0.52	0.40	0.72
3b	0.60	0.35	0.19	0.18	0.18	0.35	0.60	0.40	0.71
Rejuvenating mosaic forest									
3a	0.62	0.26	0	0	0	0	0	0.23	0.23
3b	0.83	0.43	0.23	0	0	0	0	0.30	0.30
7	0.94	0.83	0.29	0.06	0.06	0	0.06	0.50	0.50
Functional riparian zone									
3a	0.25	0.23	0.13	0	0	0	0	0.21	0.21
3b	0.90	0.82	0.41	0.11	0	0.11	0	0.67	0.67
7	0.93	0.93	0.48	0.27	0.22	0.32	0.22	0.89	0.89
Riparian wetland width									
3a	0.51	0.36	0.30	0	0	0.21	0.30	0.46	0.46
3b	0.98	0.63	0.44	0	0	0.28	0.44	0.89	0.89
7	1	0.94	0.68	0.33	0	0.55	0.77	1	1

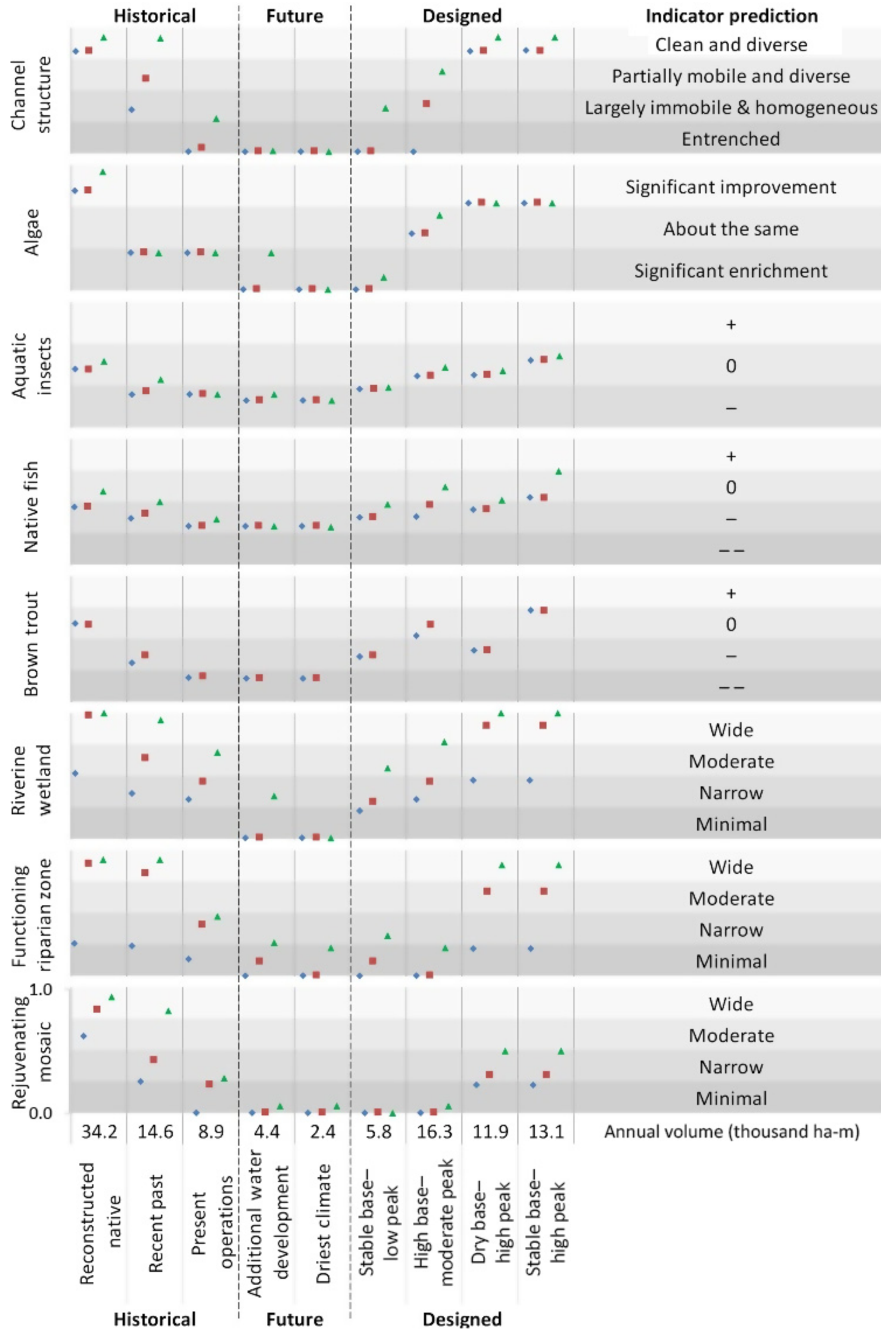

FIG. 6. Indicator predictions for three historical, two future, and four designed hydrologic scenarios for eight indicators of river condition in each of three Poudre River reaches. Each indicator is scaled from 0 to 1, with the four different gray-shaded rows for each indicator showing quartiles of change. From up to downstream, blue diamonds are for the confined reach, red squares for the moderately confined reach, and green triangles for the least confined reach. The annual volume of flow (ha-m) required to achieve each Hydrologic Scenario is portrayed at the bottom of each results column. Scores for river condition indicators for aquatic insects (+, 0, –) and fish (+, 0, –, – –) are arrayed from lowest to highest. No trout scores are presented for the downstream, least confined reach because water was warm, and few trout were present.

scenarios because assigned probabilities for various effects were conservatively estimated, mainly because few specific links to flows and other drivers were apparent (Shanahan et al. 2014). Details for indicator responses to flow scenarios are below.

Channel condition

Channel structure scores declined through the progression from Historical to Future hydrologic scenarios, due to declining peak flows and increased channel simplification, a pattern generally similar for other indicators. Highest channel structure scores (0.80–0.91) under reconstructed native and some designed scenarios resulted from high magnitude flows for a minimum of three consecutive days that provided sediment flushing, coarse substrate mobilization, channel migration, and increased geomorphic complexity. Alternatively, channel structure score was 0 in high base–moderate peak, additional water development, and driest climate scenarios in confined and moderately confined reaches because flow magnitude was inadequate to mobilize substrate and halt channel simplification.

Flows required for substantive geomorphic work varied spatially along the river corridor. Increasing channel structure scores from upstream confined and moderately confined reaches to the downstream least confined reach reflected increased downstream channel migration and complexity. Increased downstream geomorphic work can be achieved, despite identical simulated river flows, because median sediment size decreased more rapidly than channel gradient from upstream to downstream, so the same peak flow magnitudes increased channel structure scores more downstream.

Instream biota

Algae indicator scores were also highest under reconstructed native and designed hydrologic scenarios with high peak flows (score range 0.70–0.95) but lowest in confined reaches with low peak flows because substrate mobilization and scour were minimal. Identical recent past and present operations scores resulted because flow thresholds that altered channel structure were not achieved.

Aquatic insect scores were highest (0.46–0.57) in high peak and higher base flow scenarios (reconstructed native, stable base–high peak) because those conditions increased taxa richness, life history diversity, and abundance and were lower in confined reaches with low peak flows and low or variable base flows. Native fish indicator scores were higher (0.38–0.75) in scenarios with higher peak flows and consistent base flows (reconstructed native and designed scenarios except stable base–low peak) due to higher taxa richness, life stage diversity, abundance, and channel-structure-related habitat diversity, attributes that were reduced in low peak or variable base flow scenarios. Reasons for reduced score ranges over all flow scenarios and reaches for aquatic insects and native fish were discussed above. Native fish scores in the least confined reach were consistently higher, regardless of hydrologic condition, reflecting greater habitat availability and low abundance of predaceous trout in that warmer reach.

Trout reproduction, abundance, and age-class diversity varied with summer and winter base flow levels, summer water temperatures (higher in low flows), aquatic insect abundance, and channel structure. Thus, highest trout scores (0.40—0.72) resulted from higher peak and consistent base flow scenarios (reconstructed native, high base-moderate peak, and stable base-high peak), which was supported by empirical data that linked trout reproductive success with higher winter base flows. Conversely, trout were negatively affected by low base flows in summer (reduced survival) and winter (reduced reproduction), and elevated summer water temperatures that may reduce dissolved oxygen levels. Effects of lower winter base flows are evident by comparing the dry base-high peak score (0.40) to other designed scenarios with higher base and higher peak flows (score range 0.52–0.72).

Riparian zone

Riparian forests responded positively to high peak flows that saturated soils, mobilized sediment, and created channel movement, and they responded negatively to low flows and bank armoring, especially in confined reaches. Among historical flow regimes, reconstructed native and, to a lesser extent, recent past scenarios elicited the strongest positive response by the rejuvenating mosaic indicator, particularly in the least confined reach (0.94 and 0.83, respectively). Designed hydrologic scenarios with high peak flows showed the greatest improvement over those with moderate or lower peaks. Native riparian tree recruitment was negligible with low peak flows (score range 0.00–0.29) because floodplain connections rarely occurred, even in the least confined reach.

Scenarios with high peak flows (reconstructed native, recent past) produced the highest functional riparian zone scores, especially in the least confined reach (scores = 0.93), similar to riparian wetland scores (0.94–1.00). Wetland development was limited in channel-confined reaches under most flow scenarios (confined reach = 0.00–0.51) because high, steep banks and channel entrenchment prevented river–floodplain connections. Similar to the functional riparian zone, wetlands would increase if bank height were reduced and banks were set back and sloped to allow greater river–floodplain connection and a more continuous moisture gradient. Rejuvenating mosaic scores were lower than the other two riparian vegetation scores under the same flow and reach conditions because flow magnitudes and velocities were insufficient to disturb and scour surfaces needed for seed germination sites.

Annual flow volume required to implement the nine ERM flow scenarios varied widely. For example, annual discharge volume in the reconstructed native scenario was more than twice as high (34,246 ha-m; 278,000 acre-feet, Appendix S1: Table S2) as other scenarios and up to 14× greater than low peak flow scenarios, regardless of base flow characteristics. Notably, when compared with the reconstructed native or recent past scenarios, the stable base–high peak scenario produced comparable or higher indicator scores for most metrics with substantially less water (13,117 ha-m;

106,000 acre-feet, Appendix S1: Table S2). Reach differences for indicators reflected prevalence of overbank flooding, or, of differences in channel structure rather than flows, which were identical across reaches.

All indicators were sensitive to changes in assumptions of driving variables; those with linear or continuous responses were relatively more sensitive than categorical driving variables. For example, increased flows and shear stress caused channel structure change, especially when thresholds for bed particle mobility were exceeded. Channel structure changes then cascade interactively through most instream biological indicators. Categorical variables were less sensitive to flow changes, unless they resulted in response category changes, indicating that additional quantitative data that explicitly linked indicators to flows would improve model performance. Additionally, all indicators have assumptions and thresholds that can be changed, to reflect differing local conditions or addition of new or refined flow regimes, which increases model flexibility and utility.

Discussion

Ecological response model outcomes and important drivers

The integrated ERM for the urban Poudre River demonstrated how the structure and function of the coupled aquatic and riparian ecosystem are strongly shaped by flow and illuminated complex interactions between different taxa and trade-offs with different flow regimes. Thus, this model could provide restoration ecologists and managers with a tool to assess effects of potential future flows to target specific, desired processes or ecosystem attributes. Assuming additional changes from new development or climate change will cause further alterations to the urban Poudre River, the ERM would also allow insights into what specific flow components may need to be "designed" as part of any new infrastructure to help sustain or improve ecological integrity.

Our modeling led to three main observations. First, the conceptual hydrologic calendar and ERM predictions increased our understanding of the complex interactions among flows, bed mobilization, channel structure, and biota (e.g., Fig. 4) that contribute to overall ecosystem condition. Second, specific peak flow magnitudes based on geomorphic measurements and hydraulic modeling were critical for substrate cleansing and mobilization, channel morphology, and overbank flows, with strong subsequent effects on riparian and instream biota. Instream biological indicator scores (aquatic insects, native fish, trout) increased in hydrologic scenarios with greater peak flow magnitudes because of improved channel structure, the physical habitat template of the river, even though those indicators were only interactively linked to peak flows. Implicit is that other important ecological processes and communities not modeled by the ERM, including those supported by ascending or descending limb flows, are maintained. Third, an unexpected model result was that designed flows with high peaks resulted in restoration of impaired processes using about the same Poudre River annual water volume available in the flow-depleted recent past scenario. These complex and interacting Poudre River insights demonstrated by the ERM would not be possible with more traditional flow assessments that evaluate only single variables independent of each other (Brewer et al. 2016, McManamay et al. 2016).

Modeling ERM flow effects indicated how river management could be optimized. For example, high flows had the greatest effects in the least confined channel reach, but all reaches may benefit if flow effects were combined with levee or bank modifications. To this point, lowered banks in the downstream portion of the confined reach promoted successful floodplain cottonwood recruitment in recent higher flow years. Stable base flows most effectively increased instream biological indicators such as trout and aquatic insect scores compared to present conditions because periods of stream desiccation and extreme fluctuations were reduced. Indicator scores in low peak flow scenarios were only about 50% of those with high peaks, demonstrating strong links between geomorphic function and biota.

The importance of natural flow regime components (Poff et al. 1997, Postel and Richter 2003) to a higher-functioning Poudre River ecosystem was illustrated by ERM modeling because peak flows scoured riverbed substrate, increased channel complexity, removed excess algae, and promoted a diverse aquatic insect community that supported fish and likely, other ecosystem components such as terrestrial insectivores (e.g., Baxter et al. 2005). Extreme peak flows that may cause channel incision may not be an issue here because discharge magnitudes in designed flows are relatively low. High flows may also increase the quantity of large wood via channel migration (Yarnell et al. 2010, Wohl et al. 2015, 2019), and river connectivity to floodplain wetlands important to backwater-dependent aquatic organisms. Descending limb flows, although not modeled explicitly, likely modified channel morphology, cued reproduction by fishes and other aquatic organisms, and prepared surfaces needed for native seed germination and seedling growth and survival necessary for perpetuating the ecologically important riparian gallery forest (Mahoney and Rood 1998, Yarnell et al. 2010). Base flows supported fish and aquatic insect reproduction and growth, and successful reproduction by trout until the spring hydrologic cycle begins again.

A changing ecosystem

The Poudre River supports functioning remnants of native riparian and aquatic biota, but this urbanizing ecosystem has undergone significant change over the last 150 yr. Examples include channel modification and simplification, diminished native fish populations, and limited recruitment of young trees in stands of senescent narrowleaf and plains cottonwood. Native fish only approached the highest indicator condition once (stable base–high peak in the least confined reach 7) because local extinctions are exacerbated by negative modeled interactions with trout (e.g., predation) and habitat changes (e.g., backwater loss) related to simplified channel structure and, presumably, greater upstream river fragmentation and dewatering by diversion dams. Regardless, and specific to the Poudre River system, dynamic model responses of indicators demonstrated ecosystem decline was not inevitable, and that designed flows using existing and proposed infrastructure could lead to improved conditions. The flexible ERM could model ecosystem responses to additional designed Poudre River flow regimes, or be used as a general assessment approach in other altered systems where managers seek to improve ecosystem conditions, after tailoring geographically relevant indicator information for the model.

Similar to other modified arid-land rivers, the Poudre River ecosystem is a spatially variable patchwork of physical conditions with a changing biological composition whose functioning varied even across the relatively short reaches we evaluated. For example, modeling showed confined reaches had reduced ecosystem complexity and indicator scores compared to the least confined downstream reach, which more typified predevelopment conditions (Fig. 2). Thus, modeled ecosystem responses to flow management varied in a spatial context and may better allow practitioners to align restoration prescriptions with reaches most suited for a particular management action. Extreme low flows presently occur in some Poudre River reaches and result in persistent riverbed desiccation especially in winter, effects that are exacerbated by diversion dams that limit upstream recolonization by downstream biota. Effects of management strategies to enhance river connectivity or bank restoration could be modeled in the ERM to evaluate indicator responses and relative costs and benefits of such actions.

We acknowledge that flows discussed here may benefit some nonnative species. For example, anglers fish for nonnative brown trout, because native cutthroat trout (*Oncorhynchus clarkii* [Richardson]) disappeared decades ago due to competition and hybridization with nonnative trout species (Behnke 1992, Bestgen et al. 2019). Further, predaceous trout may have a negative impact on non-salmonid native fishes, creating a challenge in managing for healthy populations of both. We speculate that flows to benefit nonnative trout would also likely benefit native cutthroat trout that once existed here but flow management would do little to restore native trout because they were extirpated by other mechanisms (Behnke 1992).

Unlike the situation with trout, designed flows, and increased channel and floodplain management, may promote native cottonwoods via increased seedling recruitment (Merritt and Poff 2010). This is important because of limited recruitment of young trees to replace old stands of native cottonwoods, keystone species in western stream ecosystems (Merritt and Bateman 2012) that are being replaced by nonnative taxa. Thus, species-specific responses to flow management and the relative ability to favor native taxa over nonnative ones is a planning consideration, and can be modeled with the ERM.

Strengths and limitations of the Ecosystem Response Model

The ERM was constructed to evaluate linked biophysical responses over a range of possible flow futures, with few constraints on what is likely, affordable, or administratively possible. Decision-makers must ultimately weigh stakeholder interests with the ecological, economic, and societal consequences associated with various policy options. Although ERM predictions are not precise in an absolute sense, the power of this modeling approach lies in its integrative and comparative nature. For example, modeling showed that instream biological indicators (e.g., algae, aquatic insects) benefitted from higher and more stable base flows and high peak flows, but stable base flows with low peak flows were only half as effective to increase indicator scores. A nuance was that trout scores in high peak designed scenarios nearly doubled when base flows changed from low to higher levels, reflecting the important seasonal role of flow on reproductive success. Thus, explicit baseflow management to enhance trout in the absence of peak flows would result in only a modest improvement in scores and at the expense of other indicators dependent on high peak flows.

Modeling also showed the strong positive link between channel structure and riparian indicators with peak flow, reflecting gradient (channel structure) or threshold (riparian) effects as peaks declined from historical flow levels. The ERM provides insight into what magnitudes of designed flows would be minimally sufficient to reestablish higher functioning along the river corridor. Thus, designed flows with high peaks would likely enhance channel and riparian functioning, but if peaks came at the expense of higher and more stable base flows, instream biota indicators would decline, demonstrating the utility of the ERM to evaluate flow scenario trade-offs and to explore nuances that may vary seasonally or spatially.

The interactive and data-driven ERM differs from another flow modeling approach, ELOHA, in several ways. ELOHA is mainly a multisite comparative approach intended for use in situations that are data sparse and where scientific capacity to generate detailed knowledge is lacking. Studies more detailed than ELOHA-type analyses are required for highly valued local ecosystems, where the assumption that streamflow alone drives ecological function cannot be accepted, and where other environmental factors such as water temperature, channel structure, and streambed scour and movement, are important. The ERM for the Poudre River is such a detailed, site-specific model that includes many relationships that are both directly and interactively influenced by flow, directly via flow-linked pathways to indicators, and interactively through indicators. Differences notwithstanding, ERM findings could be placed into an ELOHA-type framework by classifying the Poudre River as a particular flow regime type (in a given geomorphic context) to set expectations for the ecological performance of similar river types.

Indicator response comparisons across a set of diverse and plausible hydrologic scenarios reveal certain futures are likely better than others in terms of a highly functioning ecosystem that provides valued river amenities. Given the altered condition of the present-day Poudre River ecosystem, managers and the public need to consider the vulnerability of the system to further hydrologic alteration and the associated trade-offs. The ERM also illustrates another salient point for river managers to consider: that the same volume of flow can achieve substantially different ecological outcomes, depending on how it is managed.

Thus, the ERM provides a clear framework and useful decision support tool for understanding trade-offs and consequences of various management options on water supply and biota. Indeed, a general, risk-based modeling approach may be more useful than traditional environmental assessments that produce unintegrated measures of resource alteration, especially considering the trajectory of ecosystems under changing environmental conditions including climate warming (Schindler and Hilborn 2015). Application of probabilistic models to other systems will require the system-specific quantification of geomorphic and ecological relationships, which will inform a transparent and science-based process to aid decision-making and clarify the likely trade-offs and consequences of flow management regimes. Modeling approaches that predict ecosystem pathways also allow decision-makers to compare a variety of stakeholder interests and the engineering, ecological, economic, and societal consequences associated with policy options (see Baker et al. 2004).

Futures for flow-altered systems

The ERM analyses confirmed changes in historical Poudre River ecological conditions and indicated additional legacy shifts will occur even if present flow management practices are maintained. Further, ecological changes will be accelerated by additional water development or a drying climate. However, results also indicated carefully managed flows that link key hydro-geomorphic processes with biological responses are likely to enhance ecological functioning of the river ecosystem. Key elements of a designed flow in this and other systems similar to the Poudre River would be peak magnitudes in spring and early summer that meet threshold levels for channel maintenance and riparian vegetation, gradually ascending and descending limb flows, and relatively stable and adequate magnitude base flows, which collectively should improve geomorphic and biological indicators. Because flow requirements differ among biota, maintenance of interannual variability is important to support a more biodiverse ecosystem through time. Although we evaluated only a few designed scenarios, other flow regimes that incorporate additional seasonal or interannual variability in peak or base flows could easily be modeled to better understand those effects.

In any plausible future, the Poudre River will not return to native flows, because annual discharge in the reconstructed native scenario is up to 14× higher than other scenarios. This large gap between natural flow conditions that set the original physical template for the Poudre River and current or future flows suggests that (1) managers of heavily altered river systems may need to set ecological objectives that are not strictly “natural,” and (2) designed flows are needed to achieve specific objectives (e.g., Acreman et al. 2014, Brewer et al. 2016, McManamay et al. 2016). The ERM demonstrated that specific Poudre River objectives could be achieved with about one-half the annual discharge of the reconstructed native scenario, if certain flow targets are met. Social and ecological benefits from designed flows in altered systems are most likely to occur if basin-wide flow management is combined with other actions to promote upstream–downstream and channel–floodplain connectivity along the river corridor.

Additional future depletions of Poudre River flows are possible given an existing proposal to store water in a new off-channel reservoir, which will further diminish already reduced peak flow magnitudes and impact river resources. Proposed project mitigation (Northern Colorado Water Conservancy District 2017) has focused on stabilizing base flow, which is needed to reduce present streambed desiccation. Our modeling indicated water levels to accomplish base flow functions in the stable base–high peak scenario was about 1 m^3/s flow (about 35 cubic feet per second), the required level for successful trout reproduction (Bartholow 2010, Appendix S1: Table S2), and improved functioning of other indicators. However, the proposed base flow would meet this threshold on average only 50% of years and would not benefit river resources downstream of the city because flows will be diverted.

Peak flow frequencies and magnitudes proposed are also inadequate to maintain channel condition and biota because a 3-d peak bypass flow is projected to occur in only 43% of years (Northern Colorado Water Conservancy District 2017; data *available online*).[12] Further, mean peak Poudre River flow magnitudes are unlikely to reach even the 31 m^3/s estimated for the relatively low present operations scenario in most years. As modeled

[12] http://www.northernwater.org/docs/NISP/MapsDocuments/2017FWMEPFinal.pdf

by the ERM and predicted by fundamental principles of river science (Poff et al. 1997, Wohl et al. 2015), changes from proposed additional water development would essentially ensure a general and long-term decline in Poudre River aquatic and riparian ecosystem functions. Thus, the best possibility for maintaining or improving Poudre River ecological conditions with the proposed off-channel storage is designed peak flows that bypass the newly proposed storage reservoir for a minimum of three consecutive days with the predicted highest magnitude flows each year. This scenario also ensures the natural interannual variability in flows needed to sustain ecosystem functioning, effects of which are seen by comparing ERM outcomes of managed scenarios with different peak flow levels.

Ideally, the frequency and magnitude of peak flows in flow-depleted rivers could be partially restored to more closely approximate natural flows, which here are those in the reconstructed native scenario (i.e., ≥3-d peak flows in more than 50% of years that reach 94.9 m^3/s at Fort Collins, to provide the flow magnitude and duration needed for channel maintenance (Andrews and Nankervis 1995, Emmett and Wolman 2001)). Although existing storage reservoirs and diversions have substantially reduced Poudre River peak flows, our analyses show that the estimated "deficit" in peak flow volume and duration could be met with bypasses from existing storage facilities or diversions in the Poudre River basin, which in real time would require adequate flow forecasting. Other studies that have implemented designed flows (Kiernan et al. 2012) or modeled them (Chen and Olden 2017, Sabo et al. 2017) show it is feasible to balance existing human demands while provisioning key ecosystem targets. Adaptive management will be needed to ensure flow scenarios support desired outcomes. Additional details regarding the high flow mitigation specific to the Poudre River are elsewhere (Appendix S2).

As stressors on over-allocated river ecosystems increase from human water demands and climate change, modeling approaches that predict future ecosystem responses to water development and management will play an increasingly important role in informing public debate and choices about management of these resources (Baker et al. 2004, California State Water Resources Control Board. 2017). Ecosystem-based models such as the ERM can identify strategies to achieve firm targets to assist with rehabilitation or mitigation plans in water development scenarios. Unfortunately, no policy requires that integrated, holistic, ecosystem-scale impacts be assessed before new water projects are approved. Rather, requirements for assessing "impact" under NEPA are satisfied when analyses are framed only in traditional single-variable models. Thus, even when river engineers and other scientists not associated with water development interests construct holistic models of "impact" (e.g., the ERM), there is no clear pathway to having those substantively considered in project development, much less adopted. Another fundamental problem with the traditional NEPA-driven "environmental impact" approach is failure to consider ecosystem functions and societal values on par with the economic factors that largely dictate proposed alternatives for development. Typically, impacts of the preferred project alternative are evaluated with a few single-factor analyses that are portrayed as causing minimal environmental alteration. Joint consideration of both long-term ecological issues and short-term economic gain at the project proposal stage may aid development of more environmentally sustainable alternatives, especially in light of new uncertainties posed by climate change (see Poff et al. 2016). This would promote more robust science and more transparent trade-off analyses of alternative development options needed to support more rational societal decisions about river management in a complex and uncertain future.

Acknowledgments

We appreciate the contributions of J. Stokes, B. Anderson, the Northern Colorado Water Conservancy District staff, and especially J. Shanahan for assistance throughout. Comments from S. Brewer, J. Friedman, S. Yarnell, K. Zelasko, and an anonymous reviewer improved the manuscript. M. Haworth assisted with construction of Fig. 1. J. Shanahan, B. Bledsoe, and N. L. Poff conceived the study. D. Baker and M. Lorie conducted modeling. K. Bestgen, B. Kondratieff, B. Bledsoe, J. Shanahan, D. Merritt, and N. L. Poff provided data. K. Bestgen led manuscript writing but all authors contributed.

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Supporting Information

Additional supporting information may be found online at: http://onlinelibrary.wiley.com/doi/10.1002/eap.2005/full

Data Availability

Data are available from the City of Fort Collins Natural Areas Department at https://www.fcgov.com/naturalareas/pdf/erm_report.pdf, https://www.fcgov.com/naturalareas/pdf/erm_appendix.pdf?1421099850, and https://www.fcgov.com/naturalareas/eco-response.php

The Natural Flow Regime

A paradigm for river conservation and restoration

N. LeRoy Poff, J. David Allan, Mark B. Bain, James R. Karr, Karen L. Prestegaard, Brian D. Richter, Richard E. Sparks, and Julie C. Stromberg

Humans have long been fascinated by the dynamism of free-flowing waters. Yet we have expended great effort to tame rivers for transportation, water supply, flood control, agriculture, and power generation. It is now recognized that harnessing of streams and rivers comes at great cost: Many rivers no longer support socially valued native species or sustain healthy ecosystems that provide important goods and services (Naiman et al. 1995, NRC 1992).

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The ecological integrity of river ecosystems depends on their natural dynamic character

The extensive ecological degradation and loss of biological diversity resulting from river exploitation is eliciting widespread concern for conservation and restoration of healthy river ecosystems among scientists and the lay public alike (Allan and Flecker 1993, Hughes and Noss 1992, Karr et al. 1985, TNC 1996, Williams et al. 1996). Extirpation of species, closures of fisheries, groundwater depletion, declines in water quality and availability, and more frequent and intense flooding are increasingly recognized as consequences of current river management and development policies (Abramovitz 1996, Collier et al. 1996, Naiman et al. 1995). The broad social support in the United States for the Endangered Species Act, the recognition of the intrinsic value of noncommercial native species, and the proliferation of watershed councils and riverwatch teams are evidence of society's interest in maintaining the ecological integrity and self-sustaining productivity of free-flowing river systems.

Society's ability to maintain and restore the integrity of river ecosystems requires that conservation and management actions be firmly grounded in scientific understanding. However, current management approaches often fail to recognize the fundamental scientific principle that the integrity of flowing water systems depends largely on their natural dynamic character; as a result, these methods frequently prevent successful river conservation or restoration. Streamflow quantity and timing are critical components of water supply, water quality, and the ecological integrity of river systems. Indeed, streamflow, which is strongly correlated with many critical physicochemical characteristics of rivers, such as water temperature, channel geomorphology, and habitat diversity, can be considered a "master variable" that limits the distribution and abundance of riverine species (Power et al. 1995, Resh et al. 1988) and regulates the ecological integrity of flowing water systems (Figure 1). Until recently, however, the importance of natural streamflow variability in maintaining healthy aquatic ecosystems has been virtually ignored in a management context.

Historically, the "protection" of river ecosystems has been limited in scope, emphasizing water quality and only one aspect of water quantity: minimum flow. Water resources management has also suffered from the often incongruent perspectives and fragmented responsibility of agencies (for example, the US Army Corps of Engineers and Bureau of Reclamation are responsible for water supply and flood control, the US Environmental Protection Agency and state environmental agencies for water quality, and the US Fish &

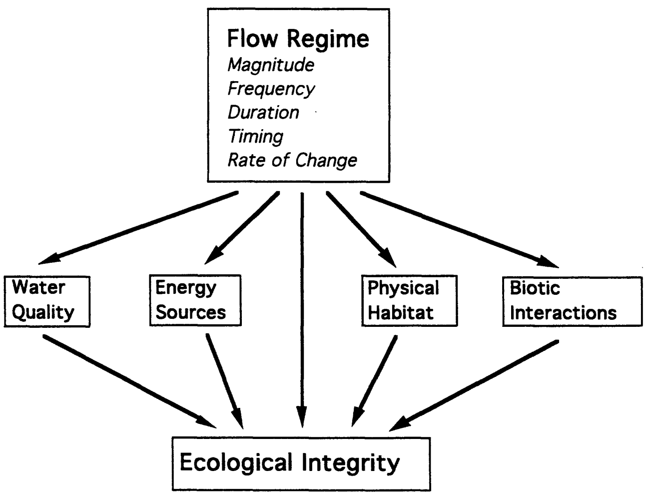

Figure 1. Flow regime is of central importance in sustaining the ecological integrity of flowing water systems. The five components of the flow regime—magnitude, frequency, duration, timing, and rate of change—influence integrity both directly and indirectly, through their effects on other primary regulators of integrity. Modification of flow thus has cascading effects on the ecological integrity of rivers. After Karr 1991.

Wildlife Service for water-dependent species of sporting, commercial, or conservation value), making it difficult, if not impossible, to manage the entire river ecosystem (Karr 1991). However, environmental dynamism is now recognized as central to sustaining and conserving native species diversity and ecological integrity in rivers and other ecosystems (Holling and Meffe 1996, Hughes 1994, Pickett et al. 1992, Stanford et al. 1996), and coordinated actions are therefore necessary to protect and restore a river's natural flow variability.

In this article, we synthesize existing scientific knowledge to argue that the natural flow regime plays a critical role in sustaining native biodiversity and ecosystem integrity in rivers. Decades of observation of the effects of human alteration of natural flow regimes have resulted in a well-grounded scientific perspective on why altering hydrologic variability in rivers is ecologically harmful (e.g., Arthington et al. 1991, Castleberry et al. 1996, Hill et al. 1991, Johnson et al. 1976, Richter et al. 1997, Sparks 1995, Stanford et al. 1996, Toth 1995, Tyus 1990). Current pressing demands on water use and the continuing alteration of watersheds require scientists to help develop management protocols that can accommodate economic uses while protecting ecosystem functions. For humans to continue to rely on river ecosystems for sustainable food production, power production, waste assimilation, and flood control, a new, holistic, ecological perspective on water management is needed to guide society's interactions with rivers.

The natural flow regime

The natural flow of a river varies on time scales of hours, days, seasons, years, and longer. Many years of observation from a streamflow gauge are generally needed to describe the characteristic pattern of a river's flow quantity, timing, and variability—that is, its natural flow regime. Components of a natural flow regime can be characterized using various time series (e.g., Fourier and wavelet) and probability analyses of, for example, extremely high or low flows, or of the entire range of flows expressed as average daily discharge (Dunne and Leopold 1978). In watersheds lacking long-term streamflow data, analyses can be extended statistically from gauged streams in the same geographic area. The frequency of large-magnitude floods can be estimated by paleohydrologic studies of debris left by floods and by studies of historical damage to living trees (Hupp and Osterkamp 1985, Knox 1972). These historical techniques can be used to extend existing hydrologic records or to provide estimates of flood flows for ungauged sites.

River flow regimes show regional patterns that are determined largely by river size and by geographic variation in climate, geology, topography, and vegetative cover. For example, some streams in regions with little seasonality in precipitation exhibit relatively stable hydrographs due to high groundwater inputs (Figure 2a), whereas other streams can fluctuate greatly at virtually any time of year (Figure 2b). In regions with seasonal precipitation, some streams are dominated by snowmelt, resulting in pronounced, predictable runoff patterns (Figure 2c), and others lack snow accumulation and exhibit more variable runoff patterns during the rainy season, with peaks occurring after each substantial storm event (Figure 2d).

Five critical components of the flow regime regulate ecological processes in river ecosystems: the magnitude, frequency, duration, timing, and rate of change of hydrologic conditions (Poff and Ward 1989, Richter et al. 1996, Walker et al. 1995). These components can be used to characterize the entire range of flows and specific hydrologic phenomena, such as floods or low flows, that are critical to the integrity of river ecosystems. Furthermore, by defining flow regimes in these terms, the ecological consequences of particular human activities that modify one or more components of the flow regime can be considered explicitly.

- The *magnitude* of discharge[1] at any given time interval is simply the amount of water moving past a fixed location per unit time. Magnitude can refer either to absolute or to relative discharge (e.g., the amount of water that inundates a floodplain). Maximum and minimum magnitudes of flow vary with climate and watershed size both within and among river systems.
- The *frequency* of occurrence refers to how often a flow above a given magnitude recurs over some specified time interval. Frequency of occurrence is inversely related to flow magnitude. For example, a 100-year flood is equaled or exceeded on average once every 100 years (i.e., a chance of 0.01 of occurring in any given year). The average (median)

[1]Discharge (also known as streamflow, flow, or flow rate) is always expressed in dimensions of volume per time. However, a great variety of units are used to describe flow, depending on custom and purpose of characterization: Flows can be expressed in near-instantaneous terms (e.g., ft^3/s and m^3/s) or over long time intervals (e.g., acre-ft/yr).

flow is determined from a data series of discharges defined over a specific time interval, and it has a frequency of occurrence of 0.5 (a 50% probability).

- The *duration* is the period of time associated with a specific flow condition. Duration can be defined relative to a particular flow event (e.g., a floodplain may be inundated for a specific number of days by a ten-year flood), or it can be a defined as a composite expressed over a specified time period (e.g., the number of days in a year when flow exceeds some value).
- The *timing*, or *predictability*, of flows of defined magnitude refers to the regularity with which they occur. This regularity can be defined formally or informally and with reference to different time scales (Poff 1996). For example, annual peak flows may occur with low seasonal predictability (Figure 2b) or with high seasonal predictability (Figure 2c).
- The *rate of change*, or *flashiness*, refers to how quickly flow changes from one magnitude to another. At the extremes, "flashy" streams have rapid rates of change (Figure 2b), whereas "stable" streams have slow rates of change (Figure 2a).

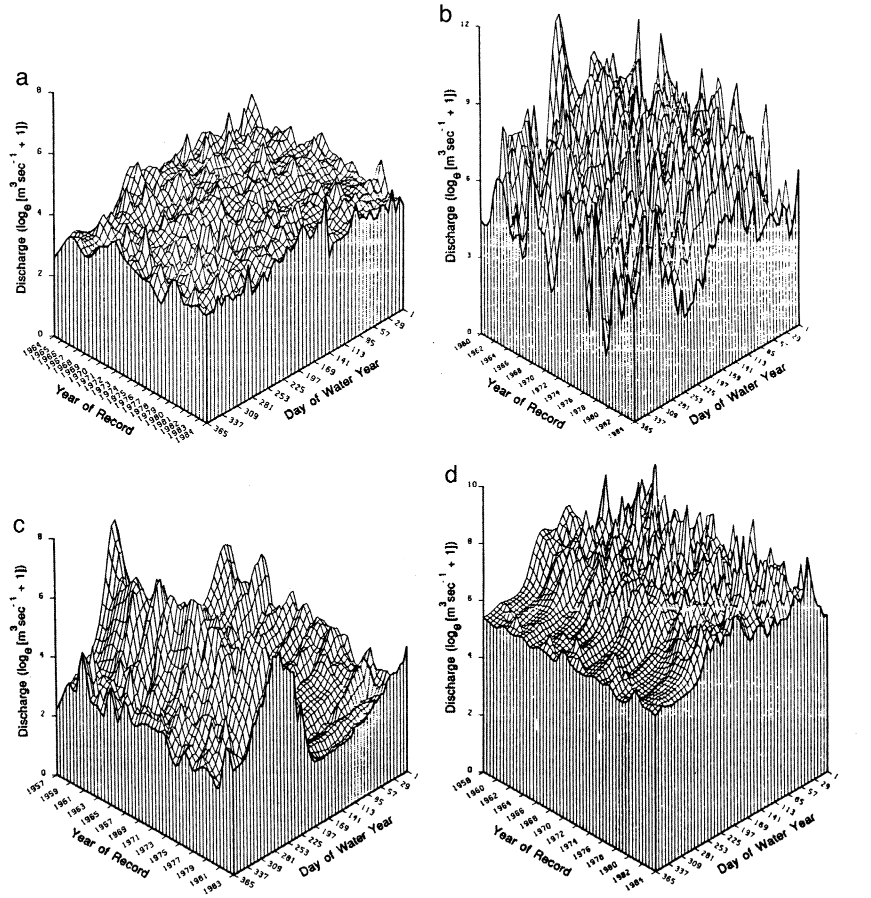

Figure 2. Flow histories based on long-term, daily mean discharge records. These histories show within- and among-year variation for (**a**) Augusta Creek, MI, (**b**) Satilla River, GA, (**c**) upper Colorado River, CO, and (**d**) South Fork of the McKenzie River, OR. Each water year begins on October 1 and ends on September 30. Adapted from Poff and Ward 1990.

Hydrologic processes and the flow regime. All river flow derives ultimately from precipitation, but in any given time and place a river's flow is derived from some combination of surface water, soil water, and groundwater. Climate, geology, topography, soils, and vegetation help to determine both the supply of water and the pathways by which precipitation reaches the channel. The water movement pathways depicted in Figure 3a illustrate why rivers in different settings have different flow regimes and why flow is variable in virtually all rivers. Collectively, overland and shallow subsurface flow pathways create hydrograph peaks, which are the river's response to storm events. By contrast, deeper groundwater pathways are responsible for baseflow, the form of delivery during periods of little rainfall.

Variability in intensity, timing, and duration of precipitation (as rain or as snow) and in the effects of terrain, soil texture, and plant evapotranspiration on the hydrologic cycle combine to create local and regional flow patterns. For example, high flows due to rainstorms may occur over periods of hours (for permeable soils) or even minutes (for impermeable soils), whereas snow will melt over a period of days or weeks, which slowly builds the peak snowmelt flood. As one proceeds downstream within a watershed, river flow reflects the sum of flow generation and routing processes operating in multiple small tributary watersheds. The travel time of flow down the river system, combined with nonsynchronous tributary inputs and larger downstream channel and floodplain storage capacities, act to attenuate and to dampen flow peaks. Consequently, annual hydrographs in large streams typically show peaks created by widespread storms or snowmelt events and broad seasonal influences that affect many tributaries together (Dunne and Leopold 1978).

The natural flow regime organizes and defines river ecosystems. In rivers, the physical structure of the environment and, thus, of the habitat, is defined largely by physical processes, especially the movement of water and sediment within the channel and between the channel and floodplain. To understand the biodiversity, production, and sustainability of river ecosystems, it is necessary to appreciate the central organizing role played by a dynamically varying physical environment.

The physical habitat of a river includes sediment size and heterogeneity, channel and floodplain morphology, and other geomorphic features. These features form as the available sediment, woody debris, and other transportable materials are moved and deposited by flow. Thus, habitat conditions associated with channels and floodplains vary among

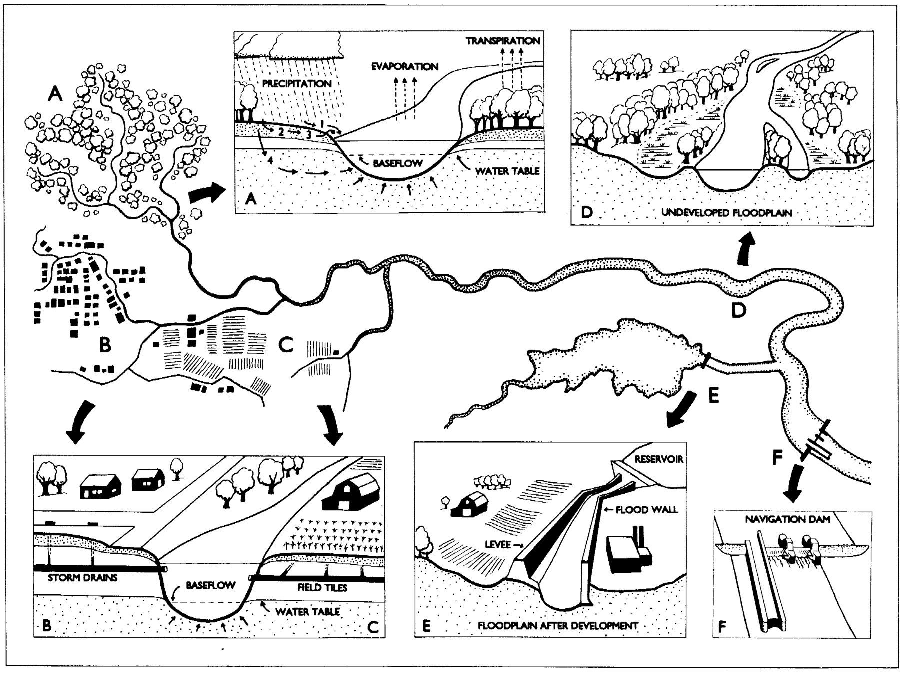

Figure 3. Stream valley cross-sections at various locations in a watershed illustrate basic principles about natural pathways of water moving downhill and human influences on hydrology. Runoff, which occurs when precipitation exceeds losses due to evaporation and plant transpiration, can be divided into four components (**a**): overland flow (1) occurs when precipitation exceeds the infiltration capacity of the soil; shallow subsurface stormflow (2) represents water that infiltrates the soil but is routed relatively quickly to the stream channel; saturated overland flow (3) occurs where the water table is close to the surface, such as adjacent to the stream channel, upstream of first-order tributaries, and in soils saturated by prior precipitation; and groundwater flow (4) represents relatively deep and slow pathways of water movement and provides water to the stream channel even during periods of little or no precipitation. Collectively, overland and shallow subsurface flow pathways create the peaks in the hydrograph that are a river's response to storm events, whereas deeper groundwater pathways are responsible for baseflow. Urbanized (**b**) and agricultural (**c**) land uses increase surface flow by increasing the extent of impermeable surfaces, reducing vegetation cover, and installing drainage systems. Relative to the unaltered state, channels often are scoured to greater depth by unnaturally high flood crests and water tables are lowered, causing baseflow to drop. Side-channels, wetlands, and episodically flooded lowlands comprise the diverse floodplain habitats of unmodified river ecosystems (**d**). Levees or flood walls (**e**) constructed along the banks retain flood waters in the main channel and lead to a loss of floodplain habitat diversity and function. Dams impede the downstream movement of water and can greatly modify a river's flow regime, depending on whether they are operated for storage (**e**) or as "run-of-river," such as for navigation (**f**).

rivers in accordance with both flow characteristics and the type and the availability of transportable materials.

Within a river, different habitat features are created and maintained by a wide range of flows. For example, many channel and floodplain features, such as river bars and riffle–pool sequences, are formed and maintained by dominant, or bankfull, discharges. These discharges are flows that can move significant quantities of bed or bank sediment and that occur frequently enough (e.g., every several years) to continually modify the channel (Wolman and Miller 1960). In many streams and rivers with a small range of flood flows, bankfull flow can build and maintain the active floodplain through stream migration (Leopold et al. 1964). However, the concept of a dominant discharge may not be applicable in all flow regimes (Wolman and Gerson 1978). Furthermore, in some flow regimes, the flows that build the channel may differ from those that build the floodplain. For example, in rivers with a wide range of flood flows, floodplains may exhibit major bar deposits, such as berms of boulders along the channel, or other features that are left by infrequent high-magnitude floods (e.g., Miller 1990).

Over periods of years to decades, a single river can consistently provide ephemeral, seasonal, and persistent types of habitat that range from free-flowing, to standing, to no water. This predictable diversity of in-channel and floodplain habitat types has promoted the evolution of species that exploit the habitat mosaic created and maintained by hydrologic variability. For many riverine species, completion of the life cycle requires an array of different habitat types, whose availability over time is regulated by the flow regime (e.g., Greenberg et al. 1996, Reeves et al. 1996, Sparks 1995). Indeed, adaptation to this environmental dynamism allows aquatic and floodplain species to persist in the face of seemingly harsh conditions, such as floods and droughts, that regularly destroy and re-create habitat elements.

From an evolutionary perspective, the pattern of spatial and temporal habitat dynamics influences the relative success of a species in a particular environmental setting. This habitat template (Southwood 1977), which is dictated largely by flow regime, creates both subtle and profound differences in the natural histories of species in different segments of their ranges. It also influences species distribution and abundance, as well as ecosystem function (Poff and Allan 1995, Schlosser 1990, Sparks 1992, Stanford et al. 1996). Human alteration of flow regime changes the established pattern of natural hydrologic variation and disturbance, thereby altering habitat dynamics and creating new conditions to which the native biota may be poorly adapted.

Human alteration of flow regimes

Human modification of natural hydrologic processes disrupts the dynamic equilibrium between the movement of water and the movement of sediment that exists in free-flowing rivers (Dunne and Leopold 1978). This disruption alters both gross- and fine-scale geomorphic features that constitute habitat for aquatic and riparian species (Table 1). After

Table 1. Physical responses to altered flow regimes.

Source(s) of alteration	Hydrologic change(s)	Geomorphic response(s)	Reference(s)
Dam	Capture sediment moving downstream	Downstream channel erosion and tributary headcutting	Chien 1985, Petts 1984, 1985, Williams and Wolman 1984
		Bed armoring (coarsening)	Chien 1985
Dam, diversion	Reduce magnitude and frequency of high flows	Deposition of fines in gravel	Sear 1995, Stevens et al. 1995
		Channel stabilization and narrowing	Johnson 1994, Williams and Wolman 1984
		Reduced formation of point bars, secondary channels, oxbows, and changes in channel planform	Chien 1985, Copp 1989, Fenner et al. 1985
Urbanization, tiling, drainage	Increase magnitude and frequency of high flows	Bank erosion and channel widening	Hammer 1972
		Downward incision and floodplain disconnection	Prestegaard 1988
	Reduced infiltration into soil	Reduced baseflows	Leopold 1968
Levees and channelization	Reduce overbank flows	Channel restriction causing downcutting	Daniels 1960, Prestegaard et al. 1994
		Floodplain deposition and erosion prevented	Sparks 1992
		Reduced channel migration and formation of secondary channels	Shankman and Drake 1990
Groundwater pumping	Lowered water table levels	Streambank erosion and channel downcutting after loss of vegetation stability	Kondolf and Curry 1986

such a disruption, it may take centuries for a new dynamic equilibrium to be attained by channel and floodplain adjustments to the new flow regime (Petts 1985); in some cases, a new equilibrium is never attained, and the channel remains in a state of continuous recovery from the most recent flood event (Wolman and Gerson 1978). These channel and floodplain adjustments are sometimes overlooked because they can be confounded with long-term responses of the channel to changing climates (e.g., Knox 1972). Recognition of human-caused physical changes and associated biological consequences may require many years, and physical restoration of the river ecosystem may call for dramatic action (see box on the Grand Canyon flood, page 774).

Dams, which are the most obvious direct modifiers of river flow, capture both low and high flows for flood control, electrical power generation, irrigation and municipal water needs, maintenance of recreational reservoir levels, and navigation. More than 85% of the inland waterways within the continental United States are now artificially controlled (NRC 1992), including nearly 1 million km of rivers that are affected by dams (Echeverria et al. 1989). Dams capture all but the finest sediments moving down a river, with many severe downstream consequences. For example, sediment-depleted water released from dams can erode finer sediments from the receiving channel. The coarsening of the streambed can, in turn, reduce habitat availability for the many aquatic species living in or using interstitial spaces. In addition, channels may erode, or downcut, triggering rejuvenation of tributaries, which themselves begin eroding and migrating headward (Chien 1985, Petts 1984). Fine sediments that are contributed by tributaries downstream of a dam may be deposited between the coarse particles of the streambed (e.g., Sear 1995). In the absence of high flushing flows, species with life stages that are sensitive to sedimentation, such as the eggs and larvae of many invertebrates and fish, can suffer high mortality rates.

For many rivers, it is land-use activities, including timber harvest, livestock grazing, agriculture, and urbanization, rather than dams, that are the primary causes of altered flow regimes. For example, logging and the associated building of roads have contributed greatly to degradation of salmon streams in the Pacific Northwest, mainly through effects on runoff and sediment delivery (NRC 1996). Converting forest or prairie lands to agricultural lands generally decreases soil infiltration and results in increased overland flow, channel incision, floodplain isolation, and headward erosion of stream channels (Prestegaard 1988). Many agricultural areas were drained by the construction of ditches or tile-and-drain systems, with the result that many channels have become entrenched (Brookes 1988).

These land-use practices, combined with extensive draining of wetlands or overgrazing, reduce retention of water in watersheds and,

A controlled flood in the Grand Canyon

Since the Glen Canyon dam first began to store water in 1963, creating Lake Powell, some 430 km (270 miles) of the Colorado River, including Grand Canyon National Park, have been virtually bereft of seasonal floods. Before 1963, melting snow in the upper basin produced an average peak discharge exceeding 2400 m^3/s; after the dam was constructed, releases were generally maintained at less than 500 m^3/s. The building of the dam also trapped more than 95% of the sediment moving down the Colorado River in Lake Powell (Collier et al. 1996).

This dramatic change in flow regime produced drastic alterations in the dynamic nature of the historically sediment-laden Colorado River. The annual cycle of scour and fill had maintained large sandbars along the river banks, prevented encroachment of vegetation onto these bars, and limited bouldery debris deposits from constricting the river at the mouths of tributaries (Collier et al. 1997). When flows were reduced, the limited amount of sand accumulated in the channel rather than in bars farther up the river banks, and shallow low-velocity habitat in eddies used by juvenile fishes declined. Flow regulation allowed for increased cover of wetland and riparian vegetation, which expanded into sites that were regularly scoured by floods in the constrained fluvial canyon of the Colorado River; however, much of the woody vegetation that established after the dam's construction is composed of an exotic tree, salt cedar (*Tamarix* sp.; Stevens et al. 1995). Restoration of flood flows clearly would help to steer the aquatic and riparian ecosystem toward its former state and decrease the area of wetland and riparian vegetation, but precisely how the system would respond to an artificial flood could not be predicted.

In an example of adaptive management (i.e., a planned experiment to guide further actions), a controlled, seven-day flood of 1274 m^3/s was released through the Glen Canyon dam in late March 1996. This flow, roughly 35% of the pre-dam average for a spring flood (and far less than some large historical floods), was the maximum flow that could pass through the power plant turbines plus four steel drainpipes, and it cost approximately $2 million in lost hydropower revenues (Collier et al. 1997). The immediate result was significant beach building: Over 53% of the beaches increased in size, and just 10% decreased in size. Full documentation of the effects will continue to be monitored by measuring channel cross-sections and studying riparian vegetation and fish populations.

instead, route it quickly downstream, increasing the size and frequency of floods and reducing baseflow levels during dry periods (Figure 3b; Leopold 1968). Over time, these practices degrade in-channel habitat for aquatic species. They may also isolate the floodplain from overbank flows, thereby degrading habitat for riparian species. Similarly, urbanization and suburbanization associated with human population expansion across the landscape create impermeable surfaces that direct water away from subsurface pathways to overland flow (and often into storm drains). Consequently, floods increase in frequency and intensity (Beven 1986), banks erode, and channels widen (Hammer 1972), and baseflow declines during dry periods (Figure 3c).

Whereas dams and diversions affect rivers of virtually all sizes, and land-use impacts are particularly evident in headwaters, lowland rivers are greatly influenced by efforts to sever channel–floodplain linkages. Flood control projects have shortened, narrowed, straightened, and leveed many river systems and cut the main channels off from their floodplains (NRC 1992). For example, channelization of the Kissimmee River above Lake Okeechobee, Florida, by the US Army Corps of Engineers transformed a historical 166 km meandering river with a 1.5 to 3 km wide floodplain into a 90 km long canal flowing through a series of five impoundments, resulting in great loss of river channel habitat and adjacent floodplain wetlands (Toth 1995). Because levees are designed to prevent increases in the width of flow, rivers respond by cutting deeper channels, reaching higher velocities, or both.

Channelization and wetland drainage can actually increase the magnitude of extreme floods, because reduction in upstream storage capacity results in accelerated water delivery downstream. Much of the damage caused by the extensive flooding along the Mississippi River in 1993 resulted from levee failure as the river reestablished historic connections to the floodplain. Thus, although elaborate storage dam and levee systems can "reclaim" the floodplain for agriculture and human settlement in most years, the occasional but inevitable large floods will impose increasingly high disaster costs to society (Faber 1996). The severing of floodplains from rivers also stops the processes of sediment erosion and deposition that regulate the topographic diversity of floodplains. This diversity is essential for maintaining species diversity on floodplains, where relatively small differences in land elevation result in large differences in annual inundation and soil moisture regimes, which regulate plant distribution and abundance (Sparks 1992).

Ecological functions of the natural flow regime

Naturally variable flows create and maintain the dynamics of in-channel and floodplain conditions and habitats that are essential to aquatic and riparian species, as shown schematically in Figure 4. For purposes of illustration, we treat the components of a flow regime individually, although in reality they interact in complex ways to regulate geomorphic and ecological processes. In describing the ecological functions associated with the components of a flow regime, we pay particular attention to high- and low-flow events, because they often serve as ecological "bottlenecks" that present critical stresses and opportunities for a wide array of riverine species (Poff and Ward 1989).

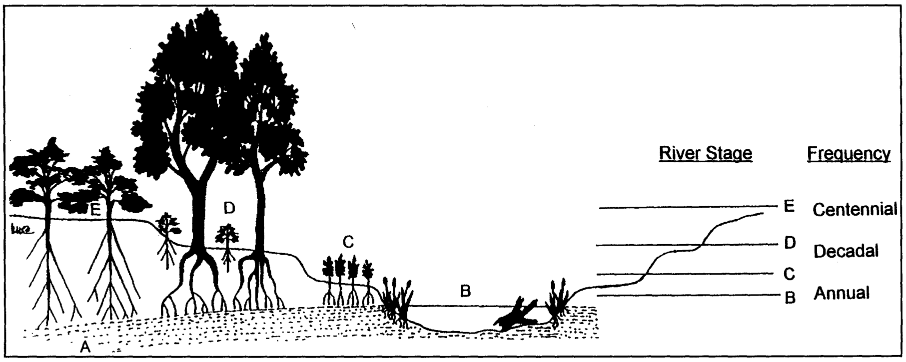

Figure 4. Geomorphic and ecological functions provided by different levels of flow. Water tables that sustain riparian vegetation and that delineate in-channel baseflow habitat are maintained by groundwater inflow and flood recharge (A). Floods of varying size and timing are needed to maintain a diversity of riparian plant species and aquatic habitat. Small floods occur frequently and transport fine sediments, maintaining high benthic productivity and creating spawning habitat for fishes (B). Intermediate-size floods inundate low-lying floodplains and deposit entrained sediment, allowing for the establishment of pioneer species (C). These floods also import accumulated organic material into the channel and help to maintain the characteristic form of the active stream channel. Larger floods that recur on the order of decades inundate the aggraded floodplain terraces, where later successional species establish (D). Rare, large floods can uproot mature riparian trees and deposit them in the channel, creating high-quality habitat for many aquatic species (E).

The magnitude and frequency of high and low flows regulate numerous ecological processes. Frequent, moderately high flows effectively transport sediment through the channel (Leopold et al. 1964). This sediment movement, combined with the force of moving water, exports organic resources, such as detritus and attached algae, rejuvenating the biological community and allowing many species with fast life cycles and good colonizing ability to reestablish (Fisher 1983). Consequently, the composition and relative abundance of species that are present in a stream or river often reflect the frequency and intensity of high flows (Meffe and Minckley 1987, Schlosser 1985).

High flows provide further ecological benefits by maintaining ecosystem productivity and diversity. For example, high flows remove and transport fine sediments that would otherwise fill the interstitial spaces in productive gravel habitats (Beschta and Jackson 1979). Floods import woody debris into the channel (Keller and Swanson 1979), where it creates new, high-quality habitat (Figure 4; Moore and Gregory 1988, Wallace and Benke 1984). By connecting the channel to the floodplain, high overbank flows also maintain broader productivity and diversity. Floodplain wetlands provide important nursery grounds for fish and export organic matter and organisms back into the main channel (Junk et al. 1989, Sparks 1995, Welcomme 1992). The scouring of floodplain soils rejuvenates habitat for plant species that germinate only on barren, wetted surfaces that are free of competition (Scott et al. 1996) or that require access to shallow water tables (Stromberg et al. 1997). Flood-resistant, disturbance-adapted riparian communities are maintained by flooding along river corridors, even in river sections that have steep banks and lack floodplains (Hupp and Osterkamp 1985).

Flows of low magnitude also provide ecological benefits. Periods of low flow may present recruitment opportunities for riparian plant species in regions where floodplains are frequently inundated (Wharton et al. 1981). Streams that dry temporarily, generally in arid regions, have aquatic (Williams and Hynes 1977) and riparian (Nilsen et al. 1984) species with special behavioral or physiological adaptations that suit them to these harsh conditions.

The duration of a specific flow condition often determines its ecological significance. For example, differences in tolerance to prolonged flooding in riparian plants (Chapman et al. 1982) and to prolonged low flow in aquatic invertebrates (Williams and Hynes 1977) and fishes (Closs and Lake 1996) allow these species to persist in locations from which they might otherwise be displaced by dominant, but less tolerant, species.

The timing, or predictability, of flow events is critical ecologically because the life cycles of many aquatic and riparian species are timed to either avoid or exploit flows of variable magnitudes. For example, the natural timing of high or low streamflows provides environmental cues for initiating life cycle transitions in fish, such as spawning (Montgomery et al. 1983, Nesler et al. 1988), egg hatching (Næsje et al. 1995), rearing (Seegrist and Gard 1978), movement onto the floodplain for feeding or reproduction (Junk et al. 1989, Sparks 1995, Welcomme 1992), or migration upstream or downstream (Trépanier et al. 1996). Natural seasonal variation in flow conditions can prevent the successful establishment of nonnative species with flow-dependent spawning and egg incubation requirements, such as striped bass (*Morone saxatilis*; Turner and Chadwick 1972) and brown trout (*Salmo trutta*; Moyle and Light 1996, Strange et al. 1992).

Seasonal access to floodplain wetlands is essential for the survival of certain river fishes, and such access can directly link high wetland productivity with fish production in the stream channel (Copp 1989, Welcomme 1979). Studies of the effects on stream fishes of both extensive and limited floodplain inundation (Finger and Stewart 1987, Ross and Baker 1983) indicate that some fishes are adapted to exploiting floodplain habitats, and these species decline in abundance when floodplain use is restricted. Models indicate that catch rates and biomass of fish are influenced by both maximum and minimum wetland area (Power et al. 1995, Welcomme and Hagborg 1977), and empirical work shows that the area of floodplain water bodies during nonflood periods influences the species richness of those wetland habitats (Halyk and Balon 1983). The timing of floodplain inundation is important for some fish because migratory and reproductive behaviors must coincide with access to and avail-

Table 2. Ecological responses to alterations in components of natural flow regime.[a]

Flow component	Specific alteration	Ecological response	Reference(s)
Magnitude and frequency	Increased variation	Wash-out and/or stranding	Cushman 1985, Petts 1984
		Loss of sensitive species	Gehrke et al. 1995, Kingsolving and Bain 1993, Travnichek et al. 1995
		Increased algal scour and wash-out of organic matter	Petts 1984
		Life cycle disruption	Scheidegger and Bain 1995
		Altered energy flow	Valentin et al. 1995
	Flow stabilization	Invasion or establishment of exotic species, leading to:	
		Local extinction	Kupferberg 1996, Meffe 1984
		Threat to native commercial species	Stanford et al. 1996
		Altered communities	Busch and Smith 1995, Moyle 1986, Ward and Stanford 1979
		Reduced water and nutrients to floodplain plant species, causing:	
		Seedling desiccation	Duncan 1993
		Ineffective seed dispersal	Nilsson 1982
		Loss of scoured habitat patches and secondary channels needed for plant establishment	Fenner et al. 1985, Rood et al. 1995, Scott et al. 1997, Shankman and Drake 1990
		Encroachment of vegetation into channels	Johnson 1994, Nilsson 1982
Timing	Loss of seasonal flow peaks	Disrupt cues for fish:	
		Spawning	Fausch and Bestgen 1997, Montgomery et al. 1993, Nesler et al. 1988
		Egg hatching	Næsje et al. 1995
		Migration	Williams 1996
		Loss of fish access to wetlands or backwaters	Junk et al. 1989, Sparks 1995
		Modification of aquatic food web structure	Power 1992, Wootton et al. 1996
		Reduction or elimination of riparian plant recruitment	Fenner et al. 1985
		Invasion of exotic riparian species	Horton 1977
		Reduced plant growth rates	Reily and Johnson 1982
Duration	Prolonged low flows	Concentration of aquatic organisms	Cushman 1985, Petts 1984
		Reduction or elimination of plant cover	Taylor 1982
		Diminished plant species diversity	Taylor 1982
		Desertification of riparian species composition	Busch and Smith 1995, Stromberg et al. 1996
		Physiological stress leading to reduced plant growth rate, morphological change, or mortality	Kondolf and Curry 1986, Perkins et al. 1984, Reily and Johnson 1982, Rood et al. 1995, Stromberg et al. 1992
	Prolonged baseflow "spikes"	Downstream loss of floating eggs	Robertson 1997
	Altered inundation duration	Altered plant cover types	Auble et al. 1994
	Prolonged inundation	Change in vegetation functional type	Bren 1992, Connor et al. 1981
		Tree mortality	Harms et al. 1980
		Loss of riffle habitat for aquatic species	Bogan 1993
Rate of change	Rapid changes in river stage	Wash-out and stranding of aquatic species	Cushman 1985, Petts 1984
	Accelerated flood recession	Failure of seedling establishment	Rood et al. 1995

[a]Only representative studies are listed here. Additional references are located on the Web at http://lamar.colostate.edu/~poff/natflow.html.

ability of floodplain habitats (Welcomme 1979). The match of reproductive period and wetland access also explains some of the yearly variation in stream fish community composition (Finger and Stewart 1987).

Many riparian plants also have life cycles that are adapted to the seasonal timing components of natural flow regimes through their "emergence phenologies"—the seasonal sequence of flowering, seed dispersal, germination, and seedling growth. The interaction of emergence phenologies with temporally varying environmental stress from flooding or drought helps to maintain high species diversity in, for example, southern floodplain forests (Streng et al. 1989). Productivity of riparian forests is also influenced by flow timing and can increase when short-duration flooding occurs in the growing season (Mitsch and Rust 1984, Molles et al. 1995).

The rate of change, or flashiness, in flow conditions can influence species persistence and coexistence. In many streams and rivers, particularly in arid areas, flow can change dramatically over a period of hours due to heavy storms. Non-native fishes generally lack the behavioral adaptations to avoid being displaced downstream by sudden floods (Minckley and Deacon 1991). In a dramatic example of how floods can benefit native species, Meffe (1984) documented that a native fish, the Gila topminnow (*Poeciliopsis occidentalis*), was locally extirpated by the introduced predatory mosquitofish (*Gambusia affinis*) in locations where natural flash floods were regulated by upstream dams, but the native species persisted in naturally flashy streams.

Rapid flow increases in streams of the central and southwestern United States often serve as spawning cues for native minnow species, whose rapidly developing eggs are either broadcast into the water column or attached to submerged structures as floodwaters recede (Fausch and Bestgen 1997, Robertson in press). More gradual, seasonal rates of change in flow conditions also regulate the persistence of many aquatic and riparian species. Cottonwoods (*Populus* spp.), for example, are disturbance species that establish after winter–spring flood flows, during a narrow "window of opportunity" when competition-free alluvial substrates and wet soils are available for germination. A certain rate of floodwater recession is critical to seedling germination because seedling roots must remain connected to a receding water table as they grow downward (Rood and Mahoney 1990).

Ecological responses to altered flow regimes

Modification of the natural flow regime dramatically affects both aquatic and riparian species in streams and rivers worldwide. Ecological responses to altered flow regimes in a specific stream or river depend on how the components of flow have changed relative to the natural flow regime for that particular stream or river (Poff and Ward 1990) and how specific geomorphic and ecological processes will respond to this relative change. As a result of variation in flow regime within and among rivers (Figure 2), the same human activity in different locations may cause different degrees of change relative to unaltered conditions and, therefore, have different ecological consequences.

Flow alteration commonly changes the magnitude and frequency of high and low flows, often reducing variability but sometimes enhancing the range. For example, the extreme daily variations below peaking power hydroelectric dams have no natural analogue in freshwater systems and represent, in an evolutionary sense, an extremely harsh environment of frequent, unpredictable flow disturbance. Many aquatic populations living in these environments suffer high mortality from physiological stress, from wash-out during high flows, and from stranding during rapid dewatering (Cushman 1985, Petts 1984). Especially in shallow shoreline habitats, frequent atmospheric exposure for even brief periods can result in massive mortality of bottom-dwelling organisms and subsequent severe reductions in biological productivity (Weisberg et al. 1990). Moreover, the rearing and refuge functions of shallow shoreline or backwater areas, where many small fish species and the young of large species are found (Greenberg et al. 1996, Moore and Gregory 1988), are severely impaired by frequent flow fluctuations (Bain et al. 1988, Stanford 1994). In these artificially fluctuating environments, specialized stream or river species are typically replaced by generalist species that tolerate frequent and large variations in flow. Furthermore, life cycles of many species are often disrupted and energy flow through the ecosystem is greatly modified (Table 2). Short-term flow modifications clearly lead to a reduction in both the natural diversity and abundance of many native fish and invertebrates.

At the opposite hydrologic extreme, flow stabilization below certain types of dams, such as water supply reservoirs, results in artificially constant environments that lack natural extremes. Although production of a few species may increase greatly, it is usually at the expense of other native species and of systemwide species diversity (Ward and Stanford 1979). Many lake fish species have successfully invaded (or been intentionally established in) flow-stabilized river environments (Moyle 1986, Moyle and Light 1996). Often top predators, these introduced fish can devastate native river fish and threaten commercially valuable stocks (Stanford et al. 1996). In the southwestern United States, virtually the entire native river fish fauna is listed as threatened under the Endangered Species Act, largely as a consequence of water withdrawal, flow stabilization, and exotic species proliferation. The last remaining strongholds of native river fishes are all in dynamic, free-flowing rivers, where exotic fishes are periodically reduced by natural flash floods (Minckley and Deacon 1991, Minckley and Meffe 1987).

Flow stabilization also reduces the magnitude and frequency of overbank flows, affecting riparian plant species and communities. In rivers with constrained canyon reaches or multiple shallow channels, loss of high flows results in increased cover of plant species that would otherwise be removed by flood scour (Ligon et al. 1995, Williams and Wolman 1984). Moreover, due to other related effects of flow regulation, including increased water salinity, non-native vegetation often dominates, such as the salt cedar (*Tamarix* sp.) in the semiarid western United States (Busch and Smith 1995). In alluvial valleys, the loss of overbank flows can greatly modify riparian communities by causing plant desiccation, reduced growth, competitive exclusion, ineffective seed dispersal, or failure of seedling establishment (Table 2).

The elimination of flooding may also affect animal species that depend on terrestrial habitats. For example, in the flow-stabilized Platte River of the United States Great Plains, the channel has narrowed dramatically (up to 85%) over a period of decades (Johnson 1994). This narrowing has been facilitated by vegetative colonization of sandbars that formerly provided nesting habitat for the threatened piping plover (*Charadius melodius*) and endangered least tern (*Sterna antillarum*; Sidle et al. 1992). Sandhill cranes (*Grus canadensis*), which made the Platte River famous, have abandoned river segments that have narrowed the most (Krapu et al. 1984).

Changes in the duration of flow conditions also have significant biological consequences. Riparian plant species respond dramatically to channel dewatering, which occurs frequently in arid regions due to surface water diversion and groundwater pumping. These biological and ecological responses range from altered leaf morphology to total loss of riparian vegetation cover (Table 2). Changes in duration of inundation, independent of changes in annual volume of flow, can alter the abundance of plant cover types (Auble et al. 1994). For example, increased duration of inundation has contributed to the conversion of grassland to forest along a regulated Australian river (Bren 1992). For aquatic species, prolonged flows of particular levels can also be damaging. In the regulated Pecos River of New Mexico, artificially prolonged high summer flows for irrigation displace the floating eggs of the threatened Pecos bluntnose shiner (*Notropis sinius pecosensis*) into unfavorable habitat, where none survive (Robertson in press).

Modification of natural flow timing, or predictability, can affect aquatic organisms both directly and indirectly. For example, some native fishes in Norway use seasonal flow peaks as a cue for egg hatching, and river regulation that eliminates these peaks can directly reduce local population sizes of these species (Næsje et al. 1995). Furthermore, entire food webs, not just single species, may be modified by altered flow timing. In regulated rivers of northern California, the seasonal shifting of scouring flows from winter to summer indirectly reduces the growth rate of juvenile steelhead trout (*Oncorhyncus mykiss*) by increasing the relative abundance of predator-resistant invertebrates that divert energy away from the food chain leading to trout (Wootton et al. 1996). In unregulated rivers, high winter flows reduce these predator-resistant insects and favor species that are more palatable to fish.

Riparian plant species are also strongly affected by altered flow tim-

1750 Prior to 1776, widespread beaver dams naturally control streamflow; dams gradually disappear as beavers are hunted to near extinction; mill dams replace beaver dams as territory is settled.

1824 - Creation of Army Corps of Engineers, with task of keeping rivers navigable; federal government begins support of commercial navigation on the Mississippi.

1825 - Completion of Erie Canal, creating transport route from the Hudson River to the Great Lakes.

1849, 1850, 1860 - Swamp Land Acts, transferring 65 million acres of wetlands in 15 states from federal to state administration for purpose of drainage;. 1850 Act gives Everglades to Florida.

1880's - ditching and draining of wetlands in tributaries to the Mississippi River begins.

1900

1901 - canal built from Colorado River to Salton Sink and the Imperial Valley is born. Floods of 1904-1905 create Salton Sea, and the river is put back in its original channel.

1902 - Reclamation Project Act, establishing Reclamation Service to "nationalize the works of irrigation".

1920 - Federal Power Act authorizes licensing of non-federal hydropower dams.

1925

1927 - Mississippi River floods, proving existing levees inadequate and leading to 1928 Flood Control Act.

1928 - Colorado River Compact ratified, partitioning the river's water

1933 - Tennessee Valley Authority Act passed, and nation embarks on first multipurpose project for controlling and using a river.

1935 - Hoover Dam dedicated by FDR.

1930-1940 - U.S. Army Corps constructs 9-Foot Channel Project, turning upper Mississippi into an intra-continental channel.

1940 - channel straightening of tributaries to the Mississippi River begins.

1944 - Flood Control Act authorizes federal participation in flood control projects, and establishes recreation as a full purpose for flood control projects.

1950

1953 - building of flood control dams begins on the Mississippi River. 750 miles channelized upstream from mouth.

1954 - Watershed Protection and Flood Prevention Act, begins active Soil Conservation Service involvement in helping farmers to channelize streams.

1963 - Glen Canyon Dam completed; 1964 - U.S. and Canada ratify Columbia River Treaty; 1965 - California State Water Project approved.

1968 - Wild and Scenic Rivers Act passed to preserve certain rivers in "free-flowing condition".

1975

1978 - PURPA passed, providing market for small-scale hydropower generation.

1986 - Electric Consumers Protection Act - amends Federal Power Act, requires FERC to give equal consideration to power generation potential and fish, wildlife, recreation, and other aspects of environmental quality during dam licensing/relicensing.

1992 - legislation approved for federal purchase and removal of 2 private dams on the Elwha River, to restore fish passage.

1993 - major flood on Mississippi River causes extensive damage.

1996 - Controlled flood of Colorado River at Grand Canyon; restoration of Everglades begins.

2000

Figure 5. A brief history of flow alteration in the United States.

ing (Table 2). A shift in timing of peak flows from spring to summer, as often occurs when reservoirs are managed to supply irrigation water, has prevented reestablishment of the Fremont cottonwood (*Populus fremontii*), the dominant plant species in Arizona, because flow peaks now occur after, rather than before, its germination period (Fenner et al. 1985). Non-native plant species with less specific germination requirements may benefit from changes in flood timing. For example, salt cedar's (*Tamarix* sp.) long seed dispersal period allows it to establish after floods occurring any time during the growing season, contributing to its abundance on floodplains of the western United States (Horton 1977).

Altering the rate of change in flow can negatively affect both aquatic and riparian species. As mentioned above, loss of natural flashiness threatens most of the native fish fauna of the American Southwest (Minckley and Deacon 1991), and artificially increased rates of change caused by peaking power hydroelectric dams on historically less flashy rivers creates numerous ecological problems (Table 2; Petts 1984). A modified rate of change can devastate riparian species, such as cottonwoods, whose successful seedling growth depends on the rate of groundwater recession following floodplain inundation. In the St. Mary River in Alberta, Canada, for example, rapid drawdowns of river stage during spring have prevented the recruitment of young trees (Rood and Mahoney 1990). Such effects can be reversed, however. Restoration of the spring flood and its natural, slow recession in the Truckee River in California has allowed the successful establishment of a new generation of cotton-

Table 3. Recent projects in which restoration of some component(s) of natural flow regimes has occurred or been proposed for specific ecological benefits.

Location	Flow component(s)	Ecological purpose(s)	Reference
Trinity River, CA	Mimic timing and magnitude of peak flow	Rejuvenate in-channel gravel habitats; restore early riparian succession; provide migration flows for juvenile salmon	Barinaga 1996[a]
Truckee River, CA	Mimic timing, magnitude, and duration of peak flow, and its rate of change during recession	Restore riparian trees, especially cottonwoods	Klotz and Swanson 1997
Owens River, CA	Increase base flows; partially restore overbank flows	Restore riparian vegetation and habitat for native fishes and non-native brown trout	Hill and Platts in press
Rush Creek, CA (and other tributaries to Mono Lake)	Increase minimum flows	Restore riparian vegetation and habitat for waterfowl and non-native fishes	LADWP 1995
Oldman River and tributaries, southern Alberta, Canada	Increase summer flows; reduce rates of postflood stage decline; mimic natural flows in wet years	Restore riparian vegetation (cottonwoods) and cold-water (trout) fisheries	Rood et al. 1995
Green River, UT	Mimic timing and duration of peak flow and duration and timing of nonpeak flows; reduce rapid baseflow fluctuations from hydropower generation	Recovery of endangered fish species; enhance other native fishes	Stanford 1994
San Juan River, UT/NM	Mimic magnitude, timing, and duration of peak flow; restore low winter baseflows	Recovery of endangered fish species	—[b]
Gunnison River, CO	Mimic magnitude, timing, and duration of peak flow; mimic duration and timing of nonpeak flows	Recovery of endangered fish species	—[b]
Rio Grande River, NM	Mimic timing and duration of floodplain inundation	Ecosystem processes (e.g., nitrogen flux, microbial activity, litter decomposition)	Molles et al. 1995
Pecos River, NM	Regulate duration and magnitude of summer irrigation releases to mimic spawning flow "spikes"; maintain minimum flows	Determine spawning and habitat needs for threatened fish species	Robertson 1997
Colorado River, AZ	Mimic magnitude and timing	Restore habitat for endangered fish species and scour riparian zone	Collier et al. 1997
Bill Williams River, AZ (proposed)	Mimic natural flood peak timing and duration	Promote establishment of native trees	USCOE 1996
Pemigewasset River, NH	Reduce frequency (i.e., to no more than natural frequency) of high flows during summer low-flow season; reduce rate of change between low and high flows during hydropower cycles	Enhance native Atlantic salmon recovery	FERC 1995
Roanoke River, VA	Restore more natural patterning of monthly flows in spring; reduce rate of change between low and high flows during hydropower cycles	Increased reproduction of striped bass	Rulifson and Manooch 1993
Kissimmee River, FL	Mimic magnitude, duration, rate of change, and timing of high- and low-flow periods	Restore floodplain inundation to recover wetland functions; reestablish in-channel habitats for fish and other aquatic species	Toth 1995

[a]J. Polos, 1997, personal communication. US Fish & Wildlife Service, Arcata, CA.
[b]F. Pfeifer, 1997, personal communication. US Fish & Wildlife Service, Grand Junction, CO.

wood trees (Klotz and Swanson 1997).

Recent approaches to streamflow management

Methods to estimate environmental flow requirements for rivers focus primarily on one or a few species that live in the wetted river channel. Most of these methods have the narrow intent of establishing minimum allowable flows. The simplest make use of easily analyzed flow data, of assumptions about the regional similarity of rivers, and of professional opinions of the minimal flow needs for certain fish species (e.g., Larson 1981).

A more sophisticated assessment of how changes in river flow affect aquatic habitat is provided by the Instream Flow Incremental Methodology (IFIM; Bovee and Milhous

1978). IFIM combines two models, a biological one that describes the physical habitat preferences of fishes (and occasionally macroinvertebrates) in terms of depth, velocity, and substrate, and a hydraulic one that estimates how the availability of habitat for fish varies with discharge. IFIM has been widely used as an organizational framework for formulating and evaluating alternative water management options related to production of one or a few fish species (Stalnaker et al. 1995).

As a predictive tool for ecological management, the IFIM modeling approach has been criticized both in terms of the statistical validity of its physical habitat characterizations (Williams 1996) and the limited realism of its biological assumptions (Castleberry et al. 1996). Field tests of its predictions have yielded mixed results (Morehardt 1986). Although this approach continues to evolve, both by adding biological realism (Van Winkle et al. 1993) and by expanding the range of habitats modeled (Stalnaker et al. 1995), in practice it is often used only to establish minimum flows for "important" (i.e., game or imperiled) fish species. But current understanding of river ecology clearly indicates that fish and other aquatic organisms require habitat features that cannot be maintained by minimum flows alone (see Stalnaker 1990). A range of flows is necessary to scour and revitalize gravel beds, to import wood and organic matter from the floodplain, and to provide access to productive riparian wetlands (Figure 4). Interannual variation in these flow peaks is also critical for maintaining channel and riparian dynamics. For example, imposition of only a fixed high-flow level each year would simply result in the equilibration of in-channel and floodplain habitats to these constant peak flows.

Moreover, a focus on one or a few species and on minimum flows fails to recognize that what is "good" for the ecosystem may not consistently benefit individual species, and that what is good for individual species may not be of benefit to the ecosystem. Long-term studies of naturally variable systems show that some species do best in wet years, that other species do best in dry years, and that overall biological diversity and ecosystem function benefit from these variations in species success (Tilman et al. 1994). Indeed, experience in river restoration clearly shows the impossibility of simultaneously engineering optimal conditions for all species (Sparks 1992, 1995, Toth 1995). A holistic view that attempts to restore natural variability in ecological processes and species success (and that acknowledges the tremendous uncertainty that is inherent in attempting to mechanistically model all species in the ecosystem) is necessary for ecosystem management and restoration (Franklin 1993).

Managing toward a natural flow regime

The first step toward better incorporating flow regime into the management of river ecosystems is to recognize that extensive human alteration of river flow has resulted in widespread geomorphic and ecological changes in these ecosystems. The history of river use is also a history of flow alteration (Figure 5). The early establishment of the US Army Corps of Engineers is testimony to the importance that the nation gave to developing navigable water routes and to controlling recurrent large floods. However, growing understanding of the ecological impacts of flow alteration has led to a shift toward an appreciation of the merits of free-flowing rivers. For example, the Wild and Scenic Rivers Act of 1968 recognized that the flow of certain rivers should be protected as a national resource, and the recent blossoming of natural flow restoration projects (Table 3) may herald the beginning of efforts to undo some of the damage of past flow alterations. The next century holds promise as an era for renegotiating human relationships with rivers, in which lessons from past experience are used to direct wise and informed action in the future.

A large body of evidence has shown that the natural flow regime of virtually all rivers is inherently variable, and that this variability is critical to ecosystem function and native biodiversity. As we have already discussed, rivers with highly altered and regulated flows lose their ability to support natural processes and native species. Thus, to protect pristine or nearly pristine systems, it is necessary to preserve the natural hydrologic cycle by safeguarding against upstream river development and damaging land uses that modify runoff and sediment supply in the watershed.

Most rivers are highly modified, of course, and so the greatest challenges lie in managing and restoring rivers that are also used to satisfy human needs. Can reestablishing the natural flow regime serve as a useful management and restoration goal? We believe that it can, although to varying degrees, depending on the present extent of human intervention and flow alteration affecting a particular river. Recognizing the natural variability of river flow and explicitly incorporating the five components of the natural flow regime (i.e., magnitude, frequency, duration, timing, and rate of change) into a broader framework for ecosystem management would constitute a major advance over most present management, which focuses on minimum flows and on just a few species. Such recognition would also contribute to the developing science of stream restoration in heavily altered watersheds, where, all too often, physical channel features (e.g., bars and woody debris) are re-created without regard to restoring the flow regime that will help to maintain these re-created features.

Just as rivers have been incrementally modified, they can be incrementally restored, with resulting improvements to many physical and biological processes. A list of recent efforts to restore various components of a natural flow regime (that is, to "naturalize" river flow) demonstrates the scope for success (Table 3). Many of the projects summarized in Table 3 represent only partial steps toward full flow restoration, but they have had demonstrable ecological benefits. For example, high flood flows followed by mimicked natural rates of flow decline in the Oldman River of Alberta, Canada, resulted in a massive cottonwood recruitment that extended for more than 500 km downstream from the Oldman Dam. Dampening of the unnatural flow fluctuations caused by hydroelectric generation on the Roanoke River in

Virginia has increased juvenile abundances of native striped bass. Mimicking short-duration flow spikes that are historically caused by summer thunderstorms in the regulated Pecos River of New Mexico has benefited the reproductive success of the Pecos bluntnose shiner.

We also recognize that there are scientific limits to how precisely the natural flow regime for a particular river can be defined. It is possible to have only an approximate knowledge of the historic condition of a river, both because some human activities may have preceded the installation of flow gauges, and because climate conditions may have changed over the past century or more. Furthermore, in many rivers, year-to-year differences in the timing and quantity of flow result in substantial variability around any average flow condition. Accordingly, managing for the "average" condition can be misguided. For example, in human-altered rivers that are managed for incremental improvements, restoring a flow pattern that is simply proportional to the natural hydrograph in years with little runoff may provide few if any ecological benefits, because many geomorphic and ecological processes show nonlinear responses to flow. Clearly, half of the peak discharge will not move half of the sediment, half of a migration-motivational flow will not motivate half of the fish, and half of an overbank flow will not inundate half of the floodplain. In such rivers, more ecological benefits would accrue from capitalizing on the natural between-year variability in flow. For example, in years with above-average flow, "surplus" water could be used to exceed flow thresholds that drive critical geomorphic and ecological processes.

If full flow restoration is impossible, mimicking certain geomorphic processes may provide some ecological benefits. Well-timed irrigation could stimulate recruitment of valued riparian trees such as cottonwoods (Friedman et al. 1995). Strategically clearing vegetation from river banks could provide new sources of gravel for sediment-starved regulated rivers with reduced peak flows (e.g., Ligon et al. 1995). In all situations, managers will be required to make judgments about specific restoration goals and to work with appropriate components of the natural flow regime to achieve those goals. Recognition of the natural flow variability and careful identification of key processes that are linked to various components of the flow regime are critical to making these judgments.

Setting specific goals to restore a more natural regime in rivers with altered flows (or, equally important, to preserve unaltered flows in pristine rivers) should ideally be a cooperative process involving river scientists, resource managers, and appropriate stakeholders. The details of this process will vary depending on the specific objectives for the river in question, the degree to which its flow regime and other environmental variables (e.g., thermal regime, sediment supply) have been altered, and the social and economic constraints that are in play. Establishing specific criteria for flow restoration will be challenging because our understanding of the interactions of individual flow components with geomorphic and ecological processes is incomplete. However, quantitative, river-specific standards can, in principle, be developed based on the reconstruction of the natural flow regime (e.g., Richter et al. 1997). Restoration actions based on such guidelines should be viewed as experiments to be monitored and evaluated—that is, adaptive management—to provide critical new knowledge for creative management of natural ecosystem variability (Table 3).

To manage rivers from this new perspective, some policy changes are needed. The narrow regulatory focus on minimum flows and single species impedes enlightened river management and restoration, as do the often conflicting mandates of the many agencies and organizations that are involved in the process. Revisions of laws and regulations, and redefinition of societal goals and policies, are essential to enable managers to use the best science to develop appropriate management programs.

Using science to guide ecosystem management requires that basic and applied research address difficult questions in complex, real-world settings, in which experimental controls and statistical replication are often impossible. Too little attention and too few resources have been devoted to clarifying how restoring specific components of the flow regime will benefit the entire ecosystem. Nevertheless, it is clear that, whenever possible, the natural river system should be allowed to repair and maintain itself. This approach is likely to be the most successful and the least expensive way to restore and maintain the ecological integrity of flow-altered rivers (Stanford et al. 1996). Although the most effective mix of human-aided and natural recovery methods will vary with the river, we believe that existing knowledge makes a strong case that restoring natural flows should be a cornerstone of our management approach to river ecosystems.

Acknowledgments

We thank the following people for reading and commenting on earlier versions of this paper: Jack Schmidt, Lou Toth, Mike Scott, David Wegner, Gary Meffe, Mary Power, Kurt Fausch, Jack Stanford, Bob Naiman, Don Duff, John Epifanio, Lori Robertson, Jeff Baumgartner, Tim Randle, David Harpman, Mike Armbruster, and Thomas Payne. Members of the Hydropower Reform Coalition also offered constructive comments. Excellent final reviews were provided by Greg Auble, Carter Johnson, an anonymous reviewer, and the editor of *BioScience*. Robin Abell contributed to the development of the timeline in Figure 5, and graphics assistance was provided by Teresa Peterson (Figure 3), Matthew Chew (Figure 4) and Robin Abell and Jackie Howard (Figure 5). We also thank the national offices of Trout Unlimited and American Rivers for encouraging the expression of the ideas presented here. We especially thank the George Gund Foundation for providing a grant to hold a one-day workshop, and The Nature Conservancy for providing logistical support for several of the authors prior to the workshop.

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Water Resources Research

RESEARCH ARTICLE

10.1002/2016WR019638

Key Points:

- Record Colorado River flow reductions averaged 19.3% per year during 2000–2014. One-third or more of the decline was likely due to warming
- Unabated greenhouse gas emissions will lead to continued substantial warming, translating to twenty-first century flow reductions of 35% or more
- More precipitation can reduce the flow loss, but lack of increase to date and large megadrought threat, reinforce risk of large flow loss

Supporting Information:

- Supporting Information S1

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Citation:
Udall, B. and J. Overpeck (2017), The twenty-first century Colorado River hot drought and implications for the future, *Water Resour. Res.*, *53*, 2404–2418, doi:10.1002/2016WR019638.

Received 14 AUG 2016
Accepted 14 FEB 2017
Accepted article online 17 FEB 2017
Published online 24 MAR 2017

The twenty-first century Colorado River hot drought and implications for the future

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Abstract Between 2000 and 2014, annual Colorado River flows averaged 19% below the 1906–1999 average, the worst 15-year drought on record. At least one-sixth to one-half (average at one-third) of this loss is due to unprecedented temperatures (0.9°C above the 1906–1999 average), confirming model-based analysis that continued warming will likely further reduce flows. Whereas it is virtually certain that warming will continue with additional emissions of greenhouse gases to the atmosphere, there has been no observed trend toward greater precipitation in the Colorado Basin, nor are climate models in agreement that there should be a trend. Moreover, there is a significant risk of decadal and multidecadal drought in the coming century, indicating that any increase in mean precipitation will likely be offset during periods of prolonged drought. Recently published estimates of Colorado River flow sensitivity to temperature combined with a large number of recent climate model-based temperature projections indicate that continued business-as-usual warming will drive temperature-induced declines in river flow, conservatively −20% by midcentury and −35% by end-century, with support for losses exceeding −30% at midcentury and −55% at end-century. Precipitation increases may moderate these declines somewhat, but to date no such increases are evident and there is no model agreement on future precipitation changes. These results, combined with the increasing likelihood of prolonged drought in the river basin, suggest that future climate change impacts on the Colorado River flows will be much more serious than currently assumed, especially if substantial reductions in greenhouse gas emissions do not occur.

Plain Language Summary Between 2000 and 2014, annual Colorado River flows averaged 19% below the 1906–1999 average, the worst 15-year drought on record. Approximately one-third of the flow loss is due to high temperatures now common in the basin, a result of human caused climate change. Previous comparable droughts were caused by a lack of precipitation, not high temperatures. As temperatures increase in the 21st century due to continued human emissions of greenhouse gasses, additional temperature-induced flow losses will occur. These losses may exceed 20% at mid-century and 35% at end-century. Additional precipitation may reduce these temperature-induced losses somewhat, but to date no precipitation increases have been noted and climate models do not agree that such increases will occur. These results suggest that future climate change impacts on the Colorado River will be greater than currently assumed. Reductions in greenhouse gas emissions will lead to lower future temperatures and hence less flow loss.

1. Introduction

A large number of studies over the last 25 years have considered the future runoff of the Colorado River (Figure 1) under climate change. Nearly all of these studies have cautioned that future warming will deplete the flow of the river, but the results have varied from minor to major [*Nash and Gleick*, 1991; *Christensen et al.*, 2004; *Milly et al.*, 2005; *Brekke et al.*, 2007; *Christensen and Lettenmaier*, 2007; *National Research Council*, 2007; *Seager et al.*, 2007; *Barnett and Pierce*, 2008; *Ray et al.*, 2008; *Barnett and Pierce*, 2009; *Rajagopalan et al.*, 2009; *Cayan et al.*, 2010; *Reclamation*, 2013; *Harding et al.*, 2012; *Seager et al.*, 2012; *Vano et al.*, 2012; *Ficklin et al.*, 2013; *Vano et al.*, 2014; *Ayers et al.*, 2016; *Milly and Dunne*, 2016]. In contrast, the latest U.S. Government assessment implies little or no change is likely because precipitation increases will be sufficient to maintain temperature-depleted flows [*Reclamation*, 2016]. Fifteen years into the twenty-first century, the emerging reality is that climate change is already depleting

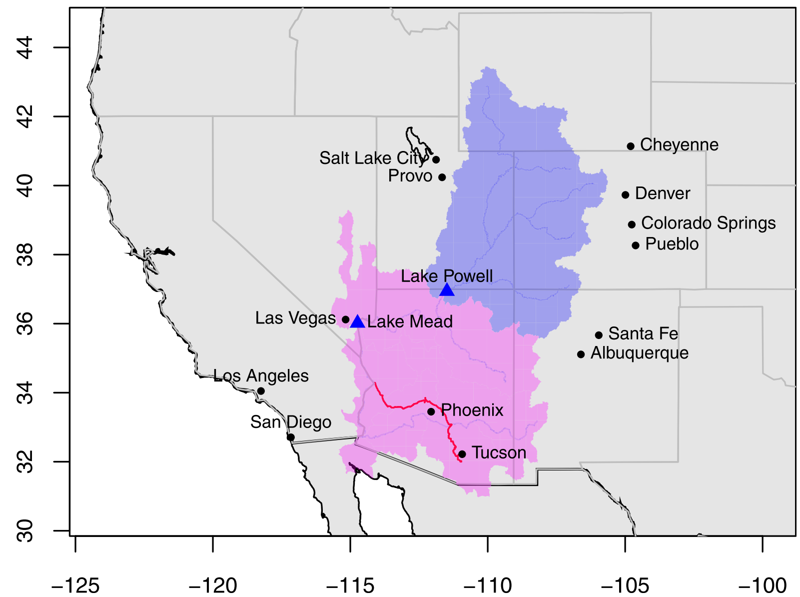

Figure 1. Map of the Colorado River Basin. Lower and Upper Basins, major U.S. cities receiving Colorado River water, major tributaries, and Lakes Mead and Powell are shown. The Central Arizona Project canal in red.

Colorado River water supplies at the upper end of the range suggested by previously published projections. Record setting temperatures are an important and underappreciated component of the flow reductions now being observed.

Between the start of the drought in 2000 and the end of 2014, our analysis period, annual flow reductions averaged 19.3% below the 1906–1999 normal period, and Lakes Mead and Powell, the nation's two largest reservoirs, ended the period at approximately 40% of maximum volume despite starting the period nearly full [*Wines*, 2014; *Colorado River Basin Stakeholders*, 2015] (Figure 2a). This drought has continued into 2015 and 2016 with higher, but still below normal, flows estimated at 94% in 2015 and 94% in 2016 with unusual late season May and June precipitation in both years that raised runoff by nearly 20% [*Alcorn*, 2015, 2016]. Despite these smaller recent reductions, Lake Mead continues to decline and in May 2016 it hit a level not seen since its initial filling in the 1930s [*James*, 2016]. The overall Colorado River reservoir system stores 4 times the annual flow of the river, one of the largest ratios in the world. This storage provides a large drought buffer when full. However, when the reservoirs are low, shortage risk can be high for years because high demands, now equal to twentieth century average flow, make it difficult to refill system storage [*Reclamation*, 2012]. While the multiyear California drought has been garnering more national attention, the more slowly unfolding Colorado River drought is every bit as serious and also has national and international ramifications [*Wines*, 2014].

The Colorado River Basin encompasses seven states and northern Mexico and is home to 22 federally recognized tribes. The river provides municipal and industrial water for 40 m people distributed across every major Southwestern city both within and without the basin, including Los Angeles, San Diego, Las Vegas, Phoenix, Tucson, Salt Lake City, Denver and the entire Front Range of Colorado, Albuquerque, and Santa Fe [*Reclamation*, 2012].

Continued low flows would result in additional declines at Lake Mead, eventually requiring Lower Basin (Arizona, California, Nevada) water delivery shortages with mandatory cutbacks imposed primarily on Arizona, but also Nevada and Mexico [*Verburg*, 2011]. At the same time, Upper Basin (Colorado, New Mexico, Utah, Wyoming) water users would continue to endure physical shortages from a lack of water. These initial Lower Basin Lake Mead delivery shortages and Upper Basin physical shortages are manageable to a point; however, under current operating rules with continued low flows during the next 6 to 8 years Lake Mead would drop to elevation 305 m (1000 feet) above sea level, resulting in a number of serious and unprecedented problems [*Collum and McCann*, 2014].

In the Lower Basin, Arizona could theoretically lose its water allocation for the entire Central Arizona Project canal, a critical \$4.4B, 530 km cross-state 2 bcm/yr water source for 4.7 m people, multiple sovereign Indian

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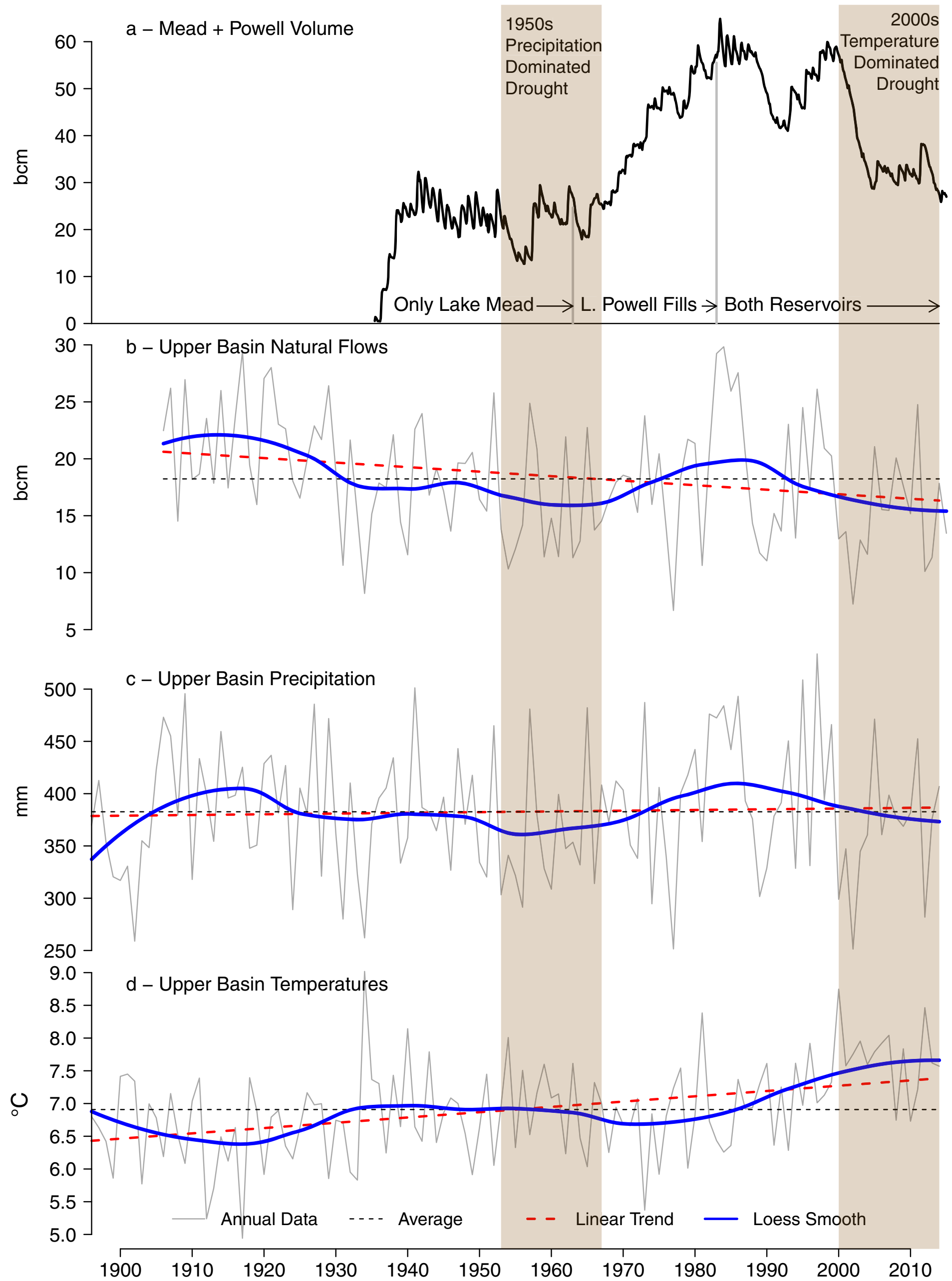

Figure 2. (a) Lakes Mead and Powell combined monthly contents. Upper Basin annual Colorado River (b) runoff at Lees Ferry from 1906 to 2014, (c) precipitation and (d) temperatures from 1896 to 2014. Mead first filled in 1935, Powell in 1963 (supporting information Text S1). Two 15-year drought periods, 1953–1967 and 2000–2014, are highlighted and discussed in main text.

nations, and over 120,000 irrigated hectares [*Glennon*, 1995; *Colorado River Basin Stakeholders*, 2015]. This canal currently relies on occasional but uncertain "equalization" releases from Lake Powell that only occur with irregular and rare large Powell inflows. The extra water is delivered when Lake Powell reaches levels substantially higher than Lake Mead, a use allowed under the 1922 Colorado River Compact section III (e) and formalized most recently under rules established in a 2007 Record of Decision for coordinated operations of Lakes Powell and Mead and for shortage sharing in the Lower Basin [*Department of Interior*, 2007].

Under normal operating rules, without these extra inflows, Lake Mead has excess outflows of 1.5 bcm per year, the so-called Lower Basin "structural deficit" [*Collum and McCann*, 2014]. The structural deficit was created in 1968 when Congress authorized the Central Arizona Project (CAP). In order to obtain the support of the large California Congressional delegation, Arizona agreed to rely on this unused, but in the long run unreliable water, because there was not enough remaining unallocated Lower Basin water. The CAP had long been a desire of Arizona and the state was willing to make this bargain despite its flaws [*Johnson*, 1977]. This same water is first available for use by the Upper Basin under the Colorado River Compact, but heretofore has not been developed for Upper Basin use. A plan to augment the Colorado River with flows from outside the basin, discussed during the hearings on the legislation, but not included in the final package due to opposition from potential source areas, was never revisited by Congress. Reclamation in 2011 said that such augmentation was now unlikely.

The structural deficit only became a problem when the CAP was fully completed in the mid-1990s combined with the drought that began in 2000. Upper Basin demand growth has also played a small role, although Upper Basin demands are still much less than forecast in 1968 for the year 2000 [*Tipton and Kalmbach, Inc*., 1965; *Johnson*, 1977]. The recent Lake Mead declines are strongly influenced by this imbalance, and solutions to this deficit have been a recent focus of the Basin states and federal government [*Central Arizona Project*, 2016; *Davis*, 2016].

The Upper Basin also has serious issues, one of which ripples into the Lower Basin. When the surface of Lake Mead declines to an elevation 305 m (1000 feet) above sea level, Lake Powell will also be below its minimum power pool 75% of the time [*Collum and McCann*, 2014]. This occurs in part because low Mead levels make "equalization" releases from Powell more likely thus driving Powell lower. Hydropower losses at Lake Powell could result in substantial rate increases for irrigators who rely on the reservoirs for long term lower cost power contracts, and would also dry up funding for basin-wide programs necessary for water delivery environmental compliance [*Adler*, 2007; *Collum and McCann*, 2014]. Under such low reservoir conditions, there is also a high likelihood that the Upper Basin states would have to curtail existing water deliveries to cities such as Denver, Colorado Springs, Albuquerque and Salt Lake City in order to make required deliveries to Lake Mead. Heretofore, largely because of the structure of the Colorado River Compact, the Upper Basin and Lower Basin have been managed separately. With permanent flow declines of approximately 20%, however, the required deliveries to Lake Mead would become a hardship on the Upper Basin, as well as create Lower Basin delivery shortages [*Reclamation*, 2007; *Barnett and Pierce*, 2009; *Rajagopalan et al*., 2009]. The original compact, signed during one of the wettest periods in the last 450 years [*Woodhouse et al*., 2006], did not envision how large scale flow declines would be managed between the basins, and such declines could cause an allocation crisis between the Upper and Lower Basins [*Adler*, 2008].

Understanding the cause of, and reacting properly to, the ongoing drought is critical to the future of the Southwest. Herein we investigate the role of precipitation versus temperatures as causes of the current drought, provide temperature-based and precipitation-based twenty-first century flow projections and provide policy implications of these findings. Our approach separates the impacts of high-confidence temperature projections from those associated with the much lower-confidence projections of future precipitation using a simple but powerful sensitivity technique. Moreover, we make a novel—and important—case that there is a high likelihood that the impacts of continued atmospheric warming will overwhelm any future increases in precipitation because prolonged dry periods lasting multiple decades are likely to negate the beneficial impacts of additional precipitation during other times.

2. Causes of the 2000–2014 Drought

The 2000–2014 drought is defined by the lowest average annual flows for any 15-year period in the historical record. To analyze this drought, gridded 4 $\times$ 4 km temperature and precipitation data from 1896–2014 for the area above Lees Ferry were obtained from the Precipitation-Elevation Regression on Independent Slopes (PRISM) model [*Daly et al*., 1994; *Guentchev et al*., 2010; *Oyler et al.,* 2015a, 2015b; *Rangwala et al.,* 2015]. In addition, we obtained reservoir contents and natural flows at Lees Ferry from the U.S. Bureau of Reclamation (Reclamation) (Text S1). Lees Ferry is situated just below Lake Powell and is the Compact dividing line between the Upper and Lower Basins. Approximately 85% of the flow originates above Lees Ferry [*Christensen and Lettenmaier*, 2007].

Historically, Upper Colorado River Basin precipitation has been the main Colorado River runoff driver such that high flow years (1920s, 1980s) were associated with high precipitation and low flow years (1930s, 1950s) with low precipitation (Figures 2b and 2c). The current drought (our study period is 2000–2014, but

Table 1. Winter/Summer/Annual Upper Basin Mean Water Year Precipitation

	1953–1967			2000–2014			1896–2014	
	mm			mm			mm	
	Total	Anomaly	Anomaly % of Mean (%)	Total	Anomaly	Anomaly % of Mean (%)	Mm	% Avg
Winter (Oct to Mar)	176	−16	−8.6	187	−5	−2.7	192	100
Summer (Apr to Sep)	184	−7	−3.6	179	−12	−6.4	191	100
Total	359	−23	−6.1	365	−17	−4.6	383	100

the drought is still on-going), with its modest −4.6% precipitation decline and −19.3% flow decline, stands in stark contrast to the second-lowest 15-year flow period (1953–1967), a precipitation-driven drought with averaged precipitation reductions of −6.1% per year and flow reductions of −18.1% per year (Figures 2b and 2c and Table 1). Compared to the 1950s drought, the 2000s feature much more (near normal) winter precipitation (−8.6% 1950s decline versus −2.7% 2000s) and significantly less summer precipitation (−3.6% 1950s decline versus −6.4% 2000s). The 2000s precipitation decline is only 75% of the decline in the 1950s, thus begging the question of why the recent drought was more serious. What has changed is that temperatures in the runoff producing Upper Basin are now 0.9°C above the 1896–1999 average and are the highest in the gaged record; whereas temperatures during the 1953–1967 drought were much cooler and only slightly above the 1896–1999 average (Figure 2d and Table 2). This makes the current drought unprecedented in the gaged record.

In contrast to the more precipitation-driven current California drought [*Diffenbaugh et al*., 2015; *Williams et al*., 2015], lack of precipitation is only partially to blame for the Colorado River runoff declines during the last 15 years. Instead, approximately a third, or more, of the recent Colorado River flow reduction is most likely a result of record-setting warmth. Since 1988 an increase in the frequency of warm years has been strongly associated with lower flows than expected [*Woodhouse et al*., 2016], suggesting an important role for temperature in flow losses. Such temperature-driven droughts have been termed "global-change type droughts" and "hot drought," with higher temperatures turning what would have been modest droughts into severe ones, and also increasing the odds of drought in any given year or period of years [*Breshears et al*., 2005; *Overpeck*, 2013]. Higher temperatures increase atmospheric moisture demand, evaporation from water bodies and soil, sublimation from snow, evapotranspiration (ET) from plants, and also increase the length of the growing season during which ET occurs [*Pitman*, 2003; *Weiss et al*., 2009; *Seneviratne et al*., 2010; *Seager et al*., 2015a]. Warm season (April to September) warming has been identified by models as especially important in reducing Colorado River flows because of the increases in ET from longer growing seasons [*Das et al*., 2011]. Increases in measured vapor pressure deficits in the Southwest caused by warming and a decrease in water vapor provide strong support for higher ET during the recent drought [*Seager et al*., 2015b]. As increasing temperatures drive further drying, additional positive feedbacks are possible in the form of lower humidity and less evaporative cooling, decreased cloudiness and increased incident radiation, as well as decreased snow cover and more radiative heating [*Betts et al*., 1996; *Brubaker and Entekhabi*, 1996; *Pitman*, 2003; *Seneviratne et al*., 2010]. In the twentieth century, droughts were associated almost exclusively with a lack of precipitation. In this century, however, high temperatures alone can lead to anomalously dry conditions.

Table 2. Upper Basin Water Year Flows and Temperatures

	Average Annual Flow		Average Annual Temperature	
Period	bcm	% 1906–1999	°C	°C Anomaly to 1896–1999
1953–1967	15.38	81.9	7.0	0.2
2000–2014	15.15	80.7	7.7	0.9
1906–1999	18.77	100.0	6.8	0.0
1906–2014	18.27	97.3	6.9	0.1

3. Estimates of 2000–2014 Temperature-Induced Flow Loss

Over the last several years several studies specific to the Colorado River Basin have investigated the specific relationships among temperatures, precipitation and flow in the basin using the concepts of temperature sensitivity and precipitation elasticity [*McCabe and Wolock*, 2007; *Nowak et al*., 2012; *Vano et al*., 2012, 2014; *Vano and Lettenmaier*, 2014]. Temperature sensitivity is defined as the percent change in annual flow per degree rise in annual temperature. Precipitation elasticity is defined as the fractional change in annual flow divided by the fractional change in annual precipitation [*Vano et al*., 2012]. Note that elasticity has been studied for both increases and decreases in precipitation, whereas sensitivity is typically investigated only for temperature increases. These numbers can be determined empirically and through model studies.

Previous studies on temperature sensitivity and precipitation elasticity show that future impacts to streamflow from increases in temperatures and changes in precipitation can be considered separately using sensitivity and elasticity, and then added together to produce flow estimates [*Vano et al*., 2014; *Vano and Lettenmaier*, 2014]. Considering these effects separately and additively is a powerful conceptual tool for investigating climate change impacts because of the ease in measuring the two variables for current impacts and the wide availability of temperature and precipitation projections from global climate models for assessing future impacts. In addition, the large differences in certainty associated with future changes in the two variables (temperature will surely increase, whereas precipitation may increase or decrease—see below) helps to set apart the risk of future changes in flow associated with each variable.

Vano et al. [2012, 2014], *McCabe and Wolock* [2007], and *Nowak et al*. [2012] provide multiple estimates of the flow sensitivity of the Colorado River flow to temperature using three different methods. *Vano et al*. [2012, 2014] utilized six high-resolution, commonly used hydrology models and two different temperature adjustment methods to obtain Lees Ferry temperature sensitivities. They report an average sensitivity of −6.5%/°C warming with a one standard deviation range from −3.0% to −10.0%/°C for the Upper Basin. Approximately 50% models show increasing sensitivity and 50% decreasing sensitivity as temperatures warm so we elect to use a constant sensitivity over all future temperatures. *McCabe and Wolock* [2007] constructed a simple water balance model that infers an average temperature sensitivity of −8.9%/°C and *Nowak et al*. [2012] found an empirical temperature sensitivity of −13.8%/°C.

We use the complete one standard deviation range (−3%/°C to −10%/°C) of the *Vano et al*. [2012, 2014] temperature sensitivity estimates as they were the most conservative and rigorous of the three studies we investigated. Using this range, we found that recent warming of 0.9°C has likely already reduced river flows from −2.7% to −9% from the mean 1906–1999 flow. This represents approximately one-sixth to one-half (average of one-third) of the total flow loss during the 2000–2014 drought.

The higher temperature sensitivities of the two other studies suggest the actual Colorado River temperature sensitivities are near the upper end and possibly exceed the *Vano et al*. [2012, 2014] estimates. These higher sensitivities imply much greater temperature-induced losses during the current drought (−7.9% to −12.3% versus −2.7% to −9%). Empirical results from the 2000 to 2014 drought also point to mid to high temperature sensitivities. *Vano et al*. [2012] report precipitation elasticities ranging from 2 to 3 at Lees Ferry. Thus, using a midrange precipitation elasticity of 2.5, the 2000–2014 annual −4.6% precipitation decline implies runoff reductions of −11.4%, leaving the remaining −7.9% decline to be explained by other causes. If temperature were the sole cause of this remaining decline, the inferred temperature sensitivity is −8.8%/°C. Using a precipitation elasticity of 3.0 implies a temperature sensitivity of −6.2%/°C, very close to the midrange Vano et al., sensitivity. These temperature sensitivities imply large losses as temperatures rise, the subject of the next section.

4. Twenty-First Century Flow Response to Changing Temperatures and Precipitation

For the analysis on how future temperatures and precipitation would affect runoff, and for investigating how well current linked climate-hydrology models can reproduce the current drought, we used Reclamation's climate projection data sets [*Brekke et al*., 2013, 2014]. These data sets use Coupled Model Intercomparison Project 3 and 5 (CMIP3, CMIP5 after the class of climate models used) climate model projection data linked to the Variable Infiltration Capacity hydrology model to produce flows from 1950 to 2099 (supporting information Text S2, Figures S2, and S3)] [*Liang et al*., 1996; *Meehl et al*., 2007; *Moss et al.,* 2010; *Taylor et al*., 2012].

The same temperature sensitivity and precipitation elasticity numbers discussed above can be used to estimate future flow reductions using climate model outputs under high (business-as-usual, SRES A2 and

RCP8.5) and moderate (somewhat reduced by mitigation, SRES A1B and RCP4.5) greenhouse gas emissions to the atmosphere. By 2050, moderate and high emissions are projected to yield Upper Basin *mean* warming of 2.6–2.8°C (Figure 3), three times recent warming, and by 2100, warming of 3.6°C under moderate emissions and 5.4°C under high emissions. This warming implies total multimodel mean temperature-induced flow losses at midrange sensitivity of −6.5%/°C of about −17% by midcentury and −25% to −35% at end-century (Figures 4 and 5). The multimodel mean complete flow loss *range* over both periods and both emissions is approximately −8% to −55% using the lower and upper temperature sensitivities (Figures 4 and 5). As discussed above, there is little empirical evidence that the true temperature sensitivity of flow to temperature increase is near the low sensitivity.

Temperature-induced losses may be somewhat buffered by projected additional precipitation that can increase runoff by 2–3% for every 1% change in precipitation [*Vano et al*., 2012]. At midcentury precipitation increases of +4–+11% given a midrange elasticity of 2.5 would balance the range of temperature-induced flow losses at a midrange—6.5%/°C sensitivity (Figure 5, right *y* axis). At end-century, with the same sensitivity and elasticity, additional precipitation increases of +4–+20% would balance the range of possible temperature-driven losses. At a higher −10%/°C sensitivity, the balancing precipitation would need to be as great as +15% or more at midcentury and +22% or more at end-century. While these may seem like relatively small increases in precipitation, and thus possible, they would represent a major and unprecedented change in precipitation regime compared to the observed historical variation in precipitation (Figure 2c). During the twentieth century, for example, the wettest 10-year period (1983–1997) had only a +8% precipitation increase. This unusual period was marked by major floods downstream of Lakes Powell and Mead due to uncontrolled reservoir spilling and the near catastrophic loss of the spillways at Glen Canyon Dam [*Udall*, 1983].

Vano and Lettenmaier [2014] argue that the sensitivity-based approach used in our projections provides similar estimates of future streamflow to those generated with more computationally intensive coupled-model methods, except for some (i.e., 10%) overstatement of flow reductions at the highest levels of possible warming by 2100 (e.g., the business-as-usual SRES A2 scenario used in the CMIP3 projections and the RCP8.5 in the CMIP5 projections). This would reduce the end of century high emissions mean flow reductions shown in Figure 5 to a still very significant −45% by 2100.

Recent studies have suggested that CO_2 fertilization may increase plant water efficiency thus reducing future evapotranspiration which could serve to mitigate our projected losses [*Milly and Dunne*, 2016; *Swann et al*., 2016]. Both studies call into question results that show large portions of the globe drying in the twenty-first century [e.g., *Dai*, 2012; *Cook et al*., 2014]. However, *Milly and Dunne* [2016] and *Swann et al.* [2016] show that, despite this increase in plant water use efficiency, the Southwestern US will still dry, a finding that is consistent with multiple global assessments showing substantial drying risk to midlatitude areas such as the Colorado River Basin. Moreover, a recent Australian study found that higher

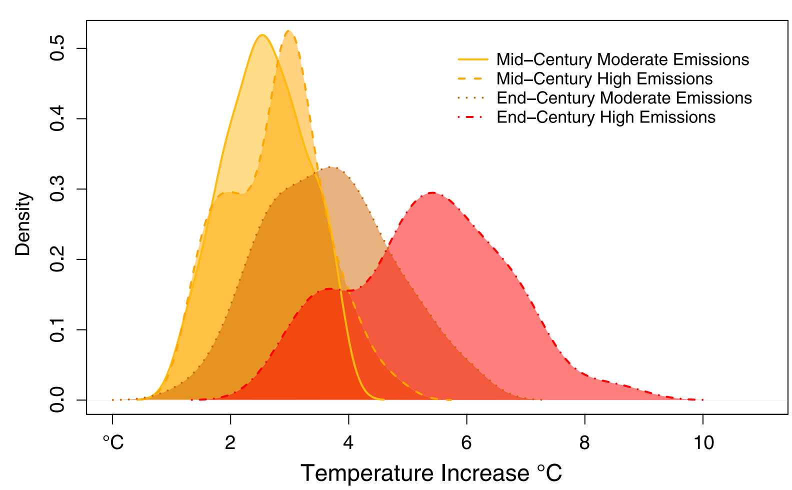

Figure 3. Probability density functions of Upper Colorado River Basin temperature projections for midcentury and end-century under moderate (SRES A1B and RCP4.5) and high (SRES A2 and RCP8.5) emissions.

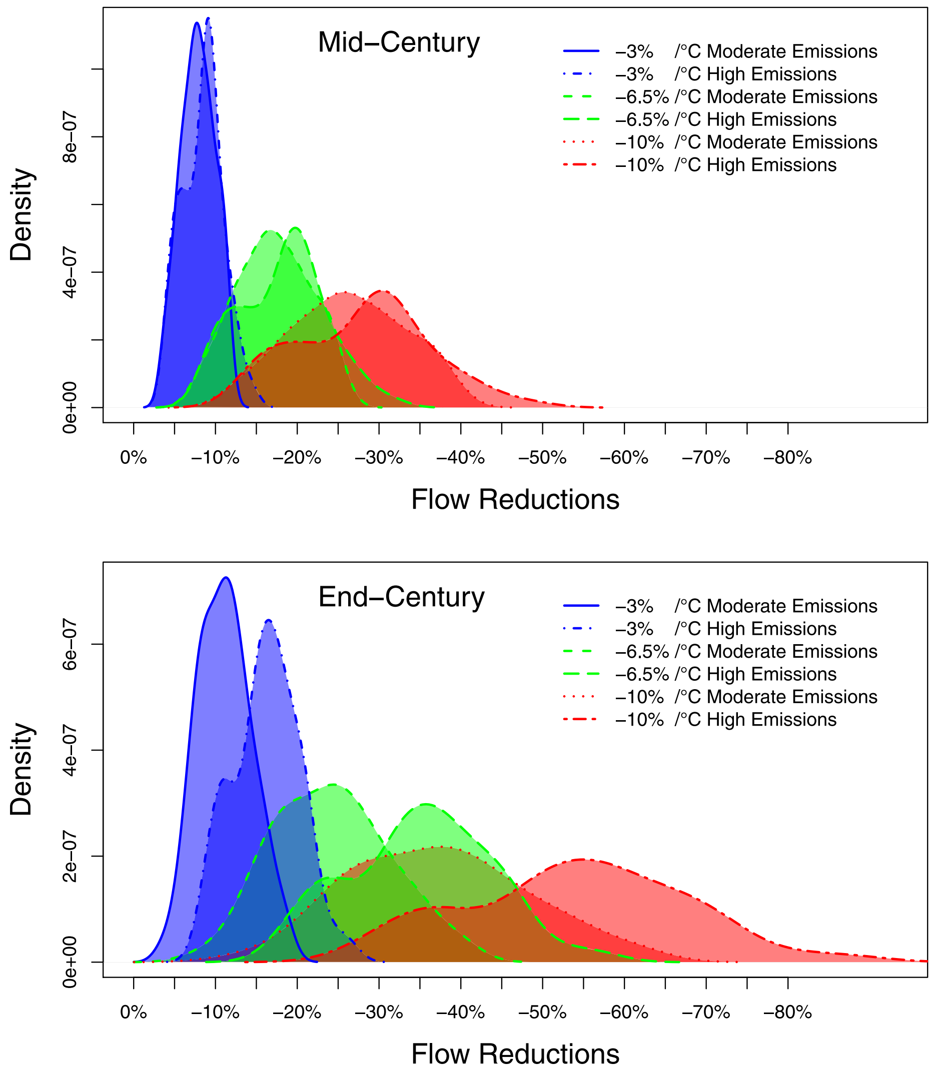

Figure 4. Probability density functions of Upper Colorado River Basin temperature-induced flow reductions for midcentury and end-century with the three temperature sensitivities (−3%, −6.5%, −10%) and the two levels of emissions (Moderate: SRES A1B and RCP4.5 and High: SRES A2 and RCP8.5).

evapotranspiration associated with the increased plant growth stimulated by higher CO_2 outweighed any CO_2-related water-use efficiency effect, and served to reduce streamflows in semiarid regions [*Ukkola et al.*, 2015], a trend that must be exacerbated by the temperature-induced lengthening of the growing season. These results suggest that plant physiological responses are likely consistent with our results, and in any case, do not invalidate them.

5. Megadrought Risks to Flows

Megadroughts lasting decades in the Colorado River Basin have occurred in the past, with resulting substantial flow reductions [*Meko et al.*, 2007]. Multiple papers now suggest there is high twenty-first century risk for megadrought in the American Southwest and that the risk will increase as temperatures rise [*Ault et al.*, 2014; *Cook et al.*, 2015; *Ault et al.*, 2016]. In addition, current GCMs underrepresent the frequency of megadrought [*Ault et al.*, 2012, 2013]. These findings provide additional support for large flow reductions during at least multidecadal drought periods and suggest that current twenty-first century flow projections underrepresent this risk.

Significant Colorado River flow losses occurred during previous multidecadal megadroughts. During the twelfth century, flow reductions of approximately −16% occurred during one 25-year period [*Meko et al.*,

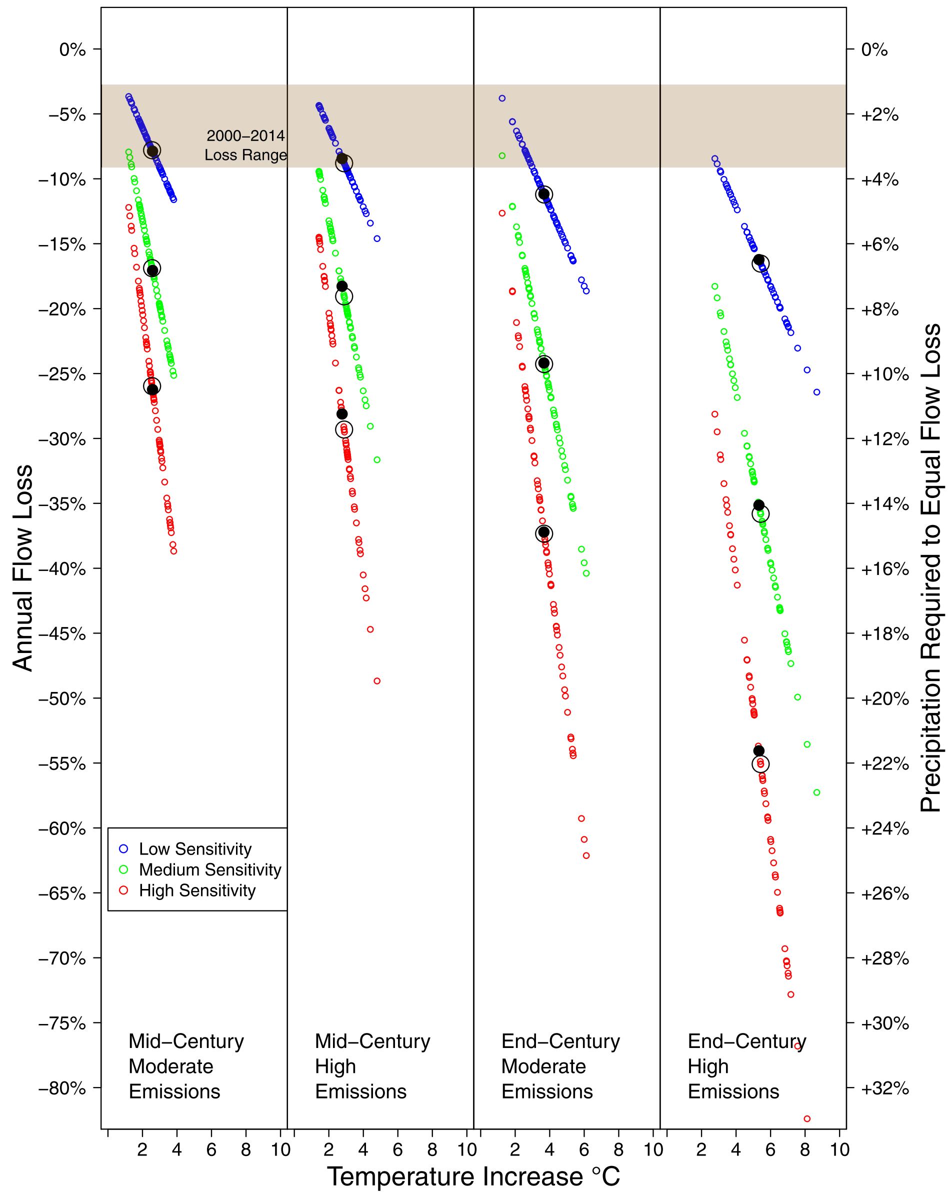

Figure 5. Temperature-induced flow losses by model run (one per dot) with temperature increases shown on horizontal axis. For each period (midcentury, end-century) and emissions type (moderate, high), flow losses for each model run are shown with the 3 (low = −3%/°C, medium = −6.5%/°C, high = −10%/°C) temperature sensitivities. Black dots/circles are averages/medians for each sensitivity. Precipitation increases needed to counteract flow losses at right are based on 2.5 precipitation elasticity. Range for the temperature-induced losses during 2000–2014 drought are shown in shaded brown at the top (supporting information Text S5).

2007]. Evidence indicates that hemispheric and Southwest temperature anomalies were significantly smaller during past megadroughts than the rapid on-going current warming that could easily exceed 4–5°C by the end of century under business-as-usual emissions [*Salzer and Kipfmueller*, 2005; *Mann et al.*, 2009; *Salzer et al.*, 2014] (Figure 5). Using the additivity concepts discussed above, additional warming of 1°C, 2°C, or 3°C beyond the historic twelfth century megadrought temperatures would have reduced the −16% flow declines by an additional −6.5%, −13%, or −19.5% at medium temperature sensitivity. These additional reductions would have thus turned a −16% flow decline into declines of −21.5%, −28%, or −34.5%, losses near the middle of our projections.

There is recent strong evidence that continued warming over the next 80 years could increase the risk of multidecadal drought [*Ault et al.*, 2014, 2016; *Cook et al.*, 2015]. Independent of the added drought risk due to continued warming, the risk of a 35-year precipitation-deficit drought later in this century exceeds 15% within a 50-year period [*Ault et al*., 2014]. In contrast, with continued anthropogenic warming, the risk of multidecadal megadrought in the Southwest increases to over 90% over this century if there is no increase in mean precipitation; even if modest precipitation increases do occur, the risk will still exceed 70% [*Ault et al*., 2014, 2016]. At medium warming (4°C), 20–30% precipitation increases will be needed to reduce megadrought risk below 50% and at high amounts of warming (>6°C), it will take a ~40% increase in precipitation to reduce megadrought risk below 50% [*Ault et al*., 2016]. These changes in precipitation are huge and unlikely, and they would still only reduce megadrought risk to below 50%.

Both the CMIP3 and CMIP5 Global Climate Models may not adequately reproduce the frequency of occurrence of known past decadal and multidecadal precipitation droughts [*Ault et al*., 2012, 2013]. In the Colorado River Basin empirical evidence of this problem can be found in the linked GCM-hydrology model results from Reclamation's projections for the basin [*Brekke et al*., 2014]. Approximately half of the CMIP5 models and one-quarter of the CMIP3 models cannot simulate the 2000–2014 drought at any point in the twenty-first century (supporting information Text S3 and Tables S1–S4). This wet bias significantly affects the mean flows of drought-capable and nondrought capable models. At the end of the twenty-first century, the models unable to simulate the current drought are much wetter (109% of twentieth century average Lees Ferry runoff for CMIP3, 113% for CMIP5) than the models that are able to simulate the current drought (85% of average runoff for CMIP3, 91% CMIP5) (supporting information Tables S1–S4). These flow differences are greater than 20%, and represent the difference between serious management challenges and significant oversupply.

6. Risk-Based Framing of Future Runoff Projections

At present, some outputs from global climate models are ready to support reliable risk-based policy while others are not as ready. A key novel aspect of our research is to provide more insight into where confidence is warranted, and where it is not, with respect to projections of future climate and flow change in the Colorado River Basin. In the case of the Basin, every single moderate and high emissions model simulation agrees that temperatures will continue to rise significantly with continued emissions of greenhouse gases to the atmosphere—this result is robust, highly certain and well-suited for informing policy choices. The fact that observations also show substantial warming only strengthens this assertion.

On the other hand, simulated future precipitation change in the Basin is clouded with much greater uncertainty due to substantial disagreement among models and a highly uncertain ability to simulate realistic change in key phenomena such as storm-track position or decadal and longer-scale drought. Whereas climate models are in general agreement that cool season (warm season much less certain) precipitation declines are likely in the Lower Colorado River Basin, these same models disagree when it comes to the sign and amount of precipitation change that is likely in the Upper Basin. This is because precipitation change in the Upper Basin will depend heavily on the exact changes in the position of cool season jet stream and storm-tracks, two aspects of climate change that are not simulated with confidence by global climate models [*Collins et al*., 2013].

Moreover, there is strong evidence that the mean positions of both the jet stream and storm-tracks are likely to push poleward, expanding the area of aridity in the Colorado River Basin, but the amount of this expansion is poorly constrained [*Collins et al*., 2013]. Multiple studies, including some focused on the American Southwest, suggest that the proximate cause of this drying, Hadley Cell expansion, is already well underway and will continue [*Seager et al*., 2007; *Scheff and Frierson*, 2012; *Feng and Fu*, 2013; *Norris et al*., 2016; *Prein et al*., 2016].

Our results regarding future changes in Colorado River flows agree with many previous studies in suggesting climate change translates to flow reductions, although our work is generally not directly comparable because we separate out high confidence temperature-related impacts from the possible effects of much less certain and highly variable precipitation projections. However, our work, as well as this larger body of literature, appears to be at odds with the recent Reclamation projections for the Colorado River Basin, which are widely cited and used. Reclamation's projections use a global climate model output that is downscaled to drive a hydrology model. It is worth understanding why our results emphasize substantially greater risks along with apparently greater flow losses.

The 2011 CMIP3 climate change flow projections by Reclamation indicate a modest multimodel median flow decline of −9% by 2060 for the river, but with a wide range of outcomes from flow increases to flow decreases [*Reclamation*, 2012] (supporting information Table S1). Reclamation's most recent CMIP5 projections show no change in mean and median basin-wide flow by 2070s [*Reclamation*, 2016], but also embody a wide range of results. Compared to CMIP3, the CMIP5 results show increased precipitation, especially in the northern parts of the basin including Northeast Utah, Northwest Colorado's Yampa River and the Green River in Wyoming [*Brekke et al*., 2014; *Ayers et al*., 2016] (supporting information Tables S1 and S3). The increased precipitation in the CMIP5 model runs compared to CMIP3 can be attributed to more southerly storm tracks in CMIP5 that occur in late spring [*Brekke et al*., 2014].

Another issue arises in both the CMIP3 and CMIP5 data sets when GCM precipitation is adjusted by the downscaling techniques necessary for off-line hydrology models. The first step in Reclamation's downscaling is a bias correction step. This step can add approximately 5% more precipitation to the raw GCM precipitation, and this increase appears to not have a physical basis [*Reclamation*, 2013; *Brekke et al*., 2013]. The final downscaling step, spatial downscaling, also increases GCM precipitation, although there is at least a plausible physical explanation for some of the increase: higher elevations in the Rockies receive large amounts of precipitation, but these elevations are not properly modeled by the GCMs. In one study of the CMIP5 data set after downscaling, dry and average models show precipitation increases of approximately +∼5% from the raw GCM output, but the wettest models show +∼10% increases, doubling future precipitation increases from +10% to +20% [*Lukas et al*., 2014]. This extra precipitation is manifested in a number of hydrology model runs that project huge and implausible flow increases in some years that are 150% of the highest known flows in the twentieth century (supporting information Text S4, Figures S2, and S3). The downscaling wetness problem has been identified, but has not been not resolved [*Lukas et al*., 2014]. Reclamation acknowledges that the newer CMIP5 projections have not been determined to be better or more reliable [*Brekke et al*., 2014]. It is noteworthy that internally consistent GCM-only Southwest runoff projections almost uniformly produce significant declines in both CMIP3 and CMIP5 runs [*Milly et al*., 2005; *Seager et al*., 2007, 2012; *Koirala et al*., 2014; *Milly and Dunne*, 2016].

Our results are generally comparable to Reclamation's most recent results when considering the full range of our analysis when both precipitation and temperatures are included. However, our focus and emphasis is on the large near-certain temperature-induced flow declines with a separate analysis of precipitation. Reclamation, by contrast, has a focused on climate multimodel-ensemble median declines, including medians calculated across emission scenarios [*Reclamation*, 2013, 2012]. Decision makers often treat these median outcomes as a proxy for risk despite the fact that the median obscures the wide range of results and lumps wet and dry, warm and hot, large and small emission increases and, most critically, near certain temperature increases and very uncertain precipitation changes.

We assert that the large precipitation increases necessary to offset substantial temperature-induced flow decreases appear unlikely to occur for a number of reasons. These reasons include the potential for storm tracks to go north of the basin due to Hadley Cell expansion, the high potential for megadrought to increase evaporation while reducing precipitation and runoff for extended periods, the large size of the needed precipitation increases, especially when compared to decadal historical increases, the consistent identification by global assessments of the Southwest as an area likely to dry, and finally the lack of any trend over the last century or last 16 years (Figure 2c). Hence, we choose to focus on highly likely temperature-induced declines with separate analysis of the precipitation needed to offset these declines.

7. Policy Implications and Solutions

The climate science take-home messages for Colorado River managers are thus: (1) there is little doubt (i.e., high confidence) that temperatures will continue to increase as long as the emissions of greenhouse gases to the atmosphere continue; (2) there is also high confidence that continued temperature increases will cause river flows to decline, ranging from −11% to as much as −55% by end of century under moderate to high emissions (Figures 4 and 5); (3) there is only low confidence associated with the possibility of storms and precipitation in the Upper Basin increasing enough to even partially offset the temperature-driven declines in river flows; (4) the risk of multidecadal megadrought in the Basin is significant even in the absence of continued anthropogenic climate change, and this risk rises substantially with continued global warming; (5) the likelihood of drought and megadrought means that there will likely be decades-long periods with anomalously low runoff even if there is an increase in precipitation relative to the historical mean during some other periods due to anthropogenic climate change.

Temperature-driven threats to the flows of the Colorado are thus large and real. The only way to curb substantial risk of long term mean declines in Colorado River flow is thus to work toward aggressive reductions in the emissions of greenhouse gases into the atmosphere. Our work shows that modest (e.g., RCP4.5) reductions in greenhouse gas emissions, while having better outcomes than the business-as-usual future (e.g., RCP8.5), still imply large Colorado River flow losses.

The record warm nature of the on-going Colorado River drought indicates that this drought is not just a natural drought, and our work demonstrates that flows are unlikely to return to the twentieth century averages if we only wait. Unusually wet periods like the 1920s and 1990s will still continue to occur, but they will co-occur with higher temperatures that will increase water demand from plants, soil, snow, and humans.

Climate models and theory suggest that flow reductions would be more severe in the Southern portions of the Upper Colorado Basin affecting tributaries such as the San Juan, Dolores, and Gunnison more severely, with smaller impacts to more northerly tributaries such as the Yampa and Green [*Ayers et al*., 2016]. Such spatial distribution would provide additional water management challenges in that the more southerly basins have in general more people, infrastructure, and uses. Such a distribution would create new localized water supply shortages in addition to the overall basin-wide issues.

Other known threats to streamflows include the potential large scale loss of conifers [*Breshears et al*., 2005; *Adams et al*., 2009; *Allen et al*., 2010, 2015], and the impacts of dust on snow [*Painter et al*., 2010; *Deems et al*., 2013]. These factors along with the observed and projected temperature-induced Colorado River flow declines, the inability of many linked climate-hydrology models to simulate persistent droughts, and the increasing likelihood of hot drought and megadrought, all imply that future Colorado River water supply risk is high. It is imperative that decision-makers begin to consider seriously the policy implications of potential large-scale future flow declines. Stable twentieth century Colorado River flow regimes may not reoccur for many centuries—the time scale of climate system readjustment to the complete cessation of greenhouse gas emissions [*Solomon et al*., 2009; *Collins et al*., 2013].

The Colorado River declines do not stand alone as the only warming-related threat to Southwestern water supplies. The Rio Grande also has a grim prognosis [*Reclamation*, 2013; *Elias et al*., 2015]. The drought in California has garnered national attention, and multiple studies have strongly implicated increasing temperatures as a contributor to these woes [*Griffin and Anchukaitis*, 2014; *Belmecheri et al*., 2016; *Diffenbaugh et al*., 2015; *Mann and Gleick*, 2015; *Seager et al*., 2015a]. Southern California is particularly at risk, with a critical economy and a very large population, all coupled with a large reliance on both climate-threatened in-state, as well as Colorado River, water.

Adjusting to the new reality of rapid climate change will not be an easy or fast task; water management and water policy change slowly. The Colorado River is managed by a complex set of agreements, interstate compacts approved by Congress, international agreements, legislation, and court decrees set in place over the last 100 years [*Verburg*, 2011]. Most agreements were derived from twentieth century state-based negotiations with win/lose policy prescriptions that minimized basin-wide considerations of economic prosperity and potential harm [*Adler*, 2008]. None expressly includes climate change risk management, nor the provision for flow reductions that will be relentless on decadal timescales. New agreements often take years to put in place [*Department of Interior*, 2007]. The recently proposed structural deficit solution [*Central Arizona Project*, 2016], while important and laudable for the short term, will not solve the problem of large scale flow losses. With reduced water supplies, much will have to change in these agreements to address equity, economics, and social concerns on regional, state, basin-wide, and even national levels. Climate change threats to western water supplies are very real, and should prompt great concern and urgency among both water managers and the citizens of the Southwest.

Acknowledgments
We thank the U.S. Bureau of Reclamation for data assistance and comments, and M. Kelly, D. Kenney, E. Kuhn, D. Lettenmaier, J. Robison, P. Troch, and C. Woodhouse for comments and discussion. A portion of this research was supported by the Colorado Water Institute, National Science Foundation, the NOAA Climate Assessment for the Southwest, and the U.S. Geological Survey Southwest Climate Science Center. We acknowledge the Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections archive at: http://gdo-dcp.ucllnl.org/downscaled_cmip_projections as well as the World Climate Research Programme's Working Group on Coupled Modeling and the U.S. Department of Energy, Office of Science. The views expressed in this article are those solely of the authors. All data used in the analysis and conclusions in this paper are available from links in supporting information.

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Climate Change in Colorado

A Synthesis to Support Water Resources Management and Adaptation

A REPORT FOR THE COLORADO WATER CONSERVATION BOARD

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University of Colorado at Boulder

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A Synthesis to Support Water Resources Management and Adaptation

A REPORT BY THE WESTERN WATER ASSESSMENT FOR THE COLORADO WATER CONSERVATION BOARD

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Funding from the Colorado Water Conservation Board of the State of Colorado to the Cooperative Institute for Research in Environmental Sciences, Western Water Assessment

Produced in cooperation with CU-Boulder University Communications, Marketing & Creative Services.

Photos
Cover *(left image) and* ***page 40***, images courtesy of Casey A. Cass, CU-Boulder University Communications, Marketing & Creative Services. ***Page 15***, ©2008 Denver Metro Convention & Visitor's Bureau.

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EXECUTIVE SUMMARY

The scientific evidence is clear: the Earth's climate is warming. Multiple independent measurements confirm widespread warming in the western United States; in Colorado, temperatures have increased by approximately 2°F between 1977 and 2006. Increasing temperatures are affecting the state's water resources. (Sections 1, 2, 4, 5, 6)

This report is a synthesis of climate change science important for Colorado's water supply. It focuses on observed trends, modeling, and projections of temperature, precipitation, snowmelt, and runoff. Climate projections are reported out to the mid-21st century, because this is a relevant time frame for development of adaptation strategies.

Although many published studies and datasets include information about Colorado, few climate studies focus only on the state. Consequently, many important scientific analyses for Colorado are lacking. This report summarizes Colorado-specific findings from peer-reviewed regional studies, and presents new graphics derived from existing datasets. The state is home to many experts in climate and hydrology, and this report also draws from ongoing work by these scientists.

Observations, Attribution, and Projections

- Changes in Colorado's climate and implications for water resources are occurring in a global context. On a global scale, climate change has been linked to observed and projected changes in the water cycle. By the mid-21st century, average river runoff and water availability are projected to increase at high latitudes and decrease over dry regions at lower midlatitudes such as the western United States. Changes in the quantity and quality of water may occur due to warming even in the absence of precipitation changes. (Section 1)
- The accumulation of greenhouse gases (including carbon dioxide) in the atmosphere is ***very likely*** the cause of most of the increase in global average temperatures (IPCC AR4 WGI 2007). In North America, temperatures have increased by 2°F in the last 30 years, and "human-induced warming has ***likely*** caused much of the average temperature increase over the past fifty years" (CCSP SAP 3.3 2008, p. 3). (Section 5)
- In Colorado, temperatures have increased about 2°F in the past 30 years. All regions examined within the state warmed during the last 30 years, except the far southeast corner, in which there was a slight cooling trend. (Section 2)
- Climate models show a 1°F warming in the West over the last 30 years in response to greenhouse gas emissions from human activities (anthropogenic). However no studies have specifically investigated whether the detected trends in Colorado can be attributed to anthropogenic greenhouse gases. (Sections 2, 4)
- Climate models project Colorado will warm 2.5°F [+1.5 to +3.5°F] by 2025, relative to the 1950–99 baseline, and 4°F [+2.5 to +5.5°F] by 2050. The 2050 projections show summers warming by +5°F [+3 to +7°F], and winters by +3°F [+2 to +5°F]. These projections also suggest that typical summer monthly temperatures will be as warm as or warmer than the hottest 10% of summers that occurred between 1950 and 1999. By way of illustration, mid-21st century summer temperatures on the Eastern Plains of Colorado are projected to shift westward and upslope, bringing into the Front Range temperature regimes that today occur near the Kansas border. (Section 5)
- Winter projections show fewer extreme cold months, more extreme warm months, and more strings of consecutive warm winters. Typical projected winter monthly temperatures, although significantly warmer than current, are between the 10th and 90th percentiles of the historical record. Between today and 2050, typical January temperatures of the Eastern Plains of Colorado are expected to shift northward by ~150 miles. In all seasons, the climate of the mountains is projected to migrate upward in elevation, and the climate of the Desert Southwest to progress up into the valleys of the Western Slope. (Section 5)
- In all parts of Colorado, no consistent long-term trends in annual precipitation have been detected. Variability is high, which makes detection of trends difficult. Climate model projections do not agree whether annual mean precipitation will increase or decrease in Colorado by 2050. The multi-model average projection shows little change in annual mean precipitation, although a seasonal shift in precipitation does emerge. (Sections 2, 5)
- A widespread and large increase in the proportion of precipitation falling as rain rather than snow, and reduction in snow water equivalent (SWE) have been observed elsewhere in the West. In Colorado, however, these changes are smaller and not as significant. Most of the reduction in snowpack in the West has occurred below about 8200 ft.

However, most of Colorado's snowpack is above this elevation, where winter temperatures remain well below freezing. (Section 2)

- Projections show a precipitous decline in lower-elevation (below 8200 ft) snowpack across the West by the mid-21st century. Modest declines are projected (10–20%) for Colorado's high-elevation snowpack (above 8200 ft) within the same timeframe. (Section 5)
- Between 1978 and 2004, the spring pulse (the onset of streamflows from melting snow) in Colorado has shifted earlier by two weeks. Several studies suggest that shifts in timing and intensity of streamflows are related to warming spring temperatures. The timing of runoff is projected to shift earlier in the spring, and late-summer flows may be reduced. These changes are projected to occur regardless of changes in precipitation. (Sections 2, 5)
- Recent hydrology projections suggest declining runoff for most of Colorado's river basins in the 21st century. However, the impact of climate change on runoff in the Rio Grande, Platte, and Arkansas Basins has not been studied as extensively as the Colorado River Basin. (Section 5)
- The lowest five-year period of Colorado River natural flow since records began in the late 1800s occurred in 2000 to 2004 (9.9 million acre feet per year). Recent hydrologic studies of the Upper Colorado River Basin project multi-model average decreases in runoff ranging from 6% to 20% by 2050 compared to the 20th century average, although one statistical streamflow model projects a 45% decline by 2050. The range of individual model projections within a single study can include both increasing and decreasing runoff due to the range of climate model output used to drive the hydrology models. Ongoing studies are attempting to resolve methodological differences in order to reduce the range of uncertainty in runoff projections. (Sections 2, 5)
- Throughout the West, less frequent and less severe drought conditions have occurred during the 20th century than revealed in the paleoclimate records over the last 1000 years. Precipitation variations are the main driver of drought in Colorado and low Lake Powell inflows, including the recent drought of 2000–07, and these variations are consistent with the natural variability observed in long-term and paleoclimate records However, warming temperatures may have increased the severity of droughts and exacerbated drought impacts. (Sections 4, 5)
- Because global climate models do not represent the complexity of Colorado's topography, researchers are using "downscaling" and other techniques to study processes that matter to Colorado water resource managers. Several projects are underway to improve regional understanding: Some use statistical "downscaling" methods, which adjust for the effects of elevation and the mountains on snowfall and temperature; other studies involve compiling, calibrating, and studying historical datasets; others involve enhanced climate modeling efforts to include finer spatial resolution that better represents Colorado's mountainous terrain. (Section 3)

SIDEBAR ES-1. Communicating Uncertainty

Recognizing the difficulty in communicating scientific uncertainty to those outside the community, climate assessments now make statements designed to communicate probability. The so-called likelihood terminology indicates "the assessed likelihood, using expert judgment, of an outcome or a result" (IPCC AR4 WGI 2007, p. 3). The likelihood terminology quoted in this document follows two different but similar conventions, shown below.

It is important to recognize that the likelihood terminology used here is independent of consequence; these are not risk statements and the consequences of potentially cascading effects are not implicit in the likelihood statements.

The authors and editors of this report did not develop likelihood statements independently. Here, all likelihood statements are quoted from three major assessments (IPCC AR4 WGI 2007, IPCC 2008, CCSP SAP 3.3) where long-term processes involving large panels of experts arrived at conclusions based on the best available science.

Statements quoted from IPCC AR4 WGI and the IPCC Technical Paper on Water use this convention:	Statements quoted from CCSP SAP 3.3 use an intentionally less discrete system:
virtually certain (>99%)	
extremely likely (>95%)	
very likely (>90%)	*very likely* (about 75–100%)
likely (>66%)	*likely* (about 60–75%)
*more likely than not** (>50%)	
*about as likely as not** (>33-66%)	
unlikely (<33%)	*unlikely* (about 25–40%)
very unlikely (<10%)	*very unlikely* (about 0–25%)
extremely unlikely (<5%)	
*exceptionally likely** (<1%)	

* these likelihood terms used by IPCC are not quoted in this report

Implication for Water Resource Managers

Climate change will affect Colorado's use and distribution of water. Water managers and planners currently face specific challenges that may be further exacerbated by projected climate changes. The implications of climate change in this report are consistent with the broader conclusions in the CCSP SAP 4.3, the IPCC Technical Paper on Water (2008), and the 2007 National Academy of Science Report "Colorado River Basin Water Management."

This report provides a scientific basis to support further studies of water resources impacts. However, the assessment and quantification of specific climate change impacts on water resources is beyond the scope of this document.

A synthesis of findings in this report suggests a reduction in total water supply by the mid-21st century. When combined with temperature increases and related changes in evaporation and soil moisture, all recent hydrologic projections show a decline in runoff for most of Colorado's river basins by the mid-21st century. (Section 6)

1
Introduction

In response to the risks associated with global warming, Governor Ritter issued the Colorado Climate Action Plan (CCAP) in 2007. The CCAP sets out a goal to prepare the state to adapt to those climate changes "that cannot be avoided" (CCAP 2007, p. 3). Recommendations in the CCAP include assessing the vulnerability of Colorado's water resources to climate change, analyzing impacts on interstate water compacts, and planning for extreme events such as drought and flooding.

This report is a synthesis of the state of the science regarding the physical aspects of climate change that are important for evaluating impacts on Colorado's water resources. It presents scientific analyses to support future investigations and state efforts to develop a water adaptation plan. Accordingly, the document focuses on observed trends, modeling, and projections of hydroclimatic variables—including temperature, precipitation, snowmelt, and runoff—that are important factors for water supply in the state. However, the geographic scope of the document does not end at the state's borders, because of Colorado's role as a headwaters for supply in the West. Projections focus on the mid-21st century, because this is a relevant planning horizon for adaptation strategies, but some projections are for earlier and later periods (Sidebar 1-1). This document is also intended to support other planning in the state including the State Water Supply Initiative, the Colorado River Water Availability Study, the Joint Front Range Climate Change Vulnerability Study, and the Governor's Conference on Managing Drought and Climate Risks.

Changes in Colorado's climate and implications for water resources are occurring in a global context. The IPCC Technical Paper on Water finds that on a global scale, observed warming has been linked to many changes in the water cycle. Climate models project that precipitation will increase at high latitudes and decrease in parts of the subtropics and lower midlatitudes. By the mid-21st century, average river runoff and water availability are projected to elevate at high latitudes and decrease over dry regions at lower midlatitudes such as the western United States. Increased precipitation intensity and variability are projected to elevate risks of floods and droughts. Water supplies in glaciers and snow cover are projected to decline in many areas of the world.

Changes in the quantity and quality of water may occur even in the absence of precipitation change. Current practices may not be robust enough to cope with climate change. The impacts of climate change challenge the

SIDEBAR 1-1. How to Interpret the Timescales in This Report

Many of the graphics and analyses in this report focus on recent trends and mid-21st century projections, but projections for other timeframes are important depending on the type of decision or planning horizon.

2008 (the present): Climate variations such as the recent drought may influence the results of trend analysis of the historical record. Many of the climate projections in this report show changes with respect to 1950–99 averages. During this period global and North American temperatures have already risen about 2°F, some of which can be attributed to anthropogenic causes.

2025: The projected warming in 2025 is roughly half that in 2050 (see FIGURES 5-2 through 5-7). In this timeframe, all greenhouse gas emissions scenarios lead to a similar range of temperature projections. Natural variability will play an important role in determining the climate of the next few decades. However, even relatively small shifts in the average climate can substantially change the risk of extreme events (FIGURE 1-1) such as heat and cold waves and drought.

2050: The climate projections for the differing greenhouse gas emissions scenarios start to diverge by 2050, but all projections still show a quantitatively similar range. Anthropogenic effects on climate variables are projected to be larger in 2050 than 2025 or the present. Therefore, the larger climate change signal will be more easily detected against the background of natural variability, and will further shift the risk of extreme events.

Beyond 2050: The future of Colorado's climate beyond 2050 depends on the greenhouse gas emissions path that the world follows. As the world warms, feedbacks in the climate system may further increase global greenhouse gas concentrations. Warming in Colorado may trigger changes in land cover that would alter regional climate. The possibility has been raised of large, potentially irreversible changes in the climate system particularly if global average temperatures increase more than a few degrees (e.g., Hanson et al. 2007).

FIGURE 1-1. Climate and Extreme Events

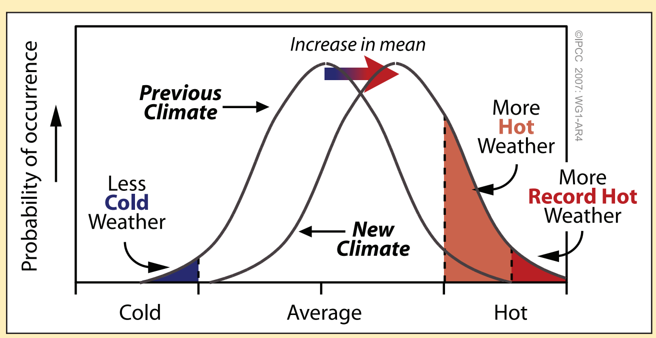

Fig. 1-1. Relatively small shifts in the average climate can substantially change the risk of extreme events such as heat and cold waves and drought. (IPCC AR4 WGI 2007)

assumption that past hydrology provides a good guide to the future. Furthermore, many gaps have been identified in observations, modeling, and applications research (IPCC 2008).

Context

Knowledge about climate and climate change is evolving; thus this report is a snapshot of the state of science at a key point in Colorado's history. The information reported here provides a basis for planning to adapt to higher temperatures and the consequences that will result, especially the impacts related to Colorado's water and forests. Like the Colorado Climate Action Plan, this is a living document, and should be updated as the science progresses.

Although many published studies and datasets include information about Colorado, there are few climate studies that focus on the state. Consequently, many important scientific analyses for Colorado have not been done. This report summarizes Colorado-specific findings from peer-reviewed regional studies, and presents new analyses derived from existing datasets and model projections. The state is home to many experts in climate and hydrology, and this report draws from ongoing work by these and many other scientists who are stepping up to the challenge of providing societally relevant studies to aid decision-makers.

This document takes advantage of recent research and syntheses of climate including the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4), the IPCC Technical Paper on Water (2008), and the U.S. Climate Change Science Program (CCSP) Synthesis and Assessment Products (SAP) from 2007 and 2008. The statements within this report that include an expert assessment of the likelihood of occurrence (Sidebar ES-1) have been extracted from these documents.

Water managers have a long history of adapting to changing circumstances, including changes in economies and land use, environmental concerns, and population growth. Climate change will further affect the decisions made about how Colorado uses and distributes its water. The report provides a scientific basis to support further studies of water resources impacts and adaptation efforts called for in the Governor's CCAP; the assessment of specific sensitivities and vulnerabilities of water supply and ecosystem impacts is beyond the scope of this report. Section 6 discusses the potential uses of the information in this report in assessment of climate risks and vulnerabilities and in integrated resource planning and adaptation.

Vulnerability assessments of water resources might include the risks of compact calls in Colorado's river basins, risks to supply within the state, or the risks of drought. Integrated planning processes following on these assessments might include mitigation planning to assess and prepare for drought, and developing mechanisms for each river basin to deal with potential compact calls.

Structure of the Report

Key findings of this report are summarized at the beginning of each section and in the Executive Summary that precedes the main document. You are of course encouraged to read the entire document, but less technical readers may find sufficient information in this Introduction, the Executive Summary, the key findings at the beginning of each section, and the figures.

The report begins with a description of the climate of Colorado, the observing systems and data available for study, and the observed trends in Colorado and the western United States for variables relevant to water resources (Section 2). Section 3 is an overview of climate models and theory intended to provide the background for later sections. Section 4 provides attribution of the principal causes of observed climate conditions including the recent multi-year drought. Section 5 then describes the global modeling projections for Colorado and the surrounding areas of the Intermountain West, and situates Colorado in the context of global climate change. It also describes how the complex topography of the state relates to interpreting and using climate change projections. Recent hydrologic projections for the Colorado River and other state resources are shown. Section 6 discusses the general implications of these findings for Colorado's water resources, although the assessment of specific impacts on water resources is beyond the scope of this report.

A glossary provides descriptions of some key climate terms, as well as an appendix of ongoing research efforts that may contribute in the near term to our understanding of climate change in Colorado. The details of data source and methods for each figure are available at **http://wwa.colorado.edu**.

2
The Observed Record of Colorado Climate

KEY POINTS

- Colorado's highly variable climate is a consequence of high elevations and the complex topography of the mountains, plains, and plateaus. Climate varies spatially and temporally, and different climatic variables fluctuate in distinct ways.
- In Colorado, statewide temperatures have increased about 2°F over 30 years. This synthesis is based on two methods estimating 2.1°F from 1977 to 2006 and 1.7°F from 1977 to 2006.
- In regions of Colorado, widespread warming is evident across most climate divisions in the 30-year period.
- In the last 50 years, the North Central Mountains warmed the most (+2.5°F), while temperatures in southwestern Colorado, including the San Juan Mountains, changed very little (+0.2°F). Minimum temperatures have warmed more than maximum temperatures during this period.
- In all parts of Colorado, no consistent long-term trends in annual precipitation have been detected in the time periods analyzed. Variability is high, which makes detection of trends difficult.
- A widespread and large increase in the proportion of precipitation falling as rain rather than snow and a reduction in snow water equivalent (SWE) have been observed elsewhere in the West between 1949 and 2004. In Colorado, however, these changes are smaller and not as statistically significant (Knowles et al. 2006). Most of the reduction in snowpack in the West has occurred below about 2500 m (about 8200 ft, Regonda et al. 2005). However, most of Colorado's snowpack is above this elevation, where winter temperatures remain well below freezing.
- Peak streamflows in the western United States are occurring earlier in the spring due to warming temperatures during spring months (Stewart et al. 2005, Hamlet et al. 2005). In Colorado, between 1978 and 2004, the spring pulse has shifted earlier by about two weeks (Clow 2007).
- Throughout the West, less frequent and less severe drought conditions have occurred during the 20th century than in the paleoclimate records covering the last 1000 years (Meko et al. 2007).

Observations are the basis for understanding past and recent climate variability, for modeling future climate, and for evaluating future climate scenarios. This discussion of observations is intended to provide a background in how observations are made, the variation inherent in Colorado's climate record, and the challenges in analyzing this record. This information provides a context for climate attribution and projections. This section also presents a brief overview of the climate of Colorado. For a discussion on the difference between climate and weather, see climate in the glossary.

This report describes a number of observational studies. Comparing these studies is inherently complicated because different researchers analyze different periods of record, which are determined in part by the data available, and by the problem they want to study. Extensive effort would be needed to re-analyze and homogenize the results, so we have merely stated the periods that the authors chose.

The results of these observational studies must be taken in the context of the years defining the period and the climatic events that may or may not be included in different records. Colorado's climate has been punctuated by several notable climatic events, including the Dust Bowl years (1930s), a relatively cool period from the 1950s to the 1970s, and the recent severe drought in which eight out of ten years (1999–2008) had below normal April 1 snow water equivalent (SWE). These variations may influence the results of ongoing analyses. This report presents 30-, 50-, 75-, and 100-year trend analyses.

2-1. Observing Systems in Colorado

The earliest instrumental weather observations in Colorado came from some of the early forts built on the western frontier. In 1870, the organization that later became the National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) established more weather stations in Colorado including Denver, Pueblo, and Pikes Peak. In the 1880s the Colorado State Legislature authorized the creation of the Colorado Weather Service, with a goal of better defining the weather and climate resources of Colorado. This network of dozens of urban and rural weather stations later became the State of Colorado National Weather Service Cooperative Observer (COOP) Network. NOAA's National Climatic Data Center (NCDC) is also concerned with tracking future climate and has recently deployed a special climate observing network called the Climate Reference Network, including six stations in Colorado (**http://www.ncdc.noaa.gov/oa/climate/uscrn/**).

There are currently ~250 weather stations in Colorado reporting to the NWS. These stations measure and report daily high and low temperatures, precipitation (rain and the melted water from snow and ice), snowfall, and total snow depth. Average daily temperature is computed as the mean of the minimum and maximum temperatures. Some of these weather stations report additional information such as wind, humidity, and cloud cover.

It is important to note that many of these observing systems were not constructed and maintained with the goal of detecting long-term climate trends. In this context, changes in instrumentation, station locations, time of measurement and other factors have affected interpretation of long-term datasets. Changes in the location of observing stations may affect long-term records. Of the ~250 current stations scattered across the state, only two are located in nearly the same place as they were when first established in the 1880s. Station moves can result in slight differences in the local climate observed, and may appear as a spurious "climate change" trend. The widespread transition from glass to electronic thermometers in the 1980s resulted in a cold shift, or bias, of about 0.5°F compared to periods prior to the instrumental change. An even larger cold bias can occur if the daily observing time is changed from the afternoon to the morning (Pielke et al. 2002), as has become more common in recent decades. Land use changes that affect local temperature are also common in Colorado, including year-round urban heat island effects and altered irrigation patterns, which impact temperatures during the growing season (Pielke et al. 2002). To further complicate the matter, changes in these parameters are not always documented (Pielke et al. 2007).

Long-term hydrologic records also face observational challenges. For example, snow data are subject to local weather modification efforts and vegetation growth near the site (Julander and Bricco 2006). Changes in instrumentation and the impact on stream gauges from changes in stream channel geometry and upstream diversions also complicate the picture.

Given the complications introduced by observing stations, climatologists spend a lot of time considering how to work with the best scientific data by routinely quality controlling datasets. Scientists have developed procedures for adjusting and accounting for observational bias (including instrumentation changes and station location) by culling aberrant records and applying calibration measures. It is important to note that the methodological processes meant to improve observational datasets are subject to scrutiny in the peer review process and have been vetted by the scientific community.

An extensive discussion of the records at some Colorado climate stations is provided in Pielke et al. (2002), who caution that, given local variability and station issues, trends at individual stations may not be representative of regional trends. Section 2-4 presents data from some individual stations, then analysis of regions of the state.

2-2. The Climate of Colorado

Colorado's climate is unlike that of any other state—it is characterized by the high elevations and complex topography of the Rocky Mountains, the Colorado plateau and valleys of the West Slope, and the high plains falling off from the Continental Divide towards the east (FIGURE 2-1). Climate varies in Colorado spatially across many regions, temporally across years and decades, and its temperature and precipitation histories differ across the state.

FIGURE 2-1. Annual Average Temperature and Precipitation in Colorado (1950–99)

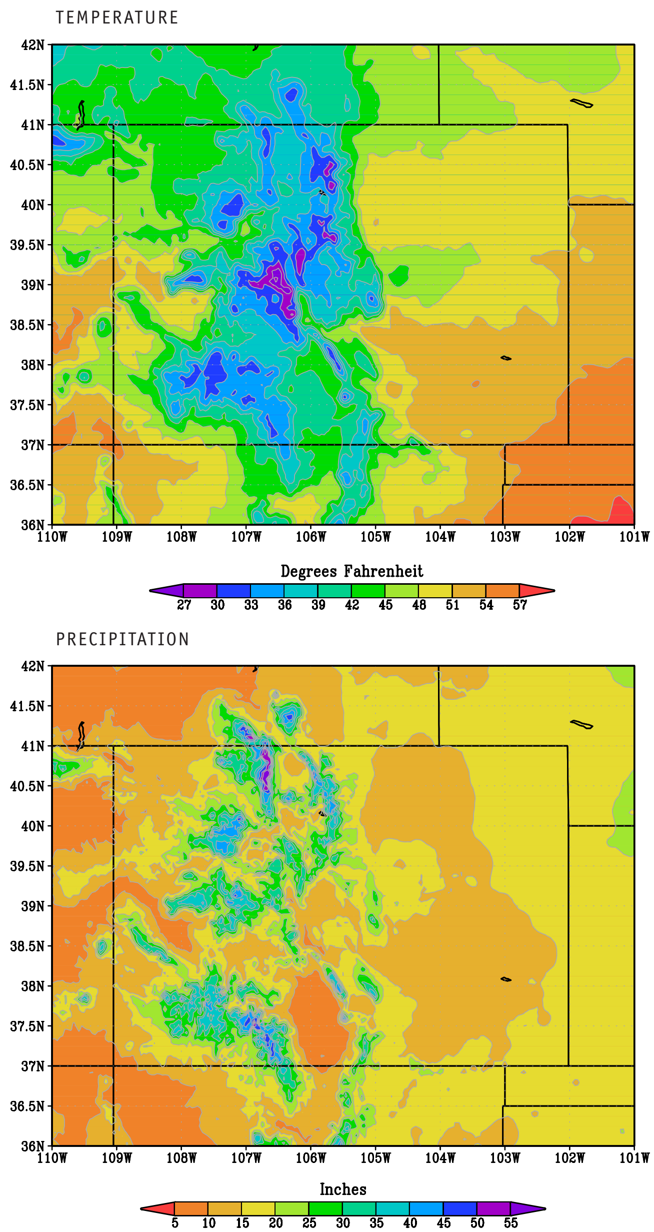

Fig. 2-1. Annual climatology (1950–99) of daily average temperature (°F) and precipitation (inches). See FIGURES 5-2 and 5-3 for January and July temperature climatologies. (Data: PRISM)

Different climate drivers influence temperature variability in different parts of the state. Western Colorado and interior mountain valley temperatures are greatly affected by the presence or absence of snow cover. In a year with deep and early snows, winter temperatures can dip to 6–10°F below average (N. Doesken, pers. comm.). The opposite (i.e., above average temperatures) may occur during winters with limited snow cover. For the high mountains, the influence of persistent upper-level ridges and troughs (regions of high and low atmospheric pressure, respectively) dominate temperature anomalies. East of the mountains the battle among subtropical, Pacific, and polar continental air masses determines which years are warmer or colder than average (Pielke et al. 2003).

The annual cycle dominates temperature variability (see FIGURES 5-2 and 5-3). Statewide, January is typically the coldest month of the year and July or August is the warmest. Temperatures vary widely from day to day and week to week, especially during the cooler months from mid-autumn to late spring. Winter temperatures are more variable than summer temperatures, and daytime temperatures are more variable than nighttime readings. The least variability occurs with summer minimum temperatures.

It is against the background of variability in temperature and precipitation (discussed in Section 2-6)that long-term climate records are analyzed to detect trends. Time series analysis, including trend analysis, uses statistical methods to analyze records spanning a period of time in order to assess whether or not there is a detectable trend. To determine whether there is an anomaly in one period of interest compared to another, scientists may compare a year or period of years to a base period or reference period climatologies. This reference period depends on the process or issue being studied, and the variability in the datasets. The IPCC used various periods, including 20- and 30-year averages; these data were global averages and included a considerable number of data points, therefore reducing variability (IPCC AR4 WGI 2007). For a smaller region or one with greater variability, a longer period may be needed in order to detect trends in a statistically robust way. Analyses generated for this report use 50-year (1950–99) climatologies where possible.

2-3. Local and Regional Climates of Colorado

Sections 2-3 and 2-4 describe Colorado's climate from the standpoint of individual stations, experimental Colorado climate divisions, and the official National Climatic Data Center (NCDC) divisions. All these analyses are based on data from the NWS COOP Observing Network.

An effort has been underway for several years to carefully scrutinize all of Colorado's long-term weather stations and identify which are best for historic time series analysis and trend detection. In collaboration with the Western Water Assessment (WWA), the Colorado Climate Center has categorized each station in Colorado according to suitability for trend analysis and detection. The Colorado Climate Center has developed a website specifically to view temperature and precipitation variations and trends for the best long-term datasets at stations in Colorado, including the data shown in FIGURES 2-2, 2-3, and 2-4 (**http://ccc.atmos.colostate.edu**).

To illustrate local variability in Colorado, nine stations were selected from 38 "better quality" stations through Colorado (FIGURES 2-2 and 2-3). These stations have 90-year or longer records in both temperature and precipitation, and comparatively fewer identified problems with station relocation, instrument changes, and missing observations, according to analysis by the Colorado Climate Center and the WWA. In contrast, stations in Denver, Colorado Springs, and throughout the central mountains relocated too frequently, or had other problems limiting their use in long-term analysis. The temperature records show

FIGURE 2-2. Temperature at Nine Observing Stations

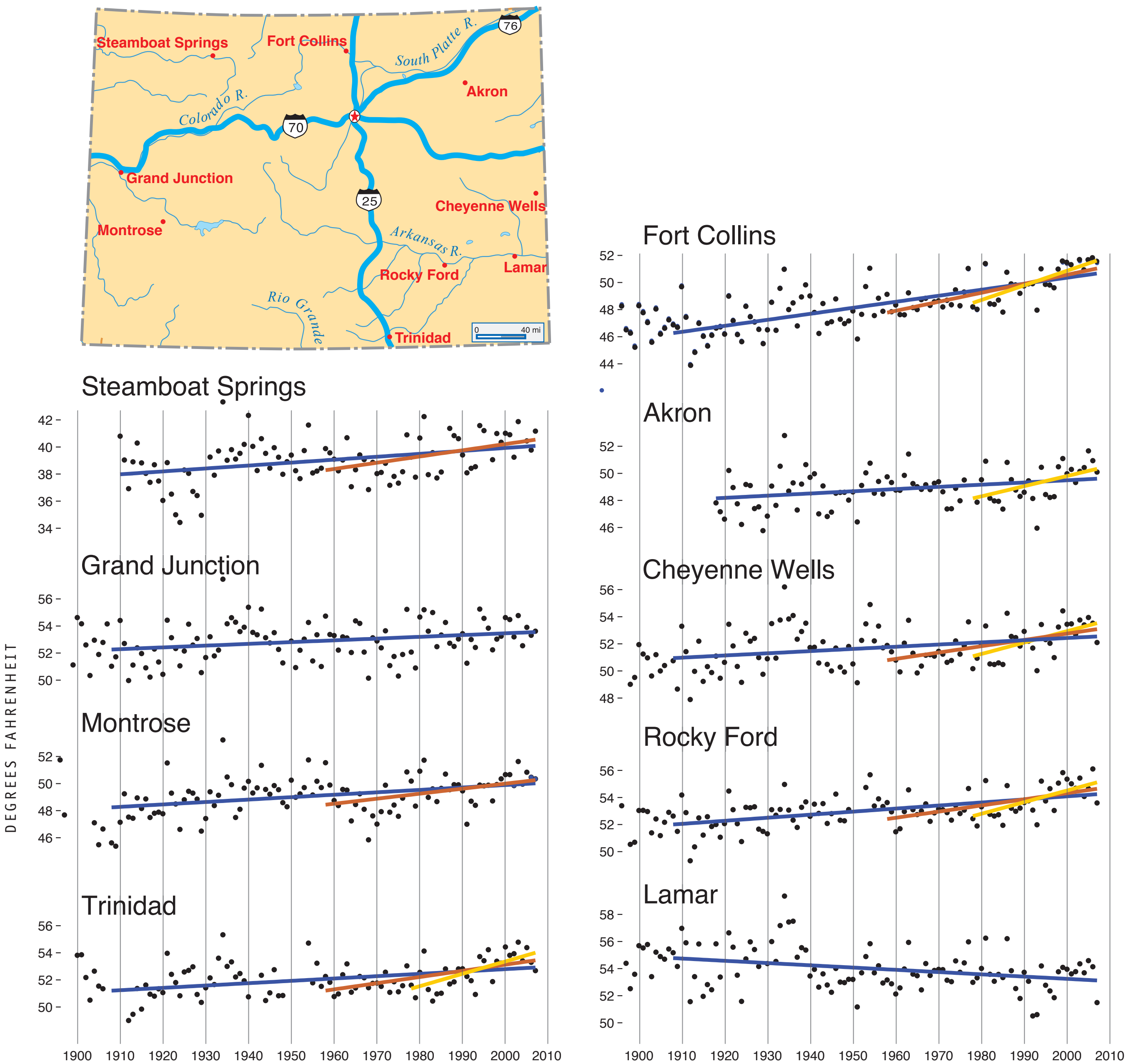

Fig. 2-2. Daily average temperature (°F), annually averaged, at nine observing stations in Colorado. Station locations are shown on the map of Colorado (top left). The 100-, 50-, and 30-year linear trends shown in blue, red, and yellow, respectively, are statistically significant (>97.5%); linear trends that are not significant are not shown. If less than 100 years of data were available, the full period of record was used to calculate the trend shown in blue. Of the 27 trends generated, 19 are increasing, one is decreasing (100-year trend at Lamar), and seven were not statistically significant.

the linear regression for the 30-, 50-, and 100-year trends in the mean (Figure 2-2), and the precipitation records (Figure 2-3) show the 10-year moving average.

Variability is apparent at all locations, and is comparatively smaller in the temperature record than the precipitation record. When added up over an entire year, the mean temperature at each location falls within a few °F of its long-term average. Statistically significant trends are detected in the temperature record when the trend emerges from the variability. Of 27 trend lines computed (100-, 50-, and 30-year time periods, at nine stations), 19 are increasing, one is decreasing (100-year trend at Lamar), and seven were not statistically significant. In all parts of Colorado, no consistent long-term trends in annual precipitation

FIGURE 2-3. Water Year Precipitation at Nine Observing Stations

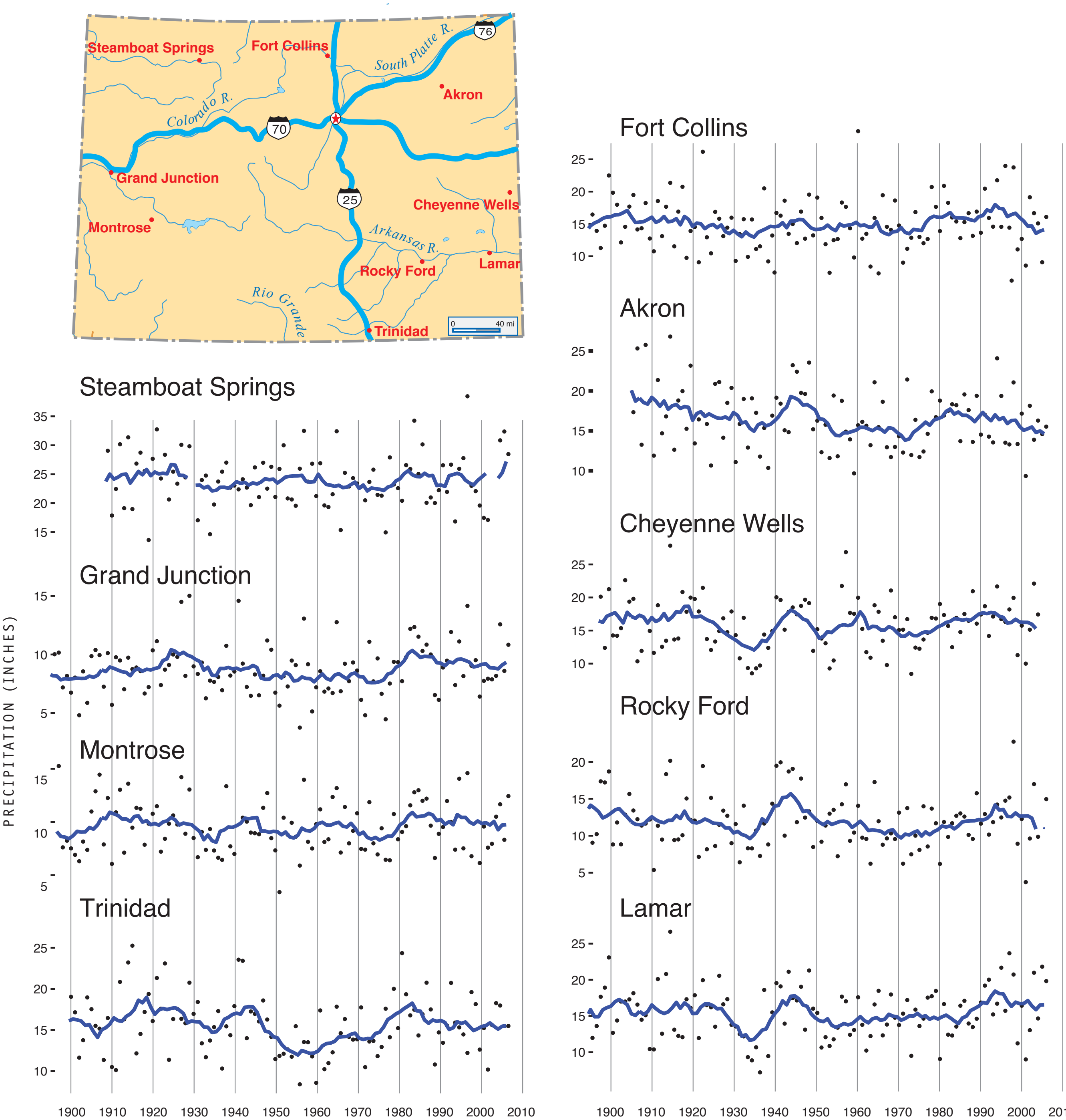

Fig. 2-3. Water year precipitation (inches) at nine observing stations around Colorado. Station locations are shown on the map of Colorado *(top left)*. Overall long-term trends are not detectable at the stations. The 10-year moving average of available data *(solid blue line)* is shown to emphasize decadal variations. Shorter-term changes, such as the droughts of the 1930s, 1950s, and the early 2000s, are apparent at some stations.

have been detected in the time periods analyzed. Seasonal trends have not been analyzed at these locations, but may be of interest to water managers.

Climatic trends at individual stations may not be representative of regional climate because of local processes at those stations (FIGURES 2-2 and 2-3). For this reason, climatologists assess long-term regional variability by grouping observing stations together. Regional trends may emerge (e.g., be statistically detectable) when the records from these stations are averaged together.

The NOAA National Climatic Data Center (NCDC) five official climate divisions group Colorado climate data into regions by river basins, but these divisions are not necessarily representative of the complex regional climates in the state. A new set of climate divisions has been developed (Wolter and Allured 2007). These new divisions are based on groups of observing stations that vary in a similar manner from year to year, and are thought to reflect similar regional climate processes. Sufficient data are available to construct time series of temperature for most of these new climate divisions back to the early 1930s. The averages calculated from the better quality observing records within each division help to detect regional temperature trends by eliminating local processes that are not indicative of regional climate at each observing station.

Temperature trends were computed for these new climate divisions for selected time periods (75-, 50-, and 30-year periods) or the whole record (FIGURE 2-4). Regionally, the north-central part of the state has been warming the fastest (a +2.5°F change in the annual average over the past

FIGURE 2-4. Colorado Regional Temperature Trends

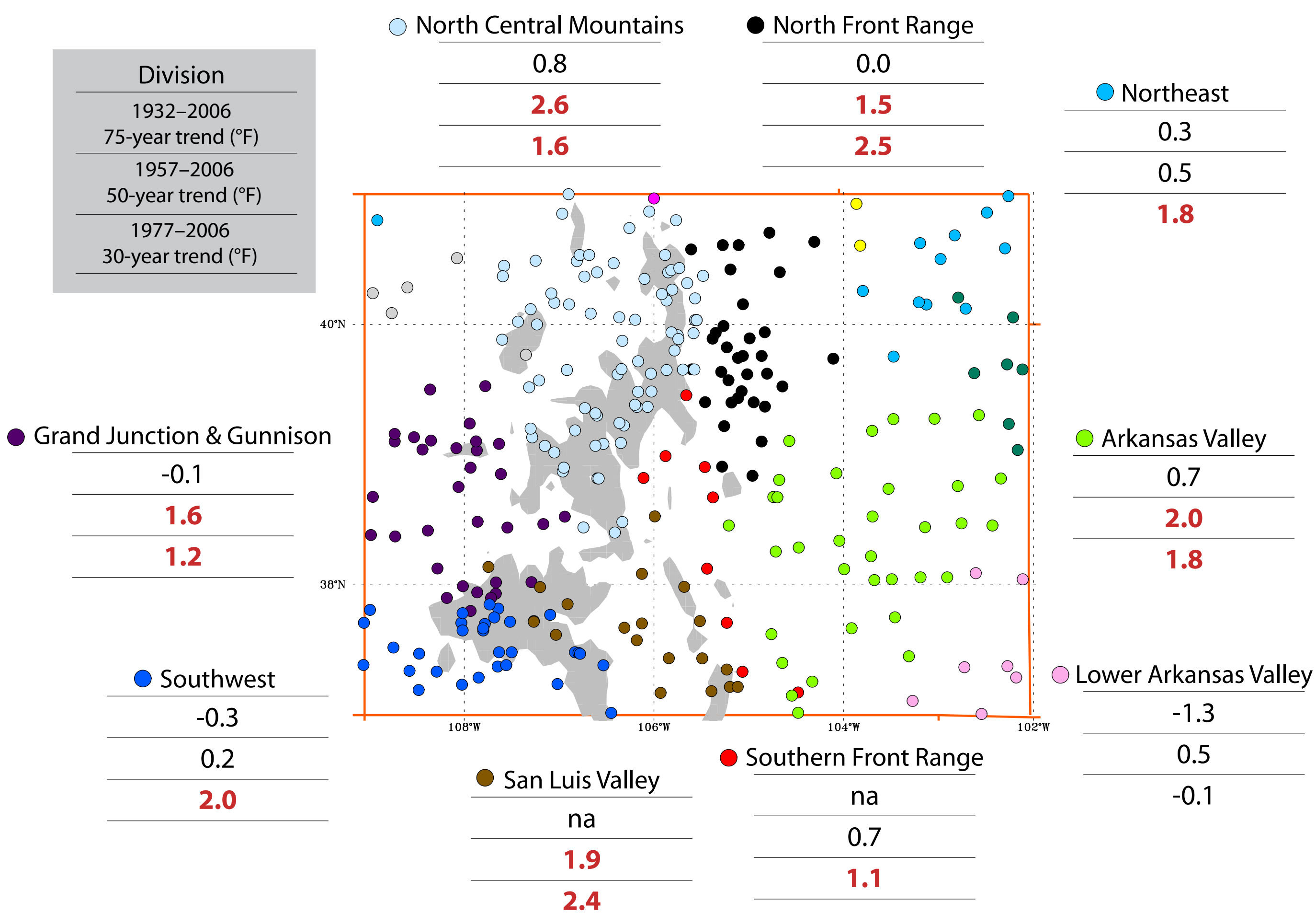

Fig. 2-4. Regional trends in annual average temperature (°F) for experimental climate divisions in Colorado. Groups of stations with similar climates comprise the divisions indicated by colored circles; there are no delineated geographic boundaries. Gray shading indicates terrain at an elevation higher than 9850 feet (3000 m). The tables show temperature changes for the 30-, 50-, and 75-year periods ending in 2006, as determined from linear trend analysis. Statistically significant trends (>95%; see the online Methods Supplement) are shown in red (warming) and blue (cooling). Trends were computed by averaging observations from a subset of locations within each division (between three and seven stations, depending on the division) that met quality control requirements. Although some divisions extend beyond the state's borders, only stations within Colorado were used to determine trends. Insufficient data were available to calculate 75-year trends for the San Luis Valley and the Southern Front Range divisions. Significant warming is evident in most divisions in the past 30 and 50 years.

50 years), while the southwestern corner has warmed the slowest over the same time period (+0.2°F). The most striking trends are for the most recent 30-year period (1977–2006), about a +2°F change during this period for most of the state, except the Lower Arkansas Valley (pink circles, FIGURE 2-4) climate division in the southeast corner of the state. This division also shows a regional cooling trend for the 75-year period. This period begins during the 1930s Dust Bowl years in Colorado, which were some of the warmest years on record for many stations. This division extends well beyond the state's borders; only two stations, Holly and Lamar were used to compute the regional average. Pielke et al. (2002, 2007) discuss problems with the observational record at these stations, including changes in observation time that may have introduced a cold bias. Using a larger selection of COOP stations in this division in Colorado and in neighboring states yields the following linear trends: 1932–2006 (-1.4°F), 1957–2006 (+0.1°F), 1977–2006 (+0.7°F).

Minimum temperatures show greater overall warming than maximum temperatures in the last 50 years. Analysis of seasonal trends for minimum and maximum temperatures for Northern Colorado Mountains and the Arkansas Valley (green circles, FIGURE 2-4) show upward trends in minimum temperatures in all seasons, with the largest trends in spring (TABLE 2-1). This finding is consistent with Knowles et al. (2006) who also found large and widespread warming trends in the intermountain west in March over a similar period. Across the state, winters also warmed during this 50-year period, but this trend is less pronounced than for spring.

TABLE 2-1: Seasonal Temperature Trends (1957–2006) in the Northern Colorado Mountains and the Arkansas Valley

		winter	*spring*	*summer*	*autumn*	*annual*
Arkansas Valley	Tmax	+2.1	**+3.8**	+0.4	+1.0	**+1.8**
	Tmin	**+3.2**	**+3.0**	**+1.4**	**+1.4**	**+2.2**
North Central Mountains	Tmax	+1.3	**+4.6**	**+1.8**	- 0.1	**+1.9**
	Tmin	**+2.7**	**+4.7**	**+3.0**	**+2.7**	**+3.2**

The observed trend in average maximum (Tmin) and minimum temperatures (Tmax) from 1957 to 2006 for the Arkansas Valley and the North Central Mountains experimental climate divisions. Locations of the divisions are shown in FIGURE 2-4. The 50-year trends for individual seasons and the annual mean are shown. Statistically significant *(red)* warming trends are evident in all seasons for Tmin. Springtime trends for Tmin and Tmax are particularly large.

2-4. Statewide Average Temperature, 1930s to present

Colorado's climate since 1930 shows a warm period in the 1930s and the 1950s, a cool period though the 1960s and 1970s, and a consistent upward trend in the 10-year average since about 1970 (FIGURE 2-5). The temperature has increased by +2.0°F from 1957 to 2006 (50 years), and by +2.1°F from 1977 to 2006 (30 years). These trends are based on the NCDC traditional climate division data.

This estimate can be compared with an alternate calculation using spatial averages of the experimental climate divisions (see FIGURE 2-4) that are based on unadjusted COOP station data. This calculation results in statewide linear trends of +1.6°F from 1957 to 2006 and +1.7°F from 1977 to 2006. Although the analysis methods and choice of dataset lead to the differing estimates of statewide trends, these methods converge on a statewide temperature increase of about 2°F. The above trends were calculated by fitting a straight line through the data. Temperatures changes between the beginning and the end of these periods show similar results.

FIGURE 2-5. Colorado Annual Mean Temperatures (°F) for 1930–2007

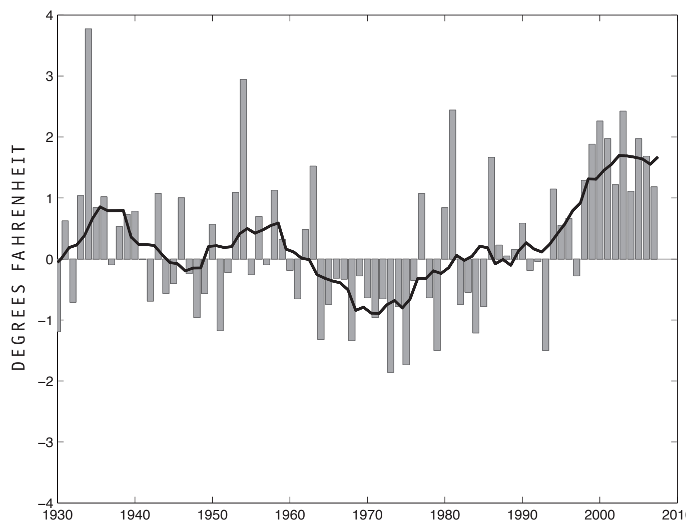

Fig. 2-5. Colorado annual mean temperatures (°F) from 1930 to 2007. Annual departures are shown as gray bars relative to a 1950–1999 reference period. The 10-year moving average of available data (black curve) highlights low frequency variations in the record. Warm periods occurred in Colorado in the 1930s and the 1950s, followed by a cool period through the 1960s and 1970s. Since about 1970, there has been a consistent upward trend in the 10-year average. (Data source: NCDC Climate Divisions, see http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp)

FIGURE 2-6. Temperature Trend and Elevation (1979–2006)

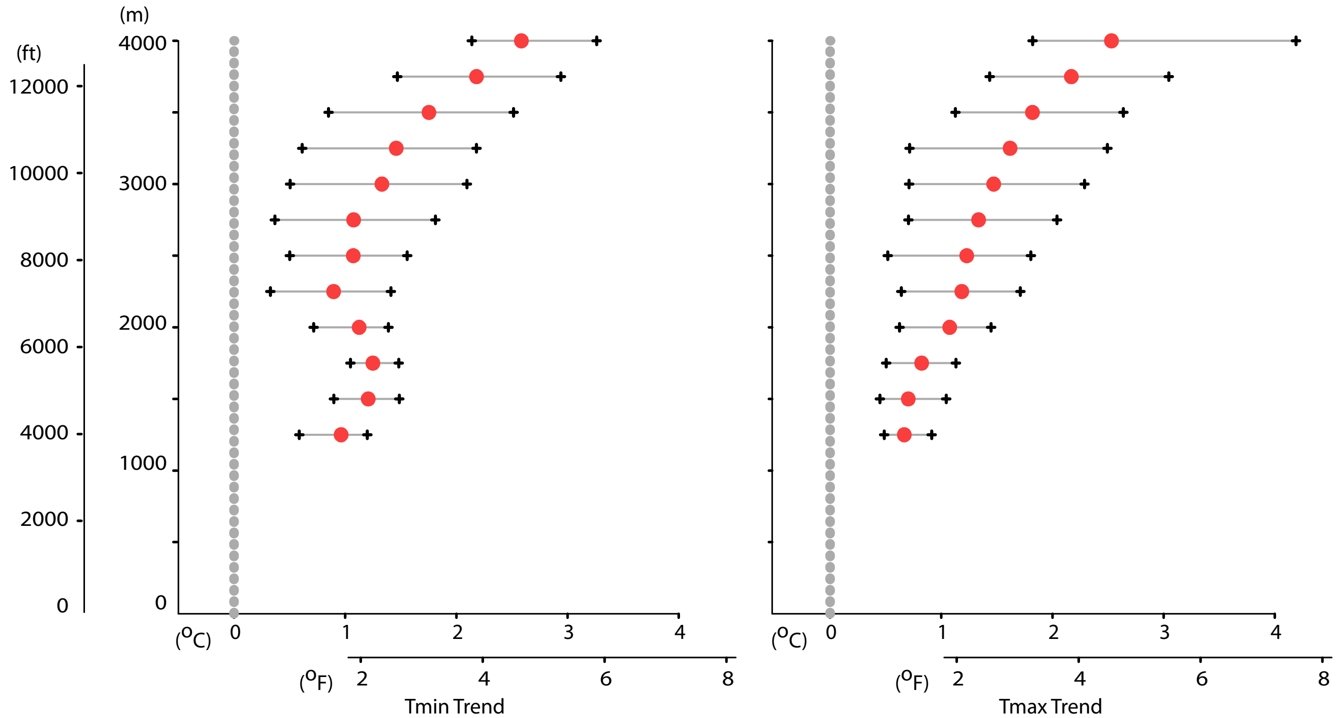

Fig. 2-6. Dependence of temperature trends on elevation. Annual mean daily minimum *(left panel)* and maximum *(right panel)* temperature trend (1979–2006) plotted in successive 250-meter elevation bands. The red dot is the median trend over the period of analysis at all locations within its elevation band; the crosses are the approximate 5th and 95th percentile values, and represent the range of trends throughout the state in the elevation band. The dotted line is zero trend or no change. (Diaz and Eischeid 2007)

2-5. Elevation

Another regional view of temperature is its relationship with elevation. Temperature typically decreases as elevation increases, and temperature is a significant factor in defining the ecosystems and habitats at different elevations. Diaz and Eischeid (2007) analyzed the temperature record using the Parameter-elevation Regressions on Independent Slopes Model dataset (PRISM; **http://www.prism.oregonstate.edu/**). They find larger warming trends at high elevations (Figure 2-6). Few reliable long-term surface air temperature records are available above 9850 feet (3000 m). PRISM temperatures at these elevations are estimated from in situ observations at lower elevation and from free-atmosphere (above the land surface) temperatures. The magnitude of estimated temperature trends from Diaz and Eischeid (2007) may not be consistent with in situ observational data from alpine locations, such as Niwot Ridge in Boulder County (>11,000 ft) and Loch Vale in Rocky Mountain National Park (>10,000 ft) (J. Baron pers. comm., M. Williams pers. comm.).

2-6. Trends in Hydroclimatic Variables: Temperature, Precipitation, Snow, and Streamflow

Colorado's temperature trends are consistent with multiple independent analyses showing widespread warming in the West (CCSP SAP 4.3 2008; Udall and Bates 2007; Mote et al. 2005; Stewart et al. 2005; Diaz and Eischeid 2007). However, a few sites in the southern San Juan Mountains show cooling (Mote et al. 2005). Regonda et al. (2005) observed that the onset of spring warm spells (defined as seven days greater than 53°F/12°C) shifted to an earlier date over the period 1950–99. Knowles et al. (2006) found positive temperature trends at the vast majority of stations across the West. The greatest warming was generally observed at the higher elevations in the Interior West, with the most warming observed in March (Figure 2-7; for other months see Knowles et al. 2006).

FIGURE 2-7. Trend in March Average Minimum Temperature on Days with Precipitation (1949–2004)

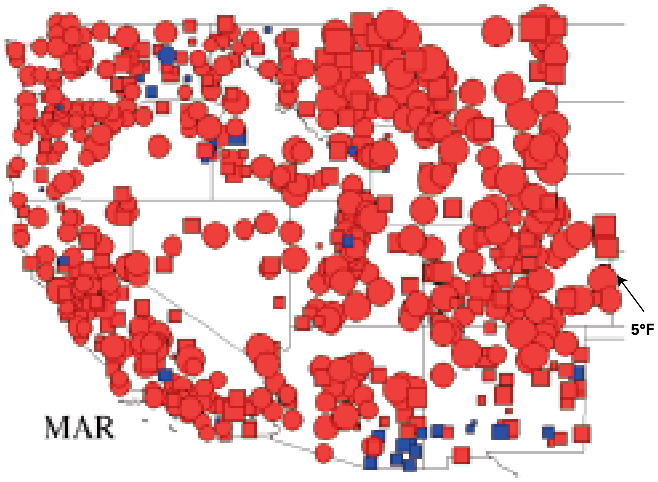

Fig. 2-7. Trend in March average minimum temperature on days with precipitation (1949–2004, the latest data available at the time of analysis). Red indicates an increase in temperature and blue indicates a decrease. The size of the circle is proportional to the temperature change. For scale, the arrow indicates a 5°F change. The circles represent statistically significant findings and the squares are not significant. (from Knowles et. al. 2006, FIGURE 9)

Water year precipitation ranges from roughly half the long-term average in a dry year to double the average in a wet year and varies across the state (see Figure 2-3). The El Niño Southern Oscillation (ENSO) has correlations with precipitation that vary regionally across Colorado (**http://www.cdc.noaa.gov/Climaterisks/**), but do not dominate the variability on annual and longer time scales (Wolter 2008). Eastern Colorado is dominated by warm season precipitation, largely a result of localized convective storms. The lower elevations of southern and central Colorado receive significant precipitation from late summer storms, while statewide, the mountains are dominated by winter and spring precipitation.

A widespread increase in the proportion of precipitation falling as rain rather than snow has been found in the winter months throughout the Western United States from 1949 to 2004; however, the data are highly variable for Colorado (Knowles et al. 2006; Figure 2-8).

At gauges throughout the West, there has been either no detected trend or a slightly increasing trend in mean annual streamflow over the period 1948–2002 (Stewart et al. 2005). In contrast, Walter et al. (2004) find a decrease in Colorado River Basin flow (1950–2000), although the trend is not statistically significant. For Colorado, Clow (2007) found that snowmelt and runoff timing shifted about two weeks earlier from 1978 to 2004, with the strongest trends in the western and southern regions of Colorado, and weak trends in the Northern Front Range. Stewart et al. (2005) also find a consistent one-to-four-week earlier shift in the spring pulse onset. Both studies (Clow 2007; Stewart et al. 2005) attribute changes in snowmelt timing to springtime warming. Hamlet et al. (2005) uses modeled runoff based on observed meteorological data and drew the same conclusion. Regonda et al. (2005) observed that between 1950 and 1999, the onset of runoff in Colorado trended toward later dates, but these data do not include the recent Colorado drought years.

Looking beyond mean streamflows, Pagano and Garen (2005) found increases in April–September streamflow variability in Colorado (the USGS gauge on the White River near Meeker, 1943–2002) which they attribute to increasing variability in spring precipitation. They also find an increase in year-to-year persistence of high or low flows.

Snow water equivalent (SWE) is a measure of the amount of water in the snowpack. SWE is measured at SNOTEL and snow course sites across the West by the Natural Resource Conservation Service (NRCS). Mote et al. (2005) and Regonda et al. (2005) have both studied trends in April 1 SWE in the West. While declining SWE is detected in other parts of the West, no spatially coherent trends were found in Colorado and some stations in Colorado recorded increases. Hamlet et al. (2005) concluded that those stations reporting increased SWE were associated with modest upward precipitation trends, and that widespread warming caused many of the downward trends in SWE.

Elevation and temperature are factors in the evolution of snowpack. Regonda et al. (2005) found that stations in the western United States below 2500 m (8200 ft) exhibited the largest decreases in SWE at March 1, April 1, and May 1. Much of Colorado's snowpack is above this elevation where winter temperatures remain well below freezing; note that

FIGURE 2-8. Trend in Snow vs. Rain in Winter (1949–2004)

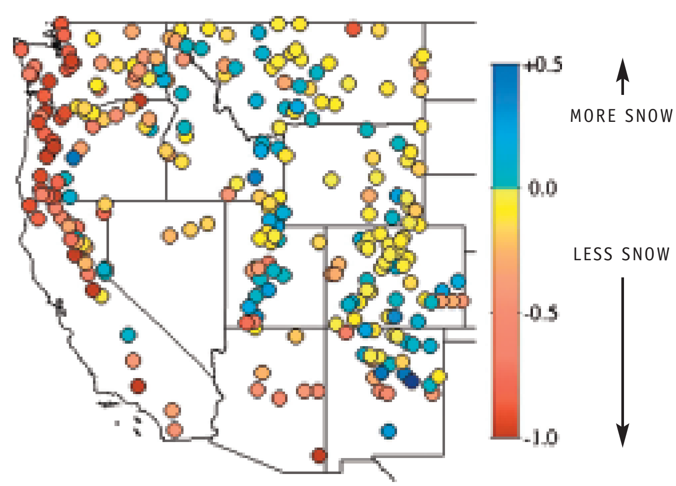

Fig. 2-8. Changes in the fraction of winter precipitation falling as snow vs. rain (1949–2004), after correcting for trends in precipitation amount. Blues indicates increasing fraction of snow; yellow decreasing fraction. Data are from NWS COOP stations. (from Knowles et. al. 2006, FIGURE 7)

SIDEBAR 2-1. Paleoclimate

Paleoclimate refers to climate during the period prior to the beginning of instrumental records—in Colorado, before the late 1800s. Various environmental indicators or "proxies" can be used to reconstruct paleoclimatic variability extending back hundreds or thousands of years.

In particular, the growth of trees in many parts of Colorado and the West closely reflects annual moisture variability, so tree-ring records can be used to reconstruct, or extend, gaged records of annual streamflow. These streamflow reconstructions can provide water managers and stakeholders with a much longer window—500 years and more—into the past hydrologic variability of a river system, and thus have the potential to inform sustainable management of water resources. The reconstructions indicate that more severe and sustained droughts occurred in the centuries prior to 1900 than those seen in the gaged records, including the most recent drought (FIGURE 2.9).

For more information on streamflow reconstructions, including access to data for Colorado and the upper Colorado River basin, see the WWA TreeFlow pages: http://wwa.colorado.edu/treeflow/. Woodhouse and Lukas (2006) provide streamflow reconstructions at 14 gauges in the Upper Colorado and South Platte River basins.

FIGURE 2-9. Reconstruction of Streamflow for the Colorado River at Lees Ferry

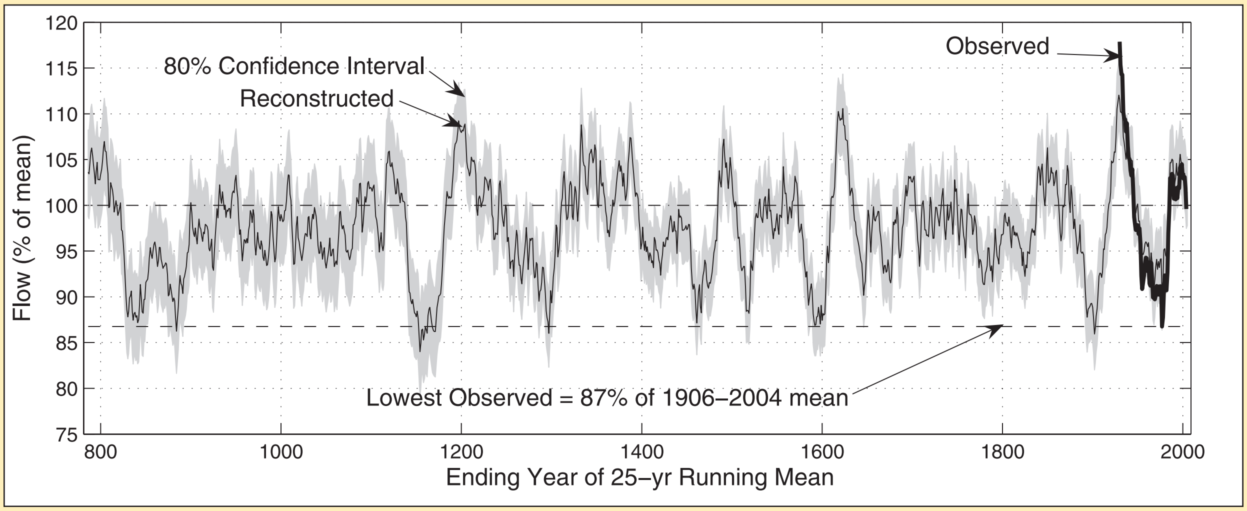

Fig. 2-9. A reconstruction of streamflow for the Colorado River at Lees Ferry (five-year moving average, with 80% confidence interval shown as gray band) is compared with the observed natural flow record (five-year moving average in black). The severity of the 2000–04 drought was probably exceeded at least once in the previous 500 years. (from Meko et al. 2007)

about 70% of the Colorado River Basin annual runoff is contributed by this higher-elevation snowpack. Therefore the statewide average snowpack in Colorado does not show the declines that have been observed at lower elevation mountains elsewhere in the West (Udall and Bates 2007).

These studies also illustrate how analysis of trends may be influenced by the period studied and by anomalies occurring during and after the period studied. For example, all but the most recent studies were completed before data was available from parts of the continuing 2000s drought, and all published analyses were completed before data on the record-setting snows of 2007–08 were available. Furthermore, analysis of year-to-year variations using SWE observations from any single month without seasonal context (e.g., March 1, April 1, and May 1) may not reflect changes in the seasonal evolution of snowpack.

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2-7. Extremes

A recent CCSP synthesis report presents a comprehensive assessment of the scientific literature for extremes in all of North America (CCSP SAP 3.3). For temperature trends, the report notes "a shift towards a warmer climate with an increase in extreme high temperatures and a reduction in extreme low temperatures. These changes have been especially apparent in the western half of North America" (CCSP SAP 3.3, P. 3). An increase in the number of heat waves nationwide has been detected over the past 50 years, but the report notes "the heat waves of the 1930s remain the most severe in the U.S. historical record" (CCSP SAP 3.3, p. 3). While there are no published recent studies on trends in heat waves in Colorado, the observed warming over Colorado is consistent with these findings. Even so, at many locations in Colorado, the extreme temperatures of the 1930s have yet to be surpassed. The number of frost days has been decreasing and the frost-free season has been lengthening, "particularly in the western part of North America" (CCSP SAP 3.3, p. 35). However, Kunkel et al. (2004) reports small (<3 days) observed changes in frost-free season length over much of Colorado; the much larger trends are located in regions to the west of Colorado. Increases in the frequency and intensity of extreme precipitation events (heavy downpours) were noted in most of the United States, however there were no significant trends detected for Colorado (Groisman et al. 2005).

A multi-year drought has occurred throughout the western United States since the late 1990s. This type of extreme event is covered in detail in Section 4.

SIDEBAR 2-2: IPCC Technical Paper on Water

Besides producing overarching assessments on global climate (e.g., IPCC AR4 2007) at the request of member nations, the IPCC will assess more detailed topics related to climate change. In July 2008, the IPCC publicly released the Technical Paper on Water (2008), which assesses the relationship between climate change and water resources. From the report, it is clear that "observational records and climate projections provide abundant evidence that freshwater resources are vulnerable and have the potential to be strongly impacted by climate change, with wide-ranging consequences for human societies and ecosystems" (IPCC 2008, p. 3). The report provides a case study on the Colorado River as an illustration of the importance of water–climate interactions in decision-making. Below is an excerpt from that section:

"As is widely documented, the allocation of Colorado River water to basin states occurred during the wettest period in over 400 years (i.e., 1905–25). The recent western drought has affected 30–40% of the region under severe drought since 1999, and the lowest 5-year period of Colorado River flow on record occurring from 2000 to 2004. At the same time, the states of the south-west USA are experiencing some of the most rapid growth in the country, with attendant social, economic and environmental demands on water resources, accompanied by associated legal conflicts (Pulwarty et al. 2005).

"Only a small portion of the full Colorado Basin area (about 15%) supplies most (85%) of its flow. Estimates show that, with increased climatic warming and evaporation, concurrent runoff decreases would reach 30% during the 21st century (Milly et al. 2005). Under such conditions, together with projected withdrawals, the requirements of the Colorado River Compact may only be met 60–75% of the time by 2025 (Christensen et al. 2004). Some studies estimate that, by 2050, the average moisture conditions in the south-western USA could equal the conditions observed in the 1950s. These changes could occur as a consequence of increased temperatures (through increased sublimation, evaporation and soil moisture reduction), even if precipitation levels remain fairly constant. Some researchers argue that these assessments, because of model choice, may actually underestimate future declines.

"Most scenarios of Colorado River flow at Lees Ferry (which separates the upper from the lower basin) indicate that, within 20 years, discharge may be insufficient to meet current consumptive water resource demands. The recent experience illustrates that 'critical' conditions already exist in the basin (Pulwarty et al. 2005). Climate variability and change, together with increasing development pressures, will result in drought impacts that are beyond the institutional experience in the region and will exacerbate conflicts among water users." (IPCC 2008, p. 105)

3
A Primer on Climate Models, Emissions Scenarios, and Downscaling

KEY POINTS

- **Climate models have improved in their ability to simulate the climate, even as the modeling community has set more demanding goals (Reichler and Kim 2008).**
- **A number of climate models are available from different research groups and countries, each with strengths and weaknesses in simulating different processes. For a set of model simulations, the average of all the models is consistently more accurate than any individual result. In projecting Colorado's water future, it is very important to compare a range of results from different models, and to consider multi-model averages.**
- **For planning horizons up to about mid-century, emissions scenarios result in a quantitatively similar range of projections of global and regional climate change. Consequently, the implications of the three scenarios (SRES B1, A1B, A2) are similar to one another for 25- to 50-year planning and adaptation horizons. These scenarios diverge in the latter half of the 21st century.**
- **The global climate models do not represent the complexity of Colorado's topography. However, they do simulate the large-scale climate processes that affect mountainous regions, including winter storm tracks.**
- **Downscaling techniques are being used to study processes that matter to Colorado water resource managers, since these methods can adjust for the effects of elevation and the mountains on snowfall and temperature.**
- **Projects are underway to improve understanding of the local processes that affect Colorado. These include developing better statistical downscaling methods, and enhanced climate modeling efforts to include finer spatial resolution that better represents Colorado's mountainous terrain.**

3-1. Anatomy of a Climate Model

Precipitation, wind, cloudiness, the ocean currents, air, and water temperatures—these and other variables evolve in time and space governed by physical, chemical, and biological processes. The processes included in the global climate models are quite varied. From the climate modeler's standpoint, these myriad processes have one thing in common—they can be expressed in terms of mathematical equations derived from scientific laws, empirical data, and observations. These equations are converted into computer code, and along with information about the Earth's geography (e.g., topography, vegetation), form the basis of a climate model.

In order to understand how a climate model is constructed, it helps to think of the Earth's climate as a complex system of many interacting parts: the atmosphere, the oceans, the cryosphere (sea-ice, land ice), the land surface, etc. "Component models" for each of these parts have been developed and are continually refined at more than a dozen scientific centers worldwide. Atmosphere models have been around the longest, having evolved during the 1960s from the first weather prediction computer models developed a decade earlier. Both weather models and the atmospheric component of climate models have at their cores the equations for fluid (air) motion and the first law of thermodynamics, and they represent similar processes; but the similarities end here. Relative to climate models, weather models cover a limited geographical area at greater spatial resolution for a shorter forecast period. Because climate is a global phenomenon, climate models cover the entire Earth, at a relatively lower spatial resolution, and simulate tens to hundreds of years of time.

The original climate models were referred to as General Circulation Models (GCMs) because of their ability to simulate the time evolution of the winds ("circulation"), temperatures, and atmospheric pressures simultaneously over the whole globe (GCM is also used as an abbreviation for Global Climate Model). Initially the models were crude representations of the Earth's climate with a very coarse model grid. As computer power and scientific understanding increased, the climate models became more refined in their ability to depict spatial detail and included more detailed process models. Oceanic "OGCMs" built to simulate ocean

FIGURE 3-1. Hydrologic Component of GCMs

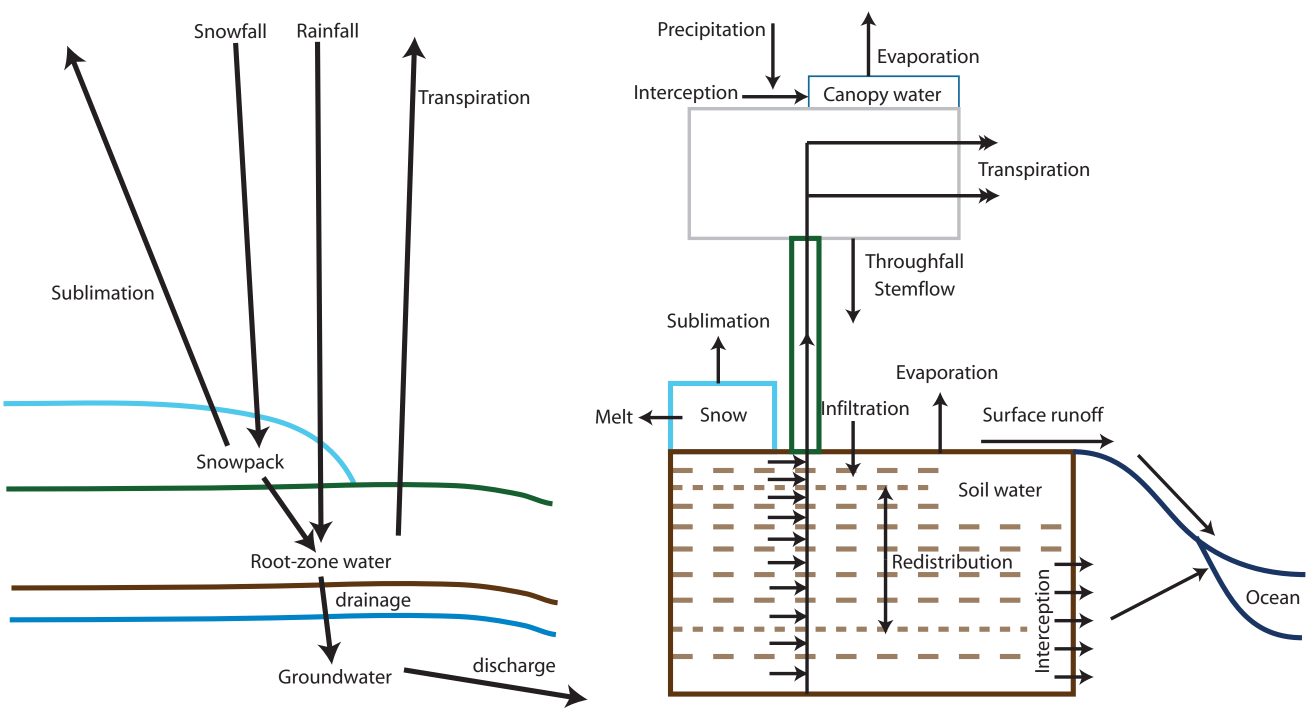


Fig. 3-1. The hydrologic component of GCMs differs in their formulation and detail. The National Center for Atmospheric Research (NCAR) Community Climate System Model (CCSM3, *right*) contains a surface hydrology model with 6 soil layers and a sophisticated biophysical model that tracks 11 categories of surface vegetation and soil type within each gridbox. The NOAA Geophysical Fluid Dynamics Laboratory (GFDL) model *(left)* represents a different philosophy, with three lumped reservoirs of water in each gridbox (snowpack, root zone, and groundwater). Only a handful of climate models still use a simple "bucket" model of hydrology; almost all models contain a river-routing model. See Chapter 8 in IPCC AR4 WGI (2007) and http://www-pcmdi.llnl.gov/ipcc/about_ipcc.php for more information on hydrology components of GCMs. (Source: GFDL model adapted from Milly and Shmakin 2002, NCAR model adapted from Oleson et al. 2008)

SIDEBAR 3-1: Time and Space in Models

Climate models are marched forward at discrete time intervals, called "timesteps." Timesteps can range from a few minutes to an hour, depending on the spatial resolution of the model. The models generate enormous amounts of data output that could easily amount to hundreds of terabytes for a single run. To put this in perspective, a single terabyte is equivalent to the storage capacity of about four typical desktop computers. Often, only a subset of the output, such as daily or monthly mean values, is archived. For the comprehensive archive of model simulations analyzed in the IPCC AR4, monthly averaged values for dozens of model variables are available from 22 climate models, while daily averaged values are available for certain time periods and for selected variables from a smaller subset of these models. (http://www-pcmdi.llnl.gov/ipcc/about_ipcc.php)

Because of the complexity of the mathematical equations in climate models, these equations can only be solved approximately, even on the most powerful super computers. In order to determine the most precise result within this limitation, climate models typically divide the globe—the atmosphere and the oceans—into a grid in the horizontal and vertical, creating so-called "gridboxes" (FIGURE 3-2). The finer the grid, the higher the spatial resolution, and the more computer power required to run the simulations. Many climate processes take place at spatial scales much smaller than a model gridbox. The term-of-art for the expression of the "sub-grid" processes in terms of parameters that are resolved at the spatial scale of the gridbox is "parameterization." Choice of the methods used in parameterization can have a sizable impact on a model's climate simulations.

FIGURE 3-2. Model Grid for the Atmosphere Component

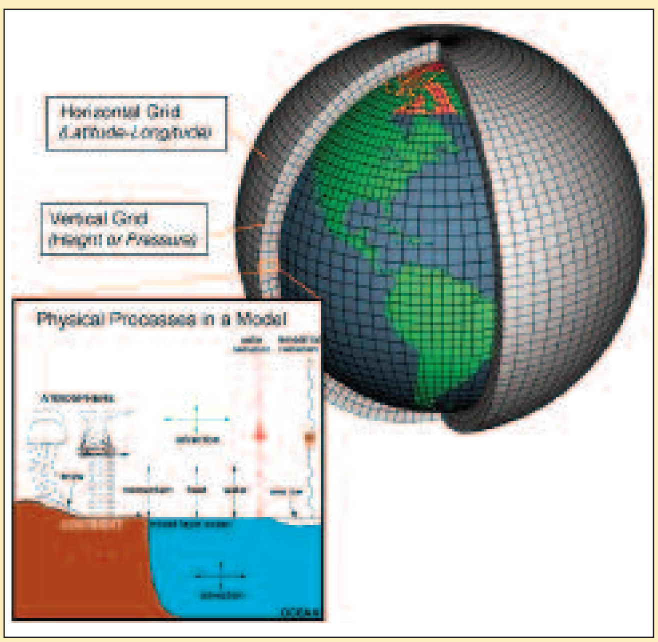


Fig. 3-2. Illustration of the model grid for the atmosphere component. Typical grid for global climate models analyzed in the IPCC AR4 WGI (2007) is about 180 mi (300 km) in the horizontal with ~25 layers of varying thickness in the vertical. The small-scale processes within a vertical column of gridboxes (shown in the inset) are represented through a process known as "parameterization." (Source: http://celebrating200years.noaa.gov/breakthroughs/climate_model/welcome.html)

currents, salinities, and temperatures soon followed. By 1970, the first coupled atmosphere–ocean GCM (AOGCM) was produced at NOAA Geophysical Fluid Dynamics Laboratory in Princeton, NJ. The terms "coupled model" and "Earth System Model" are sometimes used to describe the current generation of climate models. Other model development groups soon followed suit, and work using AOGCMs continues today. Simulations from 24 AOGCMs were included in the IPCC AR4 as part of the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset.

Surface hydrologic processes such as evapotranspiration, snowpack evolution, infiltration of water into the soil, and river routing are typically found in the "land surface" component of climate models. The hydrologic components in different climate models differ in their formulation and detail—just as do stand-alone hydrologic models. They can be quite sophisticated in the processes included, but operate on inputs from the coarse grid of the global model. Schematic illustrations of the surface hydrologic component from two GCMs are shown in FIGURE 3-1.

3-2. Emissions Scenarios—in the Driver's Seat

Emissions scenarios represent how greenhouse gas (carbon dioxide, methane, nitrous oxide) emissions, and thus the accumulation of greenhouse gases in the atmosphere, might unfold over the next century. The IPCC has developed a suite

FIGURE 3-3. Global Mean Surface Temperature and Model Projections

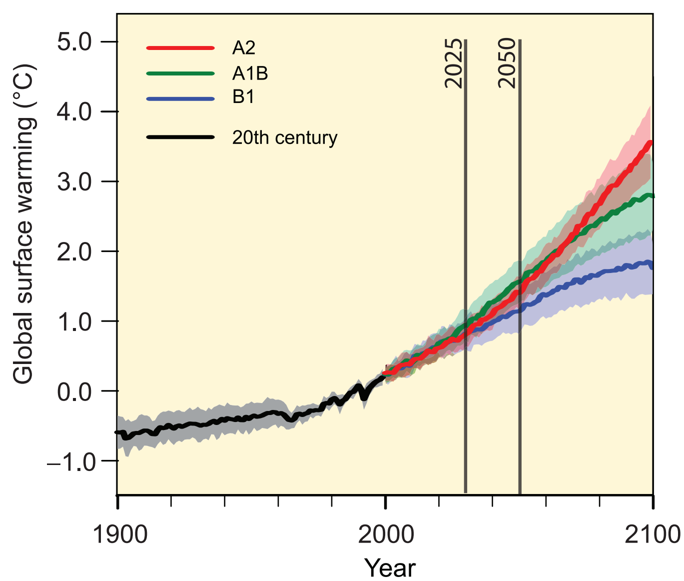


Fig. 3-3. Global mean surface temperature and model projections (relative to a baseline of 1980–99) for various emissions scenarios. Shaded regions depict the range of modeled historical simulations and projections. Temperatures for scenario B1 starts to diverge appreciably from A1B and A2 by the middle of the 21st century. A2 and A1B diverge in the latter quarter of the century. Continental and regional patterns of temperature and precipitation in these models also evolve in a similar manner. (IPCC AR4 WGI, 2007)

of emissions scenarios that are widely used to generate climate projections from GCMs. These are reported in the IPCC Special Report on Emissions Scenarios (SRES). The SRES scenarios are based, in part, on assumptions about "demographic development, socio-economic development, and technological change." Probabilities are not assigned to the future occurrence of these scenarios; the scenarios "are alternative images of how the future might unfold" (IPCC SRES 2000, p. 3).

Of the many possible futures described in the IPCC SRES document, only three scenarios, labeled B1, A1B, and A2, were intensively studied by climate modeling centers (FIGURE 3-3). These three scenarios have become de facto *low*, *medium*, and *high* emissions scenarios based on the resulting greenhouse gas concentrations and global climate changes in year 2100. For planning horizons up to about mid-century, these three emissions scenarios result in very similar projections of global and regional climate change. Consequently, the implications of these three scenarios are similar to one another for 25- to 50-year planning and adaptation horizons. The scenarios diverge in the latter half of the century reflecting the climate response to different assumptions, including those about mitigation (greenhouse gas reduction) strategies.

A new set of emissions scenarios are being developed for use in the Fifth Assessment Report planned for 2013 (see **http://ipcc-wg1.ucar.edu/** for more information). These new scenarios will reflect the fact that greenhouse gas emissions over the past decade have been at or above the upper range of the SRES scenarios.

3-3. Climate Model Evaluation

The scenarios of future greenhouse gas emissions drive the current generation of climate model projections. These models are also used to simulate the climate of the 20th century. These historic simulations include known forcing factors such as variations in solar output, volcanic and industrial aerosols (fine particles suspended in the air), and historic greenhouse gas changes. The models also simulate

SIDEBAR 3-2. Boulder Study

A study of the impacts of climate change on Boulder, Colorado's water supply is the first in the United States to combine the potential impacts of climate change with long-term climate variability. Outputs from general circulation models (GCMs) for grid boxes, including Boulder, were examined and the wettest, driest, and a middle model were selected. Climate change was estimated for 20-year periods for 2030 and 2070, and a 437-year (1566–2002) reconstruction of streamflow in Boulder Creek, South Boulder Creek, and the Colorado River (conducted by Connie Woodhouse and Jeff Lukas) were used. A "nearest neighbor" approach was also used to select years in the observed climate record that resemble the paleoclimate reconstructions. Average monthly GCM changes in temperature and precipitation for 2030 and 2070 were combined with multiple recreations of the paleoclimate record to simulate the combined effects of changes in climate and paleoclimate variability.

An increase in temperature alone was estimated to have little effect on the total annual volume of runoff, but by 2070 the effect would shift peak runoff one month earlier, which results in increased late winter and spring runoff and decreased summer runoff levels. These seasonal changes in runoff levels were estimated even with increased or decreased precipitation. Total runoff is quite sensitive to changes in precipitation.

Using Boulder's management model, and accounting for population growth in Boulder and the changes in demand for crop irrigation, the study found that wet and "middle" scenarios had little effect on the reliability of Boulder's supply. But reduced precipitation scenarios resulted in violation of some of Boulder's water supply reliability criteria. By 2070, higher greenhouse gas emissions scenarios increase the risk of supply disruptions more than the lowest emissions scenario (see TABLE 3-1). While an earlier study found that Boulder's water supplies would be reliable with a repeat of climate conditions from hundreds of years ago, this study found that the *combination* of climate change imposed on a reconstruction of events from the 16th and 17th centuries would cause violations in the city's water supply criteria. Demand for irrigation was projected to increase substantially; and very little of this increased demand would be met under the middle or dry scenarios.

In general, Boulder is in a relatively good position to adapt to climate because it has relatively senior water rights and can draw water during later winter and spring months when runoff is projected to increase. Other municipalities and users with more junior rights or with rights to withdrawal only in the summer months would possibly be at greater risk to climate change. Nonetheless, Boulder will examine contingency plans for reducing the city's demands and enhancing supplies.

This study is a collaboration of Stratus Consulting, the City of Boulder, the University of Colorado, and AMEC Consulting (formerly Hydrosphere). This work was funded by a grant from the National Oceanographic and Atmospheric Administration to Stratus Consulting.

TABLE 3-1. Effect of Climate Change on Reliability of Boulder's Water Supply

Emission Scenario	*Model Type*	*Year*	*1-in-20 year criterion met?*	*1-in-100 year criterion met?*	*1-in-1000 year criterion met?*
Drought Plan (300 years)			Yes	Yes	Yes
BASE CASE			Yes	Yes	Yes
B1	Wet	2030	Yes	Yes	Yes
B1	Mid	2030	Yes	Yes	Yes
B1	Dry	2030	No	Yes	Yes
A1B	Wet	2030	Yes	Yes	Yes
A1B	Mid	2030	Yes	Yes	Yes
A1B	Dry	2030	No	Yes	Yes
A1B	Dry3	2030	No	No	No
A2	Mid	2030	Yes	Yes	Yes
A2	Dry	2030	No	Yes	Yes
B1	Wet	2070	Yes	Yes	Yes
B1	Mid	2070	Yes	Yes	Yes
B1	Dry	2070	Yes	Yes	Yes
A1B	Wet	2070	Yes	Yes	Yes
A1B	Mid	2070	Yes	Yes	Yes
A1B	Dry	2070	No	Yes	No
A1B	Dry3	2070	No	Yes	Yes
A2	Mid	2070	No	Yes	Yes
A2	Dry	2070	No	No	No

This table is representative of the typical output of a product that can be generated using climate models to aid decision-makers.

FIGURE 3-4. Elevation (feet above sea level) on Global and Regional Climate Model Grids

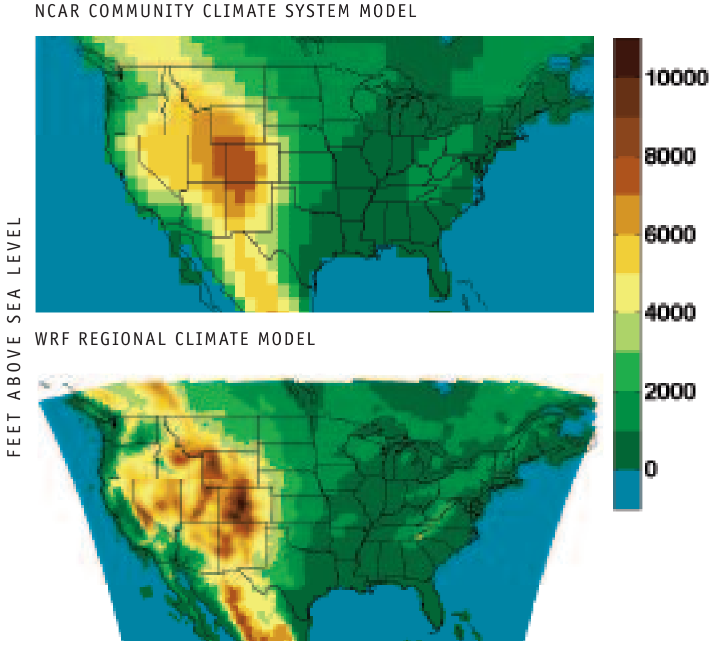


Fig. 3-4. The NCAR Community Climate System Model 3.0 (CCSM3.0) *(top panel)* has gridboxes that are about 100 miles on a side. The WRF regional climate model *(bottom panel)* has gridboxes that are about 30 miles on a side, typical of the RCMs used for dynamical downscaling in the North American Regional Climate Change Assessment Project (NARCCAP) project. The relatively smooth representation of the Colorado Rockies in global climate models reduces the elevations of the mountain peaks. Downscaling methods relate the large-scale climate features that are simulated by GCMs to the small-scale climatic and topographic features of Colorado.

natural "internal" variability of the climate from year to year and decade to decade.

Climate model simulations are evaluated by how well they reproduce climate statistics rather than individual events. This need arises because model projections are not periodically reset to observed conditions (as are weather forecasts), but rather run freely through time. Consequently, simulations cannot reproduce the weather on any specific day; but they should reproduce climatological averages and other statistics of the weather. Likewise, the projections cannot reproduce a specific event such as the 1997–98 El Niño event, but they should show El Niño and La Niña events that resemble those in nature in terms of magnitude, duration, and recurrence. These models do simulate a response to the known natural and anthropogenic forcing factors, resulting in periods of global warming in the early and late 20th century and slight cooling in the mid-20th century.

Spatial resolution poses another problem for model evaluation, particularly in mountainous regions like Colorado. Because the global models do not represent local and regional processes, they cannot exactly simulate the climate at a single observing station; but they should be able to simulate sub-continental climate averages—provided the region is relatively homogeneous. For example, in the central United States where the topography is relatively gentle, model temperature and precipitation data better represent the climate processes at individual stations.

In order to accommodate their coarse spatial grid, climate models use a smoothed representation of mountains, including the Rockies (see Figure 3-4). Individual stations in complex mountainous regions such as Colorado are influenced by topography and elevation that are not present in the climate models. Furthermore, snowpack is poorly represented in climate models due to the smoothed topography that reduces the elevation of mountain peaks. However, the climate models do simulate the large-scale climate trends affecting mountainous regions. Current climate models produce a winter storm track that impacts Colorado, and they broadly show the differences in annual precipitation as one traverses from the Great Plains across the Rockies to the Intermountain West. For this reason, it is possible that advanced techniques (e.g., downscaling, discussed later) can relate these large-scale phenomena in climate models to the detailed topography of the state, including an improved representation of snowpack.

The main reason for the differences among climate model results is an incomplete scientific understanding of many climate-related processes, particularly at smaller spatial scales. Even for processes that are comparatively well understood, there can be legitimate scientific differences about the best way to represent these processes in the models through parameterization. Developing a climate model means balancing the competing desires for higher resolution and for more complex and varied processes with the available computational resources. Different model development centers make different choices to achieve this balance. The result is that each model, while staying as close as possible to known scientific principles, has a "personality of its own" when it comes to future projections.

Each climate model has known systematic errors (model bias) in simulating climate. These biases can be assessed by comparing the temperature and precipitation (and other variables) at the model grid with a gridded observational dataset (PRISM monthly climatology, 1950–99). The Colorado temperature bias, averaged over the 22 CMIP3 models, varies throughout the year (Table 3-2). The models, on average, are too warm by about 2°F in winter, and too cold by about 3°F in summer, on par with the magnitude of the bias in neighboring regions. The models have too much precipitation in all seasons over Colorado, consistent with the biases for the western North America. Note that the model precipitation biases averaged over Central North America, a region of gentler topography, are considerably lower than for Colorado.

Year-to-year climate variability in Colorado arises from both climate oscillations and storm track dynamics. The simulation of the El Niño Southern Oscillation (ENSO),

TABLE 3-2. Seasonally Averaged Climate Biases of the IPCC AR4 WGI Climate Models in Temperature and Precipitation for Colorado

	TEMPERATURE BIAS (°F)			PRECIPITATION BIAS (%)		
	WNA	*Colorado*	*CNA*	*WNA*	*Colorado*	*CNA*
Winter	-1.62	1.94	-1.44	93	81	7
Spring	-3.60	-1.11	-1.98	71	65	8
Summer	-0.72	-3.32	-0.72	28	69	-12
Autumn	-2.16	-0.08	-1.08	61	63	-16
Annual	-2.34	-0.64	-0.90	65	65	2

Climate model biases are shown for Western North America (WNA), Colorado, and Central North America (CNA). Temperature biases are shown in °F, precipitation biases in percent above or below normal. The models are too warm over Colorado in winter, and too cold in summer, and the biases are on par with those in neighboring regions. The models produce too much precipitation over Colorado in all seasons, similar to the biases in Western North America. The values for the WNA and CNA regions are from IPCC AR4 WGI, Ch. 11 Supp. Material, Table S11.1. The area average for model gridboxes over Colorado was calculated from the same CMIP3 model output as used in the IPCC AR4.

and its effects on the atmospheric circulation patterns over North America, has improved from past generations of climate models (AchutaRao and Sperberg 2006). But while most models produce variability that resembles the observed ENSO in some respects, they still have problems accurately reproducing the amplitude, seasonal timing, and recurrence times seen in nature (see Capotondi et al. 2006). There has been comparatively little work in evaluating Pacific decadal variability that may have an influence on Colorado's climate (IPCC AR4 WGI 2007). Overall, climate models have too little Pacific Ocean variability on decadal time scales, particularly in the tropics (Newman 2007), though Barnett et al. (2008) claims that at least one model successfully simulates the Pacific Decadal Oscillation (PDO). However, climate models successfully simulate storm track dynamics in North America (CCSP SAP 3.1 2008), which are a major feature of climate in Colorado.

A combination of metrics should be used to judge the utility of a model's output. For example, a model that has a small temperature bias over Colorado may not have a good simulation of El Niño, or vice versa. A study of California precipitation projections showed that "while some models seem more capable at recreating limited aspects [of] twentieth century climate, the overall tendency is for comparable model performance when several credibility measures are combined" (Brekke et al. 2008, p. 371). It also found that culling models or applying weighting factors to models based on their overall credibility had little effect on the probabilistic distribution of outcomes in their study. Other studies may choose a smaller subset of models based on what the authors perceive as relevant selection criteria.

Climate models as a whole have improved in their ability to simulate the climate, even as the modeling community has set more demanding goals. Although they are imperfect descriptions of the Earth's climate, each generation of models has improved on the last, and the average of all the models is better than a single model (Reichler and Kim 2008). Many climate projections are available, reflecting the level of scientific understanding of the subject. Consequently, it is very important for planners to consider a range of model projections to assess the robustness of alternative planning scenarios.

3-4. Downscaling Methods

In order to use the coarse-grid global climate model output to study climate change impacts in Colorado, the model output has to be related to the detailed topography and climate of the state through a process called "downscaling." In addition a "bias correction" or "calibration" step is needed that removes known model biases in the average climate. Fowler et al. (2007) presents an overview of several downscaling methods.

TABLE 3-3. Strengths and Weaknesses of Statistical Versus Dynamical Downscaling (after Fowler et al. 2007)

	Statistical	*Dynamical*
Advantages	• Comparatively cheap and computationally efficient. • Can provide point-scale climatic variables from GCM-scale output. • Able to directly incorporate observations into method.	• Produces responses based on physically consistent processes. • Can resolve atmospheric processes on a smaller scale (e.g., orographic and rain-shadow effects in mountainous areas).
Disadvantages	• Dependent upon choice of predictors. • Does not account for non-stationarity in the predictor-predict and relationship. • Regional climate system feedbacks not included. • Affected by biases in underlying GCM.	• Computationally intensive. • Limited number of scenario ensembles available. • Dependent on GCM boundary forcing; affected by biases in underlying GCM. • Dependent on RCM parameterizations. • Different RCMs will give different results.

FIGURE 3-5. The Progression of Data and Models from Climate Models to Streamflow

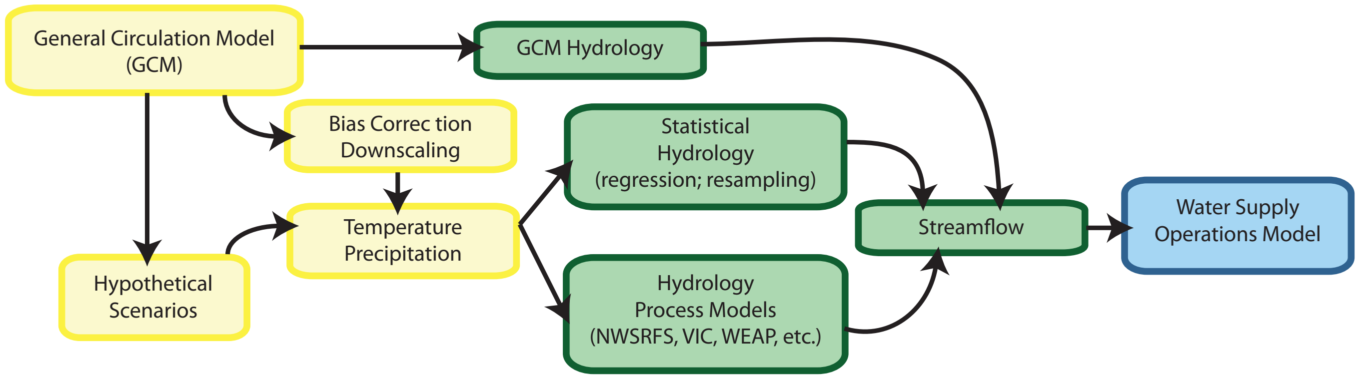


Fig. 3-5. Illustration of the progression of data and models from climate models to streamflow, which can be used in water supply operations models. While the output from the GCM hydrology component has been used in some studies (Milly et al. 2005), water supply studies typically use bias-corrected and downscaled projections. Hypothetical scenarios of climate change, such as adding or subtracting a fixed increment in temperature or precipitation to or from the historical sequences, may be used to investigate the sensitivity of water supply. The choice of these increments may be informed by climate model projections.

Simply, statistical downscaling methods use the temperature and precipitation at a model grid and relate each parameter to the smaller-scale variations within that grid. This spatial process is sometimes called disaggregation—the opposite of the spatial aggregation process that creates a gridbox (see Sidebar 3-1). The statistical downscaling procedure may be as simple as adding a model's projected changes in a gridbox to the high-resolution temperature climatology for the area within that gridbox. For precipitation, the percent change is typically applied to the high-resolution climatology (Salathe 2004; Smith et al. 2007). More sophisticated statistical methods can be used but at this time, these have found less application in Colorado.

Dynamical downscaling uses high-resolution regional climate models (RCMs)—many of which are derived from numerical weather prediction models—to simulate small-scale processes. These RCMs typically input the global model grids surrounding their geographical domain and then simulate wind, temperature, clouds, evapotranspiration, and variables on a much finer grid (see Wigley 2004; Wilby and Wigley 1997). RCM downscaling is computationally intensive.

The salient strengths and weaknesses of statistical versus dynamical downscaling are summarized in Table 3-3. In practice, the simpler statistical methods are primarily used to generate downscaled datasets on many of the global model simulations used in the AR4 report. RCM downscaling has typically involved using one or two global models downscaled with a single RCM. While this is very useful in studying how climate processes might change, it gives a very limited picture of the range and distribution of possibilities. It is worth noting that the ongoing North American Regional Climate Change Assessment Project (NARCCAP) will soon release a large dynamically downscaled dataset that uses six RCMs to downscale the projections from four of the IPCC AR4 models. This will enable a more comprehensive analysis of the full range of projections (See Resources). Even at the 30-mile (50-km) resolution of these RCMs, further downscaling may be needed depending on the application. On a finer spatial scale, the Colorado Headwaters Project plans a smaller set of model simulations using a 1.2 mile (2 km) grid (**http://www.times.ucar/ws**).

In many cases, only monthly-averaged model output is available. Since many hydrological and operational models require daily or even sub-daily inputs, the need for downscaling in time arises. So-called "weather generators" (see Gangopadhyay et al. 2005) use historical weather data that are re-sampled according to the conditions projected by the climate model. The same resampling technique can be applied to historical streamflow data to provide future hydrologic sequences that are consistent with both the historical variability (Prairie et al. 2006) and the climate model average projections.

For water resources planning, statistically downscaled climate model projections have been used as input to hydrology models (Maurer 2007; Reclamation 2008; Christensen et al. 2004; Christensen and Lettenmaier 2006). By using a single hydrology model that has been tuned to a specific river basin, a hydrologically consistent set of projections can be created based on a range of climate drivers (see the Joint Front Range Climate Change Vulnerability Study, Sidebar 3-3, Figure 3-5).

3-5. The Future of Global Models

The need for more advanced climate model projections for the anticipated IPCC Fifth Assessment Report is providing the impetus for the next stage of development in global climate models. These models will include more detailed process models—particularly those involved in the models of how sources and sinks of greenhouse gases will respond to climate change. The native resolution of these models, though increased, will still not be adequate for regional climate studies; downscaled output will be required.

Some climate modeling centers are now incorporating the observed ocean conditions into their simulations in order to make actual predictions of the climate a few decades into the future. Using this framework, Keenlyside et al. (2008) and Smith et al. (2007) predict a period of relatively unchanged global temperatures due to a natural cooling trend that is superposed on the GHG-forced warming trend. They both project this hiatus to end in the next several years and the warming to continue. These climate predictions, however, are in the early stages of development and evaluation.

SIDEBAR 3-3. Joint Front Range Climate Change Vulnerability Study (JFRCCVS)

With the increasing recognition of global and regional climate changes, metropolitan water providers along Colorado's Front Range are concerned about the possible impacts these changes may have on their future available water supply. This is of particular concern given that recent studies indicate global warming may lead to unprecedented drought conditions in the southwest United States (IPCC AR4 WGI 2007). Several Front Range providers including the City of Aurora, City of Boulder, Colorado Springs Utilities, Denver Water, City of Fort Collins, and Northern Colorado Water Conservancy District have come together to participate in a study intended to provide the education, tools, and methodology necessary to examine the possible effects of climate change on several common watersheds.

Through a collaboration with the Water Research Foundation, this JFRCCVS project will enable group members, which obtain their water supplies from the upper Colorado, South Platte, Arkansas, Cache la Poudre, St. Vrain, Boulder Creek, Big Thompson, and other similar river basins, to examine potential effects climate change may have on those supplies. This regional unified approach is intended to help Colorado water providers communicate with their customers and the media cohesively by working with the same historic and projected hydrometeorological data, historic natural streamflow, and methodology. Lessons learned from this collaborative approach can be used to encourage and establish other regional efforts in Colorado and throughout the country.

The project will assess changes in the timing and volume of hydrologic runoff that might be expected from selected climate change scenarios for the years 2040 and 2070. Since many water providers evaluate vulnerability using water allocation models that simulate system operations based on historic sequences of natural streamflow, the project will focus on investigations at these locations:

Basin	*Station*
Upper Colorado	Fraser River at Granby
	Williams Fork near Leal
	Blue River below Green Mountain Res
	Blue River below Dillon
	Colorado River near Granby
	Colorado River near Dotsero
	Colorado River near Cameo
	Homestake Creek at Gold Park
	Roaring Fork River near Aspen
Upper Arkansas	Arkansas River at Salida
Upper South Platte	South Platte River above Spinney Mountain Res
	South Platte River below Cheesman Res
	South Platte River at South Platte
	South Platte River at Henderson
Cache la Poudre	Cache la Poudre River at Mouth of Canyon
St. Vrain	St. Vrain Creek at Canyon Mouth near Lyons
Big Thompson	Big Thompson River near Drake
Boulder Creek	Boulder Creek at Orodell

4
Climate Attribution

KEY POINTS

- In North America, temperatures have increased by ~2°F in the last 30 years, "human-induced warming has likely caused much of the average temperature increase in North America over the past fifty years" (CCSP SAP 3.3, p. 3).
- In Colorado, temperatures have warmed by ~2°F in the past 30 years (Section 2). Climate models estimate that anthropogenic greenhouse gas emissions have contributed 1°F of warming over the same period. However no studies have specifically investigated whether the detected trends in Colorado can be attributed to anthropogenic greenhouse gases.
- The precipitation variations that are the main driver of drought in Colorado and low Lake Powell inflows, including the recent drought of 2000–07, are consistent with the natural variability observed in long-term and paleoclimate records (Barnett et al. 2008).
- Observed warming may have increased the severity of droughts (Andreadis and Lettenmeier 2006) and exacerbated drought impacts (Breshears et al. 2005).

Proactive planning and decisions to manage risks can benefit from an understanding of the full range of natural climate variability and the magnitude of climate trends that have happened, why they happened, and the likelihood of these trends continuing into the future. The process of establishing the principal causes for observed climate phenomena is known as climate attribution. Attribution of anthropogenic climate change, part of the focus of the Intergovernmental Panel on Climate Change (IPCC) assessment reports, has the specific objective of explaining a detected climate change that is significantly different from that which could be expected from natural variations of the climate system. According to the IPCC Third Assessment Report (IPCC TAR WGI 2001), the requirements for determining an attribution for detected change are that first, scientists can demonstrate that the change is consistent with a combination of anthropogenic and natural causes, and second, that these changes are inconsistent with alternative, physically plausible explanations of recent climate change that exclude anthropogenic causes. When attribution is established, the IPCC may assign a likelihood statement (see Sidebar ES-1) for the probability that that cause resulted in the observed conditions or trends.

Attribution studies use both empirical analyses of past climate relationships and simulations with climate models in which cause-and-effect relations are evaluated. Statistical analysis is used to analyze and compare the model simulations with the observed record, including estimates of natural variability and trends from climate models, historical observations, and paleoclimate reconstructions of past temperatures. "Fingerprint" methods seek the unique signature of climate change by simultaneously looking at changes in many variables. Attribution studies are also used to assess the natural and anthropogenic causes of drought and other extreme climate events.

4-1. The Global Consensus

Evidence that Earth's climate has changed during the last century is clear. According to the IPCC Fourth Assessment Report (IPCC AR4 WGI 2007, p. 5) "warming of the climate system is unequivocal." This statement is based on observed trends of melting snow and ice; rising sea level; and increasing surface, ocean, and atmospheric temperatures. The dominant forcing mechanisms to which recent climate change has been attributed all result from human activity. They are: increasing atmospheric concentrations of greenhouse gases; global changes to land surface, such as deforestation; and increasing atmospheric concentrations of aerosols.

The consensus attribution statements of the IPCC AR4 WGI (2007) link these observed trends, as well as changes in global wind patterns, to greenhouse gas emissions introduced to the atmosphere by human activities. For example, the IPCC reports that most of the observed increase in global average temperatures since the mid-20th century is ***very likely*** due to increased concentrations of anthropogenic greenhouse gases. Other important attribution statements made by the IPCC in 2007 include:

- It is ***very likely*** the observed warming of land and oceans, together with the loss in ice mass, is not due to natural causes alone.
- It is ***likely*** that there has been significant anthropogenic warming over the past 50 years averaged over each continent except Antarctica.
- It is ***likely*** that the increases in greenhouse gas concentrations alone would have produced even greater warming than what has actually been observed because volcanic and human-induced aerosols have offset some warming that would otherwise have occurred.

However, these statements are based on global attribution studies, and are not necessarily applicable to the trends observed in Colorado. Attribution studies are difficult on regional scales for several reasons. Natural variability grows larger as the observational scale decreases, making it more difficult to detect trends (as discussed in Section 2). Even if a signal is detected, uncertainties in regional and local processes (for example, the influence of the Rocky Mountains on precipitation patterns) complicate estimations of the contribution of anthropogenic greenhouse gases on discernable trends. Consequently, there is less confidence in the causes of observed trends as scale decreases. Thus, it is not surprising that there are no formal climate change attribution studies that focus on the spatial scale of Colorado. However, the CCSP is undertaking studies on the scale of North America, and studies are underway to understand the causes of the 2000s western U.S. drought and low Colorado River flows, and whether these are the result of natural variability or if they are related to climate change.

4-2. A Telescoping View

North America has warmed by almost 2°F in the past 30 years and it is ***likely*** that greenhouse gases produced from human activities alone caused much of this increase (CCSP SAP 3.3). Further analysis of these data will be presented in the CCSP SAP 1.3 (planned release, fall 2008). In North America, the largest annual mean temperature increases since the middle of the 20th century have occurred over the

FIGURE 4-1. Observed Annual Average North American Surface Temperature (1950–2007)

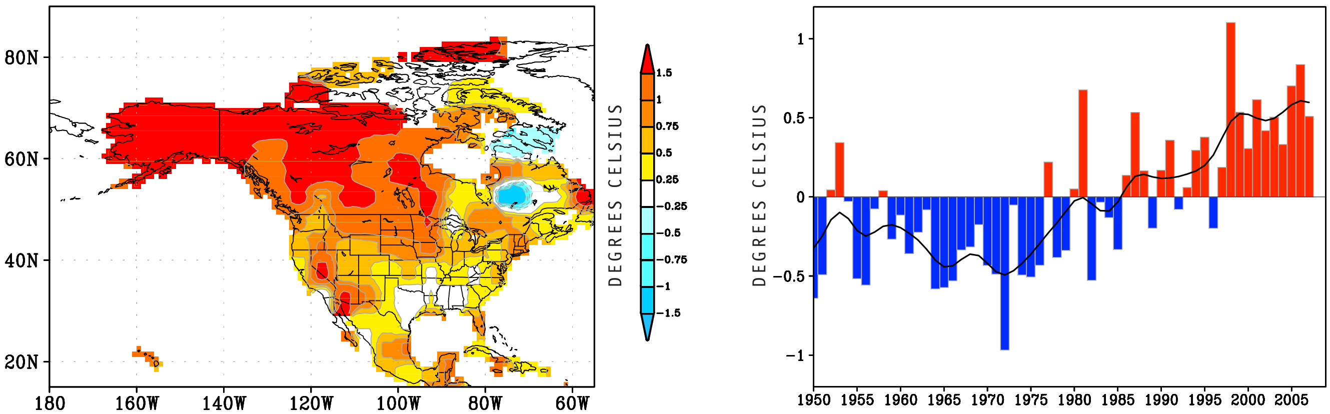


Fig. 4-1. The 1950–2007 trend in observed annual average North American surface temperature (°C, *left*) and the time series of the annual values of surface temperature averaged over the whole of North America *(right)*. Annual anomalies are with respect to a 1971–2000 reference. The smoothed curve *(black line)* highlights low frequency variations. A change of 1°C equals 1.8°F. (Data source: UK Hadley Center's CRUv3 global monthly gridded temperatures)

FIGURE 4-2. Modeled Annual Averaged North American Surface Temperature (1950–2007)

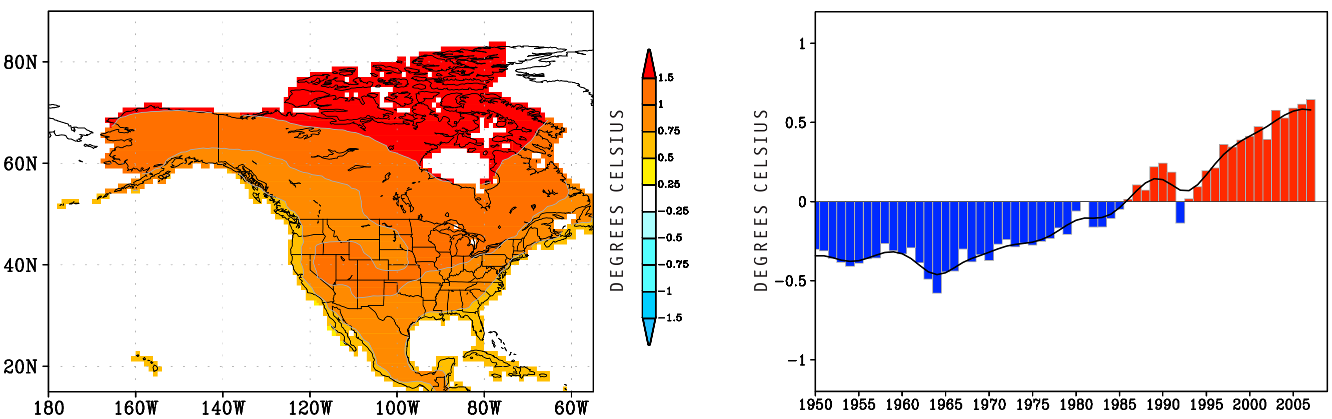


Fig. 4-2. The 1950–2007 trend in annual average North American surface temperature (°C) from 22 IPCC (CMIP3) model simulations forced with the greenhouse gas, aerosol, solar, and volcanic forcing from 1950 to 1999, and the A1B emissions scenario from 2000 to 2007 *(left)*. Annual values of surface temperature averaged over the whole of North America (anomalies compared to 1971–2000 average) *(right)*. The smoothed curve highlights low frequency variations. Comparison of these climate models with the data in FIGURE 4-1 suggests that anthropogenic greenhouse gas emissions have contributed about 1°F of the observed warming in the last 30 years.

northern and western portions of the continent. The warming trend between 1950 and 2007 in the Western United States is clear (FIGURE 4-1). The time series of annual North American-averaged temperatures (FIGURE 4-1, *right panel*) shows that every year since 1997 has been warmer than the 30-year climatological reference of 1971–2000. However, the rise in temperature has not been constant, as large year-to-year fluctuations are superimposed on an increasing trend.

To determine a cause, or attribution, of this signal, annually averaged North American surface temperatures from 1950–2007 were computed from the IPCC (CMIP3) model simulations. The models were forced with the observed record of greenhouse gases, volcanic aerosols, and solar forcing during 1950–99, and subsequently with the A1B scenario (see Section 3) of greenhouse gas emissions (FIGURE 4-2). Similarities between these results and the observed trends provide the best available evidence for external climate forcing of surface temperature change by anthropogenic greenhouse gases. First, the bulk of the warming occurs after about 1970 in both time series. Second, the externally forced warming of about 1.8°F (1°C) since 1950 is close to the observed warming rate.

Some inconsistencies between the two datasets (FIGURES 4-1 and 4-2) are also apparent. For instance, there is greater year-to-year variability in observed North American averaged temperatures, which cannot be explained by fluctuations in external forcing. Also, the IPCC simulated pattern of warming is more spatially uniform across the continent compared with spatial observations.

A simple comparison of the observed surface temperature trends across the continent and simulated changes suggests that half of the warming is attributable to greenhouse gas emissions related to human activities. This is consistent with CCSP SAP 3.3 (p. 3), which states "human-induced warming has ***likely*** caused much of the average temperature increase in North America over the past fifty years." A further analysis of these data will be presented in CCSP SAP 1.3 when it is released in late 2008.

FIGURE 4-3. Intensity and Extent of Drought in Colorado (1895–2007)

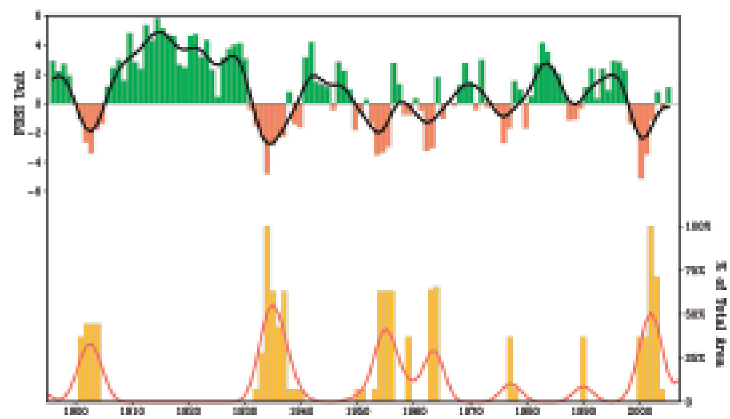


Fig. 4-3. Drought conditions in Colorado from 1895 to 2007. Top curve *(black)* is the area-averaged Palmer Drought Severity Index (PDSI), with negative anomalies *(orange bars)* indicating dry conditions compared to the region's normal moisture balance. Green bars represent wetter conditions. Yellow bars represent the % area of Colorado in severe drought (PDSI < -3). Black and red curves are smoothed similar to a 5-year moving average. (Data source: Climate division data from the National Climatic Data Center)

4-3. Drought in Colorado and the West

Drought has many definitions. Meteorological drought is a deficit in precipitation, typically over an extended period of time. Hydrologic drought may be defined in terms of reduced runoff over a period of time, and agricultural drought may be defined in terms of soil moisture deficit. Both hydrologic and agricultural droughts can be related to a precipitation deficit or to increased evapotranspiration over the watershed associated with elevated temperatures. The assessment of drought severity may take into account water storage in the basin, including natural "reservoirs" such as snowpack and groundwater, as well as engineered water storage systems. (For further definitions see **www.drought.unl.edu**.)

Multiple indicators may be used to describe drought in Colorado. The Palmer Drought Severity Index (PDSI; Palmer 1965) is derived from the monthly records of precipitation and temperature and estimates the state of surface water balance (excluding reservoir storage). The percent area coverage where the PDSI is less than -3.0 is an indicator of the spatial extent of the drought. Another indicator is the annual Colorado River natural flow at Lees Ferry below Lake Powell. The flow is an indicator of annual water supply stored in the Upper Colorado River basin snowpack as it replenishes downstream storage in Lake Powell and Lake Mead.

Interpreting trends in these drought indicators is complicated by the many dimensions of drought—duration, extent, severity, impacts—and by the diversity of area averages and of periods of analysis used in studies published in the scientific literature. Consequently, each study must be considered in the context of recent events (e.g., the 2000s drought) and whether or not these events were in the period of record that was analyzed.

The history of Colorado droughts from 1895 to 2007 (Figure 4-3) is part of a bigger picture of droughts that occurred throughout the West. In Colorado, wet conditions prevailed at the turn of the 20th century, with the entire western United States virtually devoid of severe drought from 1905 to 1920. Dry periods emerged in Colorado during the 1930s and 1950s with severe social and economic consequences, but these conditions were eventually replaced by another wet epoch lasting from the 1960s to the end of the 20th century. The current dry period began in late 1998. One the most severe drought years of the 113-year instrumental record occurred in 2002, when severe drought occurred in all five traditional climate divisions in Colorado, an event that had not occurred since 1934.

In the western United States from 1895 to 2007, no statistically significant trend in the PDSI drought record has been detected (M. Hoerling, pers. comm.) This finding is consistent with the paleo-hydroclimate evidence of droughts associated with natural variability that are more severe and longer in duration than those of recent history (Section 2, Figure 2-8). According to another study, however, there has been an increase in the severity of droughts over the period 1925 to 2003 in the southwestern United States, including the Western Slope of Colorado (Andreadis and Lettenmaier 2006). They qualitatively attribute the increased drought severity in the southwestern states (including Colorado) to the increase in observed temperatures and the resulting increase in evapotranspiration. Andreadis and Lettenmaier (2006) also show a decrease in drought severity over the eastern plains and south central Colorado (1925–2003). A different study compared the recent 2000s drought (defined in terms of vegetation impacts) to the 1950s drought and found that greater warmth has been a material factor in the recent drought's greater impacts (Breshears et al. 2005).

The Colorado River system storage is another indicator of drought. Lake Powell-Lake Mead storage was near full capacity in 1998. Storage levels have declined since; Lake Powell is 61% of capacity, and storage in Lake Mead is 46% of capacity as of August 2008. The principal reason for this rapid decline has been a reduction in Colorado River inflow (Figure 4-4, *bottom panel*). The 2000–04 period had

FIGURE 4-4. Precipitation and River Flow in the Upper Colorado Basin

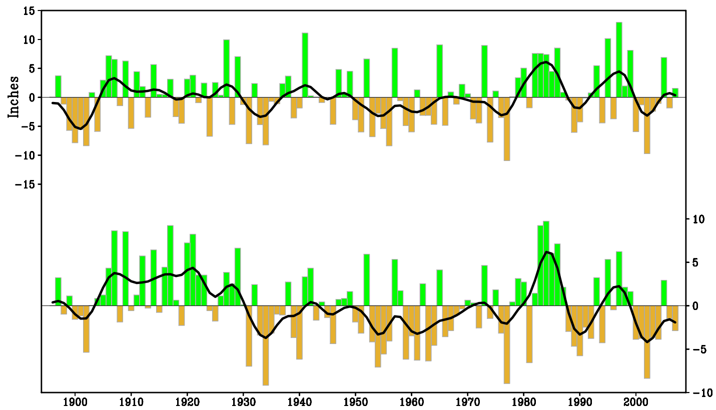


Fig. 4-4. Observed time series (1895–2007) of annually averaged precipitation departures area-averaged over the Upper Colorado drainage basin *(top panel)* and annual Colorado River natural flow departures at Lees Ferry in million acre-feet *(bottom panel)*. The precipitation data are based on 4km-gridded PRISM data. Colorado River natural flow data from the Bureau of Reclamation.

an average natural flow of 9.9 million acre feet (maf) per year, which was lower than the driest period during the Dust Bowl years of 1931–35 (11.4 maf), and the 1950s drought (1953–56; 10.2 maf) (Pulwarty et al. 2005).

Historically, reduction in Colorado River natural flow at Lees Ferry can be linked to the reduction in precipitation over the Upper Colorado River basin (Figure 4-4, top panel). Droughts in this area have been attributed in part to natural fluctuations of the El Niño and La Niña cycle of ocean surface temperature variations in the tropical Pacific (CCSP SAP 3.3 2008; Schubert et al. 2004; Seager et al. 2005). The El Niño cycle affects the movement of moisture-bearing storms in winter and spring that supply water for the region's mountain snowpack and provide the eastern plains with soil moisture. Note that IPCC model simulations indicate that it is ***very unlikely*** that the increase in greenhouse gases played a role in the recent period of low precipitation (IPCC AR4 WGI 2007).

The observed temperature trends may be exacerbating low flows. For example during the winter of 2004–05, precipitation in the Basin was average, but flow was 75% of normal. The combination of "low antecedent low soil moisture (absorption into soil), depleted high mountain aquifers, and the warmest January–July period on record (driving evaporation)" has been suggested as the cause for this discrepancy (CCSP SAP 3.3 2008).

One formal attribution study deserves special focus because of its implications for the entire hydrologic cycle in the West. Barnett et al (2008) used a "fingerprint" that combined several hydroclimatic indicators including the ratio of snow water equivalent to precipitation (SWE/P), January–March minimum temperatures, and streamflow runoff timing throughout the West, including the Colorado Rockies, to detect and attribute trends over the period 1950 to 1999. They concluded that 60% of the observed trends in the hydrologic cycle in the West are due to anthropogenic causes. These trends included earlier runoff, warming temperatures, and a smaller fraction of precipitation that is present as snow. They were unable to show any anthropogenic cause for precipitation trends in the West. Interestingly, the model fingerprint of anthropogenic warming shows very small changes in runoff timing and in SWE/P over Colorado and over the southern Sierra Nevada Mountains—the two highest elevation regions in the study area. Relevant to the recent drought they note "[t]his period excludes the large-scale changes in runoff, precipitation, and water storage that have occurred in the southwest, especially the Colorado River drainage, since 2000. We do not claim that the large changes since 2000 are necessarily the result of human-induced warming."

In summary, the research suggests that precipitation—the main historic driver of drought in Colorado—has not exhibited trends that can be attributed to anthropogenic climate change, and that the observed record of drought is consistent with natural variability. The research also indicates that observed temperature trends may have created conditions more favorable to droughts, or have exacerbated the impacts of droughts, and that, at least at the scale of the western United States, may be attributed in part to anthropogenic climate change. The CCSP SAP 1.3 and 3.4, when they are issued later this year, are planning to have specific statements on the attribution of the recent drought in the West.

5
Climate Projections

KEY POINTS

- Climate models project Colorado will warm by 2.5°F [+1.5 to +3.5°F] by 2025, relative to the 1950–99 baseline, and 4°F [+2.5 to +5.5°F] by 2050. This baseline likely includes some anthropogenic warming for North America (Section 4). The projections show summers warming more (+5°F [+3 to +7°F]) than winters (+3°F [+2 to +5°F]), and suggest that typical summer temperatures in 2050 will be as warm as or warmer than the hottest 10% of summers that occurred between 1950 and 1999. By 2050, temperatures on the Eastern Plains of Colorado will shift westward and upslope, bringing into the Front Range temperature regimes that today occur near the Kansas border. Note that the range of climate model projections does not capture the entire range of uncertainty.
- Winter projections show fewer extreme cold months, more extreme warm months, and more strings of consecutive warm winters. By contrast with summer, typical projected winter temperatures do not lie within the top 10% warmest months in the historical record. Between today and 2050, the January climate of the Eastern Plains of Colorado is expected to shift northward by ~150 miles. In all seasons, the climate of the mountains migrates upward in elevation, and the climate of the Desert Southwest progresses up into the valleys of the Western Slope.
- Individual models projections do not agree whether annual mean precipitation will increase or decrease in Colorado by 2050. The multi-model average shows little change in annual mean precipitation by 2050, although a seasonal shift in precipitation does emerge. Combined effects of a northward shifting storm track, potentially wetter storms and a global drying of the sub-tropical regions may result in more mid-winter precipitation throughout the state, and in some areas, a decrease in late spring and summer precipitation.
- Projections show a precipitous decline in lower-elevation (below 8200 ft) snowpack across the West. Modest declines (10–20%) are projected for Colorado's high-elevation snowpack (above 8200 ft) within the same timeframe (Christensen and Lettenmaier 2006). The timing of runoff is projected to shift earlier in the spring, and late-summer flows may be reduced. These changes are probably going to occur regardless of changes in precipitation.
- Recent hydrologic studies on climate change in the Upper Colorado River Basin point to an expected decline in runoff by the mid-to-late 21st century (Table 5-1). Those studies that explicitly calculate runoff report multi-model average decreases ranging from 6% to 20% by 2050 compared to 20th century conditions; the one recent study that bases streamflow on a large-scale statistical relationship (Hoerling and Eischeid 2006) projects a 45% decrease by 2050.
- The range of individual model projections within a single study can include both increasing and decreasing runoff due to the range of climate model output used to drive the hydrology models, reflecting both model-simulated climate variability and differences in model formulation.
- Ongoing studies are attempting to resolve methodological differences in order to reduce the range of uncertainty in Upper Colorado River Basin runoff projections.
- The impact of climate change on runoff in the Rio Grande, Platte, and Arkansas Basins has not been studied as extensively as the Colorado River Basin.

This section provides temperature and precipitation projections for North America, then telescopes into Colorado. To illustrate how broad scale model projections may play out at a local scale, projections from a downscaled dataset for three areas in Colorado are highlighted. It then synthesizes projected changes in hydroclimatic variables in the state and its river basins. The focus here is on mid-21st century projections, although projections for other timeframes may be of use depending on the type of decision or planning horizon (Sidebar 1-1). Most temperature projections show continued warming beyond 2050.

5-1. Temperature and Precipitation Projections

Projected changes in North American temperature and precipitation from a recent baseline (1950–99 average) through mid-century (2040–60 average) are shown in Figure 5-1. Focusing on Colorado, the multi-model average projects an annual mean warming of about 4°F [+2.5 to +5.5°F] by 2050 in Colorado as part of a continent-wide pattern of warming. The projections show summers warming more (+5°F [+3 to +7°F]) than winters (+3°F [+2 to +5°F]) (Figure 5-1, *top row*). For total yearly precipitation, the dominant pattern in North America projects a wetter climate in regions north of Colorado and a drier climate southwest of the state (Figure 5-1, *middle row*). However, for Colorado, projections diverge and the models do not show substantial agreement (Figure 5-1, *bottom row*). While the multi-model average shows little change in annual mean precipitation in Colorado, a seasonal shift in precipitation emerges with a decrease in late spring and summer, and an increase in winter precipitation.

The range of climate model projections (shown in square brackets above) was estimated from the 10th and 90th percentiles of 112 model projections for the 20-year period centered on 2050, averaged over Colorado, rounded to the nearest half-degree Fahrenheit. These 112 CMIP3 model runs of 16 climate models include projections from the B1, A2B, and A2 emissions scenarios. The range of projections results from different model formulations, model-simulated natural variability, and differences in emissions scenarios used to drive the climate models.

Several processes triggered by greenhouse gas increases contribute to the warming over the Western United States, including increased water vapor in the atmosphere (Compo and Sardeshmukh 2008), changes in atmospheric circulation patterns (Tebaldi et al. 2006—particularly for increased heat waves), and drying of the soils in summer. Precipitation changes in the Colorado Mountains, which receive the bulk of their precipitation from winter and spring storms— are dominated by changes in the climatological storm track. The storm track is projected to move slightly to the north as the climate warms (Yin 2005), but with somewhat wetter storms. The net effect over Colorado is a seasonal shift towards more mid-winter precipitation, and in some areas a decrease in late spring precipitation. Summertime precipitation is projected to decrease over much of the conterminous United States, but there is more disagreement among the models than for winter. The thunderstorms that dominate Colorado's summer precipitation are difficult to simulate and must be parameterized in the climate models. Larger scale systems such as the North American Monsoon that influence Colorado's summertime precipitation are not well simulated by climate models (Lin et al. 2008). Despite these shortfalls, the magnitude of potential changes in the timing of precipitation is small compared to year-to-year or even decade-to-decade variations in precipitation. Consequently, interpretation of these projections suggests that the future out to 2050 will be dominated by natural variations in precipitation.

5-2. A Closer Look

Average daily temperature in Colorado for 1950–99 and projections for 2025 and 2050 are shown in Figures 5-2 (January) and 5-3 (July). It is clear that by 2050 the January climate of the Eastern plains has moved northward by a distance greater than half the state. The climate zones of the mountains have migrated upward in elevation, and the climate of the Desert Southwest has progressed into the valleys of the Western Slope. For July, the temperatures on the Eastern Plains have moved westward and upslope, such that the temperature regime near the western Kansas border has reached the Front Range by 2050.

FIGURE 5-1. Temperature and Precipitation Changes over North America Projected for 2050

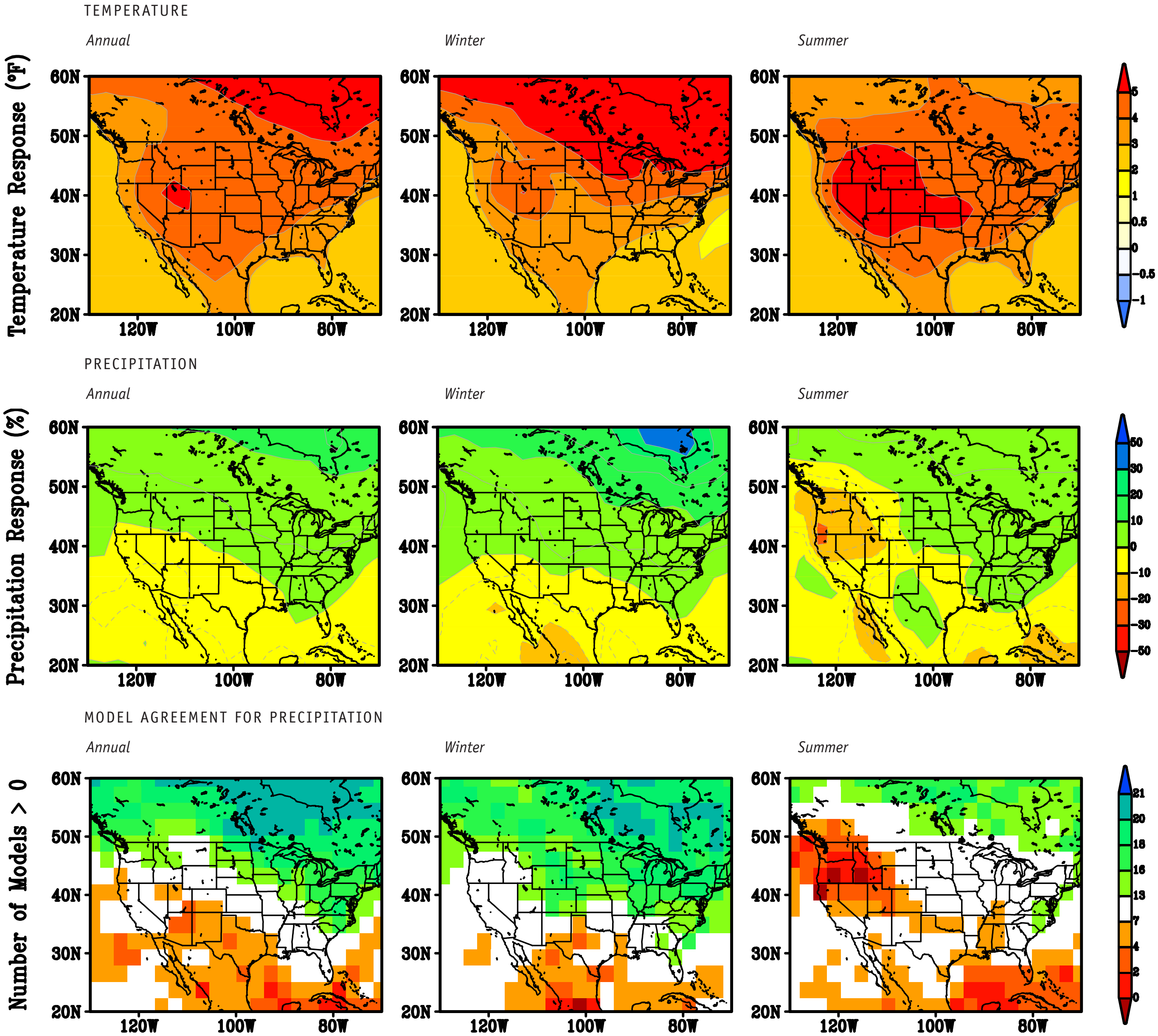


Fig. 5-1. Temperature and precipitation changes over North America projected for 2050 (2040–60 average) by an ensemble of 22 climate models used in the IPCC AR4. Changes are shown relative to the 1950–99 baseline average. The top row is the multi-model average temperature change for the annual mean *(left)*, winter *(center)*, and summer *(right)*. For Colorado, the average projected temperature changes are about 4°F (annual), 3°F (winter), and 5°F (summer). The second row shows the percentage change in total precipitation. The multi-model average shows small changes in precipitation in Colorado, although individual model projections *(not shown)* exhibit a range of projected changes. There is only weak agreement among the models whether annual precipitation will increase or decrease in Colorado *(third row)*, though there is an indication of an increase in winter and a decrease in summer. (Data source: CMIP3 multi-model dataset, PCMDI)

FIGURE 5-2. January Observed and Projected Temperatures

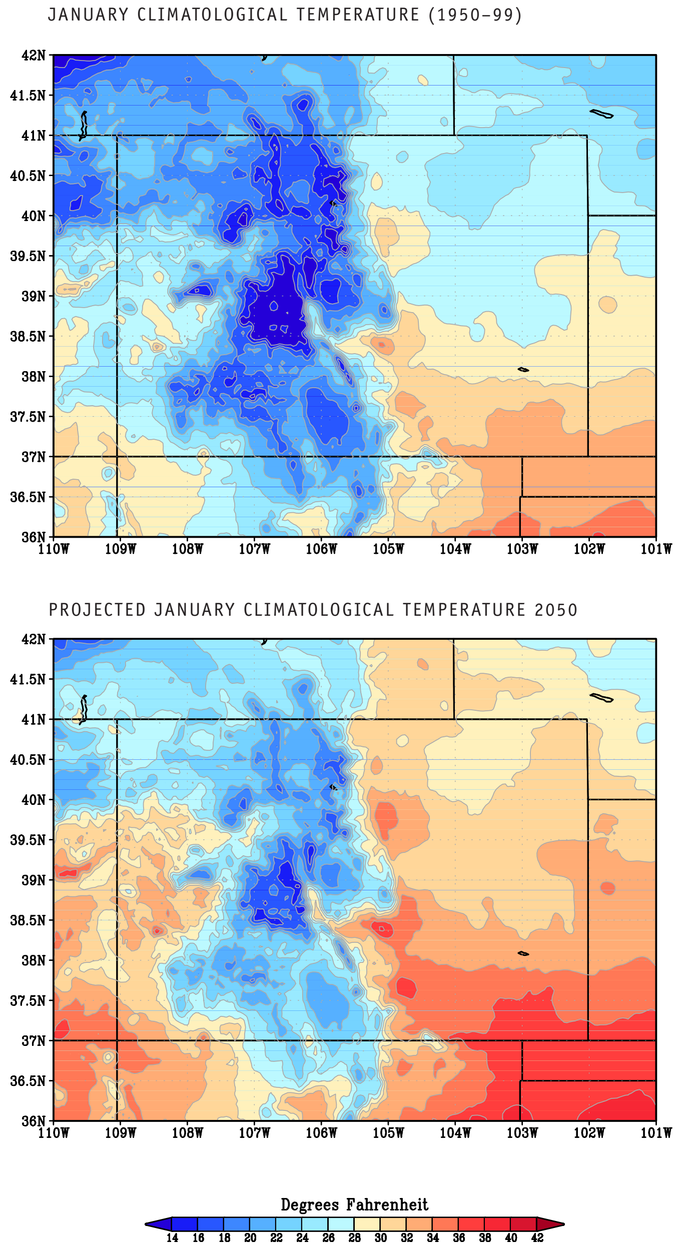


Fig. 5-2. January observed average daily temperature in Colorado for 1950–99 *(top panel)* and projections for 2050 *(bottom panel)*. By 2050 the January climate of the Eastern Plains has moved northward by a distance greater than half the state. The climate zones of the mountains have migrated upward in elevation, and the climate of the Desert Southwest has progressed into the valleys of the Western Slope. Projections were calculated by adding the multi-model average temperature changes to the observed climatology. Observed climatological averages are from PRISM (DiLuzio et al. 2008), and projected changes from the IPCC (CMIP3) 22-model average for the A1B emissions scenario.

FIGURE 5-3. July Observed and Projected Temperatures

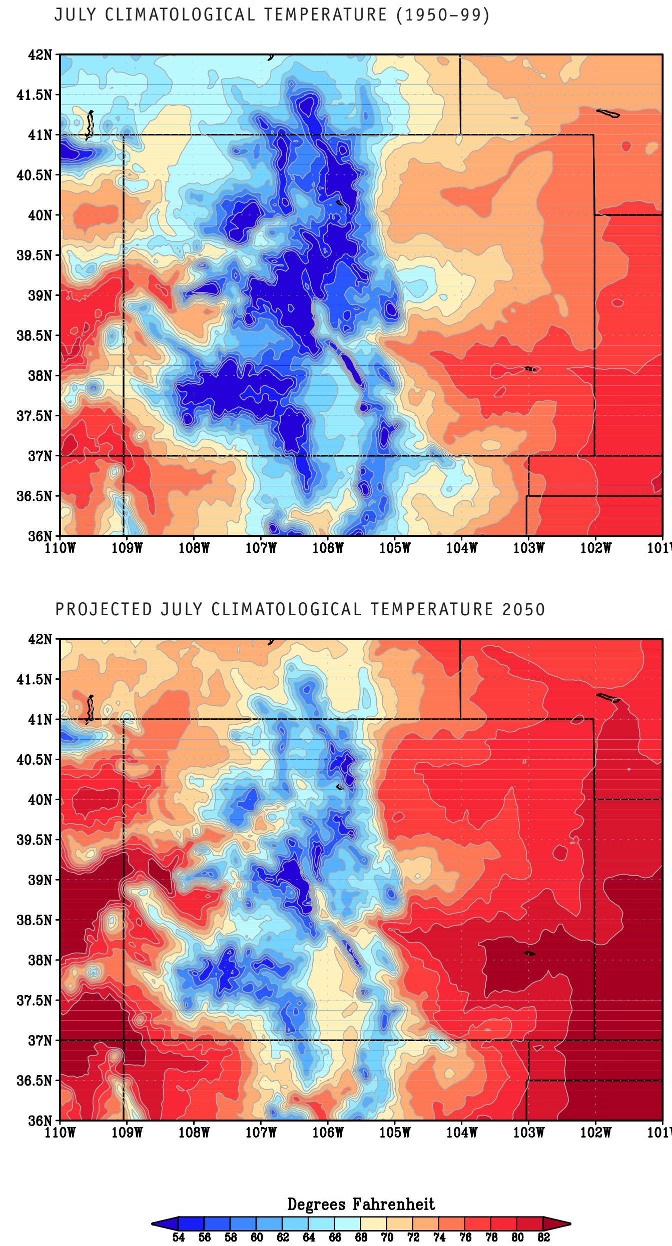


Fig. 5-3. July observed average daily temperature in Colorado for 1950–99 *(top panel)* and projections for 2050 *(bottom panel)*. For July, the temperatures on the Eastern Plains have moved westward and upslope, such that the temperature regime near the western Kansas border has reached the Front Range by 2050. Projections were calculated by adding the multi-model average temperature changes to the observed climatology. Observed climatological averages are from PRISM (DiLuzio et al. 2008), and projected changes from the IPCC (CMIP3) 22-model average for the A1B emissions scenario.

Just as the observed temperature climatology does not capture the year-to-year or day-to-day variations (Figures 5-2 and 5-3, *top*), neither do the climate projections (Figures 5-2 and 5-3, *bottom*). While Figures 5-2 and 5-3 are illustrative of climate change in Colorado, it is unclear how the details will play out at any given location. Due to local and regional climatic effects, some places may warm more than projected, some less (or even cool, particularly in the next couple of decades when average warming trends are comparable to observed variability). Until higher resolution dynamical downscaling is performed, and until projected local land use and potential ecosystem changes (e.g., forest cover changes resulting from pine beetle infestation) are considered, it will be difficult to determine these local variations. But the larger picture must be kept in mind. Comparable warming is projected for most of the western United States. The projected changes, especially in summer, are large compared to present-day climate variations—an indication that the warming signal may be clearly seen throughout Colorado by 2050.

The implications of the model-projected changes in 2050, including the seasonal cycle, are best illustrated by looking in more detail at three locations in Colorado (FIGURE 5-4): the Western Slope (FIGURE 5-5), the North Central Mountains (FIGURE 5-6), and the Eastern Plains (FIGURE 5-7). At all these sites, the monthly average temperatures from 1950 to 1999 are compared with those projected for 2050 using the statistically downscaled projections of Maurer (2007; **http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/**). The cluster of lines shows the seasonal cycle of all 112 available projections from the B1, A1B, and A2 scenarios, depicting the range of model projections (FIGURES 5-5, 5-6, and 5-7; *bottom panels*). To provide a reference for how unusual the projected temperatures *(red lines)* will seem, compared to today, the 10th and 90th percentiles of monthly average temperatures are also shown *(dashed black lines)*. These percentiles represent the top-five-warmest and top-five-coolest months in the period 1950–99. The present and range of projected precipitation climatologies are shown in the bottom panels of FIGURES 5-5, 5-6, and 5-7 for each location.

FIGURE 5-4. Locations of Precipitation and Temperature Projections in FIGURES 5-5, 5-6, and 5-7

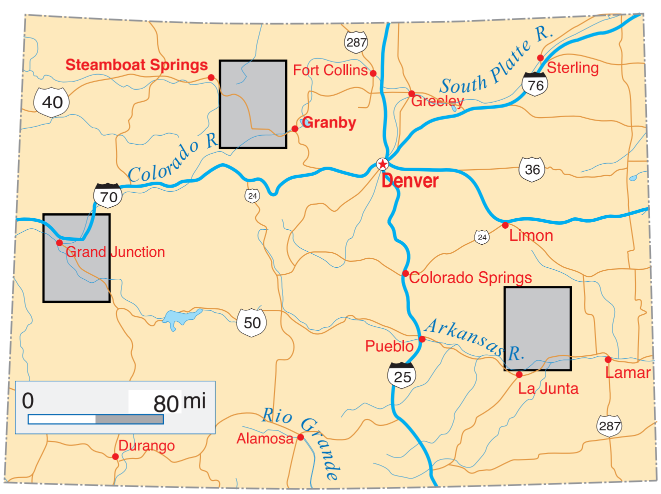


Fig. 5-4. The areas used to calculate monthly temperature and precipitation projections for FIGURES 5-5, 5-6, and 5-7.

FIGURE 5-5. Projected Monthly Temperature and Precipitation near Grand Junction, CO (2050)

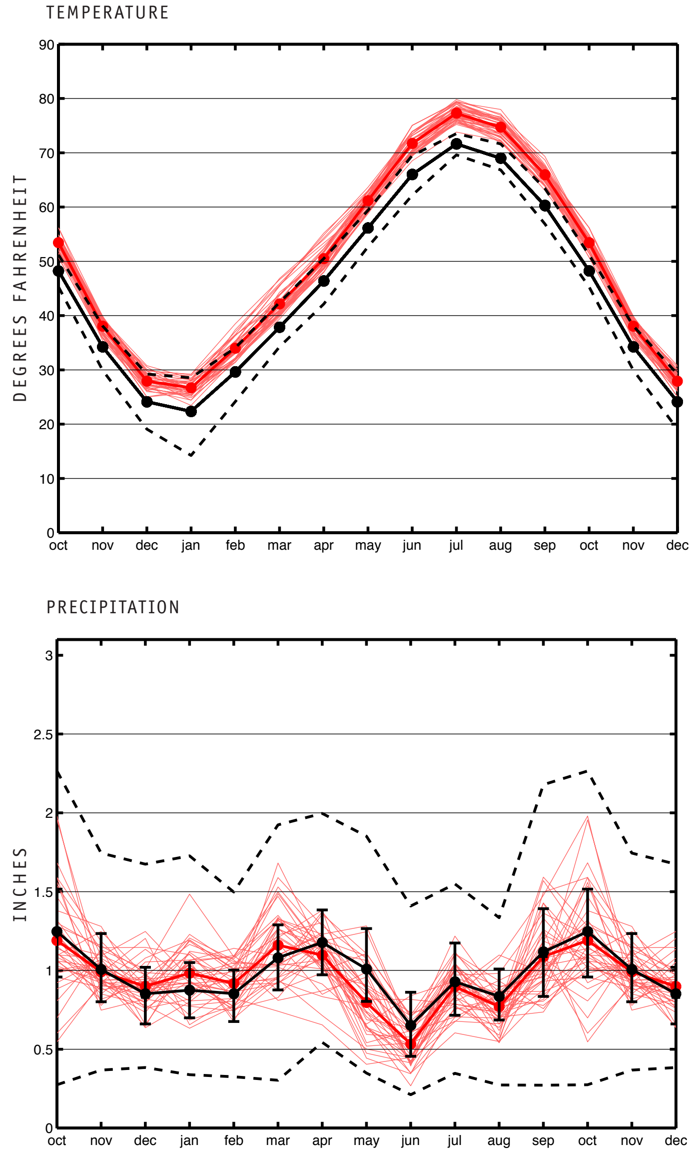


Fig. 5-5. Observed monthly average temperature (°F) *(top panel)* and precipitation (inches) *(bottom panel)* compared with projections for 2050 over a 30 x 40 mile region on the West Slope near Grand Junction *(see FIGURE 5-4)*. The monthly average *(solid black)* and 10th and 90th percentiles values (dashed black lines) are based on observations over the period 1950–99. Projected monthly climatologies *(thin red lines)* are from the multi-model ensemble for the 20-year period centered on 2050. Average of the projections is shown as a heavy red line. Data are derived from bias-corrected and downscaled climate model output and gridded observations (Maurer et al. 2007). For precipitation, the 10th and 90th percentile values of 20-year averages, estimated from nearby station data with ~100 year records, are also shown *(vertical bars)*. The magnitude of projected temperature change is comparable to or greater than the year-to-year variations throughout the historical record; however, this is not the case for precipitation.

FIGURE 5-6. Projected Monthly Temperature and Precipitation near Steamboat Springs, CO (2050)

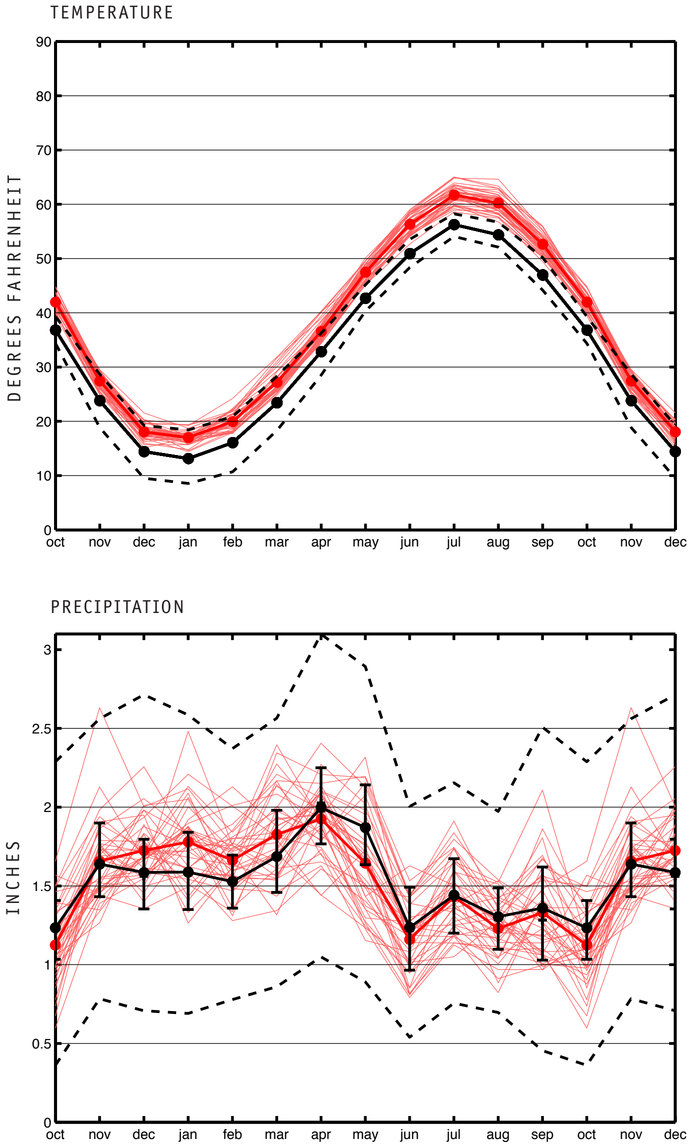


Fig. 5-6. Same as FIGURE 5-5, but for a region in the North Central Mountains between Granby and Steamboat Springs.

FIGURE 5-7. Projected Monthly Temperature and Precipitation near La Junta, CO (2050)

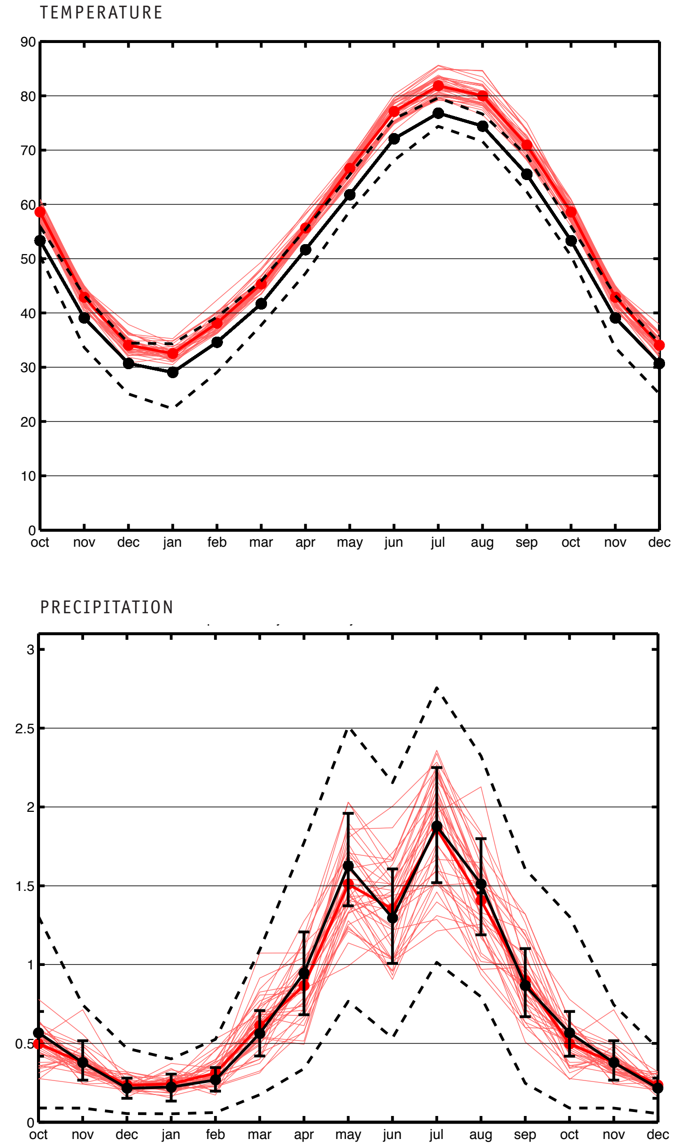


Fig. 5-7. Same as FIGURE 5-5, but for a region on the Eastern Plains near La Junta.

At all three sites, the temperature increases are largest in summer. The July temperatures from almost all the model projections at all three sites lie at or above the 90th percentile of the present climate. The bulk of the projections suggest that typical summer temperatures will equal or exceed the extreme warm summers of the last half of the 20th century. The projected temperature changes are somewhat smaller in winter and the year-to-year variations are larger. While extreme warm winter months would increase in these projections, most years, even in 2050, will not be extreme by present standards. Winter warming will be manifest in the relative absence of cold months and in the cumulative effects of consecutive warm winters.

Unlike temperature projections, potential future changes in precipitation are smaller than the year-to-year and decade-to-decade variations observed in the historical record. This is consistent with the IPCC: "Models suggest that changes in mean precipitation amount, even where robust, will rise above natural variability more slowly than the temperature signal" (IPCC AR4 WGI 2007, p. 74). The Western Slope site has considerable precipitation in most months, with maxima in the spring and autumn. The multi-model average projections for this locale show a shift to a wetter winter and drier spring, although the range of projections is large. In the central mountains, where most precipitation falls in the cold season, the projections show an increase in winter precipitation and smaller changes in other times of the year. There is a strong summertime maximum in precipitation in the present climate near La Junta in the eastern plains. The downscaled multi-model projections indicate little change. However, model uncertainties are largest in summer, so less confidence can be put in the projected precipitation at this location. These three locations are indicative of what may happen throughout Colorado, as they reflect the large-scale climate model projections.

5-3. Hydrologic Changes

The state of Colorado is the headwaters of the Arkansas, Platte, Rio Grande, and Colorado Rivers. While climate change is projected to impact all these basins (Figure 5-8), the impact on the Colorado River has received by far the most study. A decrease in runoff in the Upper Basin of the Colorado River—and the resulting decrease in the natural flow at Lee Ferry on the Colorado River—could increase the chance of the Upper Basin failing to meet its delivery requirements under the Colorado Compact (e.g., Christensen et al. 2004; McCabe and Wolock 2008). Other interstate water compacts could also be affected.

Recent hydrologic studies on climate change in the Upper Colorado River Basin point to an expected decline in runoff by the mid-to-late 21st century (Table 5-1). Those studies that explicitly calculate runoff report multi-model average decreases ranging from 6% to 20% by 2050 compared to 20th century conditions; the one recent study that bases streamflow on a large-scale statistical relationship (Hoerling and Eischeid 2006) projects a 45% decrease by 2050 (Table 5-1). The range of individual model projections within a single study can include both increasing and decreasing runoff due to the range of climate model output used to drive the hydrology models (Figure 5-9). Table 5-1 also identifies the studies that analyze the risk that climate change poses to water supply and storage (details are beyond the scope of this document, see references in Table 5-1).Extensive discussions of hydrologic studies can be found in National Research Council (2007), the USBR Climate Technical Working Group (Appendix U of USBR EIS 2008), and in chapter four of the CCSP SAP 4.3 (2008).

FIGURE 5-8. Projected Changes in Annual Runoff (2041–2060)

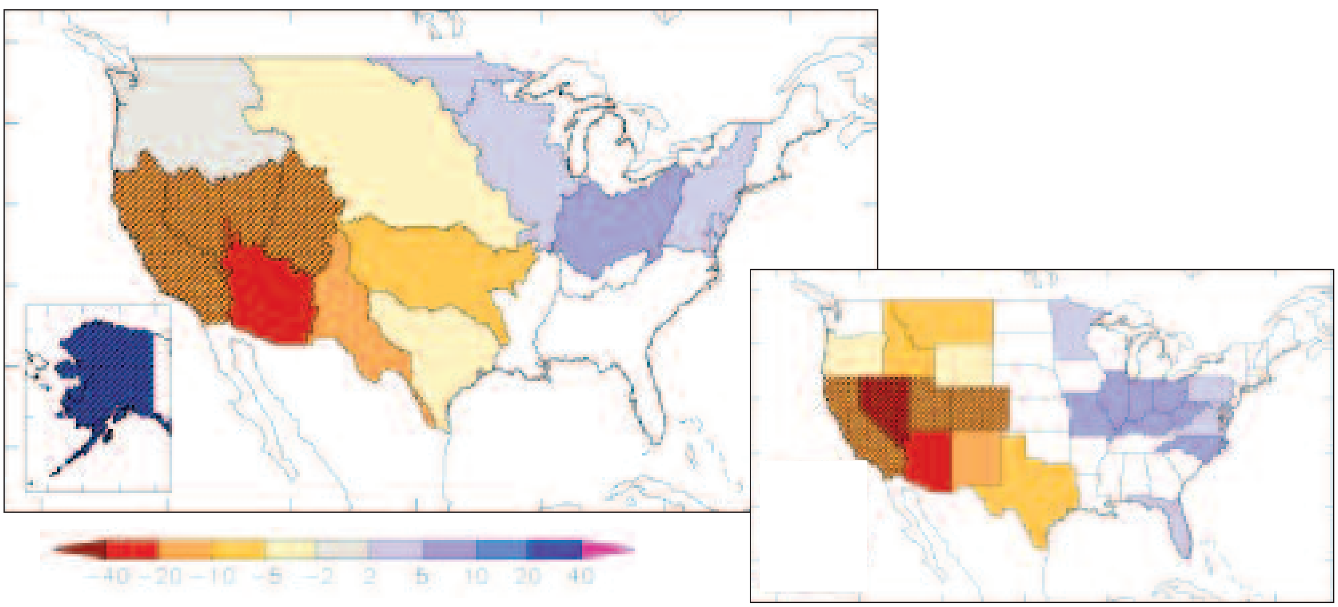


Fig. 5-8. Model-projected changes in annual runoff (2041–60 average) for different river basins in the United States. The scale represents the percentage change relative to a 1900–70 baseline. Colors indicate that >66% of models agree on whether the change is positive or negative; diagonal hatching indicates >90% agreement. (data from Milly 2005, replotted by P.C.D. Milly)

TABLE 5-1. Projected Changes in Colorado River Basin Runoff or Streamflow in the Mid-21st Century from Recent Studies

Study	*GCMs (runs)*	*Spatial Scale*	*Temperature*	*Precipitation*	*Year*	*Runoff (Flow)*	*Risk Estimate*
Christensen et al. 2004	1 (3)	VIC model grid (~8 mi)	+3.1°F	-6%	2040–69	-18%	Yes
Milly 2005, replotted by P.C.D. Milly	12 (24) (~100–300 mi)	GCM grids —	—		2041–60	-10 to -20% 96% model agreement	No
Hoerling and Eischeid 2006	18 (42)	NCDC Climate Division	+5.0°F	~0%	2035–60	-45%	No
Christensen and Lettenmaier 2007	11 (22)	VIC model grid (~8 mi)	+4.5°F (+1.8 to +5.0)	-1% (-21% to +13%)	2040–69	-6% (-40% to +18%)	Yes
Seager et al. 2007*	19 (49)	GCM grids (~100–300 mi)	—	—	2050	-16% (-8% to -25%)	No
McCabe and Wolock 2008	—	USGS HUC8 units (~25–65 mi)	Assumed +3.6°F	0%	—	-17 %	Yes
Barnett and Pierce 2008*	—	—	—	—	2057	Assumed -10% to -30%	Yes

Values and ranges (where available) were extracted from the text and figures of the references shown. Columns provide the number of climate models and individual model runs used to drive the hydrology models, the spatial scale of the hydrology, the temperature and precipitation changes that drive the runoff projections, and whether or not the study quantified the risk these changes pose to water supply (e.g., the risk of a compact call or of significantly depleting reservoir storage).

* Two studies do not specifically make projections of Upper Basin runoff or streamflow. Seager et al. (2007) average over a large area (95°W–125°W, 25°N–40°N) that only partially overlaps with the Upper Basin. Barnett and Pierce (2008) assume Lees Ferry streamflow changes to drive their water balance model of reservoir storage.

FIGURE 5-9. Range in Temperature and Precipitation Projections for the Upper Colorado River Basin

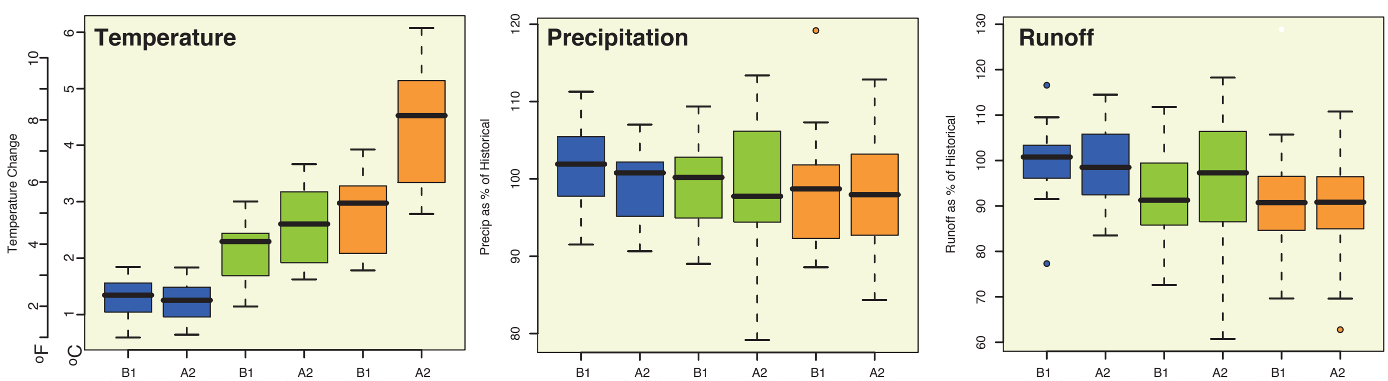


Fig. 5-9. Range in temperature and precipitation projections for the Upper Colorado River Basin from 11 GCMs, and the resulting range in runoff projections from Christensen and Lettenmaier (2007). Box-and-whiskers symbols represent the 5th, 25th, 50th, 75th, and 95th percentiles of the data; outliers are shown by circles. Projections are shown for the SRES B1 and A2 emissions scenarios for 30-year averages centered on the years 2025, 2055, and 2085. Changes are relative to 1950–2000 averages. The range results from different climate model formulations and from model-simulated climate variability. For comparison, 30-year averages of the historical and reconstructed flows at Lees Ferry (Meko 2006) range from 92% (5th percentile) to 108% (95th percentile) of the long-term average. Note that when the downscaled precipitation data that is used as input for this study is adjusted to show the same percentage change as the GCM gridboxes, the runoff shows a greater decline, ~14% on average, by 2070–2100. (D. Lettenmaier, pers. comm.)

The range in model projections both within and among the various studies is influenced by modeling methodologies and natural variability. First, a number of differently formulated climate models, each with different projected temperature and precipitation changes over the Upper Basin, are used to drive the hydrology models that generate runoff projections. These different climate drivers lead to different runoff projections (Figure 5-9). A second, related factor is that runoff in the Upper Basin varies due to natural climate variability, some of which is captured by the climate models. Therefore the range of individual model simulations (e.g., the range reported by Christensen and Lettenmaier 2007) results from differences in climate model formulation and from different realizations of model-simulated climate variability. It would be ideal to analyze a large number of realizations (runs) from each climate model to isolate these two factors, but multi-run ensembles are not available for most GCMs. For this reason, most researchers emphasize the multi-model average over the range of individual model projections.

A third factor is that different downscaling and bias-correction techniques are used to relate GCM grids to hydrology model grids (see Section 3-4). For example, the percentage change in GCM precipitation projections is modified by the downscaling technique used by Maurer (2007) (Dennis Lettenmaier, pers. comm.). Fourth, different hydrologic models are used to make runoff projections. These include GCM hydrology component models (Milly 2005), simple statistical regressions (Hoerling and Eischeid 2006), and distributed hydrologic process models (Christensen and Lettenmaier 2007).

The spatial scale at which the hydrology is resolved is a particularly important factor in determining the simulated hydrologic response to climate change. In particular, there is the need to resolve small-scale topographic effects including cooler average temperatures at higher elevations that have a strong effect on evapotranspiration and snow hydrology. For the studies listed in Table 5-1, the spatial scale ranges from a few hundred miles (the typical GCM grid) to eight miles (the Variable Infiltration Capacity hydrology model grid).

Feedback from water managers has motivated an ongoing research project, the NOAA-funded *Reconciling Projections of Future Colorado River Stream Flow* study, to understand the differences among these projections in order to provide water managers with more useful information. The goal of this project is to quantify the effects of methodological differences on the range of streamflow projections and, if possible, to reduce the range of uncertainty in these projections.

The impact of climate change on runoff in the Rio Grande, Platte, and Arkansas basins has not been studied as extensively. A multi-model study of GCM-simulated runoff projects a decrease of 5–10% in the Arkansas (62% model agreement on the sign of the change) and Rio Grande (75% model agreement) basins by 2050, and no appreciable change in the Platte/Missouri Basin (Figure 5-8). This is compared with the 10–25% reduction (95% model agreement) for the Upper Colorado River Basin. These numbers should be interpreted with caution because they are based on GCM-scale hydrology and they reflect the runoff in the entire river basins, not just the part in Colorado. Hurd and Conrood (2007) project a decline in streamflow of -3% to -14% by 2030 and -8 to -29% by 2080 for the Rio Grande Basin.

Regarding hydroclimatology of the western United States, the IPCC (2008, p. 102) states, "[w]arming and changes in the form, timing and amount of precipitation will be ***very likely*** to lead to earlier melting and significant reductions in snowpack in the western mountains by the middle of the 21st century." The high-elevation snowpack in the Colorado River Basin is projected to have a moderate decline (Figure 5-10), whereas lower-elevation snowpack (primarily outside Colorado) experiences a precipitous decline. At high elevations mid-winter temperatures would remain below freezing even with relatively large warming, and the main effects of rising temperatures on snowpack would be seen in the spring. The high-elevation headwaters also lie in a region where small, or even positive, changes in wintertime precipitation are projected.

FIGURE 5-10. Projected Change in Colorado River Basin Snowpack

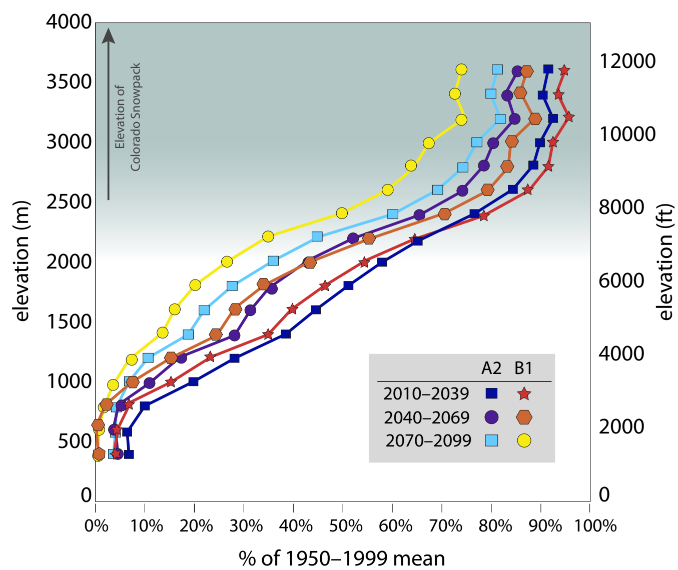


Fig. 5-10. Projections of snowpack changes as a function of elevation for the Colorado River Basin. The data show average snowpack declines throughout the cold season, and are a function of both the snow water equivalent and the amount of time snow is on the ground. The downscaled projections from 11 climate models for the 30-year average centered on 2025, 2055, and 2085 are shown for the B1 and A2 emissions scenarios. Most of the snowpack in the state of Colorado that feeds the Colorado River lies above 2500 m (8200 ft) in elevation. Modest declines in snowpack are projected at these high elevations, and larger declines (80–90%) may occur at lower elevations. The basinwide average April 1 snow water equivalent (SWE) is projected to decline by 13% (2025), 21% (2055), and 38% (2085) in scenario A2, and by 15% (2025), 25% (2055), and 29% (2085) in scenario B1. (Christensen and Lettenmeier 2007)

FIGURE 5-11. Projected Soil Moisture Changes in the Upper Colorado River Basin for 2050 for April, May, June, and July

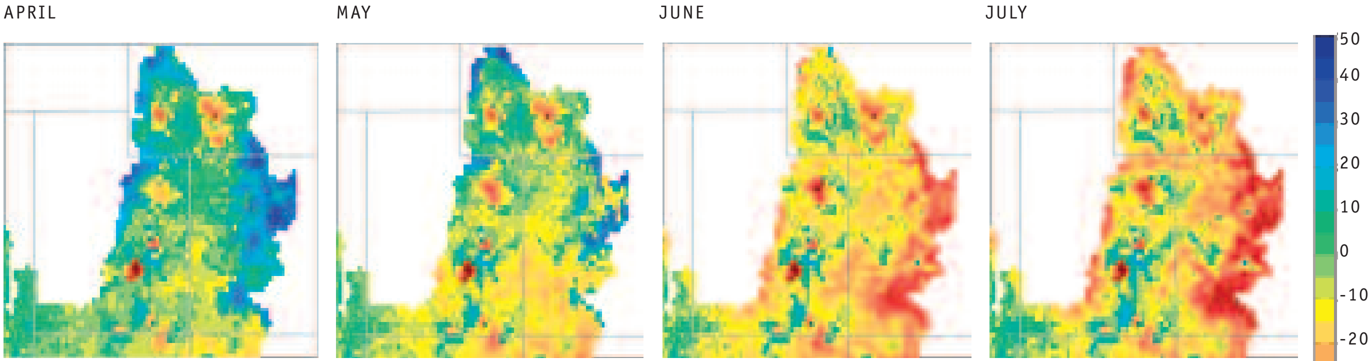


Fig. 5-11. Projected soil moisture changes for 2050 in the Upper Colorado River Basin for April, May, June, and July. The shift in the median (50th percentile) soil moisture is shown in terms of the percentiles of the 1950–2000 soil moisture simulation. Zero shift represents no change in the median soil moisture. Warm colors represent drying in the future; cool colors represent wetter conditions in the future. Earlier snowmelt leads to wetter soil moisture conditions in April and drier conditions by summer.

The resulting earlier snowmelt is evident in the maps of projected changes in soil moisture in the Colorado River Basin (Figure 5-11). April soil moisture *(left)* increases in most of the mountainous regions due to the earlier snowmelt. In May *(center left)*, only the highest elevations show increased soil moisture, while by June *(center right)* and July *(right)*, the soil moisture is greatly reduced compared to the present values. This is consistent with the IPCC Technical Paper on Water (2008), in which projections for mountain snowmelt-dominated watersheds indicate an increase in winter and early spring flows (raising flooding potential), and a substantial decrease summer flows. "Hence, over-allocated water systems of the western USA and Canada that rely on capturing snowmelt runoff could be especially vulnerable. . . ." (IPCC 2008, p. 102).

5-4. Extremes

An extreme weather event is defined by the IPCC as an "event that is rare at a particular place and time of year," where rare is below the 10th or above the 90th percentile of observations. Using analyses of the IPCC AR4 climate model monthly and daily output, the CCSP SAP 3.3 (2008) addresses projections of climate extremes, including heat waves, drought, flooding, and storms that are most relevant to Colorado.

For the western United States, projected changes in precipitation extremes are larger than changes in mean precipitation (IPCC 2008). Model simulations suggest that in the West, cold air outbreaks will continue to occur even in a warmer climate, though the frequency will be somewhat reduced.

Damaging flood events have been associated with intense summer precipitation on the Eastern Plains and the Front Range. Based on physical principles, thunderstorms could be more intense in a warmer climate because warmer air can potentially "hold" more moisture and transport it into the storms (Trenberth 1999). Multi model analyses (Tebaldi et al. 2006) discussed in the CCSP SAP 3.3 suggest an increase in strong precipitation events over most of the conterminous United States. However, the vicinity of Colorado shows an unchanged or decreased chance of strong events. The reason for this result is not understood. Given the small spatial scales involved, and given the often dominant importance of topographic effects precipitation, an analysis such as Tebaldi et al. (2006) that is based on the global climate models has to be interpreted with great caution. Regional climate model simulations may help to shed some light on this difficult problem in the future.

The CCSP projects that in the southwestern United States (boundaries not specified), the combination of increasing temperature and decreasing wintertime precipitation means that it is "***likely*** that droughts will become more severe" (CCSP SAP 3.3, p. 5). Of relevance for Colorado is that "in other places where the increase in precipitation cannot keep pace with increased evaporation, droughts are also ***likely*** to become more severe. It is ***likely*** that droughts will continue to be exacerbated by earlier and possibly lower spring snowmelt run-off in the mountainous West, which results in less water available in late summer" (CCSP SAP 3.3, p. 5).

SIDEBAR 5-1. Aspen Snow: Consideration of Climate Change Information in Planning

A case study evaluated how the quantity and quality of snow at Aspen Mountain ski area in 2030 and 2100 may be affected by changes in regional climate resulting from increased greenhouse gas emissions. This study estimated changes in regional climate using MAGICC/SCENGEN, software for downscaling models, and ran combinations of five general circulation models (GCMs) that best simulate current conditions. The climate change estimates were run using the relatively low, mid-range, and high GHG emissions scenarios: B1, A1B, and A1FI. Output from a regional climate model statistical downscaling model was used to generate higher resolution estimates of changes in climate using output from the Hadley model (HADCM3). Snow quantity was evaluated using the Snowmelt Runoff Model and a module developed to estimate snow quantity during the accumulation season, before snowmelt initiation. Snow quality was also evaluated.

By 2030, the estimated temperatures increase is 1.8 to 2.5°C at Aspen Mountain from circa 1990, and the length of the ski season is estimated to decrease by approximately 1 to 1.5 weeks. By 2030, the snowline is estimated at 2250 m above sea level; an increase of approximately 200 m from current (2006) conditions. By 2100, average annual temperatures are projected to increase 2.9 to 9.4°C. The snowline is estimated at 2800 to 2900 m for the A1B and B1 scenarios in 2100, and 3100 to 3200 m for the A1FI scenario. The date when snow starts to accumulate at the base area is delayed by six to seven days by 2030, and anywhere from 1.5 to 4.5 weeks by 2100 relative to circa 1990. For mid-winter snows, a 15% increase in snowfall compensates for a 1.5°C increase in air temperature such that there would be little change in snow depth. Snow depth is reduced to almost zero for the base area in 2100 under the medium greenhouse gas emissions A1B scenario. In the high greenhouse gas emissions A1FI scenario, snow depth is reduced to near zero for the entire lower two-thirds of the mountain. The effect is substantially reduced under the low greenhouse gas emissions B1 scenario (FIGURE 5-12). In spite of earlier snowmelt initiation and the reduction in snowpack, snow density in the top 10 centimeters increases by less than 20% by 2030.

The study was led by the Aspen Global Change Institute and funded by the City of Aspen. Stratus Consulting analyzed snowpack and ecological changes; the Rural Planning Institute analyzed economic implications of climate change impacts on tourism; and the University of Colorado examined stakeholder responses and adaptation; Tom Wigley at the National Center for Atmospheric Research provided advice on modeling simulations.

FIGURE 5-12. Projected Change in Snow Covered Area, Aspen

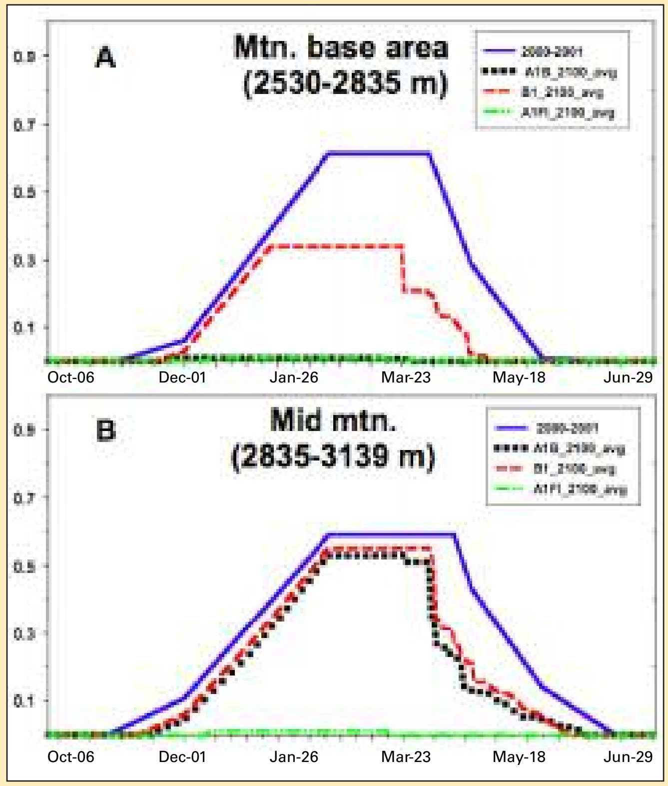
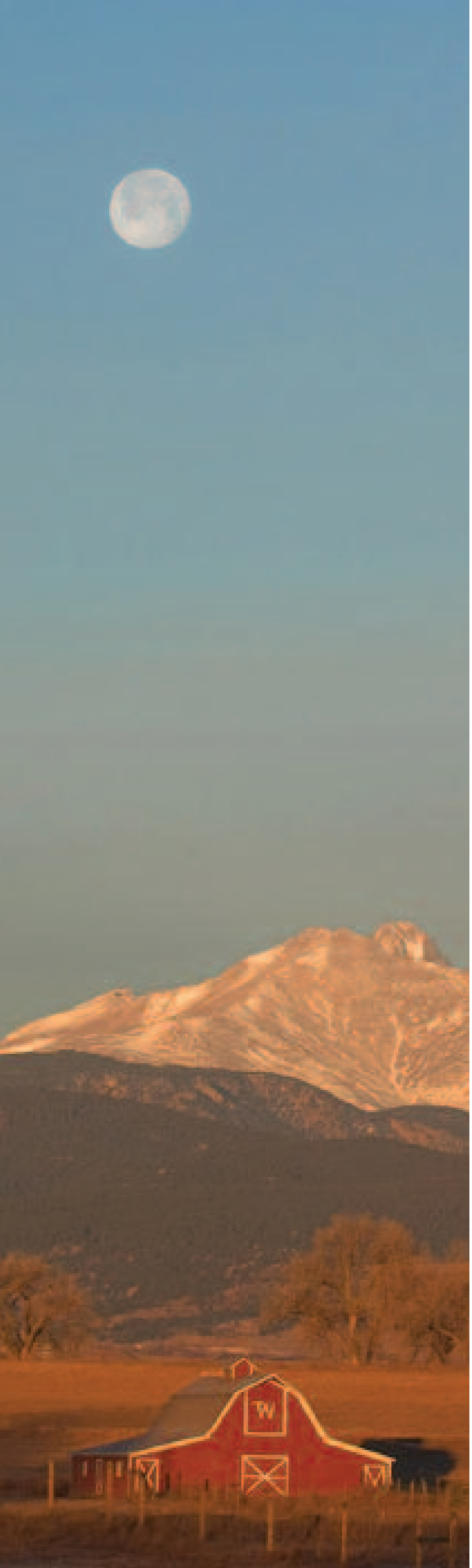


Fig. 5-12. Change in snow covered area. Percentage of the mountain zone covered in snow in 2100 from October through June based on scenarios A1B, B1, and A1FI.



6
Implications of Changing Climate for Colorado's Water Resources

Colorado's water resources are sensitive to the changing climate on a range of time scales. As a buffer against natural seasonal and interannual variability, Colorado pioneers and their descendants developed infrastructure for water storage and conveyance, and adopted institutional arrangements capable of allocating shortages when necessary, including the prior appropriations system and interstate compacts. These actions helped in managing water during drought and other climate variations in the 20th century. But the 21st century climate may pose new challenges to water managers that are unlike those experienced in the 20th century.

Paleoclimate studies reveal that previous centuries were unlike the past century. Lengthy droughts and wet periods were more common from about 800 to 1900 in the West (Figure 2-8). Even in the absence of climate change this new understanding of past hydrology would warrant a renewed focus on drought planning. Second, water supply systems are facing complex stresses, including increasing demands from a growing population and potential energy development. Third, these challenges are magnified by the need to consider climate change. Therefore, there is an emerging need for vulnerability assessments, for adaptation planning, and for bringing climate change information into ongoing integrated resource planning.

This report provides a synthesis of the physical aspects of changing climate and a scientific basis to support further studies of water resources impacts. The assessment and quantification of specific climate change impacts on water resources is beyond the scope of this document. Few published studies address potential water resources impacts in Colorado. Two of these—Aspen and Boulder (Sidebars 5.1 and 3.2)—are examples of how climate change information has been considered in water-related resource planning. However, much further work is needed to assess the multi-dimensional impacts and cascading effects on water resources affecting humans and the environment. A number of projects are in progress, such as the Joint Front Range Climate Change Vulnerability Study (JFRCCVS, Sidebar 3.3) and the Colorado River Water Availability Study (**http://ibcc.state.co.us/Process/Needs/WaterSupplyAvailability/**), in which climate projections are being used to explore possible water supply scenarios to which managers may need to adapt.

Section 6 identifies some implications of climate change for Colorado water management. It also briefly discusses the potential uses of the information within this report in water resources management, including assessing vulnerabilities and creating adaptive strategies, such as those called for in the Governor's Colorado Climate Action Plan.

Key Implications

Climate change will affect Colorado's use and distribution of water. Changes in economies and land use, environmental concerns, and population growth are already affecting water management decisions. Water managers and planners currently face specific challenges that may be further exacerbated by projected climate changes (Table 6-1). The implications of climate change in this report are consistent with the broader conclusions in the CCSP SAP 4.3 and the report, *Colorado River Basin Water Management* (NRC 2007).

The consistent projections for a substantial temperature increase over Colorado (IPCC 2008) have important implications for water management. Increases in temperature imply more evaporation and evapotranspiration leading to higher water demands for agriculture and outdoor watering. Temperature-related changes in the seasonality of streamflows (e.g., earlier runoff) may complicate prior appropriation systems and interstate compact regimes; and modify the interplay among forests, hydrology, wildfires, and pests (e.g., pine beetles).

The wide range of precipitation projections makes it difficult to assess likely changes in annual mean precipitation by mid-21st century. However, a synthesis of findings in this report suggests a reduction in total water supply by then. Furthermore, there is potential for increased drought severity in the region due to higher temperatures alone. When combined with temperature increases and related changes in evaporation and soil moisture, recent hydrologic studies on climate change in the Upper Basin of the Colorado River point to an expected decline in runoff by the mid-to-late 21st century. These studies report multi-model average decreases ranging from 6% to 20% by 2050 (Section 5-3). This synthesis is consistent with the conclusion of the IPCC that globally the negative impacts of climate change on water resources outweigh the positive (IPCC 2008).

Strategies for Incorporating Climate Information into Water Planning and Adaptation

Two pathways for integrating climate information into water resources planning and management are vulnerability analysis and integrated resource planning (see Cromwell et al. 2007; Miller and Yates 2006). Vulnerability analysis includes *top-down* or *bottom-up* perspectives. In the top-down perspective, projections of global or spatially downscaled models are used to drive resource models and project resource impacts. The top-down strategy is illustrated in Figure 3-5, which depicts how climate projections may be used in water operations models. Some approaches include the use of sensitivity studies based on changing temperature and/or precipitation by a fixed amount guided by the range of model projections, the direct use of climate model output with existing downscaling methods (e.g., the Aspen Study, Sidebar 5-1), and the use of conditionally re-sampled historical record that shifts the average climate according to the model projections, while preserving the character of day-to-day and year-to-year historical sequences.

TABLE 6-1. Challenges Faced by Water Managers, and Projected Changes

Issues	*Observed and/or Projected Change*
Water demands for agriculture and outdoor watering	Increasing temperatures raise evapotranspiration by plants, lower soil moisture, alter growing seasons, and thus increase water demand.
Water supply infrastructure	Changes in snowpack, streamflow timing, and hydrograph evolution may affect reservoir operations including flood control and storage. Changes in the timing and magnitude of runoff may affect functioning of diversion, storage, and conveyance structures.
Legal water systems	Earlier runoff may complicate prior appropriation systems and interstate water compacts, affecting which rights holders receive water and operations plans for reservoirs.
Water quality	Although other factors have a large impact, "water quality is sensitive both to increased water temperatures and changes in patterns of precipitation" (CCSP SAP 4.3, p. 149). For example, changes in the timing and hydrograph may affect sediment load and pollution, impacting human health.
Energy demand and operating costs	Warmer air temperatures may place higher demands on hydropower reservoirs for peaking power. Warmer lake and stream temperatures may affect water use by cooling power plants and in other industries.
Mountain habitats	Increasing temperature and soil moisture changes may shift mountain habitats toward higher elevation.
Interplay among forests, hydrology, wildfires, and pests	Changes in air, water, and soil temperatures may affect the relationships between forests, surface and ground water, wildfire, and insect pests. Water-stressed trees, for example, may be more vulnerable to pests.
Riparian habitats and fisheries	Stream temperatures are expected to increase as the climate warms, which could have direct and indirect effects on aquatic ecosystems (CCSP SAP 4.3), including the spread of in-stream non-native species and diseases to higher elevations, and the potential for non-native plant species to invade riparian areas. Changes in streamflow intensity and timing may also affect riparian ecosystems.
Water- and snow-based recreation	Changes in reservoir storage affect lake and river recreation activities; changes in streamflow intensity and timing will continue to affect rafting directly and trout fishing indirectly. Changes in the character and timing of snowpack and the ratio of snowfall to rainfall will continue to influence winter recreational activities and tourism.
Groundwater resources	Changes in long-term precipitation and soil moisture can affect groundwater recharge rates; coupled with demand issues, this may mean greater pressures on groundwater resources.

FIGURE 6-1. Approaches to Climate Change Assessment

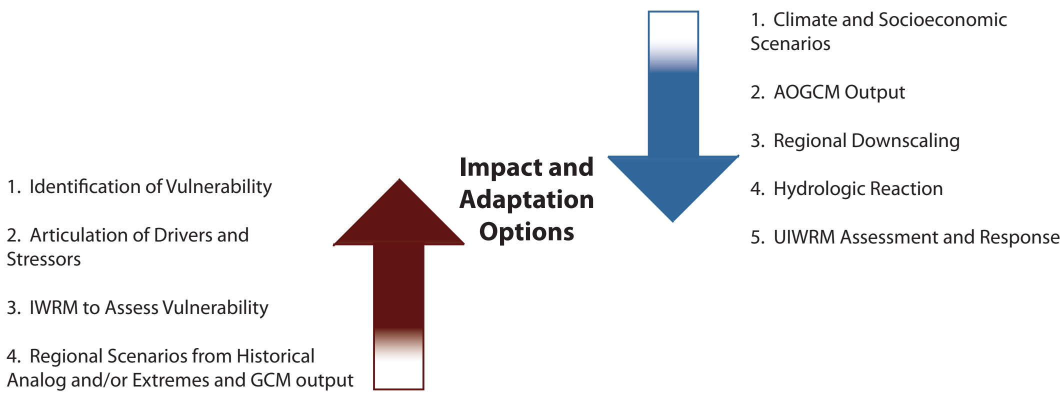


Fig. 6-1. Bottom-up and top-down approaches to climate change assessment. These approaches are not necessarily exclusive. (Yates and Miller 2006)

Information from global climate model simulations is beginning to be used in water resource related planning studies, such as the Environmental Impact Study supporting the recent Record of Decision on Colorado River Interim Guidelines (DOI 2007, see **http://www.usbr.gov/lc/**). This report assessed the state of knowledge with regard to climate change and modeling to support planning for operations under long-term drought conditions (Bureau of Reclamation 2007). Miller and Yates (2006) find that most efforts to incorporate climate change information into their planning process have used the top-down perspective. These top-down perspectives, however, are limited by the current state of the art of climate models, downscaling techniques, and observations.

Another approach is often referred to as bottom-up, illustrated in Figure 6-1. Bottom-up approaches are place-based and deal with specific resources of interest, as described for agriculture by Pielke et al (2007). In this approach water managers start with their knowledge of their system and utilize their water supply planning tools to identify what changes in climate would be most threatening to their long-range plans or operations. These are the system's critical vulnerabilities, such as the types of changes in climate that would cause these critical problems e.g., a 10% increase in flow from the 100-year flood. This is known as the threshold approach. The next step is to assess what adaptations can be made to cope and roughly at what cost. By examining the outputs of climate models or studies, water managers can then assess the likelihood of such system critical vulnerabilities.

Climate change information can be incorporated into either top-down scenario-driven or bottom-up vulnerability assessments. In the case of water resources, these assessments might include the risks of compact calls in Colorado's river basins or the risks of large-scale drought. Integrated planning processes based on these might include mitigation planning to assess and prepare for drought and developing for each major river basin a mechanism to deal with potential interstate compact calls.

The information in this report can be used to generate climate vulnerability assessments for Colorado water management that are consistent with the IPCC and CCSP reports. There remain uncertainties in projections of temperature, precipitation, and runoff; model formulation; emissions scenarios; and the role of natural variability.

Therefore, water managers will have to make plans based on a range of possible futures. This uncertainty suggests incorporating climate information in Integrated Resource Planning (IRP) (Cromwell et al. 2007; Yates and Miller 2006). IRP is a widely used long-term planning approach that integrates multiple facets of water management challenges, and is a strategy for keeping a wide range of options open and maintaining flexibility in the face of uncertain futures. This strategy is important given the uncertainties about climate futures. While the science continues to advance, the information will always have uncertainties, a range of possible futures, and there will still be natural variability across time scales. Lempert and Collins (2007) recommend decision pathways that are robust for a range of conditions.

Key Unresolved Issues

The current state of the science is unable to provide sufficient information to decision makers and stakeholders on a number of crucial scientific issues regarding Colorado's water resources. Often, there are insufficient data, in time or space, to assess long-term observational trends. In other cases, research is in progress, but the results may not be as robust as needed. Four overlapping areas with unresolved issues are climate models, research specific to Colorado, drought, and reconciling hydrologic projections.

- **Modeling issues.** To produce model projections at the scale desired by decisionmakers, regional and local processes and their role in Colorado's climate must be better modeled. Precipitation projections and related phenomena are key uncertainties. Enhanced climate modeling efforts to include finer spatial resolution are needed that better represent Colorado's mountainous terrain and precipitation processes.
- **Colorado-specific research.** Further research is needed focused on the state of Colorado and its river basins, and specifically on regions where there is little or no work, such as the basins of the Arkansas, Rio Grande, and the North and South Platte Rivers.
- **Understanding the causes of drought.** Issues include runoff efficiency, effects of increased temperatures, and uncertainty in precipitation projections. The attribution of the 2000s drought is an area of ongoing research.
- **Hydrologic projections for the Colorado River.** There is a large range among projections of river flows (Section 5). A key uncertainty is how efficient future runoff will be in the Colorado as well as other basins. A study is underway to reconcile the differences among these projections, and to better resolve projections for future flows. These uncertainties arise both from climate models and hydrologic models.

A View Toward the Future

This is a challenging time for both climate science and water management in Colorado. A warming climate will amplify Colorado's water related challenges, with potential reductions and seasonal shifts in water availability. While most water resource planning has been based on past hydrology, water users can no longer assume that future conditions will reflect the past. Although there are uncertainties regarding aspects of the science, enough information is available to support adaptation planning for risks associated with climate variability and change. Understanding of climate change in Colorado is evolving and many projects are underway to reduce these uncertainties. A continuing dialogue among climate scientists, water resources managers, planners, and policymakers will ensure that the robust scientific findings benefit society.

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Glossary

Most of the definitions included in this glossary are quoted directly from other sources, including IPCC products and Colorado State documents. The source for each definition is noted after each definition.

A1B

The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (A1B) (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end use technologies).

IPCC AR4 WGI SPM

A2

The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than other storylines.

IPCC AR4 WGI SPM

Adaptation

An adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous, and planned adaptation.

IPCC AR4 WGII

Aerosols

A collection of airborne solid or liquid particles, with a typical size between 0.01 and 10 micrometer (a millionth of a meter) that reside in the atmosphere for at least several hours. Aerosols may be of either natural or anthropogenic origin. Aerosols may influence climate in several ways: directly through scattering and absorbing radiation, and indirectly through acting as cloud condensation nuclei or modifying the optical properties and lifetime of clouds.

IPCC Technical Paper—Climate Change and Water

Annual mean temperature

The average of all daily high and low temperatures.

Anthropogenic

Resulting from or produced by human beings.

IPCC AR4 WGI

Attribution

Climate varies continually on all time scales. Detection of climate change is the process of demonstrating that climate has changed in some defined statistical sense, without providing a reason for that change. Attribution of causes of climate change is the process of establishing the most likely causes for the detected change with some defined level of confidence.

IPCC AR4 WGI

B1

The B1 storyline and scenario family describes a convergent world with the same global population, that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social and environmental sustainability, including improved equity, but without additional climate initiatives.

IPCC AR4 WGI SPM

Climate

Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. For further discussion of the difference between weather and climate, see the IPCC AR4 WGI, FAQ 1.2.

IPCC AR4 WGI

Climate Divisions

The five NOAA National Climatic Data Center (NCDC) official climate divisions group Colorado climate data into regions by river basins, but these divisions are not necessarily representative of the complex regional climates in the state. A new set of climate divisions has been developed (Wolter and Allured 2007). These new divisions are based on groups of observing stations that vary in a similar manner for year to year, and are thought to reflect similar regional climate processes.

Climate variability

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, statistics of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). See also climate change.

Cryosphere

The component of the climate system consisting of all snow, ice and frozen ground (including permafrost) on and beneath the surface of the Earth and ocean.

IPCC AR4 WGI

Downscaling

Downscaling is a method that derives local- to regional-scale (10 to 100 km) information from larger-scale models or data analyses. Two main methods are distinguished: dynamical downscaling and empirical/statistical downscaling. The dynamical method uses the output of regional climate models, global models with variable spatial resolution or high-resolution global models. The empirical/statistical methods develop statistical relationships that link the large-scale atmospheric variables with local/regional climate variables. In all cases, the quality of the downscaled product depends on the quality of the driving model.

IPCC AR4 WGI

Drought

Drought can be defined in a number of ways. In general terms, drought is a 'prolonged absence or marked deficiency of precipitation', a 'deficiency that results in water shortage for some activity or for some group', or a 'period of abnormally dry weather sufficiently prolonged for the lack of precipitation to cause a serious hydrological imbalance'. Agricultural drought relates to moisture deficits in the topmost 1 meter or so of soil (the root zone) that affect crops, meteorological drought is mainly a prolonged deficit of precipitation, and hydrologic drought is related to below-normal streamflow, lake, and groundwater levels. A megadrought is a long-drawn out and pervasive drought, lasting much longer than normal, usually a decade or more.

IPCC AR4 WGI

El Niño Southern Oscillation (ENSO)

The term El Niño was initially used to describe a warm-water current that periodically flows along the coast of Ecuador and Perú, disrupting the local fishery. It has since become identified with a basin-wide warming of the tropical Pacific Ocean east of the dateline. This oceanic event is associated with a fluctuation of a global-scale tropical and subtropical surface pressure pattern called the Southern Oscillation. This coupled atmosphere-ocean phenomenon, with preferred time scales of two to about seven years, is collectively known as the El Niño-Southern Oscillation (ENSO). It is often measured by the surface pressure anomaly difference between Darwin and Tahiti and the sea surface temperatures in the central and eastern equatorial Pacific. During an ENSO event, the prevailing trade winds weaken, reducing upwelling and altering ocean currents such that the sea surface temperatures warm, further weakening the trade winds. This event has a great impact on the wind, sea surface temperature and precipitation patterns in the tropical Pacific. It has climatic effects throughout the Pacific region and in many other parts of the world, through global teleconnections. The cold phase of ENSO is called La Niña.

IPCC AR4 WGI

Emissions scenarios

A plausible representation of the future development of emissions of substances that are potentially radiatively active (e.g., greenhouse gases, aerosols), based on a coherent and internally consistent set of assumptions about driving forces (such as demographic and socioeconomic development, technological change) and their key relationships. Concentration scenarios, derived from emission scenarios, are used as input to a climate model to compute climate projections. In IPCC (1992) a set of emission scenarios was presented which were used as a basis for the climate projections in IPCC (1996). These emission scenarios are referred to as the IS92 scenarios. In the IPCC Special Report on Emission Scenarios new emission scenarios, the so-called SRES scenarios, were published, some of which were used, among others, as a basis for the climate projections presented in Chapters 9 to 11 of IPCC (2001) and Chapters 10 and 11 of this report. For the meaning of some terms related to these scenarios, see SRES scenarios.

IPCC AR4 WGI

Evapotranspiration

The combined process of evaporation from the Earth's surface and transpiration from vegetation.

IPCC AR4 WGI

Extreme

An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of the observed probability density function. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. Single extreme events cannot be simply and directly attributed to anthropogenic climate change, as there is always a finite chance the event in question might have occurred naturally. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season).

IPCC AR4 WGI

Forcing

The climate system can be driven, or "forced" by factors within and external to the system. Processes within the system include those related to the atmosphere, the cryosphere, the hydrosphere, the land surface, and the biosphyere. Volcanic eruptions, solar variations and anthropogenic changes in the composition of the atmosphere and land use change are external forcings.

IPCC AR4 WGI

General Circulation Models

Climate model: (spectrum or hierarchy) A numerical representation of the climate system based on the physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties. The climate system can be represented by models of varying complexity, that is, for any one component or combination of components a spectrum or hierarchy of models can be identified, differing in such aspects as the number of spatial dimensions, the extent to which physical, chemical or biological processes are explicitly represented, or the level at which empirical parameterizations are involved.

Coupled Atmosphere-Ocean General Circulation Models: (AOGCMs) provide a representation of the climate system that is near the most comprehensive end of the spectrum currently available. There is an evolution towards more complex models with interactive chemistry and biology (see Chapter 8). Climate models are applied as a research tool to study and simulate the climate, and for operational purposes, including monthly, seasonal and interannual climate predictions.

IPCC AR4 WGI

Greenhouse effect

Greenhouse gases effectively absorb thermal infrared radiation, emitted by the Earth's surface, by the atmosphere itself due to the same gases, and by clouds. Atmospheric radiation is emitted to all sides, including downward to the Earth's surface. Thus, greenhouse gases trap heat within the surface-troposphere system. This is called the greenhouse effect. Thermal infrared radiation in the troposphere is strongly coupled to the temperature of the atmosphere at the altitude at which it is emitted. In the troposphere, the temperature generally decreases with height. Effectively, infrared radiation emitted to space originates from an altitude with a temperature of, on average, −19°C, in balance with the net incoming solar radiation, whereas the Earth's surface is kept at a much higher temperature of, on average, +14°C. An increase in the concentration of greenhouse gases leads to an increased infrared opacity of the atmosphere, and therefore to an effective radiation into space from a higher altitude at a lower temperature. This causes a radiative forcing that leads to an enhancement of the greenhouse effect, the so-called enhanced greenhouse effect.

IPCC AR4 WGI

Greenhouse gas

Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapor (H2O), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4), and ozone (O3) are the primary greenhouse gases in the Earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. In addition to CO2, N2O and CH4, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).

IPCC AR4 WGI

Hydroclimatic variables

Physical parameters relevant to both hydrology and climate, including temperatures, precipitation, and snowpack.

Hydrologic drought

Hydrologic drought is related to below-normal streamflow, lake, and groundwater levels.

IPCC Technical Paper—Climate Change and Water

Interstate Compacts

Interstate waters are allocated under agreements between two or more states that govern specific interactions among those states, and require consent by the United States Congress. These compacts are intended to allow each state to exercise its own water law and to use its allocated water within its boundaries whenever it might choose.

IPCC

The Intergovernmental Panel on Climate Change (IPCC) established by World Meteorological Organization (WMO) and United Nations Environmental Programme (UNEP) provides an assessment of the state of knowledge on climate change based on peer-reviewed and published scientific/technical literature in regular time intervals.

Bureau of Reclamation
Climate Technical Work Group—Appendix U

IPCC Fourth Assessment Report

The Fourth Assessment Report "Climate Change 2007", also referred to as AR4 is a series of reports by the IPCC and provides an assessment of the current state of knowledge on climate change including the scientific aspects of climate change, impacts and vulnerabilities of human, natural, and managed systems, and adaptation and mitigation strategies.

Bureau of Reclamation
Climate Technical Work Group—Appendix U

Likelihood

The likelihood of an occurrence, an outcome or a result, where this can be estimated probabilistically.

IPCC Technical Paper—Climate Change and Water

Model bias

Known systematic error of a climate model; biases can be assessed by comparing the temperature and precipitation (and other variables) at the model grid with a gridded observational dataset over a given period.

Model grid

Spatial scale represented in a climate model.

North American monsoon

The North American monsoon (NA monsoon), variously known as the southwest United States monsoon, the Mexican monsoon, or the Arizona monsoon, is experienced as a pronounced increase in rainfall from an extremely dry June to a rainy July over large areas of the southwestern United States and northwestern Mexico. These summer rains typically last until mid-September when a drier regime is re-established over the region. Geographically, the NA monsoon precipitation region is centered over the Sierra Madre Occidental in the Mexican states of Sinaloa, Durango, Sonora, and Chihuahua. The regime extends northward into the Arizona, New Mexico, and Colorado. Typically, the NA Monsoon region is defined by sites that receive at least 50% of its annual precipitation in July, August, and September.

Bureau of Reclamation
Climate Technical Work Group—Appendix U

Pacific Decadal Oscillation

The Pacific Decadal Oscillation (PDO) is a pattern of ocean variability in the North Pacific that is similar to ENSO in some respects, but has a much longer cycle (20–50 year). Specifically, it is defined as the standardized difference between sea surface temperatures (SSTs) in the north-central Pacific and Gulf of Alaska.

Bureau of Reclamation
Climate Technical Work Group—Appendix U

Paleoclimate

Climate during periods prior to the development of measuring instruments, including historic and geologic time, for which only proxy climate records are available.

IPCC AR4 WGI

Palmer Drought Severity Index

An index formulated by Palmer (1965) that compares the actual amount of precipitation received in an area during a specified period with the normal or average amount expected during that same period. The PDSI is based on a procedure of hydrologic or water balance account by which excesses or deficiencies in moisture are determined in relation to average climatic values. Values taken into account in the calculation of the index include precipitation, potential and actual evapotranspiration, infiltration of water into a given soil zone, and runoff. This index builds on Thornthwaite's (1931; 1948) work; adding 1.) soil depth zones to better represent regional change in soil water-holding capacity; and 2.) movement between soil zones and, hence, plant moisture stress, that is, too wet or too dry.

Bureau of Reclamation
Climate Technical Work Group—Appendix U

Prior Appropriations System

A simplified way to explain this system is often referred to as "first in time, first in right." An appropriation is made when an individual physically takes water from a stream (or underground aquifer) and places that water to some type of beneficial use. The first person to appropriate water and apply that water to use has the first right to use that water within a particular stream system. This person (after receiving a court decree verifying their priority status) then becomes the senior water right holder on the stream, and that water right must be satisfied before any other water rights can be fulfilled.

(http://water.state.co.us/wateradmin/prior.asp)
Colorado Division of Water Resources

PRISM

Parameter-elevation Regressions on Independent Slopes Model.

Projection

A projection of the response of the climate system to emission or concentration scenarios of greenhouse gases and aerosols, or radiative forcing scenarios, often based upon simulations by climate models. Climate projections are distinguished from climate predictions in order to emphasize that climate projections depend upon the emission/concentration/radiative forcing scenario used, which are based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized and are therefore subject to substantial uncertainty.

Bureau of Reclamation
Climate Technical Work Group—Appendix U

Regional climate models

These models typically input the global model grids surrounding their geographical domain and then simulate wind, temperature, clouds, evapotranspiration, and other variables on a much finer grid.

SNOTEL

Abbreviation for SNOwpack TELemetry. A west-wide system for obtaining snow water equivalent, precipitation, air temperature, and other hydrologic measurements from remote data sites via radio transmission.

Bureau of Reclamation
Climate Technical Work Group—Appendix U

Snow water equivalent (SWE)

The amount of water contained within the snowpack. It can be thought of as the depth of water that would theoretically result if you melted the entire snowpack instantaneously.

Bureau of Reclamation
Climate Technical Work Group—Appendix U

Streamflow

Water flow within a river channel, for example expressed in m3/s. Also a synonym for river discharge.

IPCC Technical Paper—Climate Change and Water

Time series analysis

Time series analysis, including trend analysis, uses statistical methods to analyze records from a period of time.

Urban heat island effect

Urban heat island (UHI) The relative warmth of a city compared with surrounding rural areas, associated with changes in runoff, the concrete jungle effects on heat retention, changes in surface albedo, changes in pollution and aerosols, and so on.

IPCC AR4 WGI

Variability

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic or external forcing (external variability).

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Climate Technical Work Group—Appendix U

Water Year

The 12-month period, October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 1992, is called the “1992 water year.”

USGS, http://il.water.usgs.gov/glossary.html

Acronym List

AOGCM	Atmospheric-Oceanic General Circulation Models
AR4	Fourth Assessment Report of the IPCC
CCAP	Colorado Climate Action Plan
CCSM3	Community Climate System Model
CCSP	US Climate Chance Science Program
CMIP3	Coupled Model Intercomparison Program
COOP	National Weather Service Cooperative Observer Network
CT	Streamflow Central Tendency
ENSO	El Niño Southern Oscillation
FRCVG	Front Range Climate Vulnerability Group
GCM	General Circulation Models
GHG	Greenhouse Gas
HADCM3	Hadley Centre Coupled Model Version 3
IPCC	Intergovernmental Panel on Climate Change
MM5	Mesoscale Model
NARCCAP	North American Regional Climate Change Assessment Project
NCAR	National Center for Atmospheric Research
NCDC	National Climatic Data Center
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service
NWS	National Weather Service
OGCM	Oceanic General Circulation Models
PCM	Parallel Climate Model
PDSI	Palmer Drought Severity Index
PRISM	Parameter-elevation Regressions on Independent Slopes Model
RCM	Regional Climate Models
SAP	Synthesis and Assessment Product (of the CCSP)
SDSM	Statistical Downscaling Model
SNOTEL	Snowpack Telemetry
SNTHERM	Snow Thermal Model
SRES	Special Report on Emissions Scenarios
SWE	Snow Water Equivalent
SWE/P	Snow Water Equivalent Normalized by Precipitation
TAR	Third Assessment Report of the IPCC
WGI	Working Group I of the IPCC
WWA	Western Water Assessment

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COLORADO WATER CONSERVATION BOARD · STATE OF COLORADO · 1876 · 1937

Western Water Assessment

Colorado
University of Colorado at Boulder

Climate Change Hydrologic Impacts Analysis

for the Common Technical Platform for the NISP and HSWSP Environmental Impact Statements

March 2014

FINAL

Prepared by DiNatale Water Consultants and CDM Smith

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List of Acronyms

3PC	Third Party Contractor to the Corps of Engineers
AF	Acre-feet
AFY	Acre-feet per year
CDSS	Colorado Decision Support System
CMIP3	Coupled Model Intercomparison Project Phase 3
CMIP5	Coupled Model Intercomparison Project Phase 5
CTP	Common Technical Platform
CWCB	Colorado Water Conservation Board
EIS	Environmental Impact Statement
ET	Evapotranspiration
FWSE	Free Water Surface Evaporation
GCM	General Circulation Model
HSWSPs	Halligan and Seaman Water Supply Projects
IPCC	Intergovernmental Panel on Climate Change
IWR	Irrigation Water Requirement
IY	Irrigation Year (November to October)
JFRCCVS	Joint Front Range Climate Change Vulnerability Study
M&I	Municipal and Industrial
NCWCD	Northern Colorado Water Conservancy District
NISP	Northern Integrated Supply Project
NRC	National Research Council
PBN	Poudre Basin Network
RFFA	Reasonably Foreseeable Future Actions
SEO	State Engineer's Office
SPWCP	South Platte Water Conservation Project
SSD	South Side Ditch
USGS	U.S. Geological Survey
WCRP	World Climate Research Programme
WRF	Water Research Foundation
WSSC	Water Supply and Storage Company

Executive Summary

For the Northern Integrated Supply Project (NISP) Environmental Impact Statement (EIS) and the Halligan-Seaman Water Supply Projects (HSWSPs) EIS, the United States Army Corps of Engineers (Corps) directed the third-party consultants (3PC) to address potential climate change to the Cache la Poudre River (Poudre) Basin in northern Colorado as a trend occurring in the environment, with the potential impacts of climate change evaluated and qualitatively described in the EISs. Due to the wide variability of climate change projections, the Corps directed the use of a qualitative approach method utilizing climate change projections within the region and Poudre Basin. The Corps determined that a qualitative analysis of potential climate change impacts within the Poudre Basin for the NISP and HSWSPs EISs complies with current Corps policy directives and is a reasonable approach.

A reasonable range of potential climate change impacts based on findings from historical trends in temperature and runoff, published studies, reports, and other scientific literature is used to guide the description of the potential impacts on hydrology. The hydrologic impacts described in this report can be translated into specific resource impact analyses. Existing quantitative studies in the Poudre Basin and the nearby Boulder Creek Basin were used to characterize a range of changes expected for water supply and water demands. This information was then used to qualitatively describe potential impacts to various stream reaches during dry, average and wet years under climate change conditions and during different times of the year.

Published reports and scientific studies (including large scale computer models known alternately as General Circulation Models, Global Climate Models, or Global Circulation Models (GCM)) project a wide range of changes to climate and hydrology at local, regional, and global scales. Most sources agree that temperatures are rising and will continue to increase globally. Projections of precipitation are generally less consistent, but point to increased precipitation in the arctic and sub-arctic regions and decreasing precipitation in sub-tropical areas (Karl et al. 2009).

There have been several reports that make projections about climate change in Colorado. Key points from these reports include projections that temperatures will likely increase between 2.5 to 5.5 degrees Fahrenheit, with larger temperature increase in the summer than the winter, decreasing snowpack statewide, earlier runoff in the spring, longer periods of drought, and lower streamflows in the summer. The Bureau of Reclamation offers bias-corrected spatially downscaled (BCSD) data of a large number of GCM model results included in the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project Phase 3 and Phase 5 (CMIP3 and CMIP5) datasets. Data from the downscaled datasets was obtained for an area approximately overlapping the Poudre Basin. The downscaled CMIP3 data indicate an increase in the multi-model average annual temperatures of 3 to 4 degrees Fahrenheit by 2060, but do not indicate a clear trend in precipitation (see **Figures 2-4** and **2-5**). The CMIP5 data are similar, but project smaller increases in temperature, and a higher percentage of the models indicate increased annual precipitation than the CMIP3 datasets (see **Figure 2-6**). Climate researchers use the changes in temperature and precipitation to project changes to stream runoff. A study produced by several Front Range water providers included the Poudre basin specifically (JFRCCVS 2011) and two other studies in the nearby Boulder Creek Basin were used as a basis for potential changes to runoff under climate change conditions. The JFRCCVS concluded that annual average flows in the Poudre Basin could increase or decrease by 15 percent, with an earlier onset to the runoff. Flows in the nearby Boulder Creek basin were estimated to increase or decrease by up to 30 percent, with an earlier onset to runoff than currently.

Water demands are expected to increase under climate change conditions due primarily to the increase in temperature. Agricultural water demands in the Poudre Basin currently exceed 450,000 AFY, and agricultural water use is the largest water use in the region. Agricultural water demands are expected to increase by 15 to 25 percent, depending on the future temperature increases and the timing and change in precipitation patterns under climate change. As municipalities continue to grow, the outdoor water use component of their overall water demand is also predicted to increase at a similar rate as the agricultural water demand.

These local and regional studies indicate that the earlier onset of runoff will exacerbate the timing difference between water supply and demand, with more water available during the earlier spring runoff before water demands peak in the later summer months. A study by the State of Colorado projects that climate change impacts will shift Front Range climate conditions to the climate currently experienced on the eastern plains of Colorado. Evaporation rates on the eastern plains are currently about 25 percent higher than in the Front Range. While evaporation rates depend on many factors in addition to temperature (e.g., relative humidity, water temperature, wind speed), an increase of 25 percent was used to evaluate Poudre Basin plains reservoir evaporation under climate change conditions.

Potential cumulative effects were described qualitatively, using available information of changes to streamflows in the Poudre basin, changes to temperature on water demands, and changes to evaporation under climate change conditions. The complex interaction between changes to water supply, water demands and water rights administration under climate change conditions is described for different seasons of the year, and for dry, average and wet hydrologic scenarios under climate change (see Section 3).

A shift to one-month earlier runoff and a 15 percent increase or decrease in water supply were applied to the Common Technical Platform hydrologic model used for the HSWSPs and NISP EISs to illustrate the potential changes under climate change to the Poudre Basin (**Figure 3-1**). Similarly, an increase of 15 to 25 percent was applied to agricultural water demand (**Figure 3-2**). The average monthly water supply and water demand curves were plotted together to illustrate the existing timing differences and times of the year when water is stored, and released. The potential changes in water supply and water demands due to climate change were also plotted and show the potential increasing difference in the timing of supply and demand under climate change (**Figure 3-3**). The figure shows an increasing amount of water that exceeds demands on the rising limb of the hydrograph in (April and May), and an increasing amount of demand that exceeds supply in June through September. The projected overall water balance under climate change results in an increasing gap between water supply and water demands, the severity of which will depend on actual future changes to precipitation and temperatures (**Table 3-1**).

In addition to the intra-year changes in supply and demand, droughts are expected to be longer and more frequent under climate change conditions. This may produce several years of low supply and high demand which would reduce storage levels throughout the basin compared to non-climate change scenarios. Under this type of prolonged drought condition, existing reservoirs that were designed to deliver a certain yield through a repeat of a historical drought (i.e. firm yield) may see reduced yields under climate change conditions with longer and more frequent droughts. Reservoir yields may be further reduced by increased evaporation associated with elevated temperatures.

Predicting changes to streamflows at different times of the year and at specific locations depends on the basin-wide timing of water supply and demand, and the relative priority of different water rights and their associated uses. Under Colorado water law, water cannot be diverted if there is no beneficial use for the water. Currently, many water rights that are in priority during the peak of the runoff deliver water to an agricultural demand. Under climate change conditions, the peak runoff is projected to occur prior to elevated agricultural demands and may shift water available during the peak runoff to other uses, including diverting to storage for later release.

The natural year-to-year variability of streamflows in the Poudre Basin provide an opportunity to describe potential operations under climate change conditions. Because the long-term variation of plus or minus 15 percent runoff flow volume projected under climate change conditions is well within the range of normal year-to-year variability, the differences in operations between dry, average and wet years (without climate change) can be used to describe potential impacts to streamflow at specific locations and with respect to specific water rights, and flows. Evaluating operations in wet years under non-climate change conditions provides insight into portions of a climate change scenario with increased flows (e.g. long-term yields or seasonal distribution of water rights priorities). Similarly, evaluating operations in dry years under non-climate change conditions provides insight into portions of climate change scenario with decreased flows.

Under climate change conditions, winter operations and resulting river flows in the Poudre Basin are expected to change the least from non-climate change conditions due to the seniority of water rights that fill three large reservoirs (Big Windsor Reservoir, Terry Lake and Timnath Reservoir). During the onset of the runoff under climate change conditions, more water is available on the rising limb of the hydrograph. The water rights yields for reservoirs were analyzed using the cumulative impacts model run (without climate change) in dry, average and wet years.

The differing yields under different hydrologic scenarios provided insight into how certain water rights may operate when additional water is available during the peak runoff. A group of storage water rights with priority dates in the middle third of all storage water rights in the Poudre Basin would likely be in priority more often than under non-climate change scenarios. The majority of the increased diversions in dry years under climate change conditions would likely occur at mountain reservoirs, decreasing the streamflow at all downstream points during the rising limb of the hydrograph. With increased storage in the mountain reservoirs, late summer releases would increase relative to non-climate change conditions, thereby increasing streamflows below these reservoirs primarily to the municipal intakes.

In average and wet years under climate change conditions, the junior water storage rights located primarily at mountain reservoirs would be in priority more often than under non-climate change conditions. This would produce similar results as the dry years under non-climate change conditions (decreased flow below these reservoirs during the runoff, increases in flow due to reservoir releases to the municipal diversion points later in the summer).

Post-runoff flows in the later summer months will likely remain low as currently observed, but runoff and the post-runoff lower flows will begin earlier in the year, likely in June and July. Lower flows in the summer limit the exchange potential and ability of municipal water providers to exchange transferred water rights from downstream to the upstream municipal intakes. This may result in a higher rate of exchange to upper basin storage earlier in the year or a reduction in the usable yield of transferred water rights for municipal users. In addition, some transferred municipal water rights may have monthly diversion limitations in the transfer decree. Under climate change conditions, the timing of the runoff may no longer correspond to the volumes of water in the decreed monthly limits and result in lower water yield from transferred water rights.

Under climate change conditions, evaporation is expected to increase due to rising temperatures. Evaporation depends on several factors, including wind speed, relative humidity, water temperature, precipitation and the surface area of the water. A simple method of applying the current evaporation rates from the eastern plains of Colorado to the Poudre Basin results in an estimated increase of 25 percent. Without considering climate change, evaporation computed in the Common Technical Platform (CTP) cumulative effects model in the Poudre Basin is 23,000 AFY on average. Under climate change conditions, this could increase to 29,000 AFY. Changes in diversion patterns may draw reservoirs down earlier in the year to meet earlier irrigation deficits. This may result in less reservoir surface area during high evaporation months, thereby partially offsetting the increase in evaporation rate.

1.0 Introduction

For the Northern Integrated Supply Project (NISP) Environmental Impact Statement (EIS) and the Halligan-Seaman Water Supply Projects (HSWSPs) EIS, the United States Army Corps of Engineers (Corps) directed the third-party contractors (3PC) to address potential climate change to the Cache la Poudre River (Poudre) Basin in northern Colorado as a trend occurring in the environment, with the potential impacts of climate change evaluated and qualitatively described in the EISs. The Corps directed that this approach be taken due to the wide variability of climate change projections, and to include climate change projections within the region and Poudre Basin.

Several Federal policy directives and guidance documents are applicable to Federal agencies in the climate change arena (Executive Order 13514, October 2009; CEQ Climate Change Adaptation Planning: Implementing Instructions & Support Document. March 2011; USACE Climate Change Adaptation Policy Statement. June 2011), however, they relate primarily to adaptation planning to evaluate climate change risks and vulnerabilities to agency operations and missions. The relevant Corps policy directive is the USACE Climate Change Adaptation Policy Statement (Assistant Secretary of the Army for Civil Works [ASA(CW)] June 3, 2011). This policy directs that "…USACE shall consider potential climate change impacts when undertaking long-term planning, setting priorities, and making decisions affecting its resources, programs, policies, and operations".

While none of the referenced documents provide guidance or direction on how climate change is to be addressed during NEPA compliance, the Council on Environmental Quality (CEQ) issued draft NEPA guidance in 2010 (CEQ Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions, February 2010), which has yet to be finalized. The CEQ's draft guidance suggests that agencies consider climate change as a condition of the reasonably foreseeable future affected environment. The Corps directive to consider climate change as an environmental trend comports with CEQ's suggested approach.

The Corps determined that a qualitative approach taken to address potential climate change within the Poudre Basin for the NISP and HSWSPs EISs complies with current policy directives. Quantitative projections have been used in water resources planning studies and utilize a variety of methods to address the uncertainties in quantitative predictions. A new quantitative analysis of climate change impacts to hydrology in the Poudre Basin would have been technically feasible, but the Corps determined that such an analysis was unnecessary given the availability of other qualitative and quantitative studies in the region. For the purposes of the HSWSPs EIS and NISP EIS, existing studies can be used to reasonably characterize potential impacts of climate change on hydrology in the Poudre Basin and is a reasonable approach.

The Northern Colorado Water Conservancy District (NCWCD) is the Applicant for NISP. The Cities of Fort Collins and Greeley are the Applicants for the HSWSPs. The NISP proposed action includes the new Glade and Galeton Reservoirs, and the HSWSPs proposed actions include enlarging the existing Halligan and Seaman Reservoirs. The Applicants' proposed actions for NISP and the HSWSPs and many of the other project alternatives are located primarily in the Poudre Basin in northern Colorado, although most of the NISP participants are located outside of the Poudre Basin. The City of Greeley's proposed expansion of Seaman Reservoir would impact its Poudre Basin operations, but would not affect its Big Thompson Basin operations.

Water supplies proposed to be used for NISP include the following:

- Diversions of unappropriated flows from the Poudre River through the development of the junior conditional Grey Mountain (Glade) storage rights;
- Diversions of unappropriated flows from the South Platte River through the development of the junior conditional South Platte Water Conservation Project (SPWCP) water rights; and
- Diversions of Poudre River water by exchange with two irrigation systems in the Poudre Basin—the Larimer and Weld Irrigation Company (Larimer Weld), the New Cache la Poudre Irrigation Company (New Cache), and other ditch and reservoir companies affiliated with Larimer Weld and New Cache—that have senior direct flow and storage water rights.

Under the Applicant's proposed action, NISP would deliver its South Platte River water to the Larimer Weld and New Cache systems to complete the exchange(s) for Poudre River water diverted into Glade Reservoir.

Water supply sources for the HSWSPs proposed actions include junior conditional storage rights associated with the proposed reservoir enlargements and conversion of agricultural water rights in the Poudre basin to municipal use and diversion at the proposed reservoir enlargements by exchange from the original agricultural headgates.

In order to represent the current (2010) and future (2050) baseline conditions consistently across the NISP and HSWSPs EISs, the Corps developed a Common Technical Platform (CTP), including common hydrologic modeling tools (CDM Smith 2013) and baseline resource analyses (ERO Resources Corporation [ERO] 2012; GEI 2012; Anderson Consulting Engineers [ACE] 2012; WEST Inc. 2012). The CTP was established so that the current EIS analyses in the Poudre Basin would use common hydrologic data and results would be consistent and comparable across the NISP and HSWSPs EIS documents. The study period for the CTP includes irrigation years (IY, November through October) 1950 through 2005. The use of historical hydrology is a common approach to modeling for the evaluation of water supply projects, but excludes potential impacts due to climate change (CDM Smith et al. 2011). CTP Model Run 5 concurrently simulates the cumulative effects of the three Applicants' proposed actions and RFFAs using historical hydrology for IY 1950-2005. This cumulative effects model run serves as the basis for the NISP and HSWSPs climate change assessments documented in Section 3 of this technical memorandum.

1.1 Purpose

As directed by the Corps, the purpose of this technical report is to identify and describe the potential impacts of climate change on the hydrology of the Poudre Basin relative to the historical climate and hydrologic patterns. A reasonable range of potential climate change impacts based on findings from historical trends in temperature and runoff, published studies, reports, and other scientific literature is used to guide the description of the potential impacts on hydrology. The hydrologic impacts described in this report can be translated into specific resource impact analyses.

Scientific research related to climate change and climate change studies completed by Colorado water providers and state agencies project a wide range of potential impacts of climate change on hydrology in the region (see Section 2). The potential impacts of climate change on the cumulative effects model run (CTP Run 5) results are described qualitatively in this report. A quantitative modeling approach was not used for this analysis for a variety of reasons including:

- Existing modeling performed in the Poudre Basin by the Joint Front Range Climate Change Vulnerability Study (Water Research Foundation. 2012 [also denoted JFRCCVS]) and studies in the nearby Boulder Creek (McCurry 2000, Stratus 2009) provide sufficient quantitative information that can be applied for the purposes of this report.
- The wide range of projected changes in timing and magnitude of climate change impacts on native water supply and demands in Colorado and the Poudre Basin and qualitative nature of the potential impacts described in several available documents (Colorado Water Conservation Board [CWCB] 2008, CWCB 2010, State of Colorado 2007, and State of Colorado 2011, Water Research Foundation [WRF] 2012).
- There is some disagreement among climate researchers of the validity of using spatial downscaling (a quantitative method) for predictive purposes. Pielke and Wilby (2011) argues that regional climate downscaling has practical value but with the very important caveat that it should be used for model sensitivity experiments and not as predictions. This opinion is based on the conclusion that downscaling of global circulation models (GCMs) can introduce significant errors and that it is therefore inappropriate to present multi-decadal climate prediction results to the impacts community as reflecting more than a subset of possible future climate risks.

The IPCC does not assign a probability of occurrence to the different models and emission scenarios (IPCC 2000), and acknowledges that preference for different scenarios varies among researchers and the "possibility that any single emissions path will occur as described in scenarios [described in IPCC (2000)] is highly uncertain." Discrete projections are often selected and used but their context, relative to the ensemble of projections, must be quantified (e.g. based on percentiles). Alternatively, many quantitative studies choose to use a large number of projections with or without ensembling.

In addition to projections made from quantitative analysis of GCM model results, many of the conclusions from climate change studies at both broad and regional spatial scales are qualitative in nature, e.g., timing of runoff will begin earlier or droughts will be more severe and frequent (CWCB 2008, CWCB 2010, State of Colorado 2007, and State of Colorado 2011).

To date, many quantitative hydrologic studies of climate change in Colorado have focused on water supply system sensitivity to climate change and Colorado River water availability (Stratus 2009, WRF 2012, CWCB 2010). These studies present a range of possible hydrologic changes due to climate change and the sensitivity of water supply systems, but are not developed to a level of detail that would be necessary for the NEPA effects analysis.

Furthermore, the Bureau of Reclamation (Reclamation) recently developed hydrologic runoff datasets for much of the western United States (Reclamation 2011). These hydrologic datasets use simulated temperature and precipitation from the 112 CMIP3 datasets as inputs to the Variable Infiltration Capacity (VIC) hydrologic model to project runoff volumes under climate change scenarios. These datasets are available at a 1/8th degree latitude and longitude spatial resolution (approximately 55 square miles in the Poudre Basin).

Modeling for these downscaled datasets lack concerted calibration efforts in some areas and calibration "should be addressed before these [VIC hydrology dataset] models are used in future assessments" (Reclamation 2011). For example, the VIC model calibration point nearest the Poudre River projects flows that are significantly different from observed flows, indicating that this region needs further hydrologic model calibration. Reclamation (2011) also reported on several basins key to the agency's operations throughout the western United States and projections for runoff under climate change using the VIC model vary significantly within the 5th to 95th percentile limits – often by nearly 50 percent below and 100 percent above the year 2000 median value. Methods exist to correct this bias for site specific application. Alternatively, the bias can be normalized by using change in flow between model runs rather than the modeled magnitudes themselves.

The JFRCCVS applied various methods to limit the bias and evaluate the sensitivities of native runoff projections to the downscaled GCM temperature and precipitation data. The results of the study allow for application of the change in native runoff projected under climate change scenarios in the Poudre Basin. In addition, quantitative studies performed in the nearby Boulder Creek Basin result in similar changes in native streamflow and runoff as the JFRCCVS found for the Poudre Basin. The quantitative results of these studies allow for reasonable projection of site-specific changes to water supply and demand. The resultant streamflows depend on the complex interactions of water rights administration, water transfers and operational constraints. The impacts to streamflows after water rights operations are described qualitatively.

For the reasons stated above—the Corps' policy directives, the existence of quantitative and qualitative information in the region that can be applied to water supply and demand in the Poudre Basin, and remaining uncertainties and ranges of projections in those studies —a qualitative approach was adopted to describe potential impacts to hydrology from climate change in the Poudre River Basin relative to the quantitative cumulative effects modeling. A new quantitative model would be technically feasible, but the Corps determined that such an effort was unnecessary given the existence of other available quantitative and qualitative information that can be used to reasonably characterize the hydrologic effects of climate change in the Poudre Basin for the purposes of the NISP and HSWSPs EISs.

This report is not intended to make specific climate change projections or predictions, develop climate change scenarios for the Poudre River Basin, or to assess the validity of the findings of any existing climate change study or report.

1.2 Organization

Section 2 provides a summary of scientific publications, reports, and other documentation of the potential impacts of climate change to water supply. Reports, studies, and observed trends in the Poudre Basin and surrounding region are used to guide the development of a range of reasonably foreseeable changes to Poudre Basin hydrology due to climate change. Information was gathered from studies conducted in river basins near the Poudre River Basin as well as more general studies, reports, and articles applicable to larger regions or climate change on a global-scale. Section 2 also discusses the larger climate change models that project changes in precipitation and temperature, which drive changes in hydrology.

CWCB (2008) discusses the implications for water management resulting from projected temperature increases in Colorado, stating the following:

> *Increases in temperature imply more evaporation and evapotranspiration leading to higher water demands for agriculture and outdoor watering. Temperature-related changes in the seasonality of streamflows (e.g., earlier runoff) may complicate prior appropriation systems and interstate compact regimes; and modify the interplay among forests, hydrology, wildfires, and pests (e.g., pine beetles).*

Consistent with this view and for the purposes of the NISP and HSWSPs EISs, the most relevant hydrologic changes due to climate change are the potential changes in the following key categories:

- Changes in runoff timing and magnitude
- Changes in irrigation demands (both agriculture and outdoor municipal use)
- Changes in evaporation rates.

Section 3 of this report provides qualitative descriptions of the potential changes to the results of the modeled cumulative effects of Poudre Basin EIS projects based on the ranges of changes in the key categories identified above.

2.0 Potential Changes in Key Hydrologic Characteristics Due to Climate Change

Published reports and scientific studies project a wide range of changes to climate and hydrology at local, regional, and global scales. Most sources agree that temperatures are rising and will continue to increase globally. Projections of precipitation are generally less consistent, but point to increased precipitation in the arctic and sub-arctic regions and decreasing precipitation in sub-tropical areas (Karl et al. 2009). The following sections summarize published results from a number of studies at the global scale as well as several studies more specific to the Front Range of Colorado.

2.1 General Circulation Models

Several large scale computer models known alternately as General Circulation Models, Global Climate Models, or Global Circulation Models (GCMs) have been developed by various research groups and are used to project changes in temperature and precipitation over the entire globe. These models have individual grid cells that cover large regions of the earth and vary in size by model. In general, GCM grid cells are on the order of a degree longitude and latitude, or about 3,600 square miles in the vicinity of the Poudre Basin. As a result, a smoothed representation of a larger area is used, and much of Colorado's mountainous terrain and the variation in weather patterns associated with the dramatic changes in elevation are not well represented (CWCB 2008).

There are several techniques to downscale the larger grid cells into a finer spatial resolution. The Bureau of Reclamation used a bias-corrected and spatially downscaled technique to downscale the coarser CMIP3 and CMIP5 datasets, resulting in downscaled temperature and precipitation data for the continental United States at 1/8th degree grid sizes (approximately 8.5 miles by 6.5 miles at the latitude and longitude of the Poudre Basin) for 112 GCM scenarios. The 112 GCM scenarios are comprised of 16 different models using three different emissions scenarios (B1, A1B, and A2, defined by the IPCC [2000] as the low, medium, and high emission scenarios, respectively), and several of the models have multiple runs to simulate different initial conditions. Depending on the data source referenced in the various studies, the climate change projections may pertain to large regions that may or may not encompass the entire Poudre Basin and should be understood in the context of larger regional trends.

Additionally, GCMs vary in complexity and simulated outputs (CWCB 2008). Some GCMs simulate a hydrology component, while others do not. Some studies have used the GCM hydrologic outputs (Milly et al. 2005), but "water supply studies typically use the bias-corrected and downscaled projections" (CWCB 2008). For example, the CMIP3 dataset consists of bias-corrected downscaled temperature and precipitation data. Impacts on water resources are inferred from the projected changes in temperature and precipitation, either qualitatively or quantitatively, using a hydrologic model. Results can vary significantly by location depending on regional water supply and usage patterns.

2.2 General Climate Change Projections for the State of Colorado

The 3PC gathered and reviewed multiple sources of climate change information including historical temperature and streamflow data in the Poudre River Basin; several scientific publications and documents produced by international bodies, federal agencies, and the State of Colorado; other reports and studies produced for municipalities in the same region as the Poudre River; and other informational sources that were cited in the public comments on the NISP Draft EIS (See References).

Key information and findings from these data sources not specific to the Poudre River region include:

- Temperatures are rising globally and may accelerate in the coming decades (National Academies 2008, IPCC 2001, National Research Council [NRC] 2001).
- Longer drought periods are expected (National Academies 2008, IPCC 2001, NRC 2001).
- Existing infrastructure may not be sufficient to meet water needs under climate change conditions. In particular in the western United States, water managers may no longer be able to reliably count on winter storms and spring runoff to fill their reservoirs. A balance between using reservoirs for flood control and for water supply must be struck (Wallis et. al 2008).
- The hydrologic cycle will likely change, bringing longer periods of drought alternating with spells of heavy rainfall. This may reduce the reliability of water storage and could increase reliance on groundwater potentially changing the interface between groundwater and surface water (Miller and Yates 2005).

The State of Colorado has published several studies that project climate change in Colorado and its implications for water resources in the state (CWCB 2008, CWCB 2010, State of Colorado 2007, and State of Colorado 2011). In general, conclusions from these studies include:

- Changes in temperature
  - Average temperatures will increase by 2.5 degrees Fahrenheit to 5.5 degrees Fahrenheit by 2050 relative to 1950 to 1999 baseline conditions (CWCB 2008).
  - Summers will warm more than winters (average of 3 degrees Fahrenheit to 7 degrees Fahrenheit summer increases, average of 2 degrees Fahrenheit to 5 degrees Fahrenheit winter increases) (CWCB 2008).
  - Shorter and warmer winters with less snowpack (State of Colorado 2007).
- Changes in precipitation
  - Climate models do not agree on whether precipitation will increase or decrease on an annual basis in Colorado, but seasonal trends emerge in some areas (CWCB 2008).
  - Current year-to-year and decade-to-decade variations are larger than potential changes in precipitation due to climate change (CWCB 2008).
  - Throughout the western United States, more observed winter precipitation has fallen as rain instead of snow resulting in reduced snowpack below 8,200 feet between 1949 and 2004. However, since most of Colorado's snowpack is above 8,200 feet, the snowpack

changes have been smaller and less significant than other locations in the western United States (CWCB 2008).

  - Snowpack in Colorado is projected to decline by 10 to 20 percent by 2050 (CWCB 2008).
  - In the Colorado River Basin, it is expected that there will be more precipitation during the winter months (November to March) and less precipitation during the summer months (April to October). The largest winter increases and smallest summer decreases are likely to be located in the northeast portion of the Colorado River Basin adjacent to the South Platte River Basin (CWCB 2010).

- Changes in hydrology
  - Study and modeling of climate change impacts on hydrology in the South Platte, Arkansas, and Rio Grande Basins is not as extensive as efforts to date on the Colorado River Basin (CWCB 2008).
  - Streamflow runoff will shift in timing and intensity with runoff beginning earlier in the spring and reduced late-summer flows (CWCB 2008).
  - Lower streamflows in summer months (State of Colorado 2007).
  - Modeling from multiple studies predict that Colorado River flows will decrease by 6 to 20 percent from the 20th Century average by 2050 (CWCB 2008).
  - The Colorado River Water Availability Study shows basin-wide reduction of flows of 7 to 11 percent by 2040 except in the Yampa River, where flows are projected to increase by 4 percent. However, upper Colorado River (above Kremmling) flows are projected to increase by 4 to 5 percent (CWCB 2010, Appendix E).
  - Longer periods of drought (State of Colorado 2007).
  - Statewide and regional water shortages and heat stress for irrigated agriculture. Soil moisture will decline, crops will require more irrigation and some crops may not survive mid-summer droughts and heat spells (State of Colorado 2007).

Water supply for the Front Range of Colorado (central Colorado from approximately Pueblo to Fort Collins, including the Poudre River Basin) is primarily derived from snowmelt from the mountains to the west, including transbasin diversions from the upper Colorado River watershed on the west side of the Continental Divide. Therefore, climate change that affects precipitation in these mountain areas will in large part drive the changes in water supply, though precipitation on the plains is also an important factor for streamflows and water available for a diversion under a junior water right in the South Platte Basin (Pineda 2009). Climate change on the plains will in large part drive the changes in water demands. The appendices to this technical memorandum include several reports listed in the reference section that are specific to the Front Range.

Multi-model average temperature changes from 39 GCMs indicate general agreement that temperatures along the Front Range will increase by 3 degrees Fahrenheit in the winter and 4 degrees Fahrenheit in the summer by 2050, which directly impacts crop potential evapotranspiration (ET) and reservoir evaporation rates. However, there is less agreement on the potential change in precipitation, with some scenarios projecting less precipitation and others projecting more. The following sections present local and regional climate change information for the Poudre Basin.

2.3 Local Trends in Historical Data

The historical streamflow and temperature gage data for the Poudre River were evaluated for observable warming trends or trends toward a shift in runoff in recent decades. The gaged flow for the Poudre River at the Canyon Mouth near Fort Collins (U.S. Geological Survey [USGS] 06752000/DWR CLAFTCCO) is often used as a measure of available water in the Poudre River and is upstream of many of the diversion structures used by many of the largest water users in the basin. Any changes in the runoff patterns observed at the gage would provide a good proxy for changes to the natural precipitation-runoff processes driven by changes in the climate. However, it is unlikely that the use of the historical hydrologic record alone will adequately capture the expected range in future hydrology due to climate change (Milly et al. 2008).

Figure 2-1 shows the timing of the end of the peak week of runoff (by volume) of the gaged flow of the Poudre River at the Canyon Mouth from 1883 to 2009. The long-term average peak week occurs the second week of June, but annual variability shows peak runoff as early as the first week of May and as late as the first week of July. There is no statistically significant trend over time in the runoff timing period (WEST 2014). Visually, the average runoff date of the peak runoff occurs the first week of June during the pre-1950 period of record, and shifts to 3 days later for the post-1950 period. This can be seen in the 20-year average curve in the figure. More recently, the 20-year running average is shifting earlier in the year similar to the pre-1950s timeframe. Therefore, while runoff has shifted earlier in the year in other parts of Colorado and the western United States (Stewart et al. 2004), no clear trend in runoff timing for the Poudre River is evident from the historical record at the Canyon Mouth gage.

In September 2013, a large weather system produced record amounts of rainfall over much of the Front Range of Colorado, including the Poudre Basin. This event is an abnormality for Colorado, producing more rainfall in a week in some locations than normally occurs in an entire year. The flows of all streams and rivers in the region exceeded normal spring-peak runoff flows. The flow at the Poudre River at the Canyon Mouth exceeded 6,000 cubic feet per second (cfs) on Sept 14, which is the peak runoff for 2013. Peak flows in 2013 in the region were due to rainfall runoff rather than the peak flow normally caused by snowmelt in the spring. This event may or may not be an indication of changing precipitation patterns, but without the context of decades of future weather conditions, it is difficult to link this event to any specific climate change predictions. For the purposes of this report, this flood event will be viewed as an anomaly and the assumption will remain that normal peak flow will be continue to be caused by snowmelt rather than large precipitation events.

Temperature data at the Fort Collins climate station (National Oceanic and Atmospheric Administration [NOAA] station 3005) have been recorded since 1893. **Figure 2-2** shows the annual average temperature since 1895 (data are missing for more than half of the months in 1893-1894, so those two years were excluded from this analysis). Over the period of record 1895-2010, there has been an average increase of 1 degree Fahrenheit every 24 years; the trends over the past 50 years (1961 to 2010) and over the past 30 years (1981 to 2010) show accelerating rates of temperature increase (1 degree Fahrenheit every 16 years and every 11 years, respectively) at this temperature station. **Table 2-1** shows the temperature increases by month for the periods 1895-2010 and

1950-2010 and projects the change in temperature by 2050 using observed trends. The trends in temperature were tested for statistical significance and found to have a statistically significant positive correlation of increasing temperature over time with a p-value of less than 0.001.

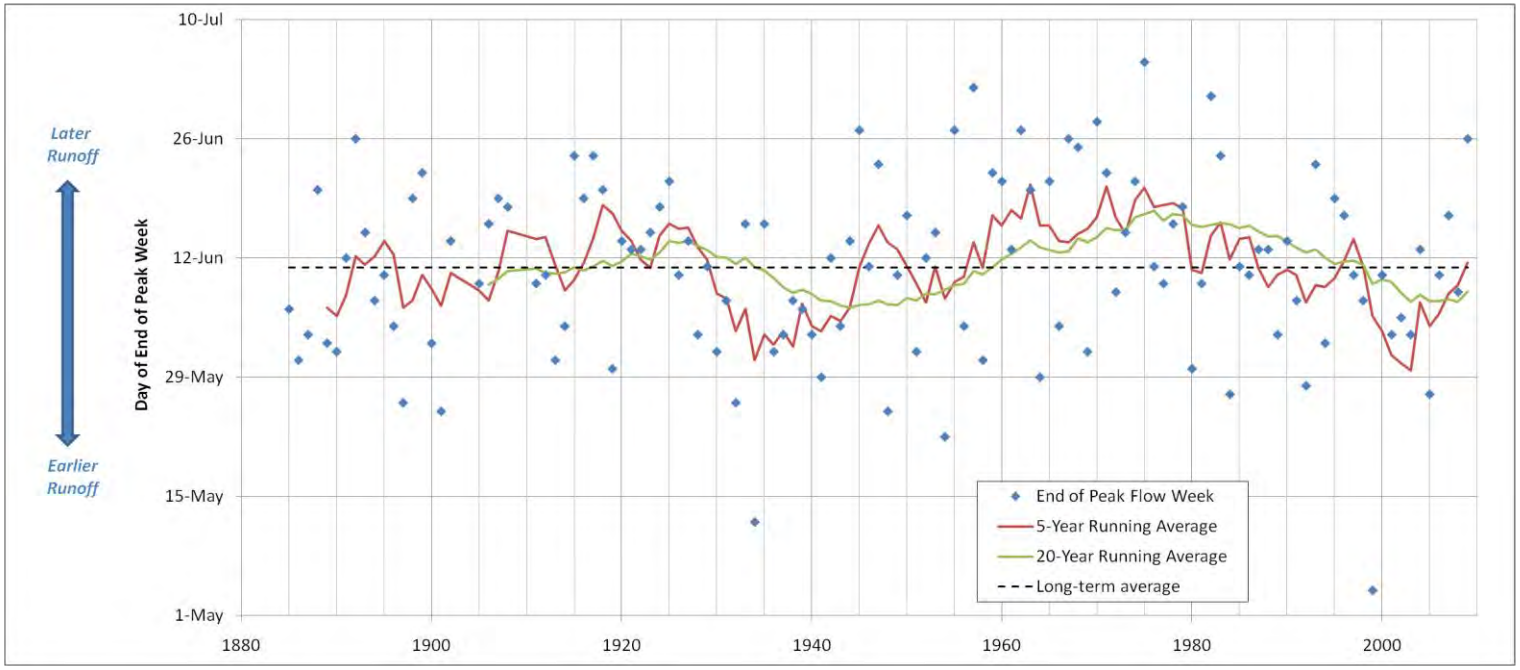


Figure 2-1. Timing of Peak Week Runoff of the Poudre River at Canyon Mouth (gaged flow).

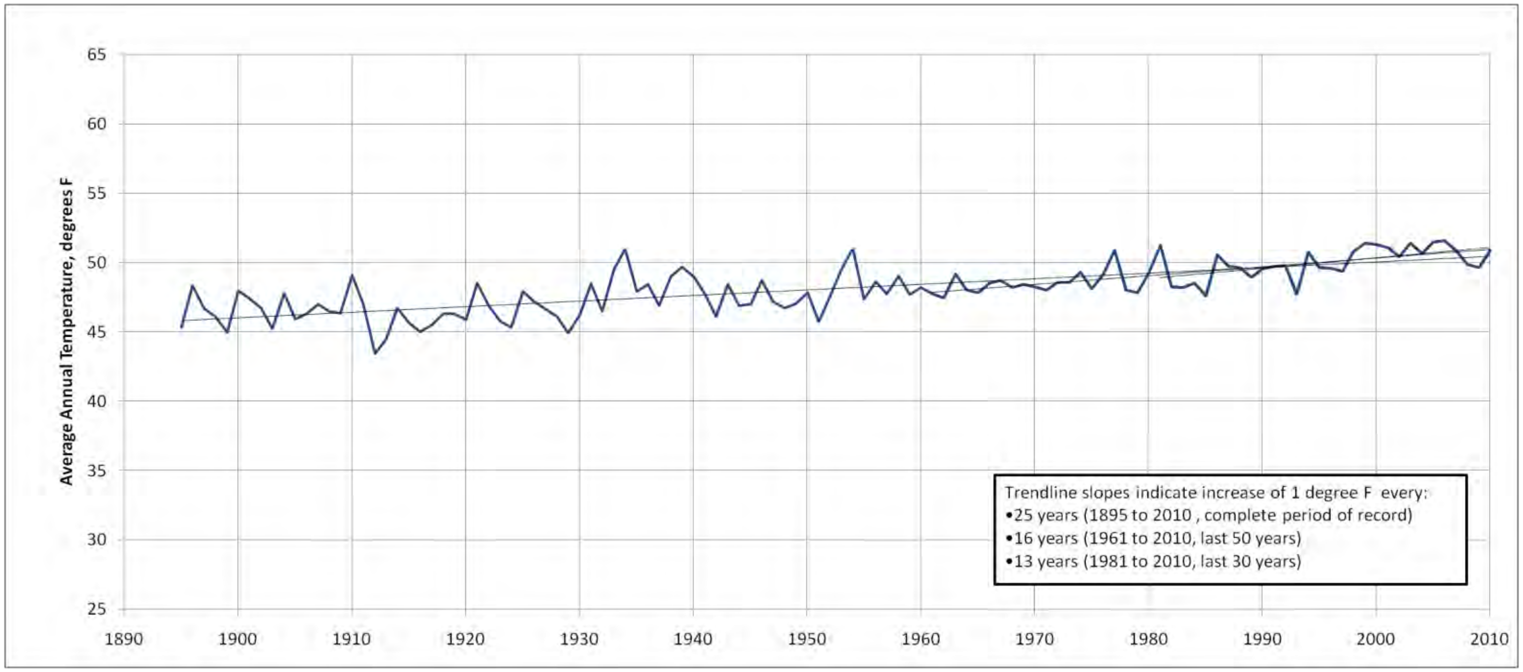


Figure 2-2. Average Annual Temperature (Fort Collins Station, degrees Fahrenheit).

Table 2-1. Observed Changes in Temperature (°F) at Fort Collins Climate Station (NOAA Station 3005), 1895-2010 and 1950-2010, and Projections to 2050 Using Observed Trends.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1895 to 2010	°F/year	0.041	0.069	0.062	0.036	0.040	0.038	0.048	0.028	0.026	0.024	0.026	0.037	0.042
	years to increase one degree F	24	15	16	27	25	27	21	36	38	42	38	27	24
1961 to 2010	°F/year	0.140	0.041	0.147	0.054	0.054	0.050	0.056	0.050	0.075	0.005	0.055	0.035	0.063
	years to increase one degree F	7	25	7	19	19	20	18	20	13	194	18	28	16
by 2050	ΔT (using 1895-2010 trend)	1.6	2.7	2.5	1.5	1.6	1.5	1.9	1.1	1.1	0.9	1.1	1.5	1.7
	ΔT (using 1950-2010 trend)	5.6	1.6	5.9	2.1	2.1	2.0	2.2	2.0	3.0	0.2	2.2	1.4	2.5

***Note:** Source dataset missing values for December 1961, May 1970, April 1973, and May 2008. These four months filled with long-term monthly average values calculated from available April, May, and December data, 1895-2010.*

2.4 Regional Projections of Change in Runoff Timing and Magnitude

The following sections summarize results from several studies relevant to the Front Range of Colorado, with particular emphasis on results for the Poudre River Basin and the Boulder Creek Basin.

2.4.1 CMIP3 and CMIP5 Results

Downscaled temperature and precipitation data as well as hydrologic modeling data recently became available for the Poudre Basin. The CMIP3 downscaled temperature and precipitation datasets were downloaded from the Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections archive (http://gdo-dcp.ucllnl.org; Reclamation 2013) using a spatial selection tool that allows selection of the 1/8th degree grid cells that approximately cover a watershed (see the blue shaded area in **Figure 2-3** below). The Poudre Basin is approximately represented by 29 of the 1/8th degree grid cells representing the headwaters area to the plains between Fort Collins and Greeley.

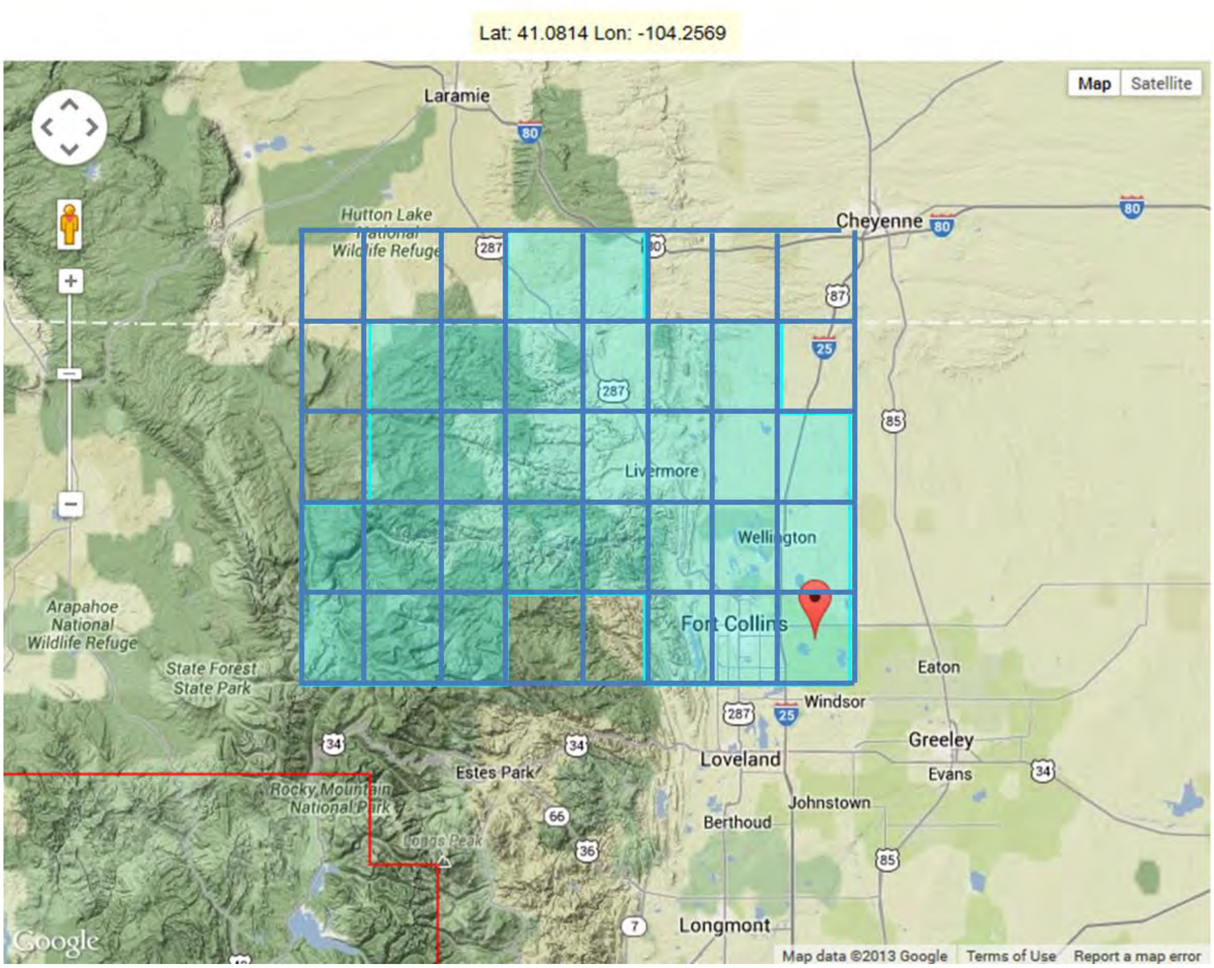


Figure 2-3. CMIP3 and CMIP 5 Dataset for the Poudre Basin, 29 - 1/8th degree latitude by 1/8th degree longitude Grid Cells (Source: http://gdo-dcp.ucllnl.org). Grid cells are approximate.

Selection of additional cells near Greeley resulted in the Big Thompson River Basin being added to the selection. The selection area shown in Figure 2-3 best represents the Poudre Basin using the selection tool on the Reclamation website. Cells that overlap the boundary of the physical basin were not weighted for the area within the physical basin.

Figures 2-4 and **2-5** show the range of results of the 112 CMIP3 datasets downscaled for the area that approximates the Poudre Basin (see **Figure 2-3**) as well as the multi-model averages by emission scenario. Historical observed data for the same gridded area is also shown through 1999. The figures include a heavy vertical line at the year 2000, which is when the GCM models begin to vary the emissions scenarios. These two figures confirm the projections from other regional reports for Colorado cited above, in that there is no clearly identifiable trend in future precipitation projections, though annual variability appears to increase, and temperatures are generally projected to increase by about 3 to 4 degrees Fahrenheit by 2050. The variability in the historical period indicates how different models simulate the historical period.

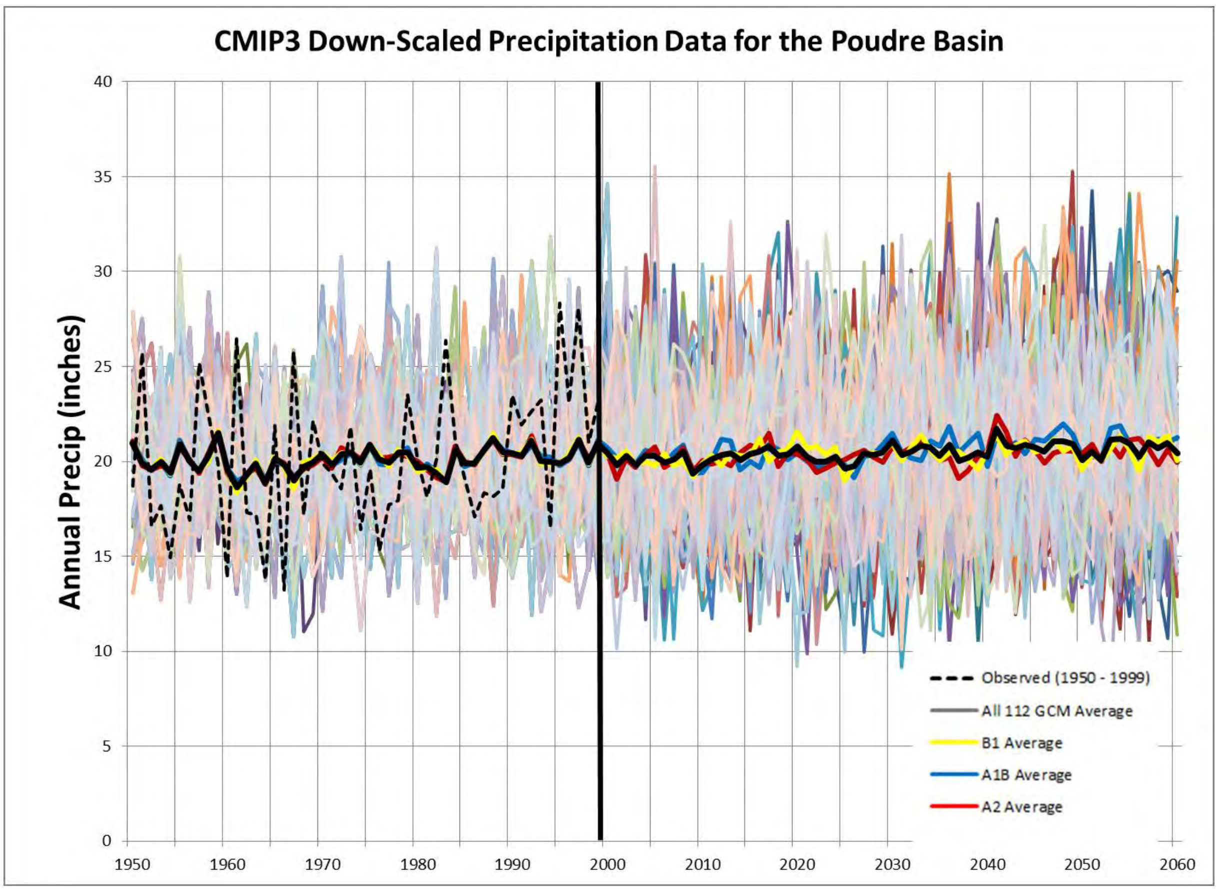


Figure 2-4. Observed Data (1950 to 1999) and CMIP3 Down-scaled Precipitation Data for the Poudre Basin.

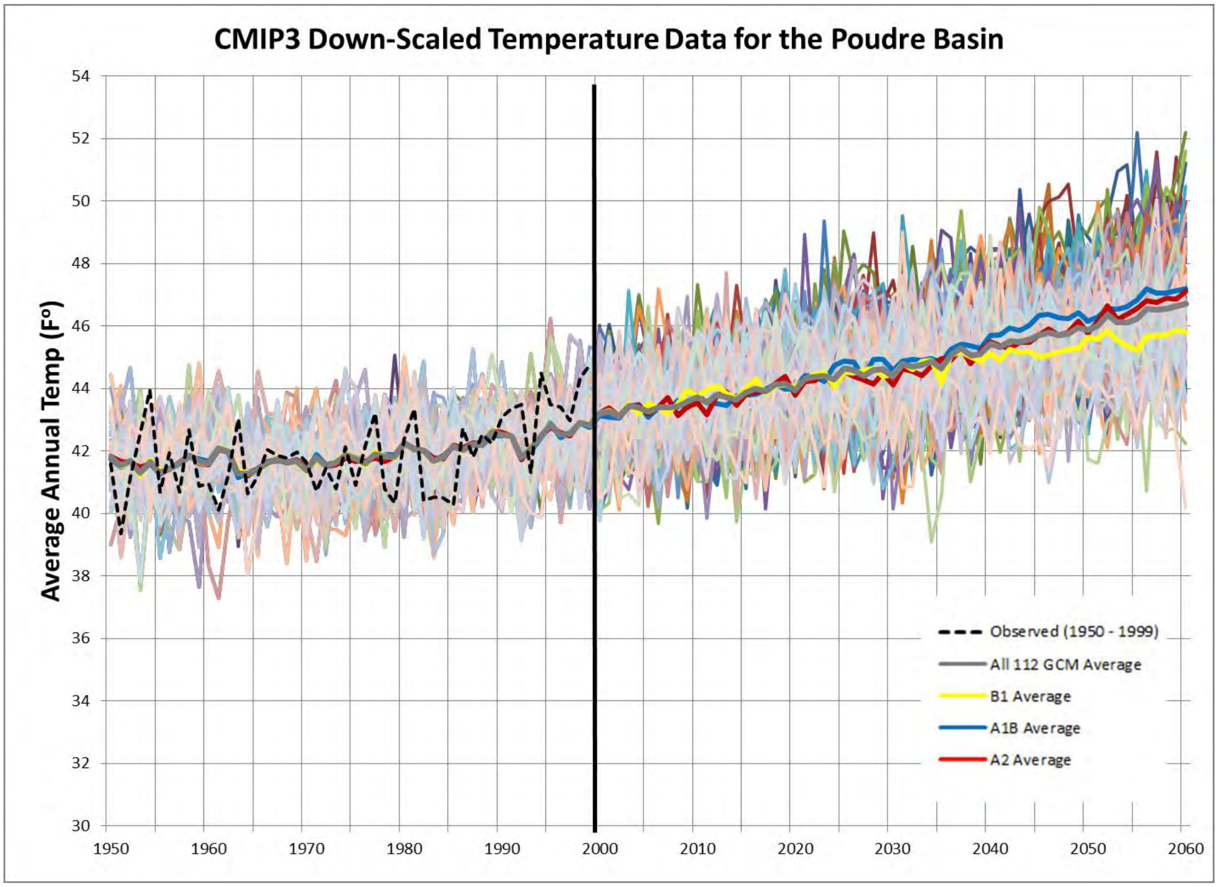


Figure 2-5. Observed Data (1950 to 1999) and CMIP3 Down-scaled Temperature Data for the Poudre Basin.

More recently, data from CMIP5 has become available, which includes output from the next generation of GCM models and adds an additional set of projections to the CMIP3 model datasets. Brekke (2013) provided a comparison of CMIP5 to CMIP3 data, comparing predicted changes in temperature and changes in precipitation. The Intergovernmental Panel on Climate Change released additional model results in early 2013. **Figure 2-6** is a replication of a portion of the Brekke (2013) presentation showing that the CMIP5 data estimates temperature increases between approximately 0 and 0.5 degrees Celsius (0 and 1 degree F) less than the CMIP3 data project. Precipitation projections from the CMIP5 data indicate much of Colorado is projected to have increased precipitation, whereas the CMIP3 data indicated that only northern sections of Colorado would likely experience increases in precipitation. The increases in precipitation in the CMIP5 data appear to be most significant on Colorado's Western Slope, but the Poudre headwater area also is projected to have more precipitation using the CMIP5 models than the CMIP3 models.

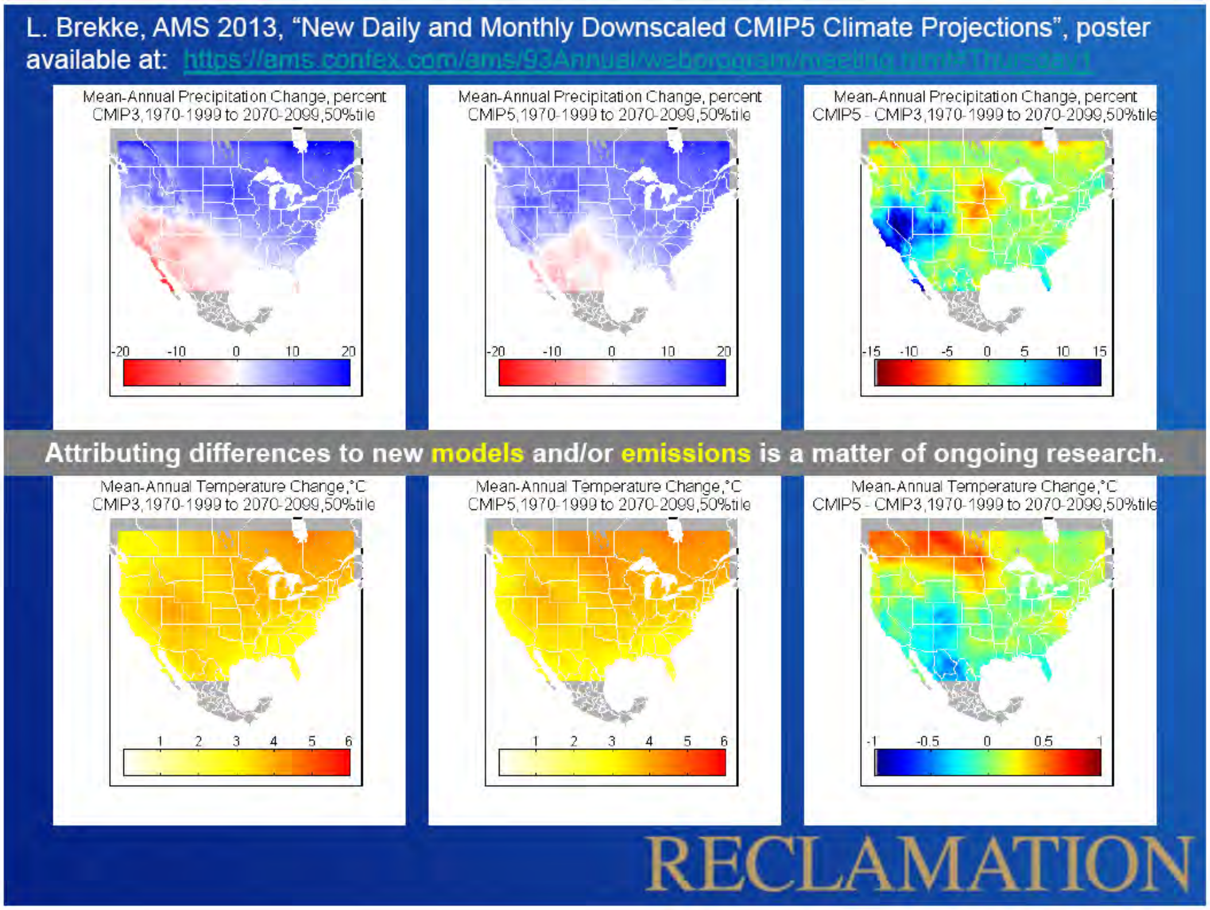


Figure 2-6. Comparison of CMIP3 and CMIP 5 Precipitation and Temperature Projections (from Brekke 2013).

2.4.2 Joint Front Range Climate Change Vulnerability Study

The Joint Front Range Climate Change Vulnerability Study (JFRCCVS) used two calibrated hydrologic models (Sacramento model and WEAP model) to simulate runoff in several locations throughout Colorado, including the Poudre River at the Canyon Mouth gage (WRF 2012). The runoff projections were made by selecting 10 temperature and precipitation datasets from the 112 CMIP3 downscaled datasets (5 datasets for 2040 conditions and 5 datasets for 2070 conditions) to represent a median and wide range of temperature and precipitation projections (warm and wet, hot and wet, median, warm and dry, hot and dry). Model calibration at the Canyon Mouth gage appear reasonable, though the model calibration in the report indicates that models tend to under-predict the peak flow in wet years and the WEAP model over-predicts the peak flow in dry years.

Appendix B of the JFRCCVS (WRF 2012) presents projections of annual percent change in streamflow volume at 18 river locations in Colorado based on the Sacramento and WEAP models for 2040 and 2070. The 2040 values are a 30-year average centered on 2040 and similarly for 2070 so that future projections rely on a future projected average, not just a single future projected year. For the Poudre River at Canyon Mouth, the results indicate increasing annual runoff in 3 of the 5 scenarios (both models) for 2040, and in 1 of the 5 scenarios for 2070 using the WEAP model and 2 of the 5 scenarios for 2070 using the Sacramento model. The variation around the model baseline ranges from approximately 22 percent above to 16 percent below for the 2040 scenarios. For the 2070 scenarios, the variation around the model baseline ranges from 18 percent above to 15 percent below. **Table 2-2** summarizes these results as averages of the 2 models for the 5 temperature and precipitation scenarios for 2040; **Table 2-3** summarizes the same results for 2070. The JFRCCVS also evaluated seasonal changes in flow patterns. For the Poudre, runoff is projected to start earlier than the historical baseline by between 1.6 and 18 days in 2040 and between 8 and 21 days by 2070.

Table 2-2. Projected Change in Streamflow from Model Baseline at Several Locations in Colorado, 2040 Climate Scenario.[1]

2040 Climate Scenario ΔT (°F) / ΔP (%)[2]	Warm and Wet +1.64°F / +11.43% P	Hot and Wet +4.25°F / +3.77% P	Median +3.40°F / +2.60% P	Warm and Dry +2.71°F / -3.67% P	Hot and Dry +5.04°F / -8.51% P
Poudre River at Canyon Mouth[3]	22%	12%	12%	-10%	-16%
Boulder Creek at Orodell[3]	19%	4%	-1%	-11%	-17%
Fraser River at Granby[3]	20%	2%	3%	-10%	-20%
Colorado River near Granby[3]	15%	2%	8%	-8%	-16%

[1] Calculated from data in Appendix B of the JFRCCVS (WRF 2012)

[2] Average annual temperature and precipitation changes from **Table 2.3** of the JFRCCVS (WRF 2012)

[3] Average of both Sacramento and WEAP model results

Table 2-3. Projected Change in Streamflow from Model Baseline at Several Locations in Colorado, 2070 Climate Scenario.[1]

2070 Climate Scenario ΔT (°F) / ΔP (%)[2]	Warm and Wet +3.93°F / +10.81% P	Hot and Wet +6.35°F / +4.95% P	Median +5.06°F / +0.38% P	Warm and Dry +4.70°F / -0.10% P	Hot and Dry +8.06°F / -5.90% P
Poudre River at Canyon Mouth[3]	18%	-3%	-12%	-5%	-15%
Boulder Creek at Orodell[3]	13%	-4%	-11%	-6%	-19%
Fraser River at Granby[3]	10%	-11%	-12%	-8%	-19%
Colorado River near Granby[3]	11%	-9%	-11%	-7%	-17%

[1] Calculated from data in Appendix B of the JFRCCVS (WRF 2012)
[2] Average annual temperature and precipitation changes from **Table 2.3** of the JFRCCVS (WRF 2012)
[3] Average of both Sacramento and WEAP model results

2.4.3 Boulder Creek Studies

Results from GCM climate change modeling do not agree on whether precipitation will increase or decrease for the Front Range, including the Poudre Basin. However, the timing of the runoff changes in most scenarios projects an earlier runoff, lower flows in the latter portion of the growing season (approximately July through September or October), and elevated winter flows due to increased precipitation as rain rather than snow below 8,200 feet, as compared to historical conditions.

McCurry (2011) details two studies completed in the Boulder Creek Basin (McCurry 2000 and Stratus 2009), located approximately 50 miles south of the Poudre Basin (**Figure 2-7**). The Boulder Creek watershed is situated similarly to the Poudre Basin along the Colorado Front Range with the western boundary at the Continental Divide and mountainous headwaters areas above 12,000 feet. The Boulder Creek at Orodell streamflow gage (USGS 06727000/DWR BOCOROCO) upstream of the mouth of Boulder Canyon is situated similarly to the Poudre River at Canyon Mouth gage and is likewise used to assess water availability in the basin. However, the area of the Boulder Creek Basin above the Orodell gage is considerably smaller than the area of the Poudre River Basin above the Canyon Mouth gage (104-square-miles versus 1,050-square-miles). The Boulder Creek Basin, while smaller in drainage area above the key gage near the canyon mouth, has a higher percentage of its area above 9,000 feet, which produces a disproportionate percentage of the total runoff.

Both studies utilize precipitation-runoff models (WATBAL for McCurry 2000 and CLIRUN2 for Stratus 2009) to make runoff projections based on changes to the temperature and precipitation changes under various climate change scenarios. **Figures 2-8, 2-9,** and **2-10** depict several scenarios for the native flow of Boulder Creek at the Orodell gage. **Figure 2-8** shows runoff results from McCurry (2000); **Figure 2-9** and **Figure 2-10** show runoff results from the more recent Stratus (2009) study for the City of Boulder. The Stratus (2009) study selected a subset of 9 GCM scenario outputs from the 112 CMIP3 models by selecting a wet, average, and dry scenario from each of the three emissions scenarios identified in Section 2.1 (B1, A1B, and A2). Due to the differences in publication dates of the McCurry and Stratus reports, different timeframes for baseline conditions were used (1950 to 1990 for McCurry, 1953 to

2004 for Stratus). The emissions scenarios in McCurry (2000) were developed prior to the definition of the CMIP3 datasets, but are equivalent to the A1B (medium emission level) scenarios[1].

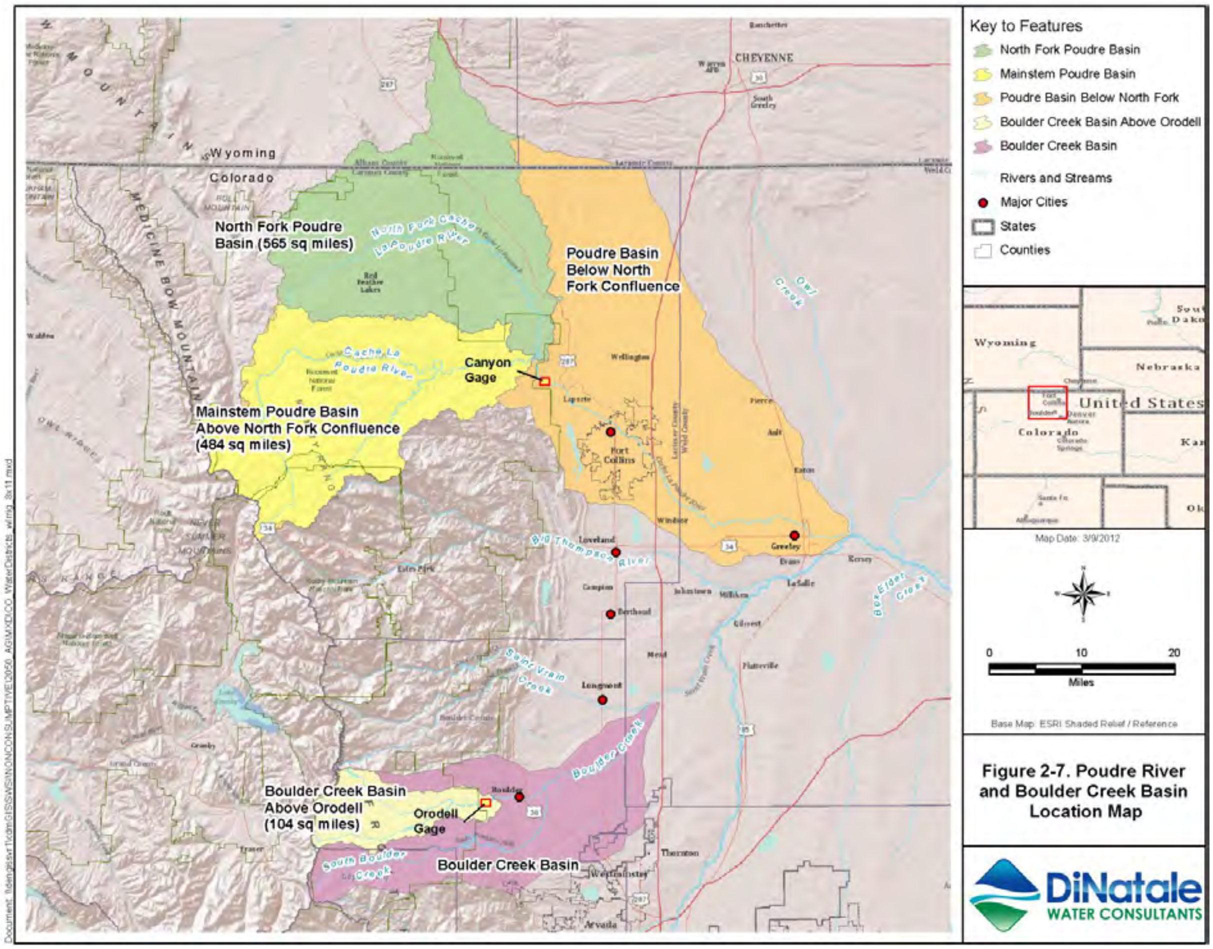


Figure 2-7. Poudre River and Boulder Creek Basin Map.

1 The greenhouse gas emission scenarios (B1, A1B, and A2) used in Stratus (2009) were defined after McCurry (2000) was published. McCurry (2000) evaluated five GCMs that at the time were most applicable to the region and whose results were readily available. In a telephone interview with McCurry (11/29/11), he indicated the emissions scenarios used in McCurry (2000) are approximately equivalent to the currently named A1B (medium) scenarios.

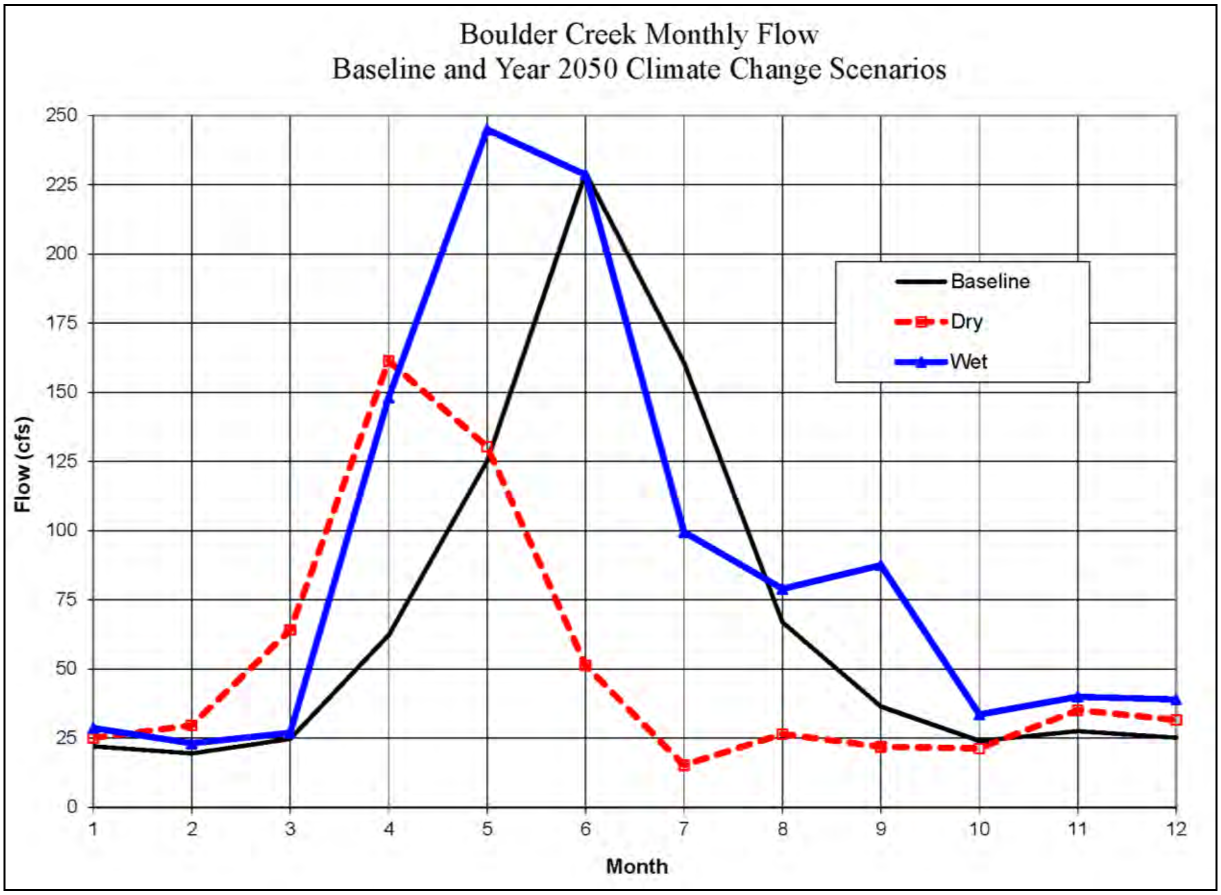


Figure 2-8. Boulder Creek Monthly Flow for Baseline (1950 to 1990) and 2050 Scenarios (McCurry 2000).

Note: Both wet and dry scenarios used an emission scenario approximately equivalent to the A1B scenarios defined for more recent studies.

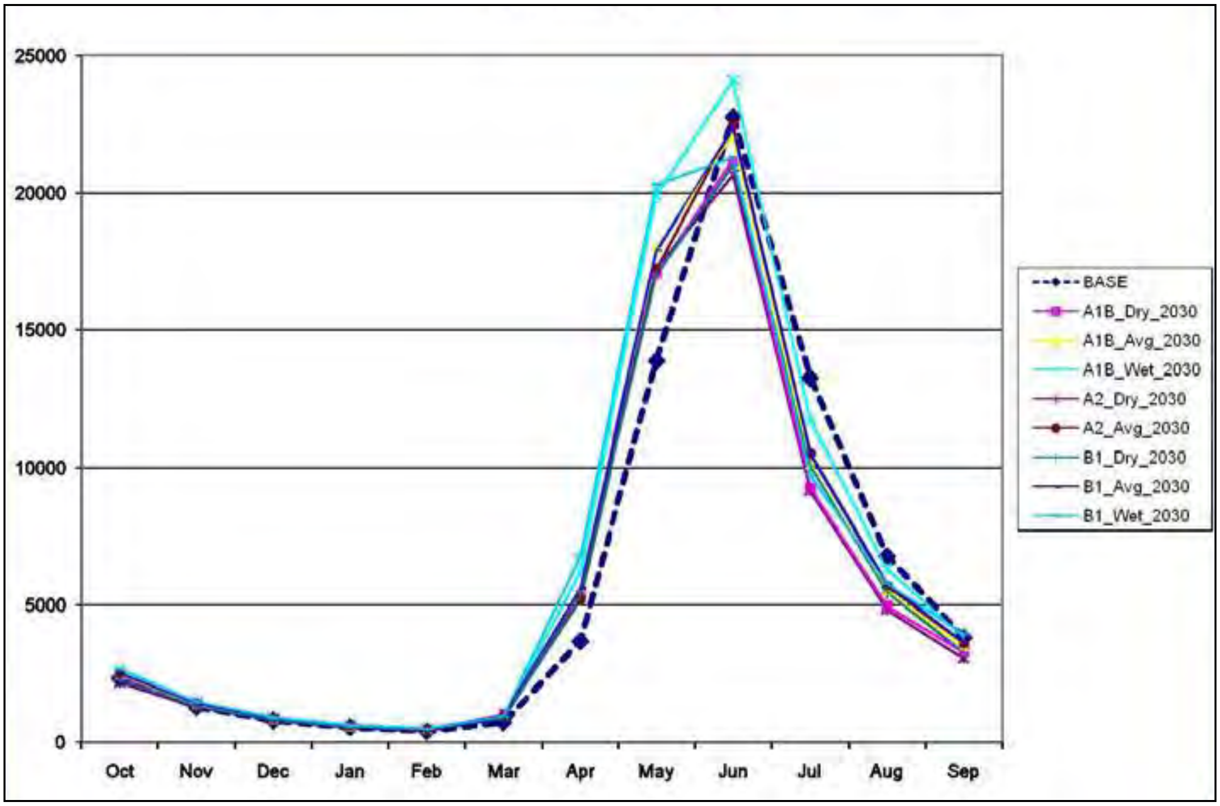


Figure 2-9. Boulder Creek Monthly Flows in acre-feet for Baseline (1953 to 2004) and 2030 Climate Change Scenarios (Stratus 2009).

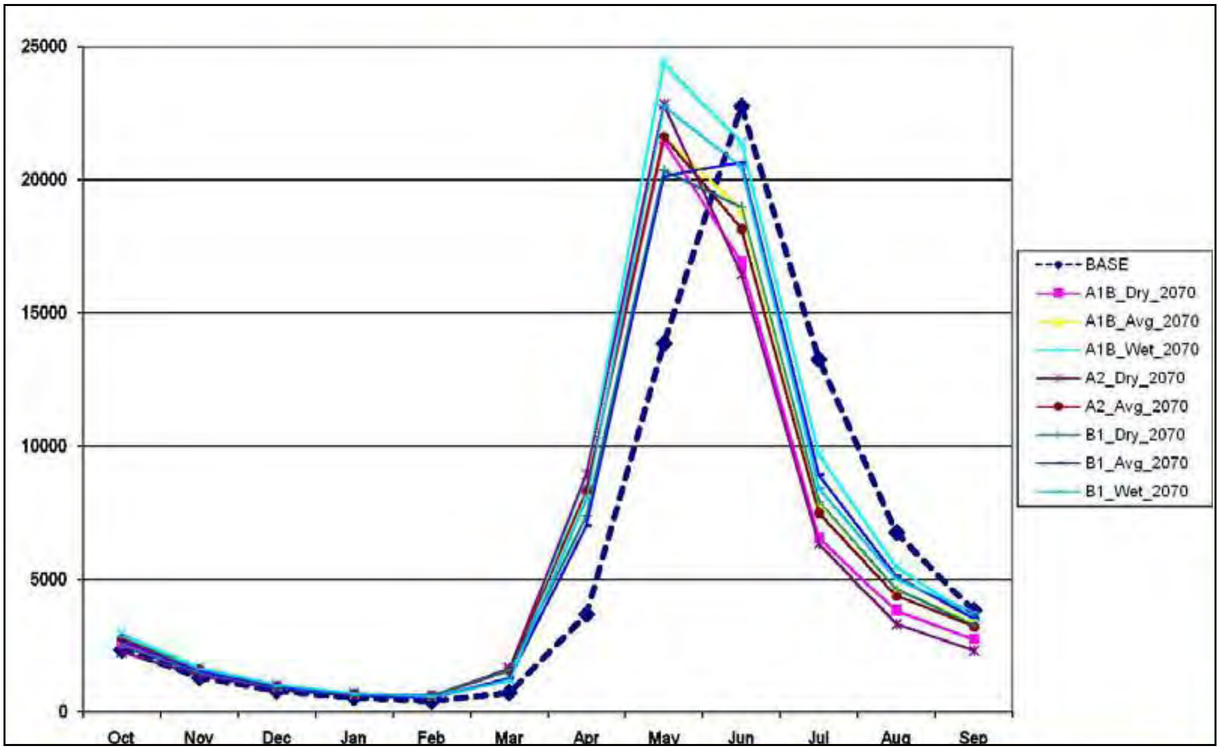


Figure 2-10. Boulder Creek Monthly Flows in AF for Baseline (1953 to 2004) and 2070 Climate Change Scenarios (Stratus 2009).

Both figures show that most climate change scenarios evaluated in the two studies project a shift in the peak runoff by about one month earlier in the year, though one scenario projects a 2-month shift. **Figure 2-8** shows runoff under baseline (1950 to 1990 average) conditions as well as the most extreme 2050 wet and dry GCM scenario outputs evaluated by McCurry (2000). **Figures 2-9** and **2-10** illustrate runoff under baseline (1953 to 2004) and four models under the three emissions scenarios[2] (B1, A1B, and A2) in 2030 and 2070 that all project higher temperatures and

> *... a wide range of potential changes in precipitation. One model had one of the largest reductions in annual precipitation for the region, one had one of the largest increases in precipitation for the region, and one was close to the middle of the projections. All of those three models project wetter winters. The fourth model projects decreased winter precipitation. (Stratus 2009).*

Figures 2-9 and **2-10** also show that between the 1953 to 2004 baseline and 2030, the changes in runoff timing are projected to be relatively small (earlier onset in May, but peak is still in June), but will accelerate in the 2030 to 2070 timeframe and the peak shifts to May with an onset beginning in April. Under all scenarios except the wettest, these two studies project native streamflow to be lower than the baseline condition (1953 to 2004) from approximately July through September. **Figures 2-9** and **2-10** project 2030 and 2070 conditions yet indicate the 2070 projections of changes in runoff to be less

[2] Stratus (2009) used four GCM models simulated for the three emission scenarios (B1, A1B, and A2) for a total of 12 model-emission combinations. **Figures 2-8** and **2-9** are reproductions of figures in the Stratus report, which show nine plots in addition to baseline. It is not clear from the text of the Stratus report why three of the combinations are not shown.

severe than those shown in **Figure 2-8**. By comparing the 2030 and 2070 charts in **Figures 2-8** and **2-9**, it can be inferred that 2050 projections from the Stratus study would be less severe than the 2070 scenarios shown in the McCurry study (**Figure 2-8**). The McCurry (2000) study used the most extreme wet and dry scenarios from the evaluated GCMs and therefore represents the likely driest and wettest scenarios, while the Stratus (2009) study appears to have selected scenarios that deviate less from historical conditions. Taken in aggregate, these two studies provide a reasonable bracketing of likely outcomes while also indicating that there are several potential scenarios where changes to hydrology are less than the most extreme projections.

Based on the data shown in the McCurry document (**Figure 2-8**), the 2050 total average annual runoff varies significantly from the historical baseline, with a 25 percent decrease for the dry scenario and a 31 percent increase for the wet scenario. The total average annual runoff for the scenarios shown in the Stratus report (**Figures 2-9** and **2-10**), when interpolated to their 2050 values, vary from a 5 percent decrease to an 8 percent increase relative to the baseline.

2.5 Regional Change in Demands

Climate change has the potential to change the timing and magnitude of water demand for both agricultural and M&I uses. The primary crops irrigated in the Poudre Basin are corn, alfalfa, and grass pasture (Colorado Decision Support System [CDSS] 2005). There is also a significant demand for outdoor watering of turf (primarily bluegrass) in urban areas, though this demand is much smaller than water use for irrigated agriculture. For example, using the winter demand for Fort Collins as proxy of indoor use, nearly 40 percent of the total annual demand is for outdoor use, and accounts for more than half the demand in the summer. In the Poudre Basin, water demand for agriculture is much larger than the outdoor watering demand for municipalities (agriculture demand is approximately 475,000 AFY, and outdoor water demand for municipal providers in the basin is approximately 40,000 AFY). The overall water demand for turf is small compared to agricultural demand, but is expected to rise as municipal populations increase. The two studies discussed in the previous section (McCurry 2000 and Stratus 2009) computed projected irrigation demands using the projected change in temperature from the climate change scenarios utilized in the respective studies.

Irrigation water requirement (IWR) for individual crops is defined as the difference between potential ET and effective precipitation (the amount of precipitation stored in the root zone and available to plants, i.e., rainfall minus runoff and deep percolation) and is the amount of consumable irrigation water required to fully satisfy ET. ET increases with temperature for most crops. The growing season length for alfalfa, as defined by Alam and Rogers (2009), "begins when the average temperature reaches 50 degrees Fahrenheit and continues until a harsh freeze occurs, usually in late fall." Under climate change scenarios with increased temperatures, alfalfa's demands for water may extend into the winter months that are not currently considered part of the growing season. Likewise, the onset of water consumption by corn is driven primarily by temperature, so under climate change conditions, the growing season for corn would likely be longer than currently, including an earlier onset of water demands (personal communication with Prof. Richard Cruse, Director Iowa Water Center, Iowa State University, February 3, 2012 and February 8, 2012).

As shown in McCurry's (2011) Tables 3 and 4 (see Appendix A), if no change in precipitation is assumed, the annual IWR for alfalfa increases by 15 to 30 percent (10 to 15 percent during the traditional growing season of April to September), while corn IWR increases 5 to 8 percent, depending on the modeled scenario. Another study by McCurry (2008) that used average change in temperature from multiple GCMs shows an increase in ET of approximately 18 percent for alfalfa and 8 percent for bluegrass by 2050. Assuming the 8 percent increase in bluegrass applied to municipal outdoor irrigation water requirements, annual municipal demand will increase by 3 to 4 percent over 2050 M&I demand projections. Incorporating a longer growing season for bluegrass similar to alfalfa would result in even greater increases to M&I demands.

Stratus (2009), as presented by AMEC (2009), projected the change in IWR for nine scenarios evaluated in 2030 and 2070. These irrigation demands are in the lower Boulder Creek Basin on the plains below the Orodell gage and are likely a mix of primarily corn, hay, and alfalfa. For the evaluated scenarios, the annual IWR increases by approximately 25 percent in 2030 and 48 percent in 2070 with different scenarios varying approximately +/- 15 percent from the average in 2030 and +/- 30 percent from the average in 2070. Interpolating to 2050 would suggest IWR increase of 36 percent with scenarios varying from 13 percent to 49 percent increase, depending on scenario (+/- 23 percent from average).

Figure 2-11 shows the changes in monthly demands for alfalfa in eastern Boulder County (lower Boulder Creek) as presented in McCurry (2011). This figure uses scenarios that have different assumptions for precipitation and shows that demands can decrease in months where precipitation increases over current conditions and also shows the increases in demand with increasing temperatures.

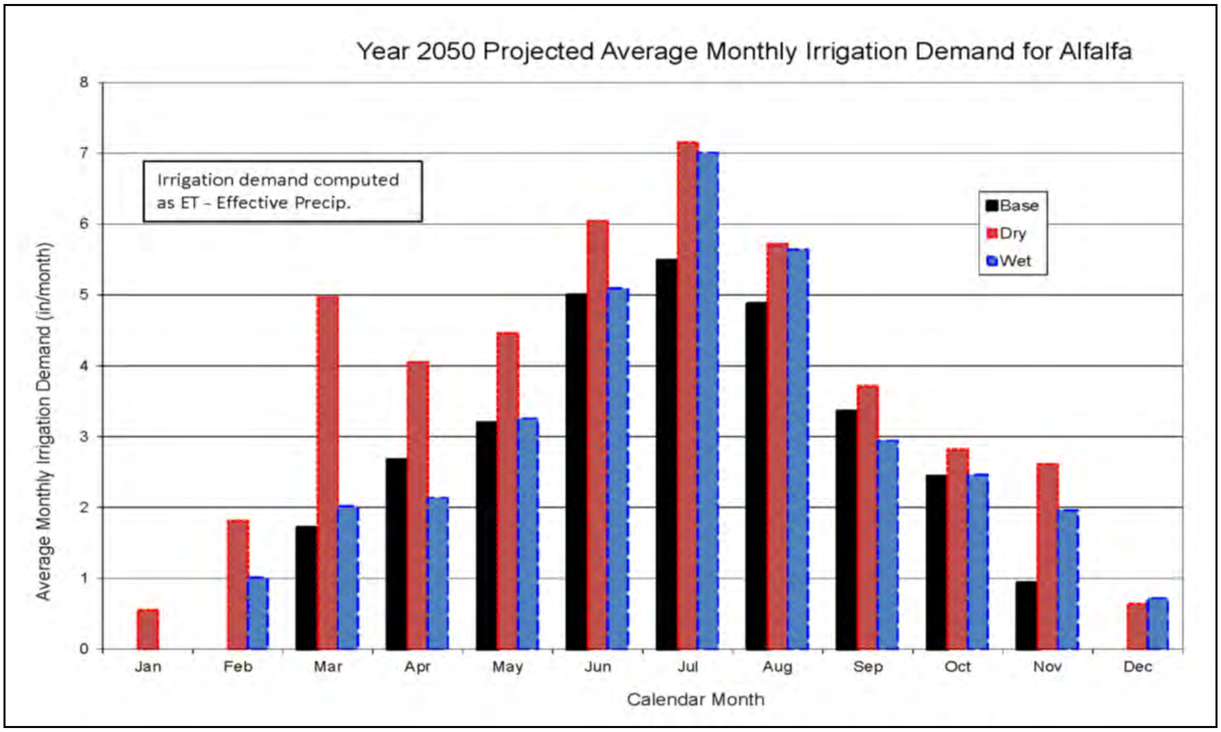


Figure 2-11. IWR for Alfalfa under Climate Change in Eastern Boulder County, CO (McCurry 2011).

2.6 Regional Impact of Change in Supply and Demand

The projected changes in the amount and timing of the spring runoff, coupled with the general increase in agricultural demands, creates additional gaps between water supply and demand. Under historical practices for many irrigation water users except for those with the most senior water rights, water is stored during the winter and the peak runoff for use later in the irrigation season when flows are lower and crop demands peak or remain high. The shift of the runoff to earlier in the season and an increase in crop demands only increases this timing offset. **Figures 2-12** and **2-13** reproduced from the City of Boulder study (Stratus 2009) graphically depict this issue. The percentages shown on the figures (72 percent and 57 percent) represent the "natural overlap" of the water supply and irrigation demands. These values infer that under climate change scenarios, an additional 15 percent of annual irrigation demand (the difference between the 72 percent base case and 57 percent dry scenario) will need to be satisfied by other sources of supply to maintain current levels of irrigation due to seasonal shifts in supply and demand. There are several potential ways to address the increasing offset between supply and demand, including different crops, additional storage, and recharge facilities. Historically the timing difference has been alleviated through storage. Additional evaporation losses would be expected if more water is stored for longer periods of time, making storage and subsequent release of water less efficient than direct use of the water.

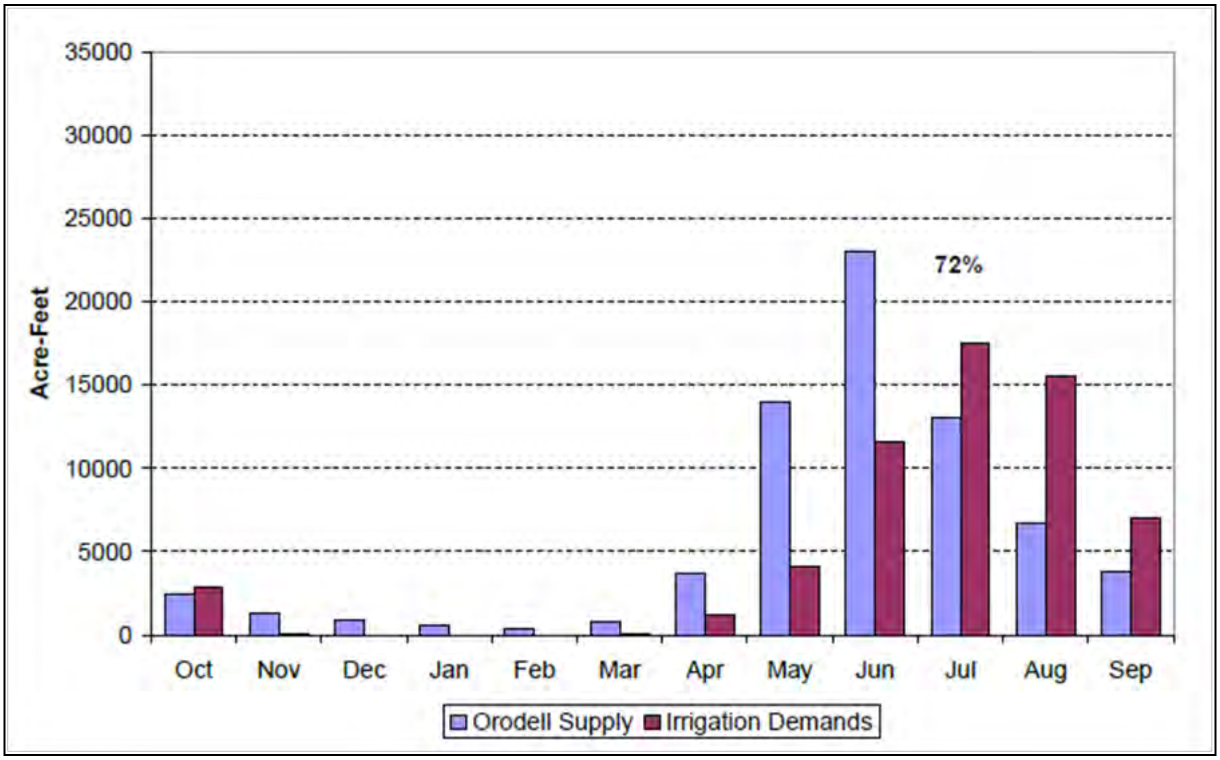


Figure 2-12. Timing of Supply and Demand in the Boulder Creek Basin, Base Case (Stratus 2030).

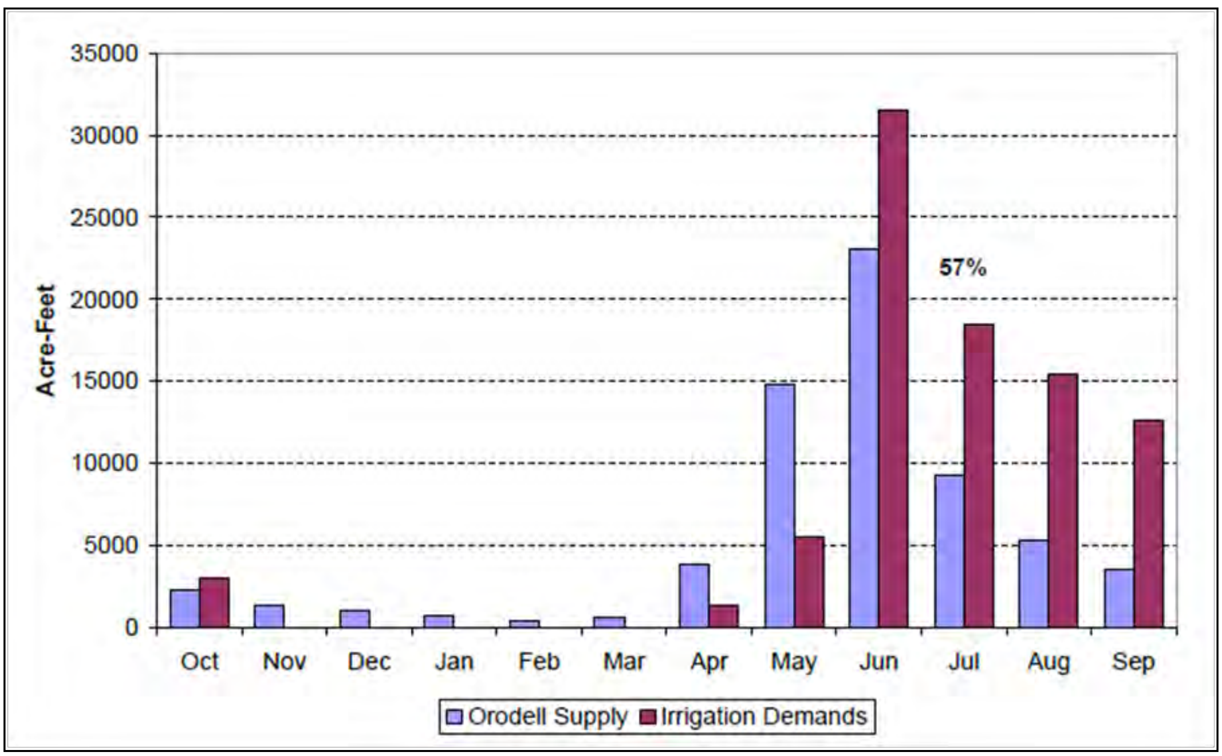


Figure 2-13. Timing of Supply and Demand in the Boulder Creek Basin, 2030 A1B Dry3 Scenario (Stratus).

An earlier runoff may not benefit irrigators since the growing season is limited by hours of daylight, is crop dependent and water rights and other factors may not allow for irrigation earlier in the year. Colorado water law generally does not allow water diverted under a direct-flow water right to be stored, and requires a beneficial use of the diverted water. Some direct flow water rights may not be able to divert water even though water is available at the headgate if there is no immediate irrigation demand for the water. The earlier peak runoff may go to other water users as storage, other water uses that are not constrained by the growing season or water rights considerations, or may simply remain in the river, which would benefit the environment. Historically, irrigated agricultural users have a significant need for water diversions for irrigation during and after the peak runoff, during the months of June through September. Under climate change conditions, water would be available earlier in the year prior to the peak agricultural demand. This would result in reduced diversions to agriculture during the peak runoff, and reduced agricultural water diversions during times of peak irrigation demand. Under the Colorado prior appropriation system, shortages are not shared among water users and under climate change, all but the most senior water users would likely experience reductions in mid- to late summer supply.

The development of water rights and diversions in most Front Range river basins initially occurred with senior direct flow water rights. As additional water diversions for agricultural users were needed, junior water users required reservoir storage water to supplement their junior direct flow right(s) in the late summer season. Irrigators with relatively junior direct flow rights often have senior storage rights as they were the first to develop storage to supplement the lack of available direct flow water needed for irrigation after the peak runoff. Water users with somewhat senior direct flow rights, but not so junior that storage was historically required, may be impacted most severely because their direct flow supply may not be available under many climate change scenarios and they have no storage water to use as a supplemental supply. The increase in IWR during the late season will make this shortage more severe than a water shortage under current conditions and could lead to crop failure or reduced crop yields.

2.7 Change in Evaporation

As noted in McCurry (2011), the warming temperature trends under climate change will tend to push the existing climate of the eastern Colorado plains and western Kansas into the Front Range. CWCB (2008) also projects the future climate of the Front Range to be similar to the current climate of the eastern plains and Kansas:

> *"By 2050, temperatures on the Eastern Plains of Colorado will shift westward and upslope, bringing into the Front Range temperature regimes that today occur near the Kansas border. Note that the range of climate model projections does not capture the entire range of uncertainty."*
>
> *"It is clear that by 2050 the January climate of the Eastern plains has moved northward by a distance greater than half the state."*
>
> *"For July, the temperatures on the Eastern Plains have moved westward and upslope, such that the temperature regime near the western Kansas border has reached the Front Range by 2050."*

The NOAA Technical Report NWS 33 free water surface evaporation maps (Farnsworth et al. 1982) were used to estimate the potential change in evaporation rates for reservoirs and lakes. **Figure 2-14** shows the South Platte River Basin with the isopleths of annual free water surface evaporation in inches from the NOAA publication's Map 3. Evaporation in eastern Colorado and western Kansas varies from approximately 50 to 60 inches. Evaporation along the Front Range near Fort Collins and Greeley in the plains area of the Poudre Basin varies from 40 to 45 inches. Evaporation from a reservoir depends on several factors, including water temperature, air temperature, wind speed, relative humidity, surface area of the reservoir, length of time water is stored and other factors. These factors introduce uncertainty into an estimate of evaporation under climate change because projected changes in temperatures do not directly affect all these factors. Based on the climate change conditions described by McCurry (2011) and CWCB (2008), a simplifying method of using the existing evaporation rate on the eastern plains was used for the purpose of this report; an increase of approximately 25 percent.

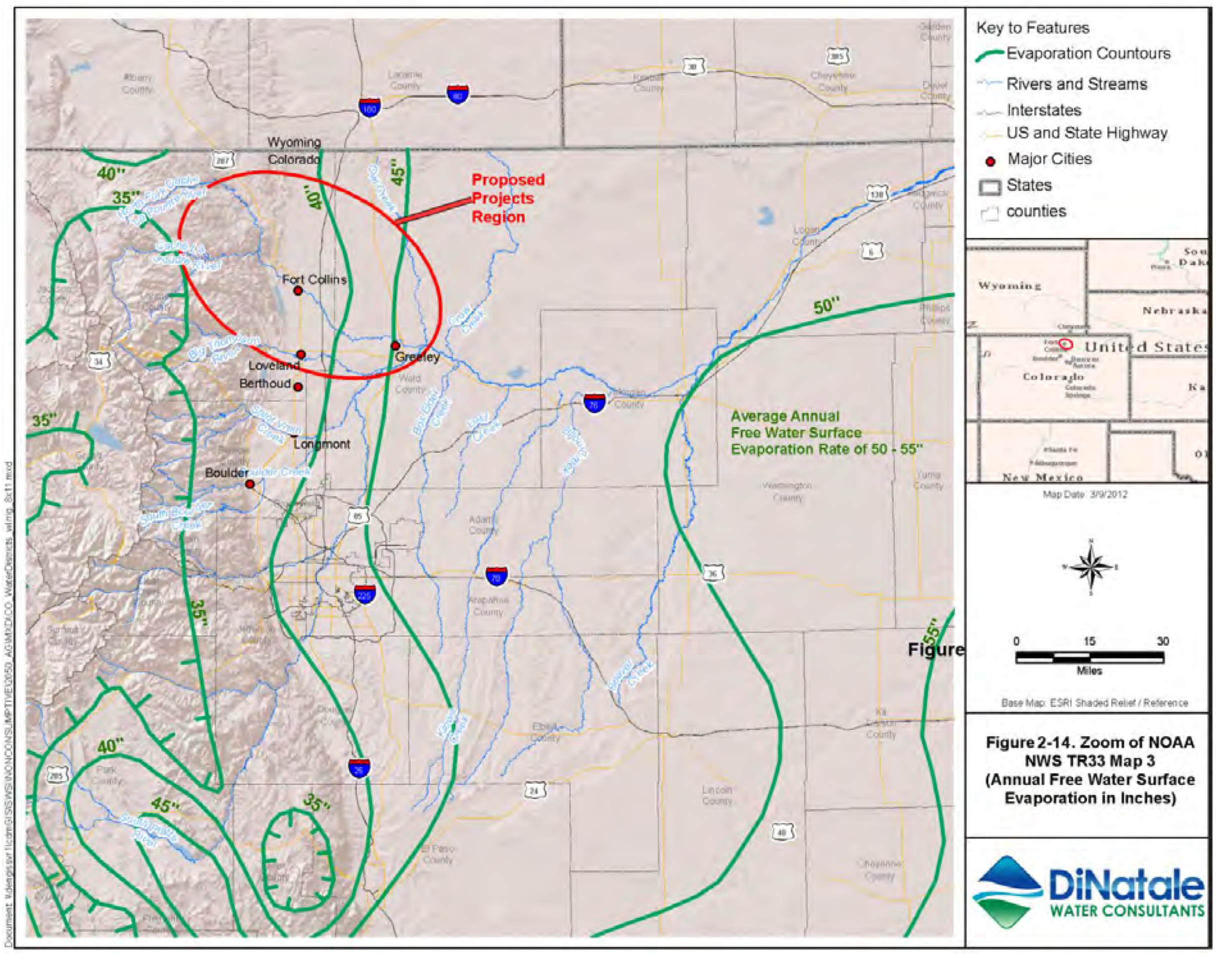


Figure 2-14. Annual Freewater Surface Evaporation Contours near the Study Area.

Changes to precipitation will also affect net evaporation. For example, an increase in precipitation of 2 inches per year would offset the first 2 inches of increased evaporation due to increasing temperatures (conversely a decrease of 2 inches per year in precipitation coupled with 2 inches of increased evaporation would have the net effect of an evaporation rate increase of 4 inches). Changes to reservoir operations also affect net evaporation. For example, if under climate change conditions, reservoir levels are lower (and correspondingly have smaller surface area) in the late summer when evaporation rates are highest, the overall volume of water evaporated may not change by the

25 percent increase in evaporation rate (conversely, more surface area at times of elevated evaporation rate would result in an increase in net evaporated volume).

2.8 General Conclusions

A large volume of scientific information supports the conclusion that global temperatures are increasing and that precipitation trends will change in the future. The warming trend is expected to accelerate in coming decades. In the western United States, longer periods of drought are expected and there is a call to re-evaluate current infrastructure and standard infrastructure planning and design practices to consider conditions outside of the historical hydrology.

There is also general agreement by climate scientists that climate change information specific to Colorado indicates that snowpack melting and spring runoff will occur earlier in the year, temperatures will increase by approximately 3 to 4 degrees Fahrenheit by 2050, with summers warming more than winters. **Table 2-4** summarizes the estimates for changes in temperature cited above. However, there is little agreement on the potential changes to precipitation in Colorado, though modeling of the Colorado River Basin indicates overall lower runoff on the West Slope.

Table 2-4. Summary of Estimated Change in Average Temperature Presented in Various Studies in Colorado.

Source	Temperature Change
CWCB (2008)	Average annual increase by 2.5 to 5.5 degrees F by 2050 relative to 1950-1999 baseline
CWCB (2008)	Summers will warm more than winters (summers increasing average of 3 to 7 degrees F, winters 2 to 5 degrees F)
Historical Temperature Data (1895 to 2010)	Average annual 1 degree F increase every 25 years using 1895 to 2010 trend, accelerating to 1 degree F increase every 13 years using 1981 to 2010 trend
CMIP3 Data	Poudre Basin Average annual increase of about 3 degrees F by 2050 compared to 2010
CMIP5 Data	Temperature increases are not as large as projected in CMIP3 data by up to 1 degree F less by 2070 (Brekke 2013).
JFRCCVS	Multiple scenario with average annual increases between approximately 1.5 and 5 degrees F by 2040, and 4 and 8 degrees F by 2070

Information gathered for the Poudre River Basin and surrounding region generally conforms to the broader global and state conclusions. Quantitative information for the Poudre Basin from the JFRCCVS and other information from studies in the neighboring Boulder Creek Basin were used preferentially over other state-wide or regional information. For the purposes of this report, the following information will be used to further describe the cumulative impacts hydrology for the EISs to include the potential impacts of climate change:

- Changes in water supply
  - Runoff may increase by as much as 15 percent and decrease by as much as 15 percent, depending on future changes to temperature and precipitation
  - Peak runoff will likely occur a month earlier than historically due to rising temperatures
  - Summer flows as a percent of annual flow will be lower than historical flows
  - Winter flows as a percent of annual flow will be higher than historically due to more winter precipitation as rain instead of snow. Much of the Poudre Basin headwaters is located above 8,200 feet where winter precipitation is expected to remain snowfall (CWCB 2008). Therefore, relatively small increases in winter flow are anticipated.
- Changes in demands
  - Average annual temperature increase of 2.5 degrees Fahrenheit to 5.5 degrees Fahrenheit; and summer months with higher increases of 3 degrees Fahrenheit to 7 degrees Fahrenheit
  - Irrigation water requirements will increase by 15 to 25 percent by 2050 for a mixture of corn and alfalfa
  - Municipal outdoor irrigation water requirements will increase by approximately 8 percent, resulting in an increase in water demand
  - Warmer winters may result in an expansion of the growing season for certain crops such as alfalfa, resulting in increased IWR.
- Change in relative timing of water supply and demands
  - Seasonal offset between the availability of water supply and the timing of greatest demands becomes larger
  - Water rights yields may change based on timing and amount of annual water supply and are likely to decrease the most for direct-flow rights holders that do not also have storage rights.
- Change in evaporation rate
  - Evaporation rate assumed to increase by approximately 25 percent
  - Total evaporation volume will depend on change in precipitation and ability of reservoirs to fill to historical levels

3.0 Potential Climate Change Impacts to Specific Poudre River Reaches and Users

Utilizing the range of potential changes in the timing and amount of water supply, demand, and evaporation due to climate change, this section qualitatively describes the potential impacts of climate change to several key areas of the modeled Poudre Basin cumulative effects hydrology. Due to the availability of quantitative and qualitative information available at multiple spatial scales (regional, state-wide and Poudre Basin specific), a new quantitative evaluation was not necessary for the purposes of the CTP EIS hydrology impacts analysis. The information presented in Section 2.8 was applied to the CTP hydrologic model and impacts are described qualitatively.

3.1 Poudre River Runoff

For the CTP hydrologic modeling, naturalized streamflow model input was developed for the upper Poudre Basin. Naturalized flows represent the flows at a certain location absent the effects of man (e.g. upstream diversions, transbasin imports, and reservoir operations). Naturalized flow is commonly used in water allocation modeling as the model input for streamflow, and represents the runoff from precipitation within the watershed. As described in Sections 2.4 and 2.8, under climate change conditions, annual runoff may increase or decrease by 15 percent, and peak runoff, as well as the majority of the annual streamflow will occur earlier in the year than historically.

Figure 3-1 shows the CTP model input naturalized flows and a dataset where the naturalized flows were shifted one month earlier and the black bars representing the range of 15 percent increase or decrease. The most significant changes to the naturalized flows from a volumetric standpoint are in April (significant increase in runoff) and June (significant reduction in runoff). The summer months of July, August and September also see reductions in naturalized flow under climate change conditions. Because more precipitation may fall as rain instead of snow under warmer climate conditions, it is anticipated that winter flows may increase moderately, and the peak streamflow shown in **Figure 3-1** may be correspondingly reduced. However, much of the Poudre Basin headwaters area is above 8,200 feet in elevation, above which winter precipitation is anticipated to remain primarily snowfall (CWCB 2008), so increases in winter flow are not expected to be large.

Climate change is expected to change the naturalized flow and runoff patterns in the Poudre basin. However, due to changing demand patterns, water rights administration and reservoir operations, changes in naturalized flow do not necessarily correspond to similar changes in observed flow (e.g. increase in naturalized flow during the peak naturalized flow does not necessarily mean gaged flows will be higher at all locations during that time). Naturalized flows provide insight to the 'supply' side of the equation that relates supply, demand and distribution. The different runoff pattern under climate change will cause changes to diversions, use and storage of water due to the timing of demands, the priority of different water rights, availability of groundwater and the location, timing and volume of reservoir releases. The following sections discuss changing demands and complex interaction of supply, demand and water rights on observed streamflows.

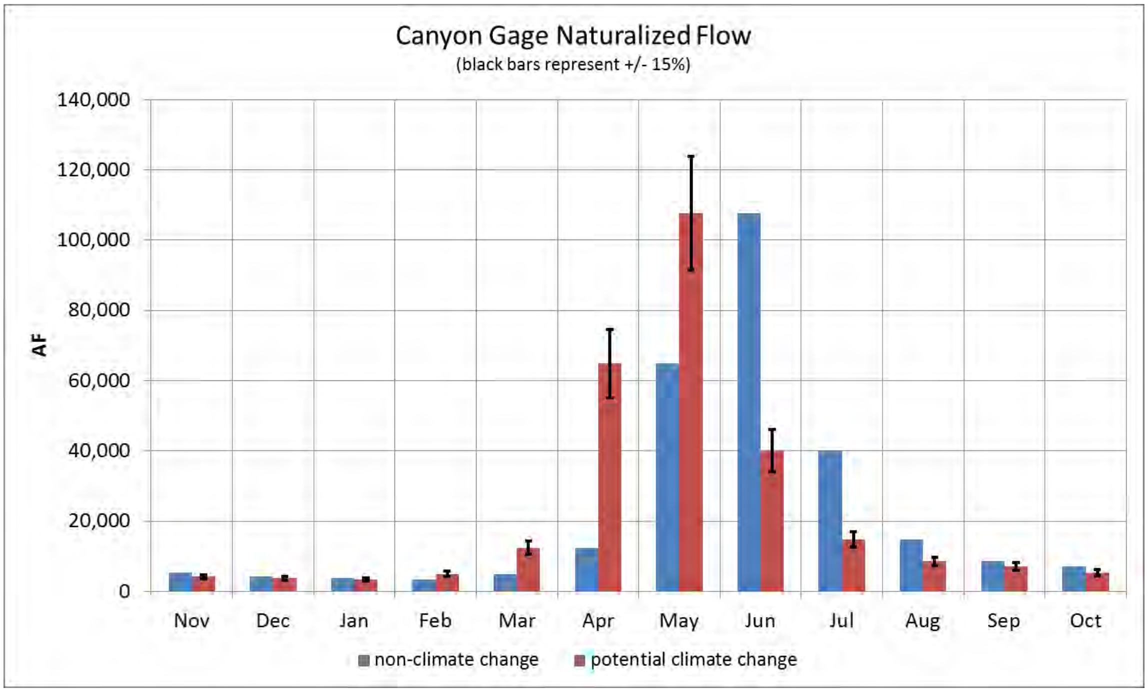


Figure 3-1. Potential Changes to Naturalized Flow at the Canyon Gage under Climate Change Conditions (one month earlier runoff and 15 percent increase or decrease in flow).

3.2 Poudre Basin Demands

Demand for irrigation water will increase with increased temperatures under climate change conditions. As discussed in Section 2.8, demands for crops typically grown in the Poudre basin will likely increase from 15 to 25 percent, including irrigation water demand for alfalfa at times of the year not currently considered the irrigation season (e.g. March, November).

Agricultural irrigation demands are based on crop type, irrigated acreage, precipitation, soil type and irrigation method. For the CTP, agricultural demands in the Poudre river basin are simulated in the Poudre Basin Network model (PBN), which is the hydrologic basin model used in the CTP (CDM Smith et al. 2013). Total headgate diversions and reservoir storage levels were calibrated to observed conditions at key ditches and reservoirs. The PBN uses historical agricultural demands, even though a significant amount of agricultural water use is expected to decrease in the future due to transfers of agricultural water to municipal use. Historical demands are used to quantify the yield of the agricultural water rights, a portion of which are then used in the municipal system models as a municipal supply depending on the municipality's projected ownership interest in the specific water right. Simulated final river flows are computed in the CTP process through an integration of the PBN and system model output (CDM Smith et al. 2013). Thus, a portion of the total agricultural demand shown in the PBN is anticipated to meet both future agricultural irrigation demands and a portion of municipal demands.

Currently, groundwater is used to meet approximately 30 percent of agricultural demands in the Poudre Basin as a supplemental irrigation supply. Physical availability of groundwater generally allows it to be applied to the crops when needed, independent of streamflows. However, the water in the Poudre basin aquifers is derived in large part from canal leakage and deep percolation of applied irrigation water. Long-term decreases in water supply diverted through canals will reduce amount of water recharged into the aquifers. Measures likely to be taken by farmers to address reduced supplies, such as canal lining and/or conversion to higher efficiency irrigation methods than used historically (e.g. conversion to sprinklers or drip systems from flood irrigation), will result in lower water levels in the aquifer and may affect water availability in some wells. For the purposes of this report, it is assumed that similar volume of water will be pumped from the aquifer, but timing may be adjusted to better meet the needs of crops.

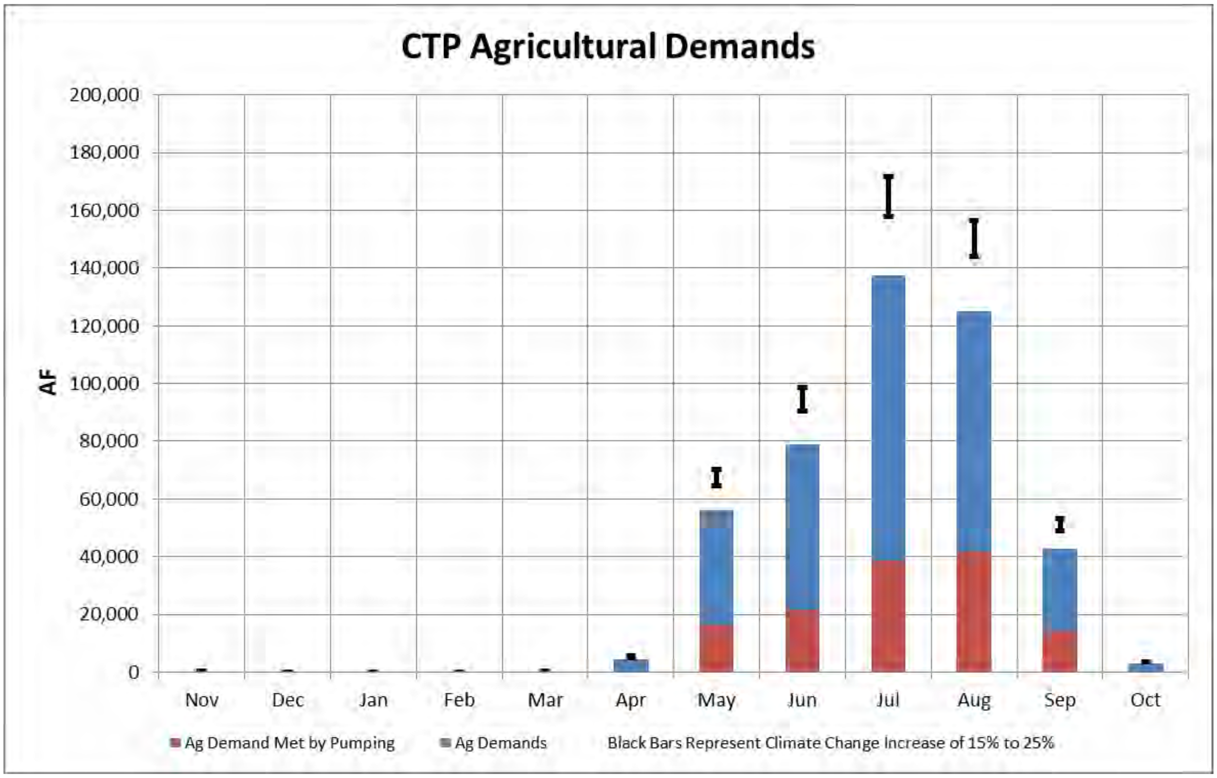


Figure 3-2. Potential Changes to Agricultural Demands in the CTP Modeling under Climate Change Conditions (15 to 25 percent increase over current demands).

Figure 3-2 shows simulated agricultural demands in the PBN, distinguishing between demand met by groundwater and the demand met by surface water. The average annual pumping volume is 132,000 AF and accounts for approximately 30% of the total agricultural demand of approximately 447,000 AF. **Figure 3-2** also shows the simulated PBN demands plus 15 to 25 percent that are expected under climate change conditions. Note that demands in March and November (historically zero), may also increase for alfalfa as the average temperature increases in those months.

3.3 Changes to Diversion Patterns and Streamflows in the Poudre Basin

Predicting future diversion patterns under climate change conditions is a difficult task due to the change in runoff and demands, coupled with the complexities of water rights administration, water transfers and operational constraints. For the purposes of this report, the description of the impacts on streamflow is based on a qualitative analysis of the cumulative impacts model run (CTP Run 5), assuming changes in runoff and demand described above. The basin-wide supply and demand curves are analyzed for climate change and non-climate change scenarios. More detailed analyses of individual water rights and times of year follows the basin-wide analysis.

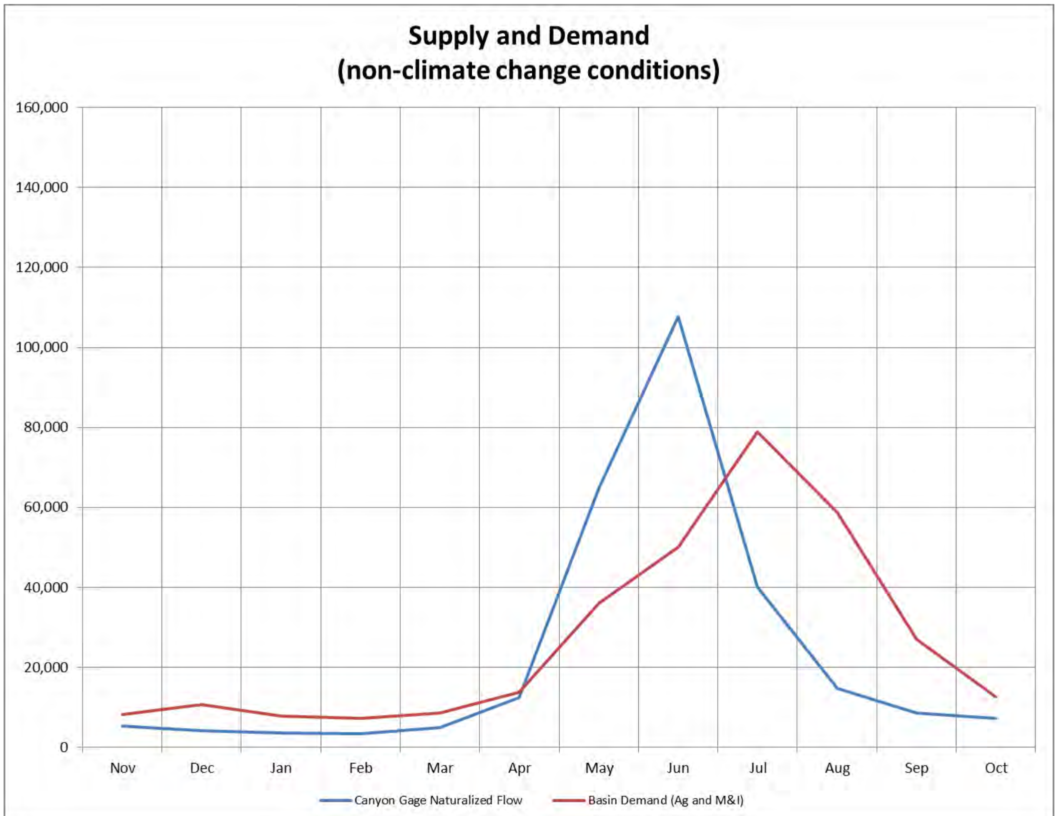
3.3.1 Basin-Wide Analysis

Under historical conditions and projected 2050 conditions without climate change, the timing of the supply of water from runoff does not align with agricultural and municipal demands (see **Figure 2-13** for the Boulder Creek basin). Historically, farmers and municipalities constructed reservoirs to capture flow in excess of demand during the peak runoff and the non-irrigation season, and released from reservoirs during times of low natural runoff to meet demands. **Figure 3-3** (top chart) shows the offset between supply and demand under non-climate change conditions. The solid blue line in **Figure 3-3** indicates native supply as simulated in the CTP model. The solid red line indicates the basin demands, comprised of agricultural demands (excluding demand met from pumping), and M&I demands (exclusive of future demand to be met by agricultural transfers). This figure shows that given average historical conditions, 18% of the runoff exceeds demands and can be stored in reservoirs in May and June (49,000 AFY). This water can then be released from the reservoirs to meet demands later in the season once the runoff no longer provides enough water to meet the demands. Note that the amount of storable water on the rising limb of the hydrograph is smaller than the supply needed to meet late-season demands (223,000 AF). This indicates that on average, the native supply of the Poudre Basin is insufficient to meet the full demands. Return flows to the river via the groundwater system from irrigation use earlier in the irrigation season help make up this deficit. The demand for water in dry years and during the late part of the irrigation season in average years exceeds the then-available native supply and return flows. Water imported from other basins and water storage projects have been used to help meet this later season demand. Water imported from other basins is brought into the Poudre Basin, stored in reservoirs (e.g. Horsetooth, Joe Wright, Chambers and Long Draw Reservoirs) and released to make up the deficit later in the year. The proposed projects rely on a combination of storing existing water rights (e.g. Fort Collins' and Greeley's transferred agricultural rights), excess Poudre Basin junior water rights that are in priority only in wet years such as the Grey Mountain right, and excess South Platte River junior water rights under the NISP South Platte Water Conservation Project that are exchanged upstream to Glade Reservoir.

The lower chart in **Figure 3-3** shows the imbalance of supply and demand under climate change conditions. The solid blue line indicates native supply shifted earlier one month, but with the same volume as in the non-climate change conditions. Dashed blue lines indicate plus or minus 15 percent with the one month shift. The solid red line indicates the basin demands, comprised of a 15 percent increase to agricultural demands and a 4 percent increase to M&I demands in the summer to represent increased outdoor watering demand. **Table 3-1** shows the average annual volume of water in excess of demand on the rising limb of the hydrograph, the demand for water in excess of native supply on the falling limb (and winter months), and the difference between the two for the four climate change scenarios.

Figure 3-3 and **Table 3-1** show that under climate change conditions, the amount of storable water increases on the rising limb of the hydrograph because the supply shifts earlier in the year, but the demand does not follow this shift to this same extent and becomes more disjointed from the supply than under non-climate change conditions. This change in alignment of the supply and demand curves would result in changes to diversions to storage, direct-flow diversions and releases from storage later in the year.

The offset between supply and demand becomes more pronounced with additional increases in demand (e.g. 25 percent increase in agricultural demand as shown by the dashed red line). Increases to the supply will result in more water available for use before there is demand to use it. This water would likely be stored in reservoirs, but due to the increased amount of storable water compared to non-climate change conditions, existing storage facilities may not have capacity to store all this water. Additionally, under all climate change conditions, the deficit between supply and demand is larger than under non-climate change scenarios. The climate change scenario with 15 percent increase in supply and 15 percent increase in agricultural demands shows an increase of approximately 10,000 AFY to this deficit relative to non-climate change conditions. The largest deficit between supply and demand occurs with a 15 percent decrease in supply and a 25 percent increase in agricultural demand, resulting in a near quadrupling of the deficit to 168,000 AFY. An increasing deficit between supply and demand relative to the non-climate change scenario may result in additional shortages or demand for additional transbasin sources and associated storage infrastructure.



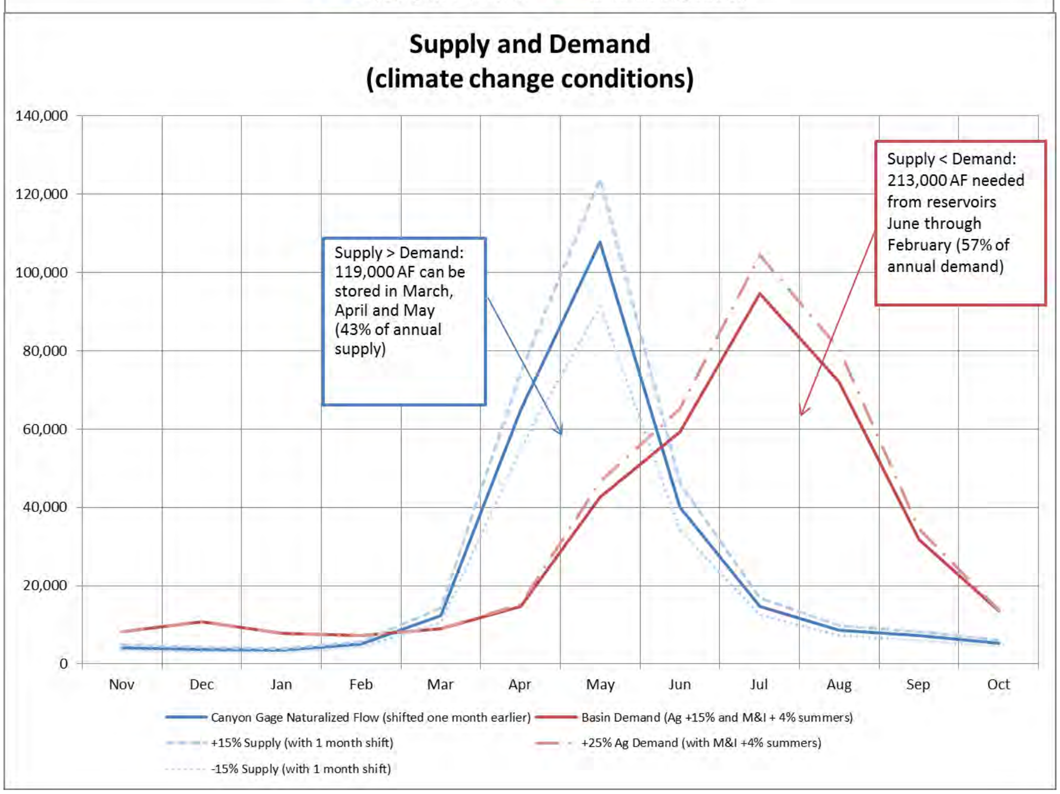


Figure 3-3. Monthly Supply and Demand under Non-climate Change Conditions and Potential Supply and Demand under Climate Change Conditions.

Table 3-1. Excess Supply, Demand and Deficit under Various Climate Change Scenarios.

	Supply Scenario	Demand Scenario	Supply > Demand (AFY)	Supply < Demand (AFY)	Deficit[1] (AFY)
2	Non-climate change	Non-climate change	86,000	129,000	43,000
2	1 month shift in runoff	15% increase in ag demands, 4% increase in summer M&I demands	119,000	213,000	94,000
	1 month shift, 15% increase in annual supply	15% increase in ag demands, 4% increase in summer M&I demands	146,000	199,000	53,000
	1 month shift, 15% decrease in annual supply	15% increase in ag demands, 4% increase in summer M&I demands	91,000	227,000	136,000
	1 month shift, 15% increase in annual supply	25% increase in ag demands, 4% increase in summer M&I demands	142,000	226,000	84,000
	1 month shift, 15% decrease in annual supply	25% increase in ag demands, 4% increase in summer M&I demands	86,000	254,000	168,000
	1 - deficit may be met by return flows and transbasin imports, or result in shortage				
	2 - scenarios shown with solid lines in Figure 3-3				

In addition to the intra-year changes in supply and demand shown in **Table 3-1** and **Figure 3-3**, droughts are expected to be longer and more frequent under climate change scenarios (see Section 2). This may produce several years of low supply and high demand (e.g. dashed demand line and lower dashed supply line in **Figure 3-3**) which would reduce storage levels throughout the basin more than under non-climate change scenarios. Under this type of prolonged drought condition, existing reservoirs that were designed to deliver a certain yield through a repeat of a historical drought (i.e. firm yield) may see this amount decline under climate change conditions with longer and more frequent droughts.

3.3.2 Specific Reaches and Water Rights

There is uncertainty surrounding the amount of annual flow under a climate change scenario. The projected changes of plus or minus 15 percent on average would have different long-term impacts to the basin. Long-term impacts of average increases in annual runoff volume would in general fill more reservoir storage, increase reservoir yields, and help maintain larger volumes of return flows and higher groundwater levels throughout the basin. Long-term impacts of decreases in annual runoff volume will have the opposite effect.

The natural year-to-year variability of streamflows in the Poudre Basin provide an opportunity to describe potential operations under climate change conditions. Because the long-term variation of plus or minus 15 percent runoff flow volume projected under climate change conditions is well within the range of normal year-to-year variability, the differences in operations between dry, average and wet years (without climate change) can be used to describe potential impacts to streamflow at specific locations and with respect to specific water rights, and flows. Evaluating operations in wet years under non-climate change conditions provides insight into portions of a climate change scenario with increased flows (e.g. long-term yields or seasonal distribution of water rights priorities). Similarly, evaluating operations in dry years under non-climate change conditions provides insight into portions of the climate change scenario with decreased flows.

The following sections describe the potential impacts to flows during different seasons and at different reaches in the basin due to a potential increase or decrease in annual flow, earlier onset of runoff, slightly higher winter flows due to precipitation falling as rainfall instead of snow in lower elevation portion of the basin, and elevated demands as shown by the solid lines in the climate change portion of **Figure 3-3**.

Winter Flows

Winter flows on the Poudre may be least likely to change under climate change scenarios. While winter flows may increase due to more precipitation falling as rainfall instead of snowfall, a large portion of the Poudre Basin headwaters is located above 8,200 feet, above which precipitation is anticipated to remain as snow (CWCB 2008). The Water District 3 Administration Memo (CDM et. al 2011) describes winter diversions and streamflows as being dominated by the filling of large plains reservoirs (Terry Lake via the Little Cache Ditch, Big Windsor via the Larimer and Weld Canal, and Timnath Reservoir via the Timnath inlet). Current administration allows these reservoirs to fill upstream to downstream in order to maximize the water available in the basin, even though the strict priority of the water rights does not follow upstream to downstream order. Under non-climate change conditions, there is a dry-up point at the diversion point for each of the reservoirs until they fill (or if they do not fill, until senior direct-flow water rights come into priority for direct irrigation in the spring). The lower reservoirs divert all return flows between the upstream reservoir headgate (and dry-up point) and its own diversion point. As the upstream reservoirs fill and no longer divert to storage, the full flow of the river is generally diverted at the next downstream reservoir.

All three of these reservoirs are involved in NISP operations and under the cumulative effects scenario, the reservoir filling will operate differently than under historical conditions. All three reservoirs will be used by NISP to exchange water from Galeton Reservoir to Glade Reservoir through a reservoir book-over. In essence, Galeton Reservoir makes releases to irrigated acreage historically served by these reservoirs in exchange for the ability to divert a like amount of water at Glade in the following year under the Terry, Big Windsor and Timnath water rights. Thus, when NISP is online, less water is physically diverted into and released from these three reservoirs than historically. The exchanged volume of water from the reservoir book-overs would be diverted at Glade Reservoir instead of at the reservoir headgates. However, the NISP proposed operation limits winter diversions to Glade by limiting NISP diversions at the Poudre Valley Canal if these diversions would reduce flow below 50 cfs at the Watson Lake minimum streamflow point and 30 cfs at the Boat Chute minimum streamflow point. NISP Alternative 2 (Applicant's Proposed Action) includes a 3,600 AF flow augmentation pool in Glade Reservoir to augment flows as necessary to maintain a flow of 10 cfs at the downstream side of the Larimer Weld Canal headgate from November 1 through April 30 and September 1 through September 30 (see Section 7.5.1 of the hydrology simulations report [CDM Smith et al. 2013]). CTP modeling (non-climate change) indicates that winter diversions into Terry, Big Windsor and Timnath Reservoirs still occur due to this constraint on diversions to NISP. Under climate change conditions, it is assumed that the minimum streamflow constraints would still apply to NISP, resulting in similar winter flows as non-climate change conditions.

An earlier onset to runoff and potentially higher levels of winter runoff (from rainfall) may fill these reservoirs more quickly than currently. However, Timnath currently does not generally fill until the rising limb of the hydrograph at the onset of runoff when flows increase significantly, so the diversions to Timnath and the associated dry-up would likely shift earlier in the year with the shifting runoff pattern since it is unlikely that the increased volume of winter flow would fill Timnath in the winter. A faster fill of Terry and Big Windsor would increase flows from the Little Cache headgate to the Timnath Inlet earlier in the winter than under non-climate change conditions. This reach would include increases in flow at the Lincoln Gage after Big Windsor fills.

Increased winter flows may allow for higher winter diversions to Glade, provided the minimum flow constraints are met. Under climate change conditions, with the runoff beginning earlier in the year, the diversions to NISP may occur earlier than under non-climate change conditions so that the reservoir book-over exchange described above can be accomplished when the reservoir water rights are in priority on the rising limb of the hydrograph, prior to direct flow rights coming into priority.

Direct-flow diversions for agriculture generally do not occur in the winter, but under climate change, may begin earlier (e.g. mid-March) and end later (e.g. mid-November) for alfalfa growers. The location of the diversions will depend on the location of the alfalfa growers and therefore the impact on streamflows is not possible to predict – farmers on ditches higher in the basin may reduce streamflows below their headgate, while farmers on ditches lower in the system may increase streamflows in many reaches above their headgate by calling for water lower in the basin than the historical winter water rights call.

Municipal direct diversions in the winter will likely be unaffected by climate change. Fort Collins and Greeley's direct flow rights (priority numbers 1, 5A, 6.5, 6B, 6C, 12B, 14B, 48) are some of the most senior water rights in the basin, particularly outside of the irrigation season. According to the Water District 3 Administration Memo (CDM et al. 2011), the Greeley intake is a dry-up point during the winter at times for a few days. Under climate change scenarios, this may occur less frequently if winter flows are higher due to precipitation as rain instead of snow, which may provide additional flow above Greeley's water right amount. In the cumulative effects model run, both Fort Collins and Greeley have the opportunity to release water stored in the enlarged Halligan and Seaman reservoirs and divert at their pipelines, but both entities have an incentive to use C-BT water during the winter in the absence of a C-BT carryover program (assumed for the cumulative impacts model run; see discussion of RFFAs in CDM et al. 2011) before using Halligan and Seaman water. Releases of water from Halligan and Seaman in the winter would increase flows from the reservoirs to the Greeley intake, decrease flows between the Fort Collins intake and the confluence with the North Fork, and have little to no impact on the rest of the river.

Irrigation Season Flows

Assessing flows during the irrigation season under climate change conditions is much more complex than winter flows. Flows during the irrigation season are governed by supply, demand, return flows, the location and priority of hundreds of individual water rights within the Poudre basin and on the South Platte, exchanges, water trades and reservoir releases. As shown in **Figure 3-3**, the runoff is anticipated to peak earlier under climate change, but demands are not anticipated to peak as early as runoff. This results in at least three predicted significant changes from non-climate change operations: 1) increase in diversions to reservoirs on the rising limb of the hydrograph; 2) reduced deliveries to direct-flow water rights on the rising limb (due to limited direct demand); and 3) reduced deliveries to direct-flow water rights and increased delivery from reservoirs during peak demand times (due to lower native water supply during peak demand months). In order to estimate possible impacts of the three major changes, an analysis was performed of diversions to storage, direct flow water use and releases from storage from the non-climate change cumulative impacts model run (CTP Run 5).

Increased Diversions to Storage on the Rising Limb of Hydrograph

Figure 3-4 shows the percent of the decreed storage volume that is diverted under individual storage water rights simulated in the Poudre Basin. In the figure, storage water rights are arranged from most senior (left) to most junior (right), with dry year yields in the top chart, average year yields in the middle chart, and wet year yields on the bottom chart. The figure shows that approximately the most senior third of storage water rights divert a similar amount of water in dry, average and wet years (approximately through Storage Priority 61 [PRIR61]). Under climate change conditions, the peak of the hydrograph is anticipated to occur before the rising limb of demands in both increased and decreased annual flow scenarios (see **Figure 3-3**). In dry years under climate change conditions, the increased water availability for storage during the rising limb of the hydrograph would likely be diverted under water rights in a similar manner as in average years under non-climate change conditions. Similarly, diversions to storage in average runoff years under climate change would operate similar to wet year storage patterns under non-climate change conditions. Wet years under climate change would likely increase the yield of the most junior storage water rights, relative to non-climate change conditions.

The changes to diversion amounts under these modified storage diversion patterns on the rising limb of the hydrograph would result in changes to streamflow in other parts of the basin. Streamflow on the rising limb of the hydrograph would be governed by the relationship between the priority and location of direct flow water rights as demand increases, and the location of the storage rights that would divert an increased amount of water under climate change conditions.

Examining **Figure 3-4**, in dry years under climate change conditions, it would be anticipated that the middle priority group (approximately Storage Priority 66 [PRIR66] to Storage Priority 136RR [PRIR136RR]) of storage water rights would be in priority more often than under non-climate change scenarios. Rights that stand out in this group as increasing in yield from the dry to average years are shown in **Table 3-2**, along with the reservoir they fill and point of diversion. The table shows that the majority of the increased diversions in dry years under climate change conditions would likely occur at mountain reservoirs, decreasing the streamflow at all downstream points during the rising limb of the hydrograph. With increased storage in the mountain reservoirs, late summer releases would increase relative to non-climate change conditions, thereby increasing streamflows below these reservoirs primarily to the municipal intakes. Terry Lake and Black Hollow also have large storage rights that would divert at the Little Cache Canal and Larimer County Canal, respectively. These headgates are relatively high in the basin, but are located downstream of the canyon mouth.

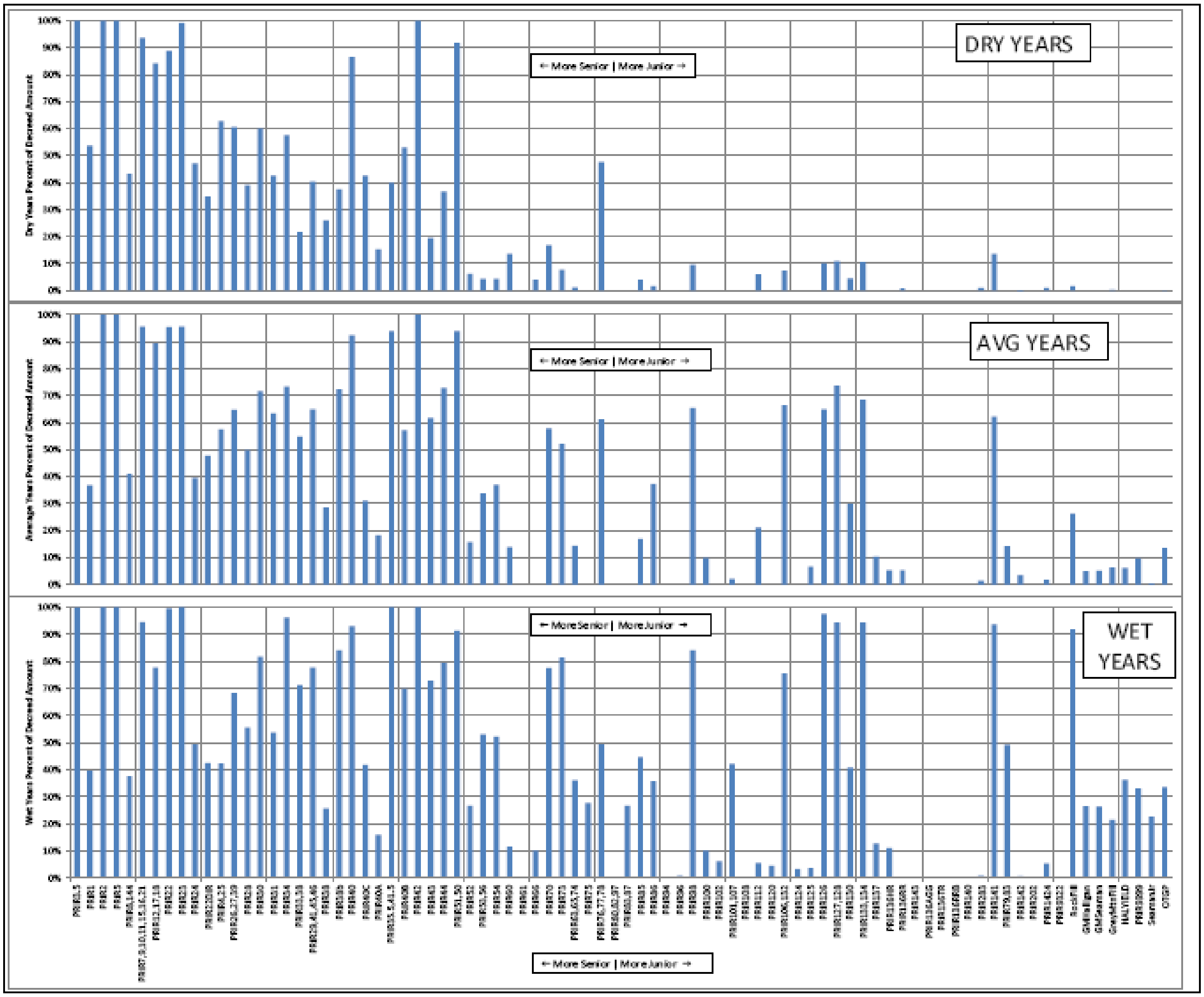


Figure 3-4. Relative Yield of Storage Water Rights in the Poudre Basin in Dry, Average and Wet Years.

Table 3-2. Water Rights in the CTP Model with Likely Increases in Diversions to Storage in Dry Years under Climate Change Conditions.

Storage Right	Reservoir (owner)	Point of Diversion	Decreed Amount (AFY)[1]
PRIR70	Joe Wright (Fort Collins)	Headwaters of Mainstem	797
PRIR73	Twin Lakes (Greeley)	Headwaters of Mainstem	278
PRIR85	Terry Lake (Larimer and Weld)	Little Cache Headgate	1,936
PRIR86	Black Hollow (WSSC)	Larimer County Canal (WSSC)	5,397
PRIR98	Worster (Tri-Districts)	Headwaters of North Fork	1,543
PRIR106,132	Chambers (WSSC)	Headwaters of Mainstem	6,338
PRIR126	Barnes (Greeley)	Headwaters of Mainstem	1,697
PRIR127,128	Peterson (Greeley)	Headwaters of Mainstem	1,183
PRIR133,134	Greeley Mountain (Greeley)	Headwaters of Mainstem	2,629

[1] CTP model input annual limits, based on Water District 3 Water Rights Listing

By similarly examining **Figure 3-4** for differences between average and wet years under non-climate change conditions, it can be seen that the conditional water rights see an increase in yield. The yields on the most senior group of water rights and the middle group of water rights do not change significantly from average to wet years. The conditional rights that see the largest yield increases during wet years include rights associated with the NISP and HSWSPs proposed projects (Rockwell Reservoir [Rockfill], the Grey Mountain right [GMHalligan, GMSeaman, GreyMtnFill, the Halligan and Seaman enlargement rights [HALYIELD, SeamanJr] and the Overland Trail Gravel Pits [OTGP]). Due to the increased availability of water on the rising limb of the hydrograph under climate change scenarios, diversions to these rights would be expected to increase in average years, and increase even more in wet years even with increased early season increases to demands under climate change conditions. The points of diversion for these water rights are relatively high in the basin (all except the Overland Trail Gravel Pits are located upstream of the Canyon Mouth). Increased volume and frequency of diversions to this junior group of water rights would result in lower flows downstream of the Canyon Mouth until the water is released from storage. Releases for these water rights are primarily to the municipal intakes of Fort Collins and Greeley.[3, 4]

[3] The Reclamation Contract Option and the No Contract Option under under the Glade alternative for NISP vary in how water is to be delivered from Glade Reservoir to NISP participants, but in general rely on a direct pipeline connection or exchange through the Hansen Supply Canal. The Glade outlet to the Poudre River is expected to be located at the same location as the Hansen Supply Canal on the opposite bank of the Poudre to facilitate this exchange and execution of the exchange would therefore not contribute to nor deplete Poudre River flows.

[4] Different HSWSPs alternatives involve diversion of flows at the Overland Trail Gravel Pits or other locations downstream of the current intakes. Diversions to and releases from reservoirs other than the proposed projects, and/or transfer of the conditional storage rights to other locations may enhance flows below the Canyon Mouth.

Peak Runoff and Late Irrigation Season Flows:

Figure 3-3 shows the increasing offset of supply and demand under climate change conditions relative to non-climate change conditions. Under non-climate change conditions, the hydrograph drops sharply in July and August, and remains low for September and October. Demands reach their peak in July, begin to subside in August and then drop sharply in September and October. Under non-climate change conditions, demand exceeds native supply from July through October and native supply meets approximately 25 percent of the demand over those months. The remaining demand is met in part by return flows, groundwater pumping, and reservoir releases (including transbasin supply). Under climate change, demand exceeds native supply from June through October and the native supply is approximately 19 percent of the demand over those months.

Other than the shift to an earlier peak runoff, streamflows in the late irrigation season would be similar under climate change conditions because the native supply is simply not sufficient to meet all demands. Under climate change conditions, water users would likely experience a longer period of low flow, but similar in nature and water rights administration to non-climate change flows following the peak of the hydrograph. The Water District 3 memo describes dry-up points at the Larimer and Weld Canal through August and September as well as occasional dry-ups at lower ditches (Fossil Creek Reservoir Inlet Canal, Greeley No. 3 and Ogilvy). The dry-up location would likely continue under climate change conditions because the seniority of the water rights would apply to a similar volume of native supply, but the dry-up would likely begin earlier in the year. Under climate change conditions, groundwater users may shift pumping relative to non-climate change conditions to meet crop demands during critical growth stages that may occur at times when surface water was historically available. Similarly, reservoirs may release earlier in the year to help meet demand in excess of native supply beginning in June and July. Reservoir releases for agricultural use are made in large part from off-channel reservoirs and would not increase streamflows. Delivery of C-BT water to agricultural users would continue to enhance streamflow from the Hansen Supply Canal to the receiving headgates as it does under non-climate change conditions.

Many of the municipal direct flow water rights are very senior and would likely not be affected by climate change conditions, and would be able to divert in a similar pattern as the non-climate change conditions. However, as described above, streamflows may be enhanced under climate change conditions from mountain reservoirs to municipal intakes in the summer due to increased diversions to storage earlier in the year and need for additional water as demands increase through the summer. The M&I providers also rely on the transfer of agricultural water rights and the ability to exchange the water from the original agricultural headgate upstream to its intake. The exchange potential in the late summer under non-climate change conditions is a limiting factor, and this limitation would apply to an additional month under climate change conditions once the peak of the hydrograph subsides. This would incentivize M&I providers to exchange water as early as possible during the runoff to any available upstream storage facilities. M&I providers with limited storage facilities may see diminished usable yields from transferred water rights (due to lack of demand for water when exchange potential exists) under climate change conditions. M&I usable yields of agricultural water may be further restricted by monthly limits in change of use decrees decreed prior to the onset of the effects of climate change on the native runoff pattern, as described further below.

3.3.3 Water Rights Transfers

The HSWSPs preliminary alternatives report (CDM Smith et al. 2013, Appendix D) indicates that nearly 50% of the farm deliveries from agricultural ditches in the Poudre Basin may be transferred to municipal use in the future. An analysis of impacts to these transfers under climate change conditions presents some uncertainty. It is common practice in water court change of use cases to limit the new use (municipal) to the historical (agricultural) diversion pattern, often by placing monthly limits on the amount of water that can be diverted. This practice ensures that the new use does not expand the historical use of the agricultural water right and thereby protects other vested water rights in the basin. For example, Fort Collins' changed South Side Ditch (SSD) water rights (case 92CW129) places different limits on the use of SSD water by Fort Collins for each month, based on the historical use pattern of the agricultural water rights.

Many older agricultural water rights do not have specific start and end dates in the decree and therefore could come into and out of priority earlier in the year with an earlier runoff under climate change conditions, provided there was sufficient agricultural demand for the water at that time. However, once transferred, water rights with monthly limitations in the transfer decree may lose that flexibility and the ability to divert earlier in the season under an earlier runoff scenario.

3.4 Evaporation in the Poudre Basin

The cumulative effects model run (CTP Run 5) simulates evaporation at several of the reservoirs located in the Poudre Basin including the proposed Glade and Galeton Reservoirs (NISP Applicant's preferred alternative), and the enlarged Halligan and Seaman Reservoirs (HSWSPs Applicants' proposed projects). The total simulated storage capacity for existing Poudre Basin plains reservoirs and the new reservoirs proposed under the Applicants' preferred alternatives is 464,500 AF. Evaporation from the plains reservoirs (including Glade and Galeton) and the enlarged Halligan and Seaman Reservoirs totals approximately 23,000 AFY. Using the simplified method of applying eastern Colorado's current evaporation rates to the Poudre Basin to simulate evaporation rates under climate change scenarios, total evaporation would increase to approximately 29,000 AFY assuming no change in precipitation and negligible differences in reservoir contents.

Table 3-3 shows the average monthly evaporation rate used in the CTP modeling for plains reservoirs, and the assumed increases under climate change conditions by applying eastern Colorado rates to the Poudre Basin for climate change conditions. The evaporation rate is slightly lower for reservoirs closer to the foothills and slightly higher for reservoirs in the easternmost part of the study area. The monthly distribution of evaporation is based on guidelines provided by the State Engineer's Office (SEO). The free water surface evaporation (FWSE) is based on the NOAA evaporation maps (Farnsworth et al. 1982). **Table 3-4** shows the evaporation for each simulated reservoir. Note that evaporation at mountain reservoirs is not charged against a reservoir's water right under current administration (see Water District 3 Administration memo, CDM Smith et al. 2011) and is therefore zero. For the purposes of this report, it is assumed that mountain reservoir evaporation under climate change conditions will not significantly increase due to the lower evaporation rates in the mountains. Also, evaporation from C-BT facilities are not included in the evaporation totals presented in this section since the CTP treats C-BT supply as a model input and does not directly simulate C-BT operations.

Table 3-3. Evaporation Rates for Most Plains Reservoirs Simulated in the CTP Modeling and Climate Change Conditions Estimated Net Evaporation Rate.

Month	SEO[1] Guidelines Distribution	FWSE[2] (inches)	1950 to 2007 CSU Gage Precipitation (inches)	Effective Precipitation[3] (inches)	Net Evaporation[4] (inches)	Climate Change Conditions Increase 25% Net Evaporation (inches)
Jan	3.0%	1.20	0.42	0.29	0.00	0.00
Feb	3.5%	1.40	0.40	0.28	0.00	0.00
Mar	5.5%	2.20	1.33	0.93	1.27	1.59
Apr	9.0%	3.60	1.86	1.30	2.30	2.87
May	12.0%	4.80	2.66	1.86	2.94	3.68
Jun	14.5%	5.80	1.93	1.35	4.45	5.56
Jul	15.0%	6.00	1.58	1.11	4.89	6.12
Aug	13.5%	5.40	1.53	1.07	4.33	5.41
Sep	10.0%	4.00	1.25	0.88	3.12	3.90
Oct	7.0%	2.80	1.08	0.75	2.05	2.56
Nov	4.0%	1.60	0.70	0.49	1.11	1.38
Dec	3.0%	1.20	0.46	0.32	0.00	0.00
TOTAL	**100.0%**	**40.00**	**15.20**	**10.64**	**26.46**	**33.07**

[1] SEO = State Engineer's Office

[2] FWSE = free water surface evaporation (Farnsworth et al. 1982)

[3] Effective precipitation is 70 percent of gaged precipitation per SEO guidelines on reservoir administration

[4] Net evaporation = FWSE minus effective precipitation

Table 3-4. Capacity and Evaporation at Simulated Reservoirs in the CTP and Estimate of Evaporation under Climate Change Conditions.

Reservoirs	Simulated Capacity (AF)	Simulated Average Annual Evaporation CTP Run 5 (AF)	Climate Change Conditions Estimated Average Annual Evaporation CTP Run 5 (AF)
Upper NPIC Reservoirs	10,787	962	1,202
Mid NPIC Reservoirs	9,532	783	978
Low NPIC Reservoirs	11,197	1,508	1,885
Upper WSSC Plains Reservoirs	7,950	954	1,192
Larimer and Weld Plains Reservoirs	35,000	3,989	4,987
Black Hollow Reservoir	6,000	599	749
Lower WSSC Plains Reservoirs	4,708	477	597
Terry Lake	7,530	832	1,041
Big Windsor Reservoir	16,423	1,443	1,803
Woods Reservoirs	3,106	295	368
Gray Reservoir	1,140	107	133
Timnath Reservoir	10,070	803	1,003
Fossil Creek Reservoir	11,100	1,259	1,574
Windsor Lake	1,070	146	183
Seeley Reservoir	1,069	164	205
Galeton Reservoir (proposed)	45,624	3,972	4,965
Claymore Reservoir	938	124	155
Warren Reservoir	2,228	280	350
Glade Reservoir (proposed)	170,000	2,702	3,378
Worster Reservoir	3,750	0	0
Joe Wright Reservoir	6,474	0	0
Chambers Lake	8,600	0	0
Barnes Meadow Reservoir	2,349	0	0
Long Draw Reservoir	10,519	0	0
Comanche and Hourglass Reservoirs	4,322	0	0
Twin Lakes Reservoir	460	0	0
Halligan (Fort Collins Enlargement)	8,125	317	396
Seaman Reservoir (enlarged)	53,000	1,339	1,673
Halligan (NPIC Enlargement)	5,000	0	0
Halligan (existing)	6,428	0	0
Total	**464,499**	**23,219**	**29,024**

Figure 3-5 shows the average monthly evaporation volume for all reservoirs simulated in the CTP Run 5, and estimated climate change evaporation volume when the evaporation rate is increased by 25 percent. The evaporation volume depends on the surface area of the reservoir at various times of year. As described in Section 3.3, the shift to earlier runoff will result in higher reservoir volumes earlier in the year (April and May). Under climate change conditions, the demand for supplemental reservoir releases would come earlier than non-climate change conditions, and storage levels could be lower through June, July and August if reservoir releases are made earlier in the year. When compared against non-climate change conditions, this could have the effect of decreasing reservoir surface area in higher evaporation rate months (June, July and August). This shift in reservoir storage patterns would partially offset the 25 percent increase in evaporation volume estimate shown in **Table 3-3** and **Figure 3-5**.

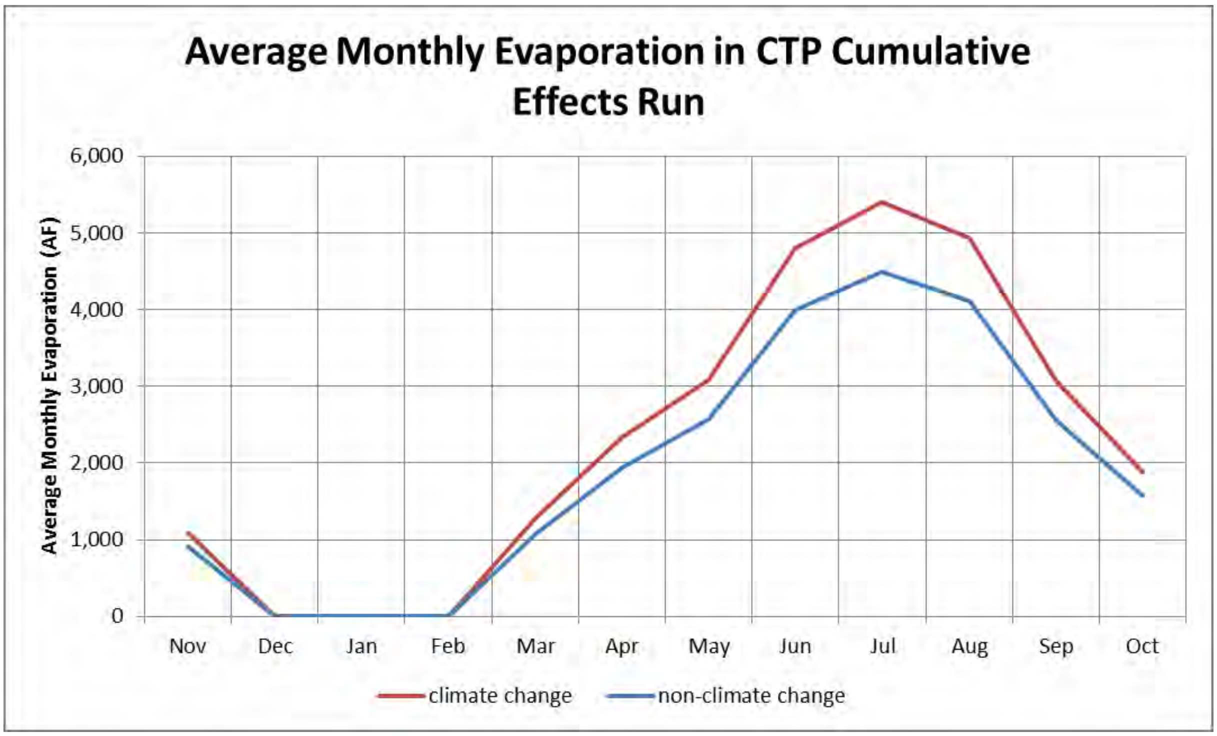


Figure 3-5. Average Monthly Evaporation.

3.5 Conclusions Specific to the Poudre Basin

The hydrology of the Poudre River is anticipated to change under climate change conditions. The predicted changes to flows at any given point are a result of a combination of changes in runoff volume and timing (water supply), increased demands due to temperature increases (both agricultural and M&I), the complex interaction of water rights administration with the changing water supply and demand scenarios, and changes in evaporation at reservoirs. Changes to native streamflow of the Poudre Basin were made based on quantitative information produced in other studies specific to the Poudre Basin (JFRCCVS 2011) and the neighboring Boulder Creek Basin (McCurry 2000 and Stratus 2009). Changes to temperature were based on quantitative and qualitative information from a variety of sources and were applied to the Poudre Basin agricultural and urban outdoor water use demands. Based on these changes to the water supply and demands, the potential impacts to water rights and streamflows were qualitatively described. The impacts descriptions include uncertainties inherent in climate change projections. The following are key points associated with each of these components

Changes to Streamflow Runoff Timing and Volume

- Changes to native streamflow runoff and timing area based on previous quantitative analyses (JFRCCVS, Stratus 2009 and McCurry 2000)
- Native flow may increase or decrease by 15 percent annually
- The most significant changes to the naturalized flows from a volumetric standpoint are in April (significant increase in runoff) and June (significant reduction in runoff). See Figure 3-1.
- There will be an earlier onset of runoff as shown by the earlier rising limb of the hydrograph in Figures 3-1 and 3-3.
- Naturalized flow is less in the summer months of July, August and September under climate change. See Figure 3-1.
- Winter flows may increase moderately due to a shift in winter snowfall to rainfall, but much of the Poudre Basin headwaters area is above 8,200 feet in elevation, above which winter precipitation is anticipated to remain primarily snowfall.

Changes to Demand

- Changes to demand are based on the application of projected temperature increases from a wide variety of quantitative and qualitative sources of information.
- Current cropping patterns coupled with increases in temperature would result in an increase of irrigation water requirements per acre of crops by 15 to 25 percent under climate change scenarios (Figure 3-2).
- Alfalfa would have a longer growing season, beginning in March, and extending into November compared to the historical growing season of April through October (Figure 3-2).

Changes to Diversion Patterns and Streamflows

- Projections of changes to diversion patterns and streamflows at specific locations are difficult due to changing water supply, demand, water rights administration, future transfers of water to M&I use and other operational constraints.

- Changes to diversions and streamflows were developed qualitatively based on the estimated changes to native water supply and water demands and include uncertainties inherent in climate change projections
- A basin-wide analysis of water supply compared to demand shows
  - Under non-climate change conditions, water supply exceeds demand in May and June, and is lower than demand in July through April (Figure 3-3, top portion)
  - Under climate change conditions, water supply exceeds demand in April and May, and is lower than demand in June through February. Supply and demand are approximately equal in March. (Figure 3-3, bottom portion)
  - Under climate change scenarios, the amount of storable water is larger than under non-climate change conditions. Existing storage facilities may not have the capacity to store this amount of water. (Figure 3-3, bottom portion).
  - The average annual water deficit (demands greater than native supply) increases from 43,000 AFY under non-climate change conditions to between 53,000 AFY and 168,000 AFY (Table 3-1).
- Analysis of specific reaches based on season and water rights administration suggests
  - Little change in winter flows due to minimum flow constraints on NISP diversions and seniority of Timnath, Terry and Big Windsor Reservoirs during the winter months and the Fort Collins and Greeley senior direct flow water rights diverted at their respective pipelines.
  - Changes to the timing of the runoff and demands are expected to result in:
    - Increased diversions to storage (increased available water for storage rights)
    - Decreased diversions to direct-flow water rights (demand limited)
    - Decreased diversions to direct-flow water rights during peak demand (supply limited)
    - Increased deliveries from reservoirs during peak demand (due to reduction in direct-flow supply).
  - Changes in water supply due to climate change will likely increase diversions at mountain reservoirs in dry years (Figure 3-4 and Table 3-2) due to the increased availability of water on the rising limb of the hydrograph and relative seniority of the water rights at these reservoirs.
  - Flows downstream of mountain reservoirs will be reduced on the rising limb of the hydrograph, and increased later in the year due to increased deliveries to primarily M&I reservoir owner intakes.
  - Yields of conditional and junior water rights will likely increase in average and wet years (Figure 3-4) via diversions during the earlier runoff before direct flow demands commence. This will have the effect of reducing flows at most points in the basin below the Canyon Mouth during the peak flow, which is predicted to occur earlier.
  - Streamflows in the late irrigation season will likely not change significantly under climate change conditions
    - Low-flow period will be longer, beginning in June instead of July or August

        - Seniority of water rights at dry-up locations will not change and will likely result in administration similar to current late-season irrigation
        - Reservoir releases will occur earlier, but many of the agricultural reservoirs are off-channel, release directly to ditches and would have no impact to streamflows
        - Use of groundwater may shift to better accommodate crop demands and could shift return flow patterns slightly.
    - An additional month of lower flows during the later irrigation season may result in municipal providers exchanging transferred water rights to upstream storage facilities earlier in the year when exchange potential exists. These exchanges may be further limited by available storage capacity.
    - Municipalities without sufficient storage may see decreases in usable yields of transferred water rights due to a combination of lack of demand or storage capacity when water rights are in priority and when exchange potential exists during the rising limb and peak of the hydrograph.
    - There are additional uncertainties associated with transfers of water rights that specify specific start and end dates for diversions, or monthly limits to the transfer to M&I use if the hydrology shifts and the decreed amount of water is no longer available under climate change conditions.
- Under climate change conditions, evaporation rates will likely increase due to temperature increases. The climate of the Colorado eastern plains is anticipated to migrate towards the Poudre Basin in the coming decades. The evaporation rate on the eastern plains is currently 25 percent higher than in the Poudre Basin, and this 25 percent increase was applied to Poudre Basin reservoirs to estimate evaporation under climate change conditions.
    - Average annual evaporation volume from basin reservoirs would increase from 23,000 AFY to 29,000 AFY assuming similar precipitation and end-of-month contents as under non-climate change scenarios.
    - Changes in diversion patterns may draw reservoirs down earlier in the year to meet earlier irrigation deficits. This may result in less reservoir surface area during high evaporation months, thereby partially offsetting the increase in evaporation rate.

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**Denotes inclusion in Appendix A*

Appendix A

Selected References Specific to Climate Change on the Front Range of Colorado

Water Research Foundation. 2012. Joint Front Range Climate Change Vulnerability Study. Tailored collaboration with Denver Water, Colorado Springs Utilities, Boulder Department of Public Works, City of Aurora Utilities, Fort Collins Utilities, and the Northern Colorado Water Conservancy District.

McCurry Hydrology. 2011. Memorandum "Summary of information on climate change effects on the Front Range, Colorado." November 9.

Stratus Consulting. 2009. The Potential Consequences of Climate Change for Boulder Colorado's Water Supplies. Prepared for NOAA Climate Program Office.

Due to 2012 Copyright, the following report is excluded from inclusion in Appendix A:

- Water Research Foundation. 2012. Joint Front Range Climate Change Vulnerability Study. Tailored Collaboration with Denver Water, Colorado Springs Utilities, Boulder Department of Public Works, City of Aurora Utilities, Fort Collins Utilities, and the Northern Colorado Water Conservancy District.

Memorandum

To: Matt Bliss, Hydros Consulting; Dale Strickland and Gretchen Norman, WEST
From: Gordon McCurry, Ph.D., McCurry Hydrology
Date: November 9, 2011
RE: Summary of information on climate change effects on the Front Range, Colorado

The following provides a summary of available studies that deal specifically with climate change on the Front Range of Colorado and its effects on the following hydrologic aspects:

- Changes in the timing and amount of natural streamflow,
- Changes in ET demand for typical crops grown in the region and for urban landscaping,
- Changes to reservoir and lake evaporation
- Other potentially relevant findings.

The information provided in this memorandum focuses on the northern Front Range and northeast Colorado.

1. Changes in timing and amount of runoff

The average monthly flow in Boulder Creek, located in Boulder County, Colorado, was computed for historic conditions and for the estimated mid-range climate conditions in the years 2020 and 2050. The historic conditions, noted as the 'Base' flows on Table 1, are the simulated average monthly inflows at the Orodell stream gage (USGS gage 06727000) for the 1950-1990 period. The gaged flows were naturalized by removing the affects by upstream reservoir storage and stream diversions based on City of Boulder reservoir storage data and Colorado DWR diversion records (McCurry, 2000).

The water balance model WatBal (Yates, 1996) was used to compute naturalized monthly flows for historic (1950-1990), 2020 and 2050 flows. WatBal uses temperature, precipitation and soil inputs to determine snow accumulation, snowmelt, evapotranspiration (ET), runoff and infiltration. The model was calibrated to average monthly historic flows at the Orodell gage. It was then used to predict flows at the Orodell gage using climate forcings from three global climate-land-water General Circulation Models (GCMs). The GCM models showed similar results for change in monthly temperature. Tables 1 and 2 show the naturalized monthly flows for the Geophysical Fluid Dynamics Lab (GFDL), MPI and HC models for climate forcings estimated for 2020 and 2050, respectively. The Max Planck Institute (MPI) and Hadley Center (HC) models represent the end-member precipitation results and were used in further analyses (McCurry, 2000).

Table 1 Naturalized Monthly Flow in Boulder Creek, Year 2020

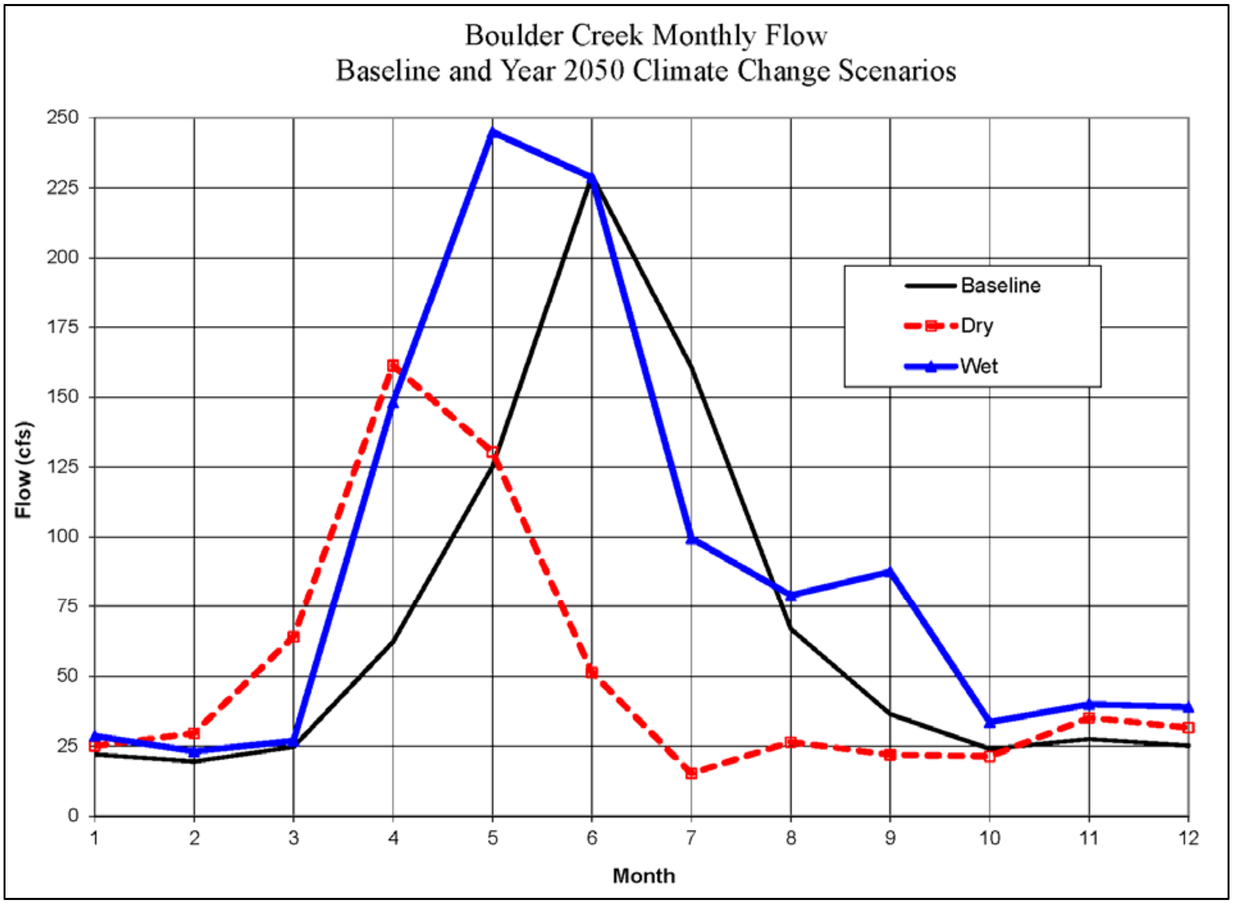
Month	**Year 2020 Flows (cfs)**			
	BASE	GFDL	MPI (dry)	HC (wet)
Jan	21.99	22.84	23.03	23.57
Feb	19.43	19.88	19.92	20.28
Mar	24.66	30.27	32.77	25.19
Apr	62.23	146.60	106.12	102.15
May	125.18	230.45	123.85	184.24
Jun	229.27	176.36	98.82	221.13
Jul	160.56	90.45	31.25	54.72
Aug	66.80	48.81	17.66	72.76
Sep	36.36	15.09	17.27	32.68
Oct	23.97	22.37	24.30	25.43
Nov	27.47	31.38	32.90	34.68
Dec	25.07	26.70	27.19	28.05
Avg	68.58	71.77	46.26	68.74

Table 2 Naturalized Monthly Flow in Boulder Creek, Year 2050

Month	**Year 2050 Flows** (cfs)			
	BASE	GFDL	MPI (dry)	HC (wet)
Jan	21.99	24.09	25.04	28.62
Feb	19.43	20.62	29.55	23.12
Mar	24.66	42.22	64.07	26.89
Apr	62.23	229.63	161.27	148.03
May	125.18	242.12	130.31	244.91
Jun	229.27	159.08	51.24	228.53
Jul	160.56	50.20	15.22	99.40
Aug	66.80	46.05	26.44	78.95
Sep	36.36	30.57	21.90	87.44
Oct	23.97	24.70	21.31	33.52
Nov	27.47	37.76	35.07	39.90
Dec	25.07	29.18	31.54	38.96
Avg	68.58	78.02	51.08	89.86

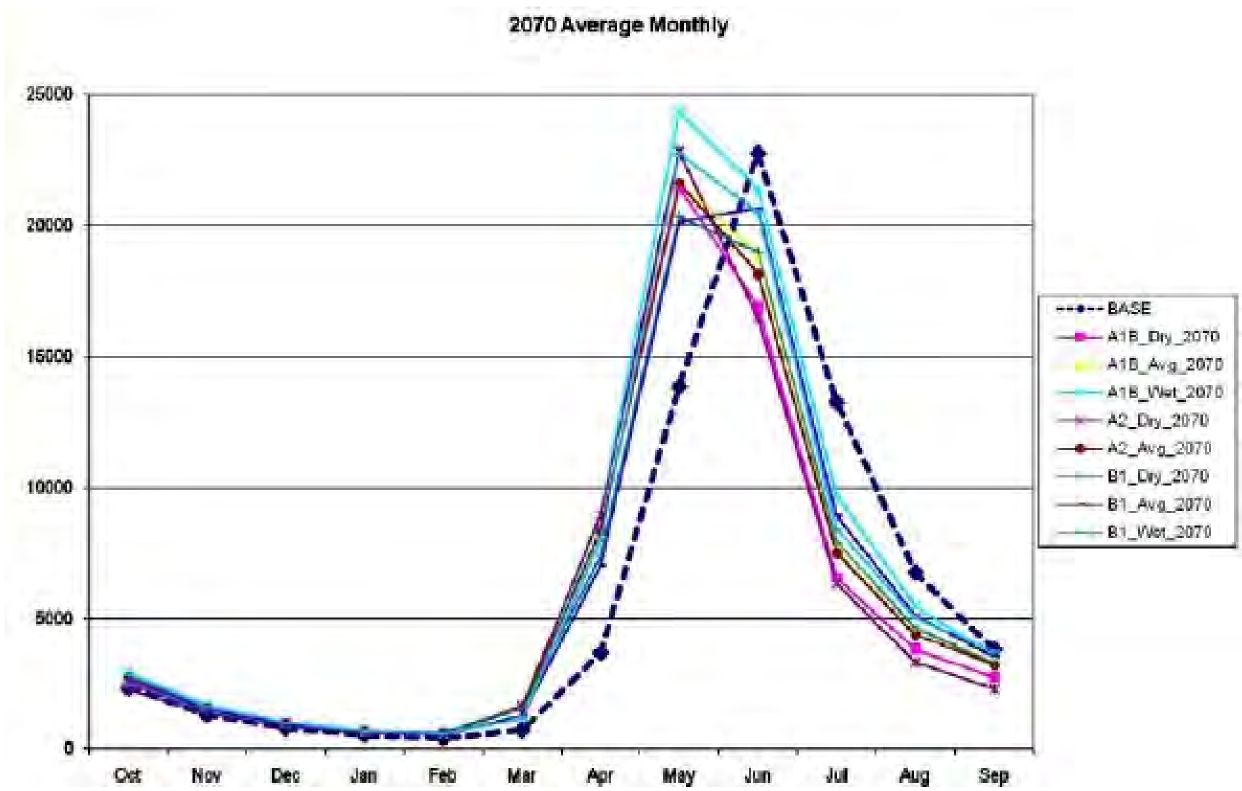
Average monthly flows in Boulder Creek are shown in Figure 1 for the 2050 climate scenario for the wet and dry end-member GCM scenarios (McCurry, 2000). When compared to the baseline flows (Figure 1) there is a 1 to 2 month shift toward earlier flows associated with peak snowmelt runoff compared to the historic pattern. Depending on the GCM scenario, there is also a change in total flows, ranging from 75 to 131 percent of the historic flows. For the dry (MPI) GCM results, peak flows are 70 percent of historic flows (Figure 1).

Figure 1 Boulder Creek Monthly Flow for Baseline and 2050 Scenarios



A more recent study has been undertaken of climate change impacts on Boulder Creek flows (Boles, 2010). Using more recent GCM results the study examined the City of Boulder's water supply under climate change in 2070. This study used a range of GCM emissions scenarios and a distributed-parameter hydrologic model. Stream flows computed for Boulder Creek are shown in Figure 2. As indicated in Figure 2, the GCM models continue to predict a 1-2 month shift earlier in peak discharge. However, the range in peak flows is approximately +/- 10 percent, smaller than those shown by McCurry (2000).

Figure 2 Boulder Creek Monthly Flows, Year 2070



2. Changes in ET

Evapotranspiration is also expected to change under a climate-impacted future. Alfalfa, corn and bluegrass are grown extensively in the plains portions of the northern Front Range and were selected for analysis.

Tables 3 and 4 show the projected potential ET (PET) for alfalfa and corn, respectively, in eastern Boulder County in the year 2050, for the historic (Base), and dry (MPI model), and wet (HC model) end-member GCM models described in the previous section (McCurry, 2000). These were calculated using WatBal (Yates, 1996) which employs an approximation of the Priestley-Taylor equation to estimate PET. WatBal first calibrated to historic ('Base'; 1950-1990) average monthly ET values to calculating the climate change-based values. Shown at the bottom of Tables 3 and 4 are the total ET and the percent increase in ET compared to baseline conditions in annual and growing season months for each GCM scenario. Alfalfa, a perennial crop, is limited in its growth and ET only by the length of frost-free days. Due to warmer temperatures under both GCM end-member scenarios the ET for alfalfa increases 15 to 32 percent on an annual basis by 2050. During the primary growing season months of April through September the ET for alfalfa increases 9 to 15 percent by 2050 compared to historic conditions.

In contrast, the growing season for corn in Boulder County generally is limited to the April to August period. Assuming no new cultivars are grown, the increase in ET for corn will range from 5 to 8 percent by 2050 under the range of GCM scenarios compared to historic conditions.

Table 3 Calculated ET Data for Alfalfa, Year 2050, Eastern Boulder County (mm/day)

Month	BASE	MPI (dry)	HC (wet)
Jan	0.17	0.45	0.24
Feb	0.43	1.59	0.88
Mar	1.48	4.15	1.76
Apr	3.16	4.34	2.99
May	4.11	4.49	4.39
Jun	5.20	5.67	5.43
Jul	5.24	6.33	6.36
Aug	4.73	5.29	5.53
Sep	3.66	3.91	3.83
Oct	2.24	2.49	2.35
Nov	0.77	2.14	1.61
Dec	0.21	0.52	0.59
total (mm)	954.6	1258.3	1093.7
Total (in)	37.6	49.5	43.1
Relative Change	---	31.8%	14.6%
Apr-Sep (mm)	782.7	900.8	856.0
Relative Change	1	15.1%	9.4%

Table 4 Calculated ET Data for Corn, Year 2050, Eastern Boulder County (mm/day)

Month	BASE	MPI (dry)	HC (wet)
Jan	0	0	0
Feb	0	0	0
Mar	0	0	0
Apr	0.81	1.14	0.79
May	2.83	3.54	3.46
Jun	5.17	5.67	5.43
Jul	5.22	5.95	5.98
Aug	3.11	2.23	2.33
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
total (mm)	521.7	563.4	547.0
Total (in)	20.5	22.2	21.5
Relative Change	---	8.0%	4.9%
Apr-Aug (mm)	514.6	555.7	539.5
Relative Change	---	8.0%	4.9%

A more recent study was conducted to assess the effects of climate change on municipal water demands throughout Colorado (McCurry, 2008). Monthly temperature data averaged from 39 GCMs that employed the A1B (midrange) emissions scenario were compiled for current (year 2000) and future (2030 and 2050) time periods for selected cities in each major watershed. Cities selected in the Front Range region included Denver, Ft. Collins, Greeley and Limon. Predicted precipitation varies widely amongst the GCMs for a given location and ranges from slight increases to slight decreases. Based on these results it was assumed that there would be no change in precipitation. Monthly GCM temperature data from an 11-year period centered on the target years was used to represent changes in ET for each target location.

The study assumed that any change in per capita demands would be due to changes in outdoor watering (McCurry, 2008). Bluegrass and alfalfa were selected as being representative of outdoor municipal landscaping and all ET estimates were based on these grasses. A modified Blaney-Criddle equation was used to compute ET, including elevation adjustments for cities above 4,429 ft above sea level (McCurry, 2008). The ET for bluegrass was assumed to be zero when the average monthly temperature was below freezing.

Tables 5 and 6 show the monthly and annual total ET for bluegrass and alfalfa, respectively, in the years 2000, 2030 and 2050 for selected Front Range locations. Also shown is the annual percent change in ET compared to year 2000 for each location. The increases in bluegrass ET are about 4.4 percent in 2030 and approximately 7.7 percent in 2050 compared to the year 2000. The increases in alfalfa ET are about 9 to 10 percent in 2030 and approximately 15 to 17 percent in 2050 compared to the year 2000.

Table 5 ET for Bluegrass in Years 2000, 2030 and 2050 (in/month)

	Denver			Ft Collins			Greeley			Limon		
Month	2000	2030	2050	2000	2030	2050	2000	2030	2050	2000	2030	2050
Jan	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	0	0	0	0
Apr	3.52	3.65	3.76	3.45	3.57	3.68	3.50	3.62	3.73	3.27	3.40	3.50
May	5.07	5.29	5.47	4.96	5.17	5.35	5.08	5.29	5.46	4.78	4.98	5.16
Jun	6.81	7.09	7.31	6.62	6.89	7.10	6.80	7.08	7.28	6.50	6.76	6.96
Jul	7.31	7.61	7.81	7.08	7.39	7.58	7.28	7.58	7.78	7.00	7.29	7.48
Aug	6.10	6.40	6.58	5.87	6.17	6.35	6.02	6.32	6.50	5.83	6.13	6.30
Sep	4.55	4.77	4.93	4.35	4.56	4.73	4.44	4.65	4.81	4.35	4.55	4.71
Oct	3.04	3.20	3.33	2.88	3.03	3.16	2.90	3.05	3.18	2.84	2.99	3.12
Nov	0	0	0	0	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	0	0	0
Total	36.39	38.01	39.21	35.21	36.78	37.95	36.02	37.58	38.75	34.56	36.09	37.24
Change:	**---**	**4.4%**	**7.7%**	**---**	**4.5%**	**7.8%**	**---**	**4.4%**	**7.6%**	**---**	**4.4%**	**7.8%**

Table 6 ET for Alfalfa in Years 2000, 2030 and 2050 (in/month)

	Denver			Ft Collins			Greeley			Limon		
Month	2000	2030	2050	2000	2030	2050	2000	2030	2050	2000	2030	2050
Jan	0.34	0.38	0.43	0	0	0.33	0	0	0	0	0	0
Feb	0.53	0.59	0.67	0.44	0.50	0.57	0.42	0.48	0.55	0	0.40	0.45
Mar	1.12	1.23	1.33	1.02	1.12	1.22	1.07	1.17	1.27	0.83	0.92	1.01
Apr	2.29	2.48	2.64	2.23	2.40	2.56	2.35	2.52	2.69	1.94	2.12	2.26
May	4.48	4.87	5.22	4.35	4.72	5.04	4.63	5.01	5.34	3.97	4.32	4.64
Jun	6.89	7.45	7.87	6.59	7.11	7.51	7.03	7.57	7.98	6.31	6.80	7.18
Jul	8.17	8.80	9.23	7.77	8.40	8.81	8.28	8.92	9.35	7.55	8.13	8.52
Aug	6.85	7.49	7.88	6.44	7.07	7.45	6.83	7.47	7.87	6.30	6.90	7.27
Sep	4.15	4.54	4.84	3.86	4.23	4.52	4.08	4.46	4.76	3.78	4.13	4.41
Oct	2.18	2.41	2.62	1.98	2.20	2.40	2.04	2.26	2.47	1.86	2.07	2.27
Nov	0.81	0.89	0.98	0.69	0.76	0.84	0.66	0.73	0.81	0.59	0.66	0.75
Dec	0.36	0.41	0.47	0	0.32	0.37	0	0	0.32	0	0	0
Total	38.17	41.52	44.17	35.35	38.82	41.63	37.39	40.60	43.41	33.13	36.46	38.78
Change:	**---**	**8.8%**	**15.7%**	**---**	**9.8%**	**17.8%**	**---**	**8.6%**	**16.1%**	**---**	**10.0%**	**17.1%**

3. Changes in Water Demand

The ET calculations presented in Tables 4 and 5 above were used to estimate year 2050 net irrigation demand for eastern Boulder County for alfalfa and corn, the two dominant crops grown in the area. Figures 3 and 4 show average monthly irrigation demand for historic (1950-1990) 'Base' case and for the dry and wet end-member GCM results. Net irrigation demand is defined here as ET – P_{eff}, where ET = PET*Kc and Kc is the crop coefficient (alfalfa = 1, corn = varies monthly, ranging from 0.26 to 1 during the corn growing season), and P_{eff} is the effective precipitation, that portion of the precipitation which can be utilized by crops for growth before running off or infiltrating. Crop consumptive demands are 129 and 117 percent of historic demands for the wet and dry GCM scenarios, respectively (McCurry, 2000).

Average monthly water demands were computed for alfalfa for northeastern Colorado for the year 2050 using averaged GCM results for the South Platte basin. These were compared to GCM-predicted monthly flows for the year 2050 dry and wet end-member scenarios and for historic conditions, as shown in Figure 5 (McCurry, 2000). The figure shows a growing contrast between timing of water availability and water demand.

Figure 3 Average Monthly Irrigation Demand for Alfalfa, Year 2050, Boulder County

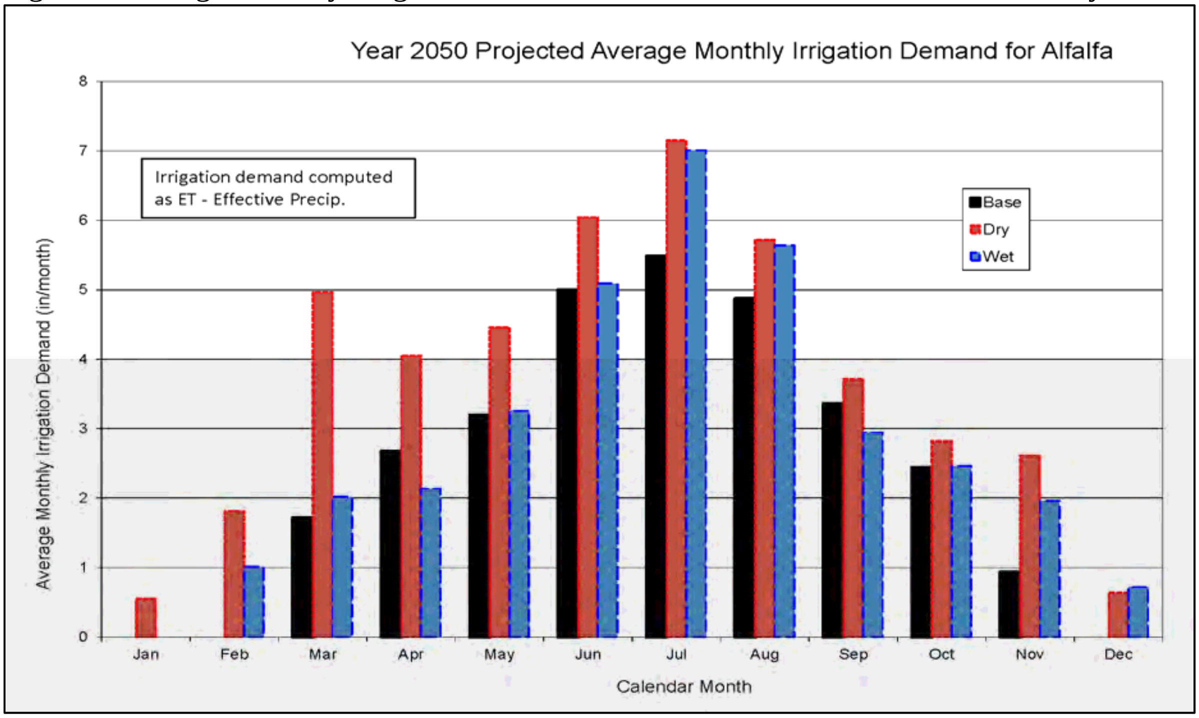


Figure 4 Average Monthly Irrigation Demand for Corn, Year 2050, Boulder County

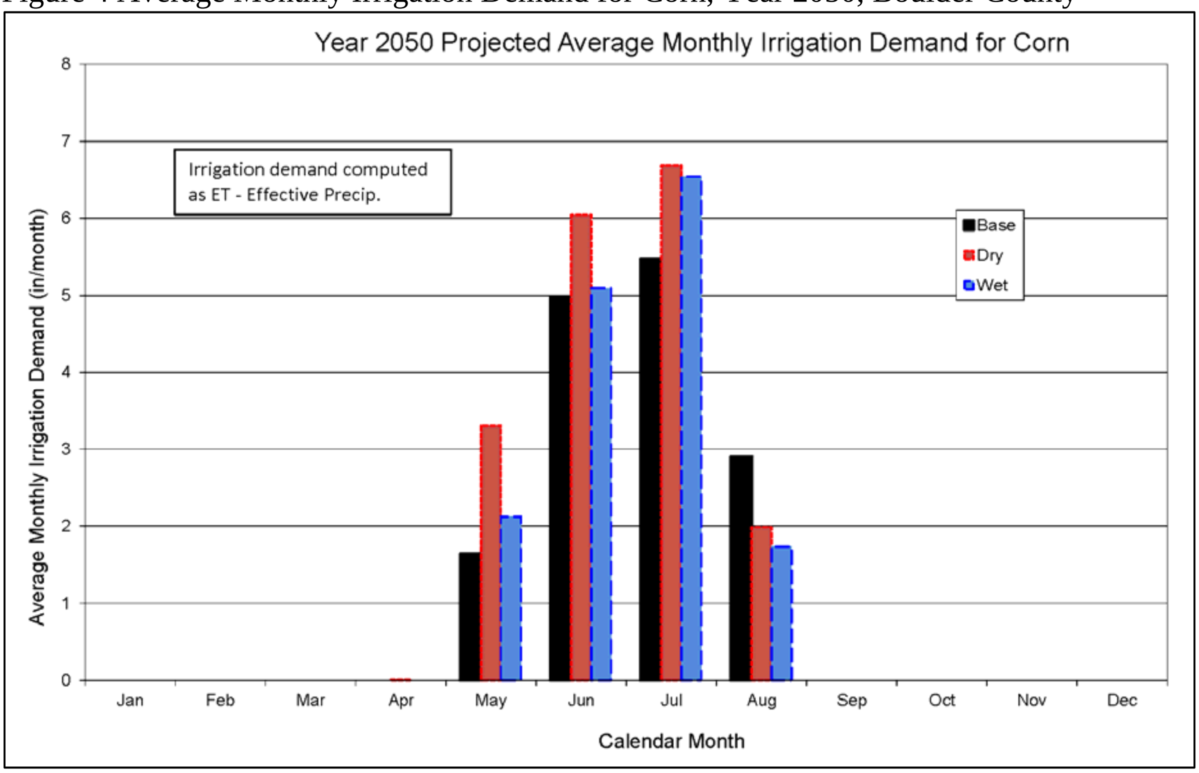
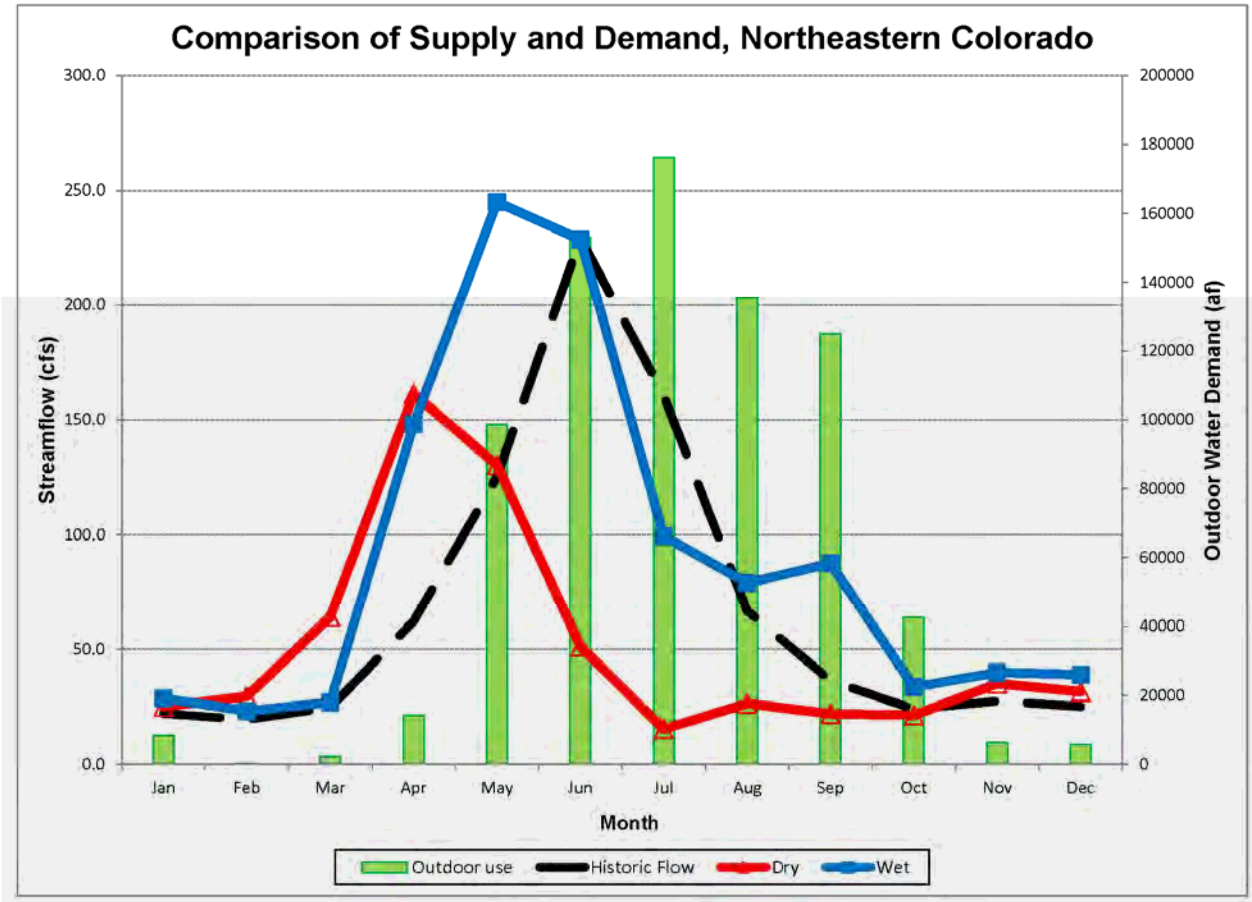


Figure 5 Comparison of Year 2050 Water Supply and Demand, Northeastern Colorado



4. Changes in evaporation from reservoirs

Evaporation can be calculated using Energy Balance, Aerodyamic, or Combinations methods, the latter including the Priestley-Taylor equation. Temperatures predicted by 39 GCMs, based on an 11-year average of average monthly values centered on the years 2000, 2030 and 2050 that were developed from the mid-range emissions scenario are presented in Table 7. These data can be used for estimating evaporation for each of the specified locations along the Front Range in northeastern Colorado. Other variables that are location- and date-specific and are used in evaporation equations include net radiation, relative humidity and wind speed. These climatic variables can be obtained but are beyond the scope of this evaluation. However, evaporation of open water bodies is proportional to temperature so general trends can be estimated based on GCM predictions of temperature increases. Predicted average monthly temperatures are shown in Table 7 for selected locations in northeastern Colorado. Relative to the year 2000, average annual temperatures are predicted to increase approximately 3.6 percent by 2030 and approximately 6.8 percent by 2050. During the growing season, average annual temperatures are predicted to increase by approximately 3.5 percent by 2030 and approximately 6 percent by 2050 relative to year 2000 temperatures.

Table 7 Average Monthly Temperature (^{0}F)

City	**Denver**			**Ft Collins**			**Greeley**			**Limon**		
Month	2000	2030	2050	2000	2030	2050	2000	2030	2050	2000	2030	2050
Jan	32.3	33.4	35.0	29.4	30.4	32.1	27.6	28.6	30.3	27.2	28.2	29.7
Feb	35.6	37.0	38.5	33.6	35.0	36.6	33.1	34.5	36.1	31.1	32.5	33.9
Mar	40.6	42.0	43.3	39.4	40.7	42.0	40.0	41.3	42.6	36.6	38.0	39.2
Apr	48.8	50.3	51.6	48.2	49.6	50.9	49.2	50.6	51.9	45.9	47.4	48.6
May	58.6	60.7	62.4	57.8	59.8	61.4	59.3	61.3	62.9	55.9	57.8	59.6
Jun	68.8	71.1	72.8	67.4	69.6	71.2	69.3	71.5	73.1	66.4	68.5	70.2
Jul	74.1	76.6	78.1	72.4	74.8	76.4	74.4	76.9	78.4	71.8	74.1	75.6
Aug	72.2	75.0	76.7	70.2	73.0	74.7	72.0	74.8	76.5	69.7	72.5	74.1
Sep	63.6	66.0	67.8	61.7	64.1	65.9	63.1	65.5	67.3	61.1	63.5	65.3
Oct	52.4	54.5	56.4	50.5	52.7	54.5	51.1	53.3	55.1	49.2	51.4	53.2
Nov	40.1	41.4	42.9	37.9	39.3	40.8	37.4	38.7	40.2	36.0	37.3	38.9
Dec	33.3	34.5	36.1	30.8	32.1	33.7	29.3	30.6	32.2	28.5	29.8	31.2
Annual Avg	51.7	53.5	55.1	49.9	51.8	53.3	50.5	52.3	53.9	48.3	50.1	51.6
Change	------	3.6%	6.6%	------	3.6%	6.8%	------	3.6%	6.7%	------	3.7%	6.9%
Apr-Sep Avg	64.4	66.6	68.2	62.9	65.2	66.8	64.6	66.8	68.4	61.8	64.0	65.6
Change	------	3.5%	6.0%	------	3.5%	6.1%	------	3.4%	5.9%	------	3.5%	6.1%

5. Other Relevant Findings

A statewide summary of potential climate change impact on hydrology was completed recently (Ray et al, 2008). Key findings from this study are presented below.

Climate models project that Colorado will warm by approximately 2.5°F and ranging from +1.5 to +3.5°F by 2025, relative to the 1950–99 baseline, and approximately 4°F and ranging from +2.5 to +5.5°F by 2050. The projections show summers warming more (approximately 5°F and ranging from +3 to +7°F) than winters (approximately +3°F and ranging from +2 to +5°F). These findings suggest that typical summer temperatures in 2050 will be as warm as or warmer than the hottest 10% of summers that occurred between 1950 and 1999.

By 2050, temperatures observed currently on the Eastern Plains of Colorado will shift westward and upslope, bringing into the Front Range temperature regimes that today occur near the lower elevation Kansas border.

Winter projections for Colorado show fewer extreme cold months, more extreme warm months, and more strings of consecutive warm winters. By contrast with summer, typical projected winter temperatures do not lie within the top 10% warmest months in the historical record. By

2050 the current average January climate of the Eastern Plains of Colorado is expected to shift northward by approximately 150 miles. In all seasons, the current climate of the mountains migrates upward in elevation, and the climate of the Desert Southwest progresses up into the valleys of the Western Slope.

Individual models projections do not agree whether annual mean precipitation will increase or decrease in Colorado by 2050. The multi-model average shows little change in annual mean precipitation by 2050, although a seasonal shift in precipitation does emerge. Combined effects of a northward shifting storm track, potentially wetter storms and a global drying of the sub-tropical regions may result in more mid-winter precipitation throughout the state, and in some areas, a decrease in late spring and summer precipitation.

Climate projections show a precipitous decline in lower-elevation (below 8200 ft) snowpack across the West. Modest declines (10–20%) are projected for Colorado's high-elevation snowpack (above 8200 ft) within the same timeframe. The timing of runoff is projected to shift earlier in the spring, and late-summer flows may be reduced. These changes are likely to occur regardless of changes in precipitation but will be amplified if precipitation decreases.

Recent hydrologic studies on climate change in the Upper Colorado River Basin point to an expected decline in runoff by the mid-to-late 21st century. Those studies that explicitly calculate runoff report multi-model average decreases ranging from 6% to 20% by 2050 compared to 20th century conditions; the one recent study that bases streamflow on a large-scale statistical relationship projects a 45% decrease by 2050.

The impact of climate change on runoff in the Rio Grande, Platte, and Arkansas Basins has not been studied as extensively as the Colorado River Basin. Projected hydrologic changes in temperature, precipitation and runoff in the Colorado River Basin are summarized from a variety of current sources in the following table.

TABLE 5-1. Projected Changes in Colorado River Basin Runoff or Streamflow in the Mid-21st Century from Recent Studies

Study	*GCMs (runs)*	*Spatial Scale*	*Temperature*	*Precipitation*	*Year*	*Runoff (Flow)*	*Risk Estimate*
Christensen et al. 2004	1 (3)	VIC model grid (~8 mi)	+3.1°F	-6%	2040–69	-18%	Yes
Milly 2005, replotted by P.C.D. Milly	12 (24) (~100–300 mi)	GCM grids —	—		2041–60	-10 to -20% 96% model agreement	No
Hoerling and Eischeid 2006	18 (42)	NCDC Climate Division	+5.0°F	~0%	2035–60	-45%	No
Christensen and Lettenmaier 2007	11 (22)	VIC model grid (~8 mi)	+4.5°F (+1.8 to +5.0)	-1% (-21% to +13%)	2040–69	-6% (-40% to +18%)	Yes
Seager et al. 2007*	19 (49)	GCM grids (~100–300 mi)	—	—	2050	-16% (-8% to -25%)	No
McCabe and Wolock 2008	—	USGS HUC8 units (~25–65 mi)	Assumed +3.6°F	0%	—	-17 %	Yes
Barnett and Pierce 2008*	—	—	—	—	2057	Assumed -10% to -30%	Yes

Values and ranges (where available) were extracted from the text and figures of the references shown. Columns provide the number of climate models and individual model runs used to drive the hydrology models, the spatial scale of the hydrology, the temperature and precipitation changes that drive the runoff projections, and whether or not the study quantified the risk these changes pose to water supply (e.g., the risk of a compact call or of significantly depleting reservoir storage).

* Two studies do not specifically make projections of Upper Basin runoff or streamflow. Seager et al. (2007) average over a large area (95°W–125°W, 25°N–40°N) that only partially overlaps with the Upper Basin. Barnett and Pierce (2008) assume Lees Ferry streamflow changes to drive their water balance model of reservoir storage.

6. Summary

Climate change is predicted to have a series of effects on the hydrology and water demands in the Front Range of Colorado. The effects include changes in the timing and magnitude of streamflow, increases in evapotranspiration, and increases in reservoir and lake evaporation. These changes will decrease the available water supply and increase water demands. Due to a shift in peak streamflow to earlier times, the gap between supply and demand will grow in the late summer when agricultural water demands are high.

Specific findings from the above studies include the following:

- When compared to historic (1950-1999) flows, there is a 1 to 2 month shift toward earlier peak flows associated with snowmelt runoff. Depending on the GCM model and emissions scenario, there is also a change in total flows, with a ranging from 75 to 131 percent of the historic flows. For the dry (MPI model) GCM results, peak flows are 70 percent of historic flows.

- The ET for alfalfa in eastern Boulder County is predicted to increase 15 to 32 percent on an annual basis by 2050. During the primary growing season months of April through September the ET for alfalfa increases 9 to 15 percent by 2050 compared to historic conditions for the range of GCMs considered.

- In contrast, the growing season for corn in eastern Boulder County generally is limited to the April to August period for both historic and predicted future conditions. Assuming no new cultivars are grown that use an expanded growing season, the predicted increase in ET for corn will range from 5 to 8 percent by compared to historic conditions.

- For a range of locations in northeastern Colorado, including Denver, Ft. Collins, Greeley and Limon, the average predicted increases in bluegrass ET are about 4.4 percent in 2030 and approximately 7.7 percent in 2050 compared to the year 2000. The increases in alfalfa ET are about 9 to 10 percent in 2030 and approximately 15 to 17 percent in 2050 compared to the year 2000.

- Crop consumptive demands, which are defined as the ET less effective precipitation, are predicted to increase in eastern Boulder County by 29 and 17 percent of historic demands for the wet and dry GCM scenarios, respectively.

- Evaporation for reservoirs and lakes is dependent on temperature, net radiation, relative humidity and wind speed. Relative to the year 2000, average annual temperatures are predicted to increase approximately 3.6 percent by 2030 and approximately 6 to 7 percent by 2050. These increases are anticipated to be proportional to the increase in evaporation from open water bodies but location- and date-specific calculations will be needed to determine the increases.

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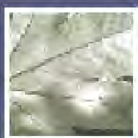

The Potential Consequences of Climate Change for Boulder Colorado's Water Supplies

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February 3, 2009
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Abstract

This study combines the potential impacts of climate change with long-term climate variability to examine their effects on the water supply of one community. The study team examined outputs from general circulation models (GCMs; supplied by the National Center for Atmospheric Research) for grid boxes that include Boulder, Colorado, and selected the wettest model, the driest model, and a middle model. Estimates of climate change for 20-year periods centering on 2030 and 2070 were used. In addition, 437-year (1566-2002) reconstructions of streamflow in Boulder Creek, South Boulder Creek, and the Colorado River (conducted by Connie Woodhouse) were used. A “nearest neighbor” approach was used to select years in the observed climate record that resemble the paleoclimate reconstructions. Average monthly GCM changes in temperature and precipitation for 2030 and 2070 were combined with multiple recreations of the paleoclimate record to simulate the combined effects of change in climate and paleoclimate variability.

Increase in temperature alone was estimated to have little effect on the total annual volume of runoff, but by 2070 would shift peak runoff one month earlier. This results in higher late winter and spring runoff and lower summer runoff. Indeed, these seasonal changes (e.g., higher winter runoff, lower summer runoff) were estimated even with increased or decreased precipitation. Annual runoff is quite sensitive to change in precipitation, with runoff decreasing with reduced precipitation and increasing with higher precipitation.

Using Boulder’s water management model (which incorporates supply and demand for water and water rights) and accounting for population growth in Boulder and changes in demand for crop irrigation, the study found that wet and “middle” scenarios had little effect on the reliability of Boulder’s water supply. But reduced precipitation scenarios resulted in violations of some of Boulder’s water supply reliability criteria, which give goals for the frequency of providing specified levels of service (e.g., for indoor use, lawns). By 2070, higher greenhouse gas emissions scenarios increase the risk of supply disruptions more than the lowest emissions scenario. Although an earlier study found that Boulder’s water supplies would be reliable with a repeat of climate conditions from hundreds of years ago, this study found that the *combination* of climate change imposed on a reconstruction of events from the 16th and 17th centuries would cause more frequent violations of the city’s water supply criteria. Demand for irrigation was projected to increase substantially, but very little of the increased demand would be met under the middle or dry scenarios.

In general, Boulder is in a relatively good position to adapt to climate change because it has relatively senior water rights and can fill its reservoirs during later winter and spring months when runoff is projected to increase. Other municipalities without reservoirs or with junior water rights that will more frequently not be allowed to divert in late summer months would likely be at greater risk due to climate change. Boulder will work to increase the flexibility of operations for its water system and examine means to reduce demands and enhance supplies.

Acknowledgements

This project was funded by grant NA05OAR4311123 from the National Oceanographic and Atmospheric Administration Office of Atmospheric Research Climate Program Office. We wish to thank our project officer, Dr. Nancy Beller-Simms, for her continued support, encouragement, and patience on this project.

We appreciate the support and collaboration by the City of Boulder. Carol Ellinghouse, Water Resources Coordinator for the City of Boulder, participated from the beginning to the end of the project, from project conceptualization, through analysis to review of results. Her involvement provided a critical to a key stakeholder, the City of Boulder.

Our efforts were greatly helped by the sound advice and thoughtful guidance provided by a number of people. The advisors included Dr. Tom M. L. Wigley of the National Center for Atmospheric Research, Dr. Connie Woodhouse of the University of Arizona (formerly at NOAA), Dr. Klaus Wolter of NOAA, and Brad Udall of the Western Water Assessment.

The University of Colorado provided extensive support for the project with minimal compensation. Dr. Kenneth Strzepek built a runoff model and estimated change in runoff. Dr. Strzepek also participated in project meetings and presentations. He and Dr. Balaji Rajagopalan applied the nearest neighbor approach that enabled us to combine climate change scenarios with the reconstructed streamflow.

Tsasha Christopoulos was the Support Associate for Stratus Consulting. Erin Miles at Stratus Consulting prepared the report for publication. Christina Thomas was the technical editor on the report.

Executive Summary

Incorporating knowledge of the effects of climate change into water resource management is a challenge for several reasons. Among the challenges are the long time frames over which climate change will happen and uncertainty about the changes. Projections of climate change are typically done at a geographic scales far larger than the scale on which water management decisions are typically made. Further, changes in climate variability are often not considered in studies of climate change impacts. And often, decision makers on water resources are not closely involved in studies, whose results may thus not be applicable to decision making.

This study focused on the vulnerability of the water supply of Boulder, Colorado to climate change. Boulder is a city serving the water needs of 113,000 people. Like many cities in the West, Boulder depends on snowpack for its water supplies. Seventy percent of Boulder's treated water supplies come from the eastern slopes of the Rocky Mountains west of the city. The other 30% comes from the Upper Colorado River on the West Slope of the Rockies and is transported via tunnels cut through the mountains.

In 2003, Boulder examined its vulnerability to a 285 -year reconstruction (1703-1987) of streamflows in Boulder Creek based upon tree ring data. The study found that Boulder's water supply reliability would not be threatened by a repeat of climate variability over several centuries. However, the City also examined a long-term reduction (15%) in average streamflows and found that such a change would significantly reduce reliability of the water supply system.

This new study, which was funded by a grant from the National Oceanographic and Atmospheric Administration's Office of Global Programs, builds on the previous study in two ways. First, climate change scenarios are combined with the paleoclimate reconstructions to effectively examine the impacts of human induced climate change imposed on a repeat of long-term variability. Second, an updated and lengthened tree ring-based reconstruction was completed shortly before this study was initiated, a 437-year record (1566-2002) and was used in this study.

A key aspect of this study was the close collaboration between the researchers and key water management staff in the City of Boulder. Carol Ellinghouse, Water Resources Coordinator for the City, was involved in this study from its conception through structuring of the study, development of scenarios, conduct of the study, and analysis of results.

Methods

The study has four main analytic components: (1) climate scenarios; (2) runoff modeling; (3) water management modeling; and (4) policy analysis.

Climate scenarios. The climate scenarios had two components: average change in long-term climate, and combined average change and long-term climate variability. The study examined climate change impacts in 2030 and 2070 by examining estimated changes in climate in the central Rocky Mountains using 21 general circulation models (GCMs). These models all project higher temperatures. Roughly half the models project decreased precipitation in the central Rockies, and half the models project an increase. The models tend to project wetter winters and drier summers. Four GCMs were selected to reflect a wide range of potential changes in precipitation. One model had one of the largest reductions in annual precipitation for the region, one had one of the largest increases in precipitation for the region, and one was close to the middle of the projections. All of those three models project wetter winters. The fourth model projects decreased winter precipitation.

Three scenarios of greenhouse gas emissions were used, drawing on the Intergovernmental Panel on Climate Change Special Report on Emissions Scenarios (Nakićenovic et al., 2000). The scenarios were B1, A1-B, and A2 and reflect a wide range of future emissions of greenhouse gases. The precipitation and temperature changes projected using the A1B emissions scenario are displayed in Figures S.1 and S.2.

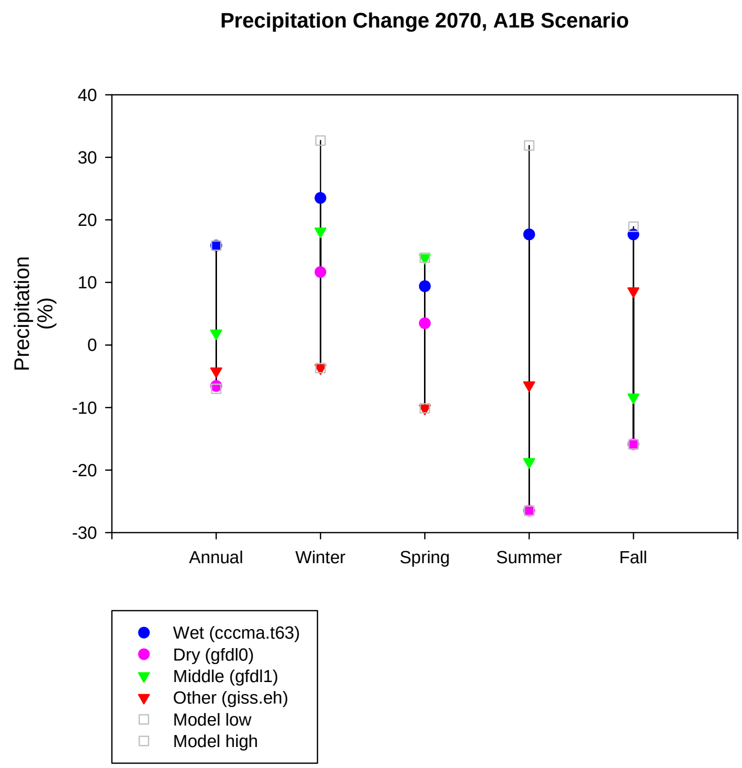

Figure S.1. Climate change scenarios on precipitation for 2070 for A1B scenario.

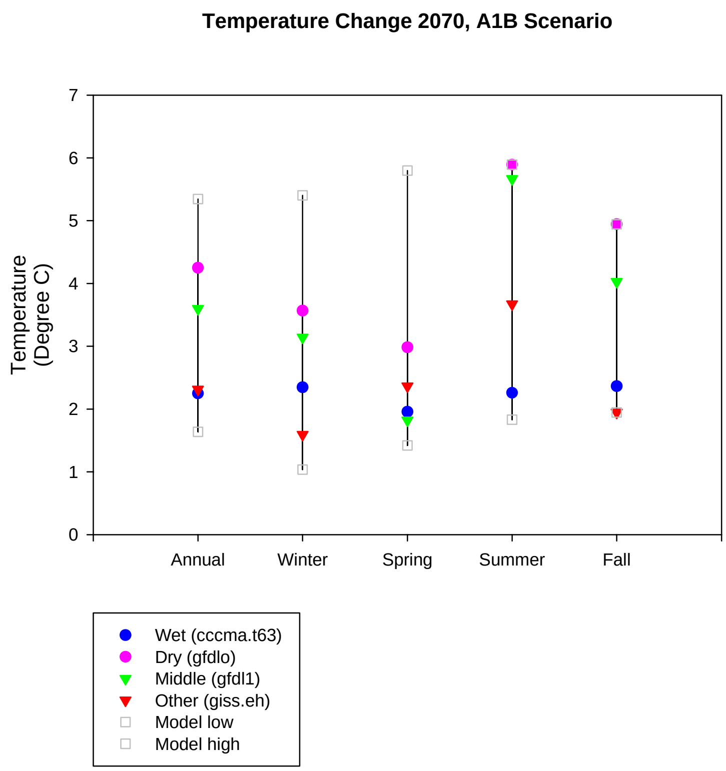

Figure 3.2. Climate change scenarios on temperature for 2070 for the A1B scenario.

This study is, as far as the authors can tell, the first in the United States to combine long-term climate change and long-term variability. The climate change scenarios were combined with the 437-year reconstruction of streamflow in Boulder Creek. The reconstructed streamflows are displayed in Figure S.3. The nearest neighbor approach was used to match streamflows in the period before 1953, when accurate climate records began in the mountains above Boulder. Years between 1953 and 2004 were then used as proxies for the pre-1953 years. Temperature and precipitation changes from the GCMs were then added to, or multiplied by in the case of precipitation, the temperature and precipitation record derived from this procedure.

Runoff modeling. A new runoff model for Boulder Creek, CLIRUN2, was developed for this project. It builds on previous models such as CLIRUN and WATBAL. This model was reconfigured for wet, middle, and dry runoff conditions.

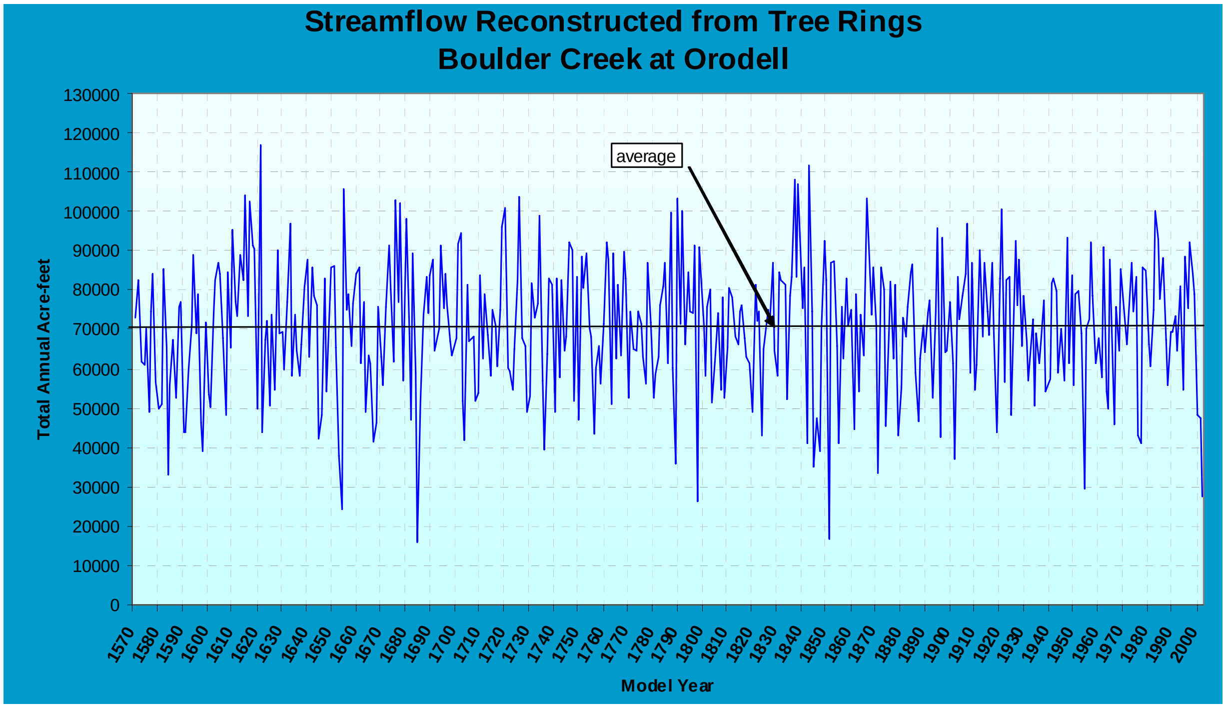

Figure 3.3. Reconstructed streamflows for Boulder Creek. Data provided by Connie Woodhouse.

Water management modeling. Boulder has a well developed management model that it has used for years to analyze water supplies and demands. The Boulder Creek Model is a network model that uses a linear programming algorithm to allocate water supplies among competing demands. It optimizes allocation of water based on relative water rights priorities or operating rules as objective function drivers. Changes in crop irrigation demand (downstream from Boulder) were also estimated.

The impacts of climate change were assessed based on whether they would increase or decrease risk of triggering drought restrictions. Boulder plans for increasing levels of reductions in water deliveries based on frequency of droughts. Restrictions are increased from relatively mild to severe depending on whether a drought is a 1 in 20 year event, a 1 in 100 year event, or a 1 in 1,000 year event. If the frequency of imposing these restrictions increases above these targets, Boulder is essentially violating its drought reliability criteria.

The team then analyzed the implications of the potential impacts for the City's water management, and in particular drought management, policies. Results were presented to the City Council, city advisory boards, and other water users.

Results

Runoff. The most robust finding of the runoff modeling was that under all climate change scenarios the hydrograph for Boulder Creek will shift because peak snowmelt will happen earlier than it does now. This is displayed in Figure S.4 for 2070. Runoff is projected to increase in February through May and decrease from June through September. Peak runoff shifts from June to May in all scenarios but one. Table S.1 displays annual and seasonal changes in runoff. Note that whether runoff increases or decreases annually is indeterminate. Generally, the wet scenarios increase runoff and the dry scenarios decrease runoff. No change in precipitation results in a slight decrease in runoff. But virtually all the scenarios project increased winter and spring runoff and decreased summer runoff.

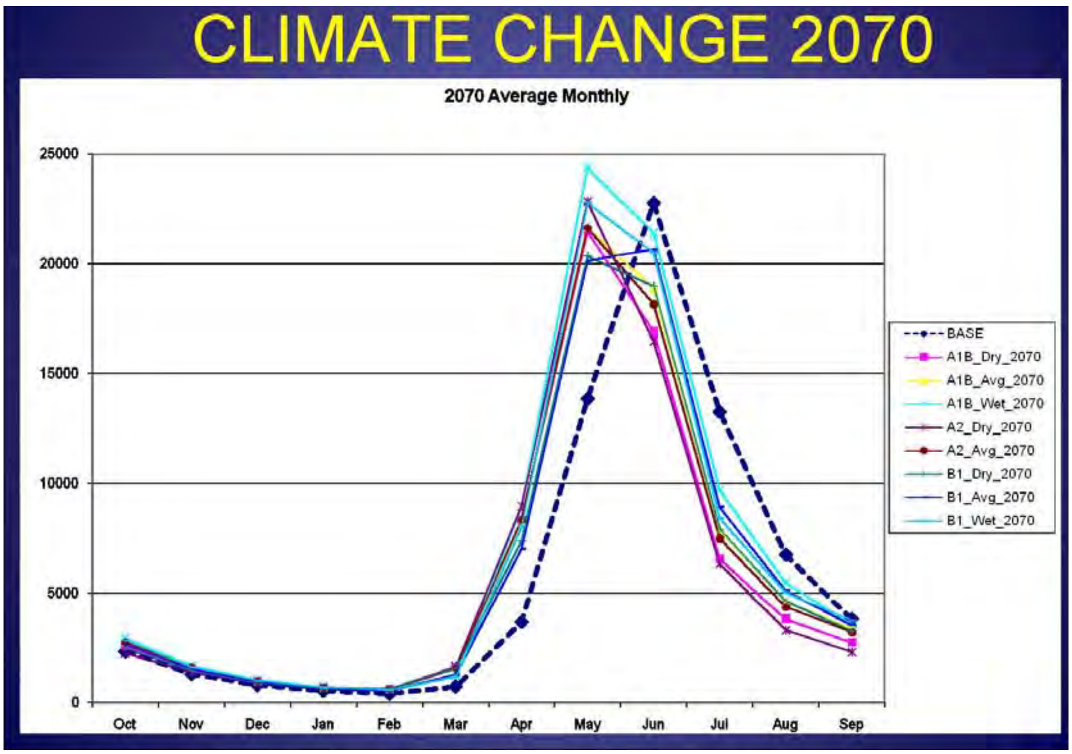

Figure S.4. Boulder Creek runoff under current climate and climate change in 2070.

Table S.1. Estimated change in runoff in Boulder Creek

Scenario	Annual	Winter	Spring	Summer	Fall
	Seasonal change				
Base case	0%	0%	0%	0%	0%
B1 Wet 2030	7%	19%	19%	-18%	15%
B1 Mid 2030	-2%	4%	13%	-28%	-7%
B1 Dry 2030	-3%	9%	7%	-21%	-1%
A1B Wet 2030	12%	21%	24%	-8%	14%
A1B Mid 2030	-2%	5%	13%	-25%	-12%
A1B Dry 2030	-4%	19%	8%	-26%	6%
A1B Dry3 2030	-6%	-3%	2%	-23%	0%
A2 Mid 2030	-1%	8%	10%	-22%	4%
A2 Dry 2030	-5%	8%	7%	-28%	-2%
B1 Wet 2070	9%	38%	27%	-28%	23%
B1 Mid 2070	0%	23%	16%	-27%	2%
B1 Dry 2070	0%	62%	15%	-34%	9%
A1B Wet 2070	16%	45%	35%	-21%	27%
A1B Mid 2070	5%	46%	25%	-35%	16%
A1B Dry 2070	-4%	65%	15%	-44%	12%
A1B Dry3 2070	-3%	32%	13%	-35%	7%
A2 Mid 2070	0%	47%	20%	-41%	11%
A2 Dry 2070	-4%	62%	19%	-49%	0%

Management modeling

The impacts of climate change on the management of Boulder's water supplies depend largely on whether annual runoff increases or decreases, but also on change in timing of peak runoff. An increase in runoff results in an increase in water supply and a decrease in demand. (Change in flood risks was not assessed in this study.) Earlier peak runoff would allow Boulder to capture a larger percentage of available annual streamflow due to less competition from downstream agricultural water users during the critical spring reservoir fill season.

Irrigation demand from agricultural water users downstream of Boulder would increase with higher temperatures because with earlier runoff, the "natural overlap" between stream flows and irrigation demands would be reduced, resulting in relatively greater shortages to irrigation uses. Irrigators would have relatively minor impacts under the wet and middle scenarios. However, under the dry scenarios, a smaller share, and in some cases a substantially smaller share, of irrigation demand would be unmet.

The likelihood of triggering drought restrictions in Boulder's water supply system moves in the opposite direction as changes in runoff. If runoff increases, then the likelihood is reduced. For most of the scenarios involving little change in precipitation, the likelihood of triggering drought restrictions does not increase. However, for the high emissions scenario (A2) with little change in precipitation in 2070, risk of triggering the 1:20 drought criteria rises. It is under all the reduced precipitation scenarios that potential for violating drought criteria rises. The increases are more likely in 2070 than in 2030 and more likely under the higher greenhouse gas emissions scenarios than under the lower emissions scenarios.

Policy analysis. The results of this study and the 2003 study have been presented to Boulder citizens, City Council, city advisory boards, and other water users. Among the main policy conclusions are the following:

- Boulder is well positioned to adapt to the estimated change in runoff patterns because it will have an increased ability to fill City reservoirs in the spring before downstream agricultural users with senior rights make their calls as the peak runoff period moves earlier in the year. Also, the City's senior direct flow water rights will allow continued diversions in late summer if streamflow decreases. Other water users may have higher risks under climate change than Boulder.

- The combination of a warmer climate and past variability poses more risk to Boulder's water supply reliability than either a repeat of the past variability without climate change or a change in average climate conditions imposed on the observed climate record.

- The City of Boulder will examine "no regrets" actions that will increase reliability of its water supplies. It also will pursue monitoring of climate as well as developments in the science of climate change. In particular, the city will monitor projections of climate change in the central Rocky Mountains. The city will also continue to educate its water users on risks from climate variability and change.

1. Introduction

There is often a disconnect between the projections of climate change and the ability of water managers to examine the risks that climate change poses at a scale appropriate for policy making. Climate projections are most reliable on very large geographic scales, much larger than the geographic scales on which water management decisions are typically made. Climate projections on such finer geographic scales are typically not reliable. In addition, substantial uncertainty exists about the magnitude and direction of climate change: How much will temperatures rise? Will precipitation increase or decrease? Beyond this, climate change is not the only aspect of climate that concerns water managers. They are also concerned about climate variability such as the potential for deep or persistent droughts.

Climate change studies are often conducted by researchers not connected to policy makers. The selection of the geographic area, the variables to be studied, and the scenarios and the interpretation of results are typically made by researchers without input from policy makers. But policy makers need to be closely involved in such studies from the beginning to ensure that the outputs of such studies are worthwhile for policy making.

This study addresses how risks to water supplies from climate change can be addressed by one community, Boulder, Colorado. City water utility staff was closely involved in this study. In addition, this study built on an earlier study of Boulder's water supply vulnerability to long-term climate variability by considering the combined effects of climate change and variability.

1.1 Boulder's Water Supply, Growth Plans, and Drought Management Plans

The Boulder Creek basin is situated within the larger South Platte basin of Colorado. Most of the city's water is from snowpack melt from the Rocky Mountains. The water is drawn from two sources. About 70% of the treated water supplied to the City of Boulder is diverted from North Boulder Creek and Middle Boulder Creek, which produce the majority of the stream flow in Boulder Creek. The natural flow of Boulder Creek near Orodell is 71,000 acre-feet per year (City of Boulder, 1988; see Figures 1.1 and 1.2).

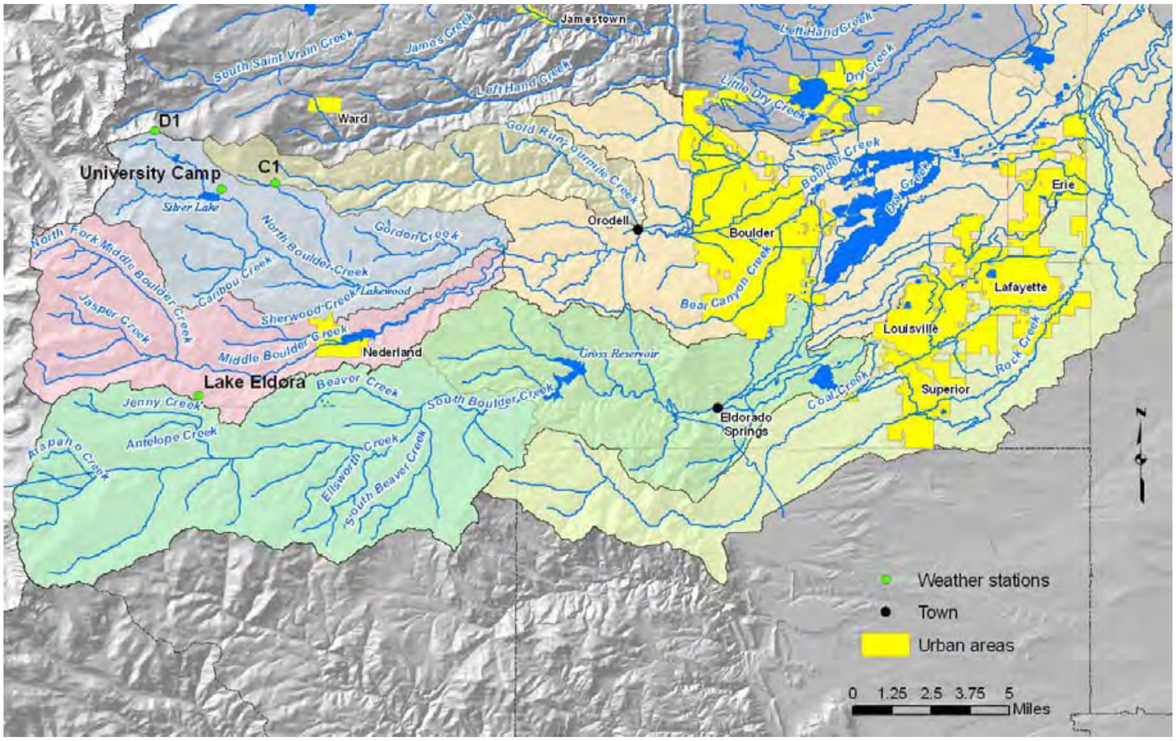

Figure 1.1. Map of the Boulder Creek basin and the C1 site.

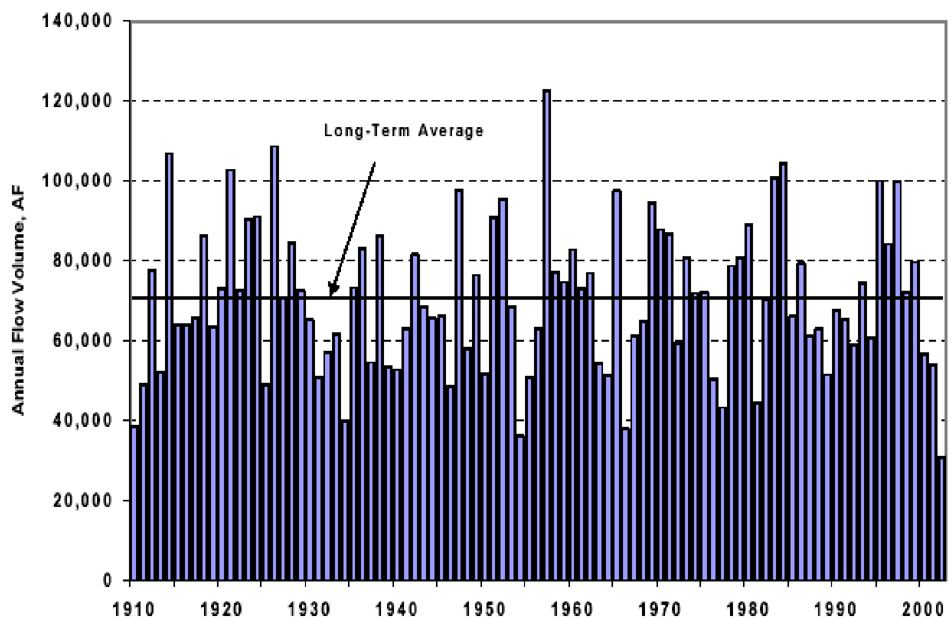

Figure 1.2. Reconstructed natural flow for Boulder Creek near Orodell.

Source: City of Boulder, 2008a.

The natural water supply of the Boulder Creek basin is supplemented by water imported into the basin from the Colorado-Big Thompson (CBT) and Windy Gap projects, which divert water from the headwaters of the Colorado River (on the West Slope of the Rocky Mountains) into the South Platte basin. This water is managed by the Northern Colorado Water Conservancy District (NCWCD; City of Boulder, 2004). A portion of that water is delivered to CBT and Windy Gap project allottees located in the Boulder Creek basin. Annual allotments, or "quotas," of CBT and Windy Gap supplies are determined each spring by the governing organizations of those projects based on reservoir storage levels and expected runoff conditions. One-half of Boulder's water supply is dependent on these projects with three-fifths of the city's imported water allocations treated for direct use (30% of the city's total treated water supply) and two-fifths exchanged for additional Boulder Creek water. Note that Colorado River water is subject to the Colorado River Compact, which guarantees the lower Colorado River basin states up to 75 million acre-feet in any ten-year period, which translates to an average annual delivery of 7.5 million acre-feet per year. A compact call on Colorado River water by lower basin states could reduce delivery of water to Boulder (and other Front Range water users).

Because Boulder's water supply is mainly from snowpack, and in the semi-arid western United States year-to-year variability in precipitation is relatively high, an extensive reservoir and transfer system is used to capture runoff and store water for when it is most needed as well as to carry over supplies from year to year. Most of Boulder's annual supply of water is stored in May and June during the spring snowmelt period for the high mountain elevations where the city's reservoirs and diversions are located. This stored water supply supplements direct diversions once streamflows drop in late summer and through the winter. In addition, the reservoirs regulate water supplies between wet and dry years because both occur with greater frequency than average years in Colorado's semi-arid climate. The city's water rights yield different amounts every year depending on hydrologic conditions and on calls for water by more senior water rights owners.

Boulder currently provides water to 113,000 people living within and nearby the city. The city's water is also consumed by more than 100,000 employees working in the area, 50,000 of whom commute to the city from other areas (City of Boulder, 2008a, 2008b); Boulder's current population is about 103,000 (City of Boulder, 2008b). In the 1990s annual consumption of water varied from 20,000 to 25,000 acre-feet (see Figure 1.3). Following the 2002 drought restrictions and other conservation measures undertaken by the city, annual consumption has dropped to just under 20,000 acre-feet per year. The city considers water demand under various "build-out" scenarios in its water planning. The scenario with the highest water demand has the population in the service area growing to 125,000, employees increasing to 172,000 (City of Boulder, 2008a), and water demand rising to 28,600 acre-feet, which includes a 10% demand safety factor (City of Boulder, 2008a).

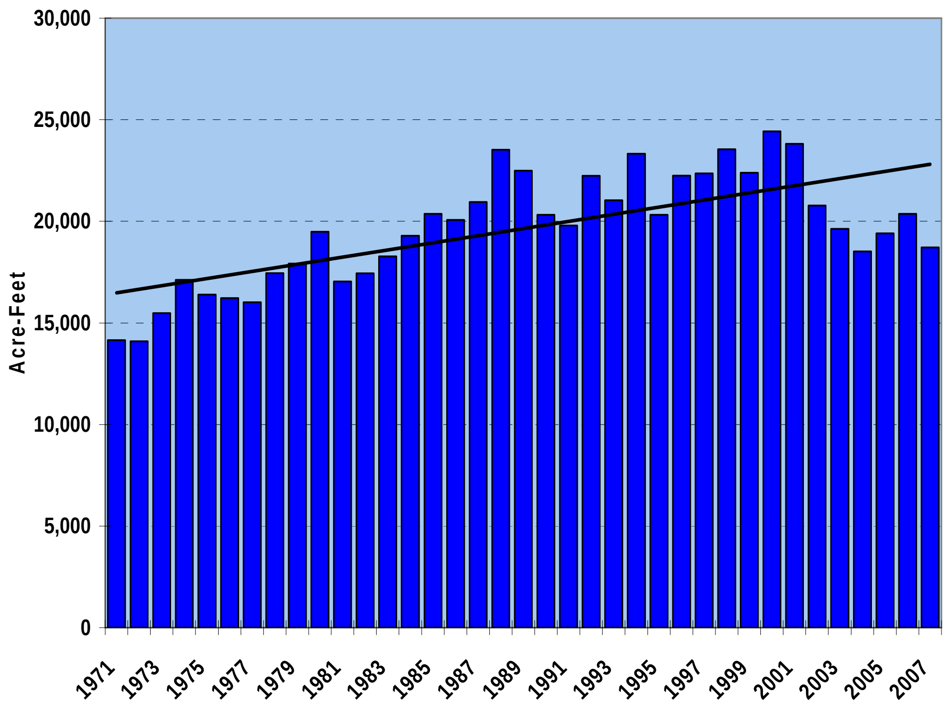

Figure 1.3. Boulder's annual water use. Note reduction following the 2002 drought.

Source: City of Boulder, 2008a.

Unlike most Front Range communities, which use a majority of their water for irrigation, Boulder uses two-thirds of its water for indoor and industrial uses and one-third for irrigation (City of Boulder, 2003). This difference likely occurs because Boulder is an older city with smaller residential lots, many multi-family units and a compact urban form. But its smaller share of water used for irrigation gives the city less flexibility in responding to droughts than its neighbors.

Boulder has donated some of its water rights to a state agency for providing minimum instream flow levels in Boulder Creek and its tributaries to protect aquatic habitat during low flow periods when the creeks would otherwise be dry due to diversions by senior water rights. The goal for minimum flow rate allowed varies by stream reach and increases as the streams drop in elevation. On main Boulder Creek as it runs through Boulder, the donated water usually prevents the stream from dropping below 15 cubic feet per second (cfs) during most of the summer and 4 cfs during other low flow times of the year. Streamflows naturally flow at a rate of hundreds of cfs during the spring runoff period and just a few cfs during the winter (City of Boulder 2008a).

There are many agricultural water users in the Boulder Creek basin downstream of Boulder and further downstream along the South Platte River, many of whom have water rights that are senior to some of the city's rights. Therefore, the city's water rights are sometimes affected by the competing demands of senior water rights ("calls") from downstream locations. Up to 70% of the water physically available at the city's high-elevation Boulder Creek basin diversion points is bypassed each year, either because the city's reservoirs and pipelines are full or because of downstream senior calls.

Boulder's water system performance is judged based on reliability criteria for the water supply established by City Council in 1989. Boulder's water planning does not provide for supplying all water that may be needed for all water uses in all years. Instead, the city anticipates reduced water deliveries in drought years within specified limits of occurrence. Boulder's water reliability standards involve having interruptions of municipal supplies depending on the frequency of droughts.

- For droughts occurring no more frequently than once in 20 years, water for landscaping would be reduced
- Water for landscaping would be substantially reduced (such that permanent damage to landscaping could happen) for droughts that are expected to happen no more frequently than once in 100 years
- Droughts occurring less often than once in 1,000 years would result in reductions of water deliveries for indoor uses and fire fighting.

The drought in 2002 was a 1 in 300 year event, and 57% of outdoor watering needs were met.

These reliability criteria became the basis for developing the city's Drought Plan, which delineated drought response triggers for the city's four Drought Stages, which range from moderate to extreme. The Drought Plan provides for the implementation of increasingly more stringent water use restrictions for each stage. Modeling of 285 years of the city's water system operations and water rights yields based on past hydrology, as extended from gauge records using tree ring data, was completed in 2003. The effort showed that 9 years of water supply restrictions would occur in the 285 modeled years. Only one of these 9 years required restrictions so severe that lawns and gardens would be permanently damaged. The city's adopted reliability criteria allow up to 14 years with water use restrictions in a 285-year period, with up to 2 years of those years requiring severe restrictions.

1.2 Vulnerability of the West to Climate Change

The literature shows that water resources in the West will be (and may already be) quite sensitive to climate change. Gleick (1990) found that compared to the rest of the country, river basins in the West are the most sensitive to changes in supply. This work was reinforced by Hurd et al. (1999). One of the key concerns is that higher temperatures will most likely reduce the size of snowpacks on which western water users mainly depend for water supplies. In addition, the snowpack will melt earlier, meaning that there will be a longer dry season during which water will need to be supplied to users. Smith et al. (2001), as part of the U.S. National Assessment, found that change in water supply is one of the major climate change concerns facing the western United States.

Reviewing the literature on freshwater resources in North America, Field et al. (2007) found that snowpack is generally projected to decrease, peak runoff will shift earlier, and summer flows will decrease. Christensen and Lettenmaier (2007) examined output from 11 climate models and estimated that a projected rise in temperature combined with small changes in precipitation would yield a range of change in runoff from no change to up to a 11% reduction.

More recent literature has shown that the West's climate and Colorado's climate in particular have been changing, and the changes in climate are affecting water supplies. Mote et al. (2005) found that across the West, snowpack as of April 1 has been decreasing. The trend in the central Rocky Mountains is more equivocal. However, from 1945-1955 to the 1990s, the water content of April 1 snowpack in the Rockies declined. Across the West, Barnett et al. (2008) find that most of the observed warming and change in snowpack are human induced.

Using climate change information in water resource management

At first glance, the literature appears to be pessimistic about the likelihood that water managers will use information on climate change in their long-term management of water resources. Studies of how water managers use relatively short-term forecasts of climate conclude that, for various reasons, such information is generally not incorporated in planning or management. A pilot study in the Northwest found that scientific and technical information competes with local knowledge, political mandates, stakeholder pressures, and internal organization needs (Lach et al., 1994; Lach and Quadrel, 1995).

Rayner et al. (2005) found that the rational choice approach, which suggests that an institution will assimilate, compare, and weigh new information to arrive at the best alternative, does not necessarily apply to institutional decision-making for water resource planning. They looked at why water resource planners in several regional water resource management institutions generally do not use probabilistic forecasts of seasonal and interannual climate variability. The reasons fell into two general categories: qualities (or perceived qualities) of the forecasts themselves and institutional design. Water managers most frequently stated that the (perceived) unreliability of forecasts was a reason for not using them, even if the interviewee had no direct experience, positive or negative, with probabilistic forecasts. Water managers also said that the spatial and temporal resolutions of these forecasts are not fine enough to be helpful in their planning processes.

Issues regarding institutional design include overlapping jurisdictions, water rights issues, and the fact that oftentimes other infrastructure construction or maintenance projects will take precedence over overhauling forecasting procedures that are seen to be working “well enough.” These institutions tend to be highly conservative and risk averse, and avoid institutional change unless they are experiencing heightened public or political scrutiny, such as during a drought or contaminant outbreak.

Callahan et al. (1999) also found that the primary obstacle to incorporating climate forecasts into water resource management lies within the resource management institutions. In their survey of Columbia River Basin management organization, the most frequently cited reason for not using long-range forecasts was inadequate skills for interpreting and implementing the forecasts. Managers in their survey also frequently cited management’s resistance to changing procedures as a major barrier to implementing long-range climate forecasts.

There is scattered anecdotal information that climate change is starting to be factored into planning in some sectors sensitive to a change in climate. For example, Easterling et al. (2004) point out examples of sea level rise being factored into coastal infrastructure design. But there are no examples of water resource managers in the United States incorporating possible change in freshwater supply or quality into their long-term planning for water resource management. This may be because sea level is not highly variable (although it does vary), sea level rise involves one variable (sea level), and the direction of change is certain (it will rise). In contrast, runoff is highly variable. In addition, climate models are not in agreement about how precipitation will change at the scale of regions such as the western United States (Houghton et al., 2001). Even though an increase in temperature is highly likely, which makes it highly likely that snowpacks will melt earlier, the uncertainty about change in precipitation makes it impossible to accurately forecast the size of future water supplies.

City of Boulder and consideration of climate change

In an effort to reduce the high level of unknowns about how future hydrologic changes caused by climate change might affect Boulder’s water supply, in 2003 the city commissioned a sensitivity study by Hydrosphere Resource Consultants (now AMEC), the city’s water resources consultant (Hydrosphere, 2003). One of the most novel aspects of the study is that it examined the vulnerability of Boulder’s water supply to the most recent 300-year climate record (as opposed to examining vulnerability to the drought of record in the observed climate data, such as the 1950s or 1930s droughts). The year record consisted of stream flows reconstructed from tree ring data for 1703-1987 (Woodhouse, 2001, 2003) and observed stream flow data for 1988-2002. The study also considered a 25% increase in interannual variability in the 300-year reconstructed record to test sensitivity to an increase in supply variability and a 15% decrease in average supply to test sensitivity to a long-term change in supply. Both of these sensitivity tests were prompted by concerns about climate change, but did not consider changes in the timing of runoff because of earlier snowmelt.

The results of the study showed that the city's water supply could be more vulnerable to the possibility of reductions in streamflow than increases in variability. Although both scenarios resulted in violation of the city's reliability criteria for the modeled 300-year sequence, the increase in variability resulted in more years with minor shortages that required a response based on voluntary water use reductions (14 years as compared to the 5 that occurred using the base hydrology). The decreased streamflow scenario caused a violation of all stages of the reliability criteria, including 6 years when the city's essential indoor water use needs could not be met even with severe mandatory water rationing. The study did not consider changes in seasonal stream flow patterns that could result from changes in snowpack due to higher temperatures, changes in demand for water, or how much of a change in supply or timing would exceed Boulder's coping capacity. In addition, it did not use climate model output to examine changes in supply or likelihood of exceeding coping thresholds. This modeling capability has created confidence in the ability to supply the city's water needs in all but the most severe drought conditions under scenarios similar to past hydrology.

Based on climate research that indicates that average temperatures in the intermountain western United States are likely to increase in the next 100 years, city staff, advisory boards, and the Boulder City Council had concerns about the continued adequacy of the city's water supplies under future hydrologic conditions. Although available information is less certain about whether future precipitation in the Boulder Creek basin will increase or decrease or whether Boulder Creek streamflows will increase or decrease on an annual volumetric basis, it is likely that mountain snowmelt will occur earlier in the year and that late summer flows will be significantly lower. Hydrologic changes are also likely to occur in the Western Slope basins that supply almost one half of the city's water supply. The resultant effects for Boulder's water system could be anything from an increased average water yield to a decreased yield depending on the timing of seasonal streamflow changes and their interaction with the city's ability to divert water in priority under Colorado's water administration system.

If future climate change occurs in a manner that leads to no changes in future streamflow conditions as compared to past streamflow, such as a scenario where increased precipitation offsets higher evaporative losses due to higher temperatures and little change in spring runoff timing occurs above 2,440 meters (8,000 feet) in elevation, the city's current water rights portfolio would be sufficient to supply water in conformance with the Council-adopted water system reliability criteria. However, if global warming were to cause severe reductions in streamflow or detrimental changes in streamflow patterns in the basins feeding Boulder's water supply, it could impair the city's ability to meet future water needs by reducing the yield of its water rights.

This study

The intent of this study was to work closely with the City of Boulder to assess long-term consequences of climate change. The study was conceived in consultation with city officials and designed to provide them with useful information on climate change. The intent was to see if what is known and not known about climate change could be conveyed and used by the city in long-term planning.

The study was funded by a grant to Stratus Consulting Inc. by the National Oceanographic and Atmospheric Administration's (NOAA). Stratus Consulting signed a Memorandum of Agreement with the city to cooperate on the study. Stratus Consulting worked closely with a representative of the city, Ms. Carol Ellinghouse, of the Water Utilities Department. Stratus Consulting subcontracted with Hydrosphere Inc. (now part of AMEC) to run the city's water management model and with Prof. Kenneth Strzepek of the University of Colorado to estimate change in runoff.

The study relied on a team of scientific and technical advisors. These included Dr. Tom Wigley of the National Center for Atmospheric Research (NCAR) on climate change scenarios; Dr. Connie Woodhouse of Arizona State University on the streamflow reconstructions; Dr. Klaus Wolter of NOAA on observed climate data; and Brad Udall of the University of Colorado on western water issues and assessment of climate change impacts.

Study structure

The focus of the study is on whether climate change poses a threat to the long-term reliability of Boulder's water supplies. The potential effects of climate change on flooding were not examined. (Note that the risk of flooding could increase because of a combination of larger winter snowpack and earlier snowmelt or the potential for increased intensity of precipitation events.)

Figure 1.4 displays the main elements of the study. The study began with an analysis of Boulder's current vulnerability to drought. Current drought criteria were used. Change in baseline demand was also considered. The study team decided to examine impacts in 2030 to capture impacts within a few decades, and impacts in 2070 to capture larger, but longer term impacts.

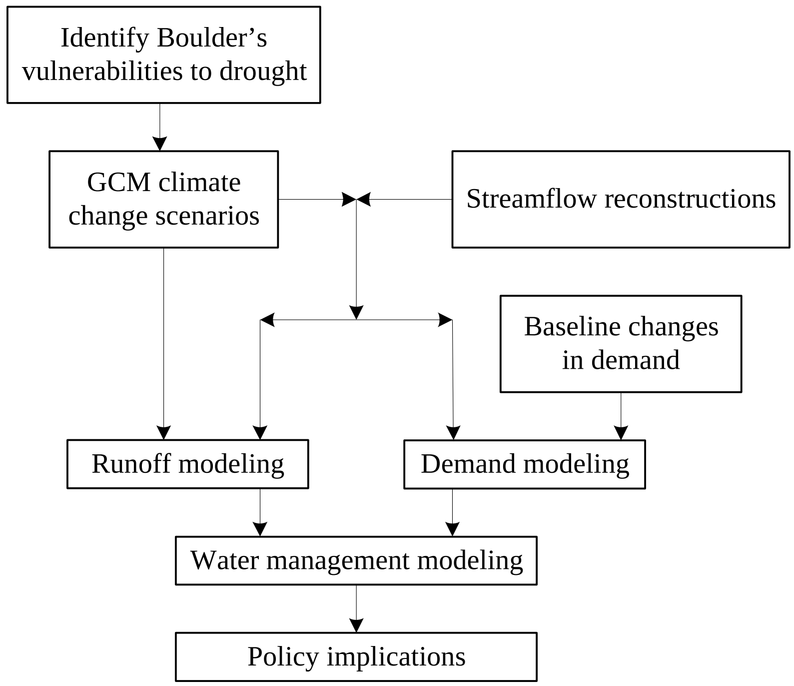

Figure 1.4. Structure of the Boulder study.

General circulation model climate change scenarios. Climate change scenarios were identified based on an analysis of output from general circulation models (GCMs). GCMs are models of the entire earth and project climate change in grid boxes that are typically several hundred miles across. As is discussed in more detail subsequently, downscaling was not used in the study. This is because only a limited number of models are available for downscaling, whereas output from about 18 GCMs was available. This presents a wider range of possible climate changes for decision making.

Streamflow reconstructions. A novel feature of this study was to combine average long-term changes in climate caused by increased greenhouse gas concentrations with a potential repeat of climate variability that happened over past centuries. Climate change studies often combine long-term mean estimates of climate change with observed data from recent decades. This effectively imposes a mean change in climate on a repeat of recent years. Even without change in atmospheric greenhouse gas concentrations, it is possible that climate variability that happened in past centuries rather than just in past decades could repeat itself. The climate variability was taken from a 437-year reconstruction of streamflow in Boulder Creek. As far as the authors are aware, this combination of a streamflow reconstruction and climate change scenarios has not been done in the United States. A similar approach was applied in the United Kingdom (Jones et al., 2006a, 2006b) and its implications for water resource management in Britain were assessed in Wade et al. (2006).

A "nearest neighbor" approach, hereafter referred to as K-NN, was used to create a temperature and precipitation record based on the streamflow reconstruction. The approach matches the reconstructions of streamflow before 1953 with observed streamflow from 1953 to 2004 (the process includes randomization so different traces are developed). Temperature and precipitation are taken from the observed record. These roughly recreate the paleoclimate record but in particular capture year to year variability from the reconstructions.

Runoff modeling. The study then estimated change in runoff in Boulder Creek. An updated version of the CLIRUN model (Kaczmarek, 1993; Yates, 1996; Strzepek et al., In preparation) was developed for the study and calibrated to historical data. The historical data included weather data from the Niwot Ridge C1 station located west of Boulder (see Figure 1.1) and natural stream flow data reconstructed from stream gages and diversion records on Middle Boulder Creek, North Boulder Creek and Boulder Creek. This model better simulates extreme wet and dry periods than previous versions of the model. The model was first run with average monthly changes in climate imposed on the observed climate record from 1952 to 2004 (e.g., adding average monthly temperature increases and multiplying percentage change in precipitation to the observed daily record).

Demand modeling. The same climate information was used to estimate change in irrigation demand from farmers downstream of Boulder.

Water management modeling. The estimated changes in runoff and demand were integrated using the Boulder Creek Model (BCM). Hydrosphere (now part of AMEC) developed and maintains the BCM for the City of Boulder. The model simulates all significant aspects of hydrology, water rights, water storage, and diversion facilities as well as water uses and return flows in the Boulder Creek basin. The model also simulates the operation of the CBT and Windy Gap projects, from which Boulder obtains a significant portion of its water supply. The model was run assuming no changes in demand other than for downstream irrigation and assuming an increase in Boulder's demand for water to 28,600 acre feet per year (assuming build out plus another 10% increase in water demand). The analysis did not consider reducing water demand through implementation of further water conservation measures.

Policy implications. The team then analyzed the results and presented them to the City of Boulder for consideration.

Climate data and current climate

Current data are from the C1 data site maintained by the University of Colorado's Institute for Artic and Alpine Research (INSTAAR) program and is part of a Long Term Ecological Research (LTER) site. The site is at 3000 meters above sea level and is located at 40º 02' 09'' N; 105º 32'

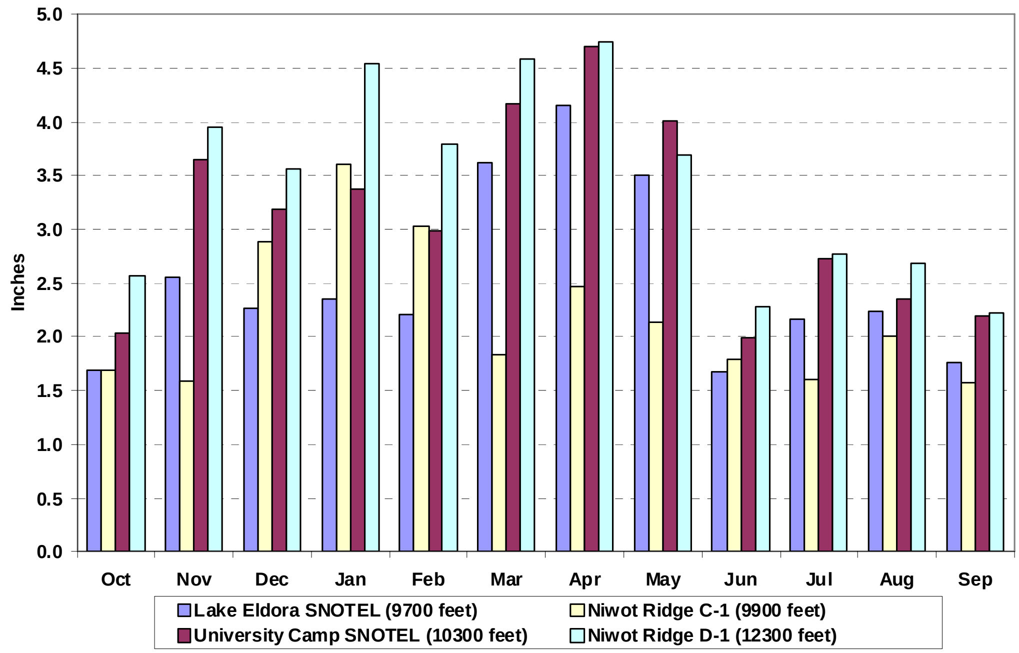

Figure 1.5. Current precipitation in Boulder Creek headwaters.

Source: City of Boulder, 2008a.

09'' W. Data on temperature, precipitation, and other variables have been continuously recorded since 1953 (University of Colorado, 2008).

Current monthly precipitation in Boulder Creek headwaters is shown in Figure 1.5 and snowpack in Figure 1.6. Precipitation typically peaks in the spring and is at a minimum in the fall. Snowpack typically begins to accumulate in the fall and peaks in April and May as higher temperatures lead to snowmelt. The city of Boulder itself typically receives 20 inches of precipitation per year (City of Boulder, 2008a).

Climate change in Colorado

Colorado's climate has warmed in recent decades. Eastern Colorado has seen a decadal temperature rise of about 0.1 to 0.3°C (0.25 to 0.4°F) per decade since the 1940s. Western Colorado has warmed at a faster rate. On the other hand, the state has generally become wetter since the 1930s, with the largest increase in the northeastern portion of the state (NOAA, 2008). Peak streamflow is happening somewhat earlier, as displayed in Figure 1.7.

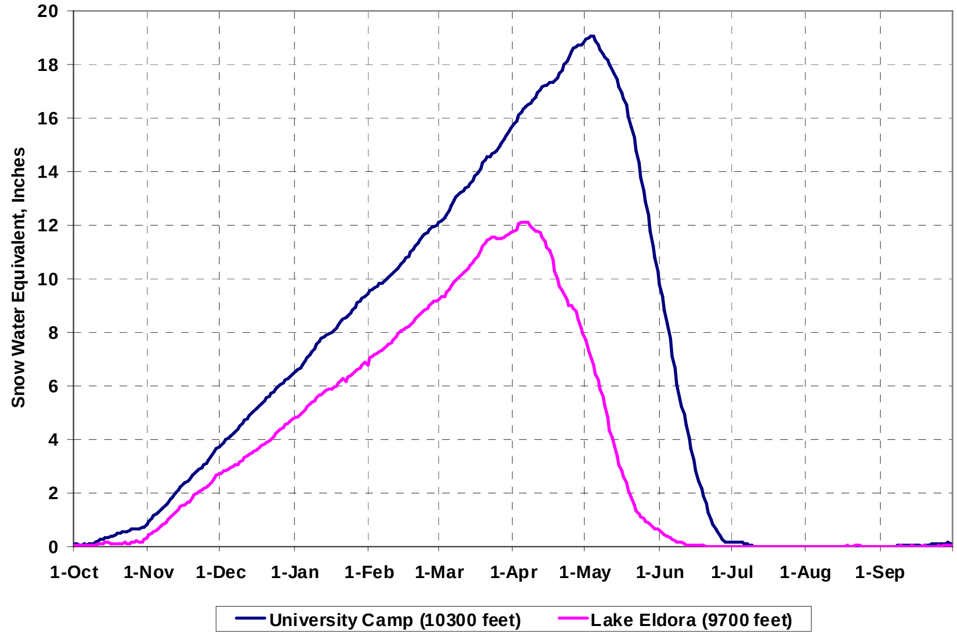

Figure 1.6. Average Snowpack in Boulder's SNOTEL sites.

Source: City of Boulder, 2008a.

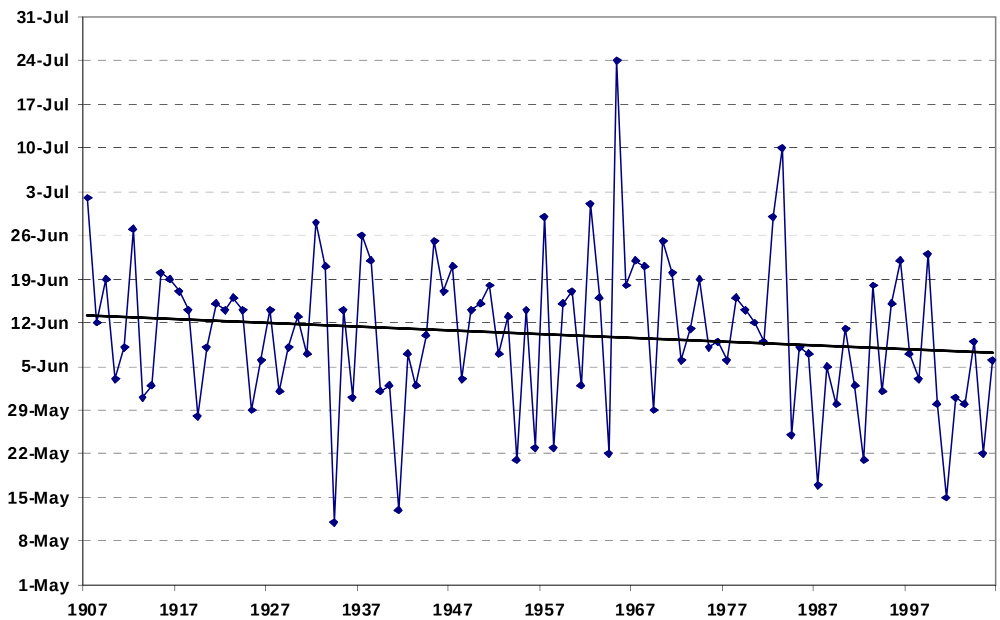

Figure 1.7. Peak streamflow in Middle Boulder Creek in Nederland.

Source: City of Boulder, 2008a.

In all likelihood, temperatures in Colorado will continue to increase, mainly because greenhouse gas emissions are projected to continue rising and for at least several decades to do so at an accelerated rate (Nakićenovic et al., 2000). The Intergovernmental Panel on Climate Change (IPCC) projects in its latest assessment a general warming across all of North America. Of the 21 GCMs run for the latest IPCC assessment, all project Colorado (and the entire lower 48 states) to warm this century (Christensen et al., 2007).

Change in precipitation is much harder to project. On average, the 21 GCMs examined by the IPCC project that the southwestern United States will see a decrease in precipitation. Based on this and other information, the IPCC concluded that it is "likely" (which means there is a two out of three chance the projection is correct) that the Southwest will be drier. The geographic domain of the Southwest is not defined by the IPCC. On average, the models show almost no change in precipitation for Colorado, but individual models differ quite considerably. Indeed, a few models project a wetter Southwest. Even those that project a drier Southwest project different patterns of change, with some areas projected to be wetter in some models and drier in others. The models tend to project circulation patterns carrying precipitation to shift poleward. Whether this shift is far enough north to reduce precipitation is not clear. In addition, the models tend to project wetter winters and drier summers, but the models have difficulty simulating the current monsoon.

The report is structured as follows:

- Chapter 2 describes the climate change scenarios including how the streamflow reconstruction was used to create scenarios which combine long-term climate change from the climate models with long-term climate variability
- Chapter 3 discusses the modeling of runoff and the change in runoff as estimated using the climate change scenarios
- Chapter 4 covers the analysis of implications for Boulder's water supplies. It describes the management modeling including implications for downstream irrigation demands and meeting Boulder's drought reliability criteria
- Chapter 5 discusses the potential policy implications of climate change for the City of Boulder and consequences for other Front Range water users
- Chapter 6 presents conclusions of the report
- The bibliography follows chapter 6.

The appendices are as follows:

- Appendix A contains the climate change scenarios
- Appendix B contains a description of the "K Nearest Neighbor" approach.

2. Climate Change Scenarios

It is critical that climate change scenarios reflect a broad range of potential changes in climate, particularly with regard to precipitation. Whether annual precipitation increases or decreases in the mountains west of Boulder will have a critical impact on net changes to Boulder's water supplies. Because this study is intended to aid in policy making, it must capture a plausible range of changes in climate that will affect Boulder. If, for example, it is uncertain how precipitation changes, but the scenarios include only increases, then users of this analysis could wrongly conclude that an increase in precipitation is likely. A similar outcome derives should the scenarios be selected from the dry end of the range of possibilities.

Precipitation is not the only key uncertainty. Future emissions and atmospheric concentrations of greenhouse gases are also uncertain. Using a range of plausible scenarios of greenhouse gas concentrations, the IPCC projected that atmospheric concentrations of carbon dioxide (CO_2), the major human increased greenhouse gas in the atmosphere, will rise from the present concentration of just of 380 parts per million (ppm) to 500 to more than 900 ppm (Solomon et al., 2007). Such differences in concentrations can result in significant differences in warming. The more temperatures increase, the more precipitation changes as well.

To capture the uncertainties about future emissions, this study used a wide range of emissions scenarios. The three scenarios (Nakićenovic et al., 2000) used are as follows:

- The B1 scenario assumes global population peaks at 9 billion by midcentury and then declines to 8 billion by 2100. There is a pronounced transition to a service- and information-based economy with clean technologies and low material intensity. CO_2 concentrations are the lowest of the SRES scenarios: more than 500 ppm by 2100.

- The A1B scenario has the same population assumption as B1. But it has the most rapid technological development and highest per capita income of the scenarios developed by IPCC. The scenario assumes a mix of fossil intensive and nonfossil fuel energy sources. CO_2 concentrations would be about 700 ppm by 2100. Note this scenario is quite widely used, although the IPCC gave no projections on which scenario is most likely to happen.

- The A2 scenario assumes very high population growth (about 15 billion people by 2100) and slower economic growth and technological development than the others. There is also less convergence in the standard of living and technology between developed and developing countries than in the other storylines. It results in the lowest per capita income of the IPCC emissions scenarios. CO_2 concentrations would be more than 800 ppm by 2100[1] (Nakicenovic et al., 2000).

For any given atmospheric concentration of greenhouse gases, there is substantial uncertainty about the regional pattern of change. This uncertainty is particularly pronounced at the geographic scale of Boulder's water supply. A minimum range of uncertainty about regional patterns of climate change is captured across the climate models, in particular across the GCMs. That is, the extent to which model projections do not yield consistent projections of regional climate change is a minimum indicator of uncertainty about future climate change. Agreement among models indicates a lower range of uncertainty, yet even then the models could be consistently in error.

For Boulder's water supply, the models consistently project that temperatures will increase but are inconsistent about precipitation. To assess the degree to which the model projections are consistent or inconsistent with each other (by consistency, we focus on the direction of change, e.g., does precipitation increase or decrease), we obtained GCM output from NCAR.[2] NCAR has put the GCM output on a standard grid and computed probability density functions (pdf) (Tebaldi et al., 2004, 2005). These should not be interpreted as a distribution function of future possibilities of climate change, but as reflecting how the GCMs project regional change.

NCAR provided data for the geographic area displayed in Figure 2.1. The colored area is the entire grid from which the date were drawn. The dotted lines connect the centers of four grid boxes used in the analysis.

Figure 2.2 shows the pdf on change in annual mean temperature for 21 GCMs in this geographic domain. The projections are for the A1B scenario and display the temperature increase in 2070 compared to 1990. Note that the years denote long-term averages (e.g., 20 years) around those dates. The differences are between model estimates of temperatures circa 1990 and projections of temperatures in 2070. Note that all of the models project an increase in temperature, but the warmest model is about three times warmer than the coolest model.

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1. Note the IPCC has an even higher emissions scenario, A1-FI, in which CO_2 concentrations exceed 900 ppm by 2100. GCM model output for this scenario was not available.

2. Data and analysis provided by the Institute for the Study of Society and Environment at NCAR, based on model data from the World Climate Research Programme's Coupled Model Intercomparison Project phase 3 (WCRP CMIP3) multi-model dataset. More information about the RCPM analysis can be found at http://rcpm.ucar.edu. © 2006 University Corporation for Atmospheric Research. All Rights Reserved.

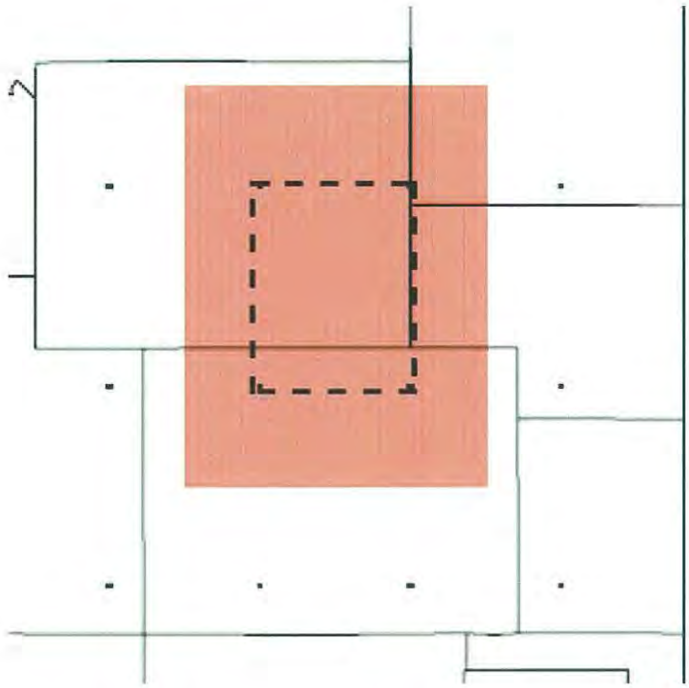

Figure 2.1. Domain of geographic area used by NCAR.

Figure 2.3 contains the pdf on precipitation: the node of the probability curve falls almost exactly over zero change. Of the 18 models in the figure, 9 project a decrease in annual precipitation, 1 projects no change, and the remaining 8 project an increase. This essentially means half the models project increased precipitation and half project decreased precipitation. Were we to examine model output for a region more to the south, the tendency would be for the models to project decreased precipitation. Were we to go farther north, the tendency would be toward projections of increases in precipitation. The area containing Boulder appears to be in the transition zone from drier to wetter.

Given this uncertainty, it is critical that the selection of models to use to examine potential climate change reflect this broad range. After examining the GCM output, the team decided to select three scenarios: a relatively wet model, a relatively dry model, and one in the middle. After analysis of model output and consultation with Dr. Wigley, we selected the following models:

- Wet model: Canadian Climate Model (CCCMA)
- Middle model: Geophysical Fluid Dynamics Laboratory (GFDL1)
- Dry model: Geophysical Fluid Dynamics Laboratory (GFDL0).

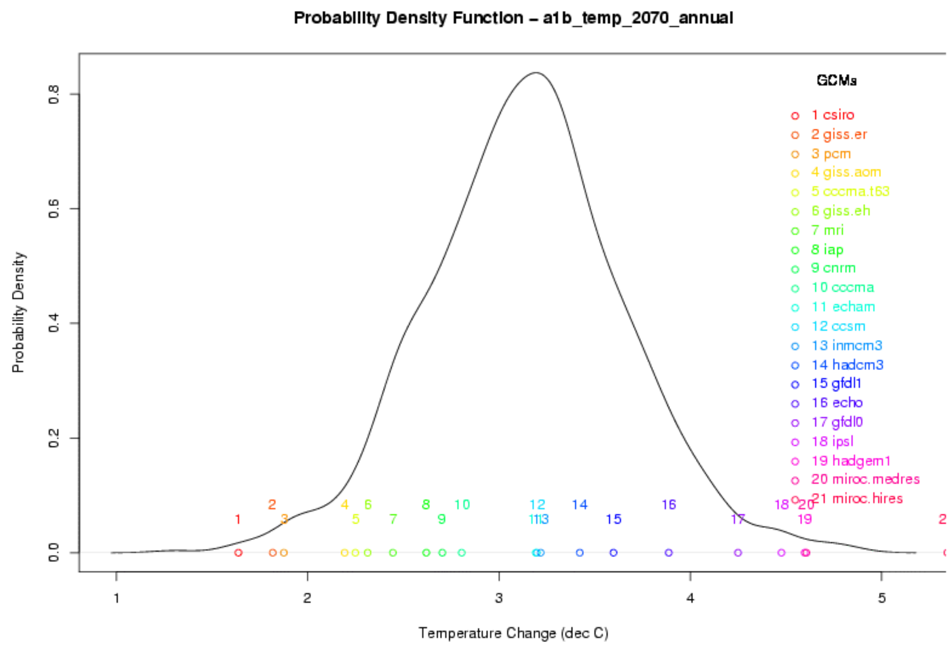

Figure 2.2. Probability density function for GCM temperature projections for Central Rocky Mountains in 2070 under A1B scenario.

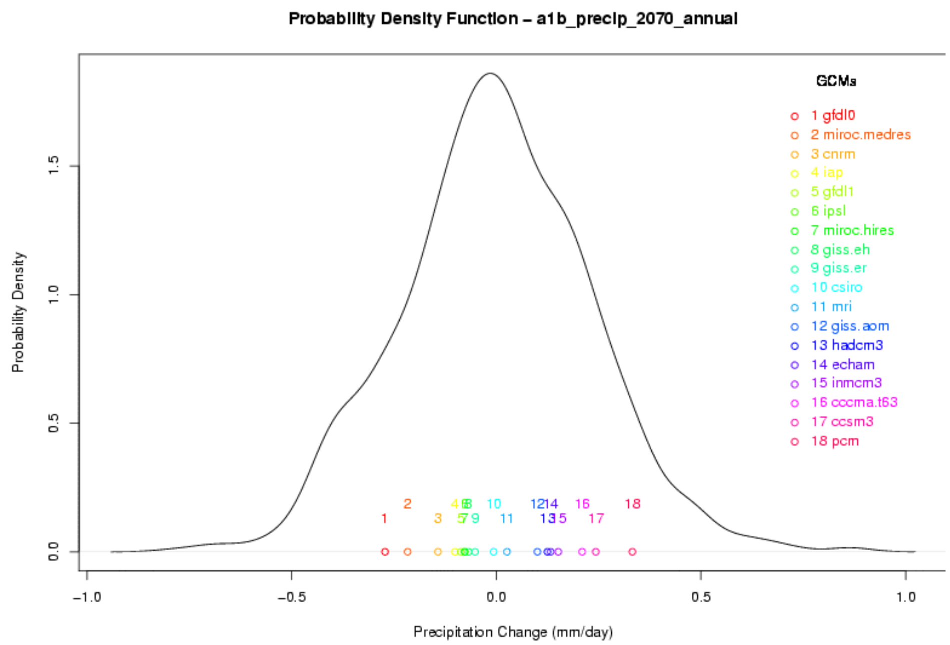

Figure 2.3. Probability density function for GCM precipitation projections for Central Rocky Mountains in 2070 under A1B scenario.

As the project proceeded, we noticed that all three models tend to project relatively wetter winters and drier summers. Indeed, most of the models project this, but not all; some models project drier winters. Given the importance of winter precipitation for Boulder's water supply, we decided to use a fourth model, the Goddard Institute for Space Studies (GISS EH) model, which projects a drier winter.

In Figure 2.3, GFDL0 is model #1, GFDl1 is model #5, CCMA is model #16, and GISS EH is model #9. The selection of models captures a wide range of precipitation output, although the "middle" model is on the wetter side of the distribution.

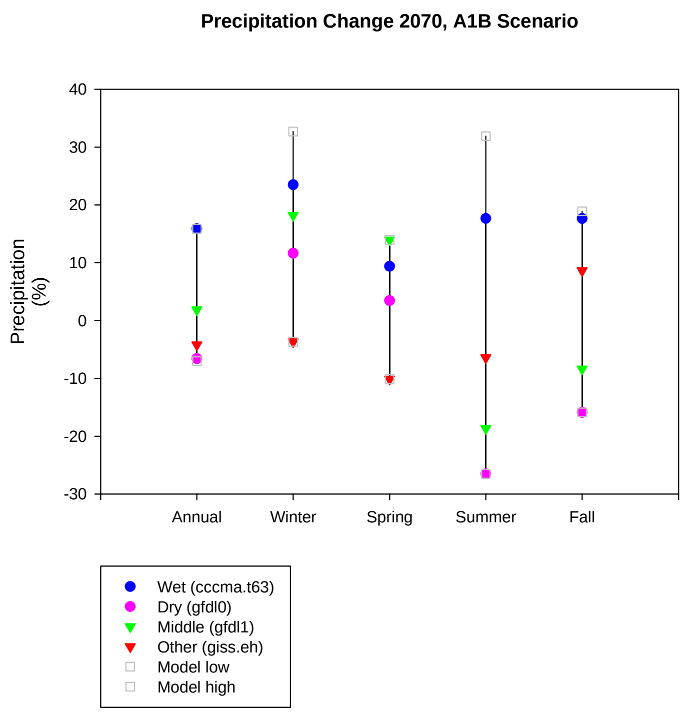

Figure 2.4. Climate change scenarios on precipitation for 2070 for A1B scenario.

Seasonal and annual projections of change in precipitation for the four models under the A1B scenario in 2070 are displayed in Figure 2.4 Two of the models project a decrease in annual precipitation, one projects a slight increase, and the fourth (CCMA) projects a larger increase. Three of the models project a wetter winter, and three project a drier summer.

Figure 2.5 displays temperature increases for the A1B scenario. The annual temperature increases range from over 2.2°C to about 4.2°C. The range of changes across all of the GCMs is much broader, ranging from 1.6°C to 5.3°C. The models project more warming in the summer than the other seasons. The four scenarios selected happen to be on the lower end of the range of models for the winter and spring seasons. Thus, the impact of higher temperatures on snowpack in winter and spring may be more significant than is discussed here.

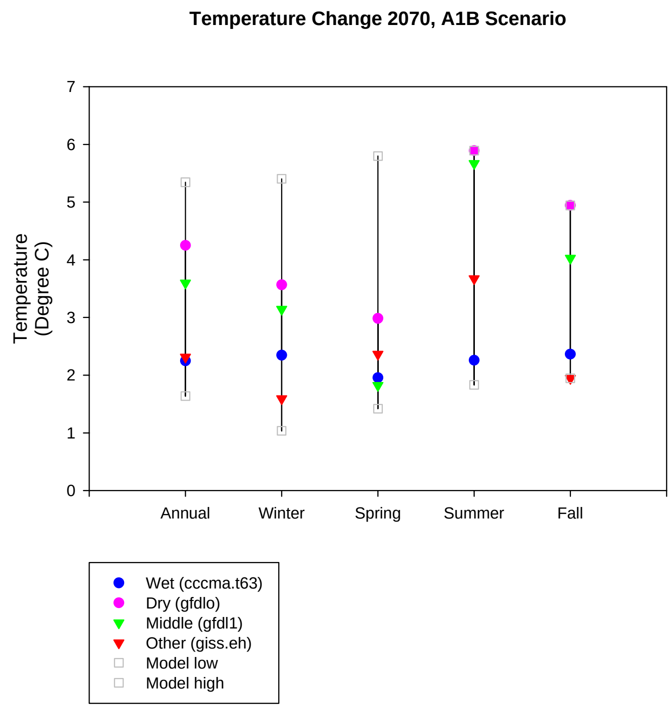

Figure 2.5. Climate change scenarios on temperature for 2070 for the A1B scenario.

Numerical scenario projections are in Appendix A. Baseline scenarios

Boulder has a buildout scenario of 125,000 people with 170,000 jobs (City of Boulder, 2008a). Annual demand for water was assumed for this analysis to increase to 28,600 acre-feet per year under buildout conditions.

2.1 Combined Climate Change and Streamflow Reconstructions

One of the unique aspects of this study was to examine the sensitivity of Boulder's water supplies, not just to a long-term change in average climate conditions (e.g., warmer temperatures) but also to a return to climate variability of past centuries.

Although there is no record of observed temperature or precipitation from past centuries (from which to draw information from past climate variability and on which to impose climate change scenarios), scientists have developed paleoreconstructions of streamflow from past centuries. Such paleoreconstructions provide information about the variability in annual streamflow. Streamflow is directly influenced by climate, both temperature, which affects the timing of snowmelt and amount of evaporation, and precipitation. Variability in streamflows, therefore, reflects climate variability.

The principal streamflow record used in this study was a 437-year reconstruction of streamflow at Orodell in Boulder Creek from 1566 to 2002 (Woodhouse and Lukas, 2006; Figure 2.6). This streamflow reconstruction is based on tree-ring data from the basin and neighboring basin. The reconstructed series represents the statistically "most-likely" annual flow for each year based on the set of tree-rings. Note that the approach estimates 65%[3] of the variance in the recorded streamflow record. So, developing a monthly climate based on this single estimate does not provide a robust estimation of the possible temperature and precipitation. The solution to this is to generate an ensemble of reconstructed historical climate that span the statistical range.

Climate models yield changes in temperature and precipitation, yet the reconstructed streamflow provides only an estimate of annual streamflow. It is not possible to combine the changes from the climate models directly with a streamflow record. The challenge was to develop an approach that could provide monthly scenarios (because the hydrology models estimate runoff on a monthly basis) of temperature and precipitation that would be consistent with variability in the paleoreconstruction of streamflow. The technique developed for this study used the available observed climate record in the higher elevation portion of the Boulder Creek watershed (1953-2004) and the reconstructed streamflow record (1566-2006) to yield new, 437-year proxy temperature and precipitation records consistent with the streamflow reconstructions.

In developing a monthly paleoclimate record from the annual paleostreamflow reconstruction, it was not important to exactly replicate monthly temperature and precipitation that would produce the streamflow reconstructions. It was more important to capture interannual variability and persistence of wet and dry periods from the paleoclimate record. It was not critical to exactly replicate the long-term droughts from the reconstruction, with warmer temperatures from climate

3. It has an R^2 of 0.65.

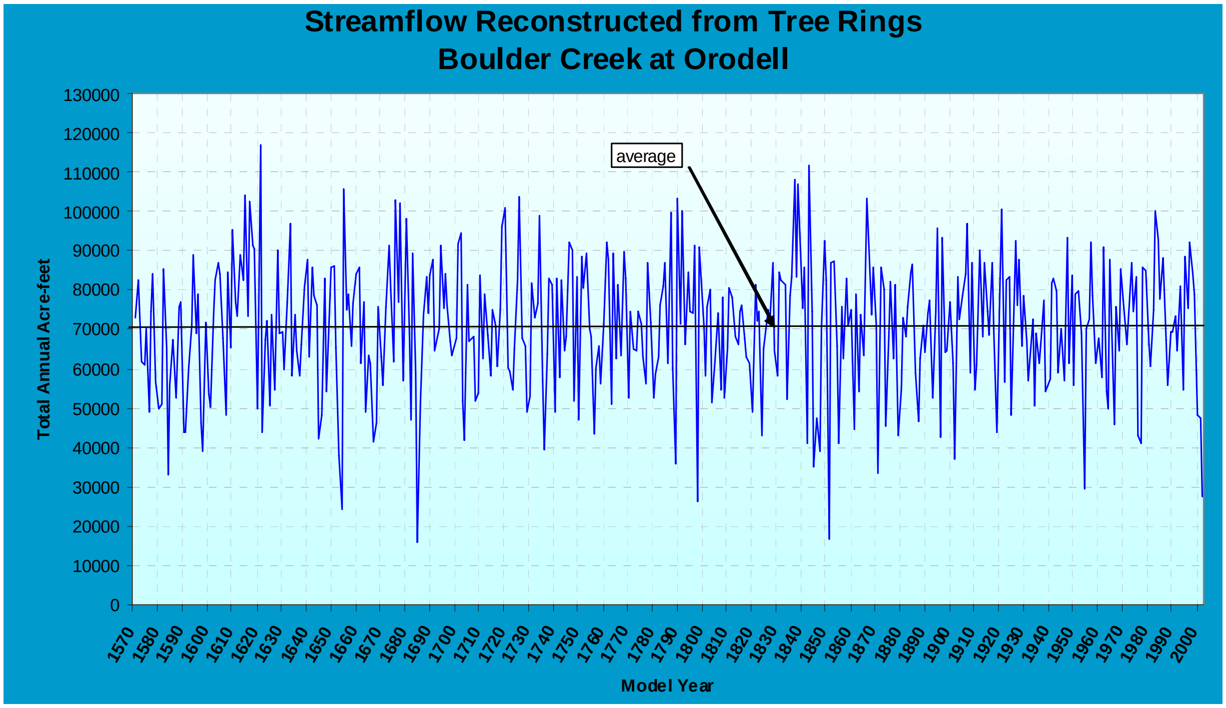

Figure 2.6. Reconstructed streamflows for Boulder Creek.

Source: Woodhouse and Lukas, 2006.

change added in. We can match these modern measured streamflows with years from the reconstructed record and assume that the temperature and precipitation in the modern record would approximately produce the streamflow of reconstructed year. Creating a climate record that could approximate the paleoclimate record was sufficient for this analysis. This develops a long-term monthly climate record that repeats the occurrence of long-term droughts from the reconstructed streamflow record with sufficient statistical accuracy and provides a monthly climate time series that can be joined with GCM generated monthly climate changes in temperature and precipitation.

We used a "non-parametric nearest neighbor" approach.[4] Reconstructed streamflows in the period before 1953 (when climate observations at the C1 monitoring station began) were compared to reconstructed streamflows from 1953 to 2004. The "nearest neighbor" in the recent record is then selected as a proxy for the pre-1953 streamflow. The temperature and precipitation record from C1 is then used to approximate the climate of the past.

4. We are indebted to Dr. Rajagopalan Balaji of the University of Colorado for advice and guidance on applying this procedure.

The "K-NN" approach is a statistical approach. The methods select a set of years in the 1953-2004 record which best matches the pre-1953 streamflow. The number of neighbors is a parameter of the method. The method then selects from the set of years "neighbors" via randomization procedure. This allowed for creation of any number of historic climate traces grouped together as an ensemble. For this analysis over one thousand traces were generated to span the statistically likely the paleoclimate record. The procedure is described in more detail in Appendix B.

3. Runoff Modeling

3.1 Model Description

CLIRUN-II was used to estimate runoff in South, Middle, and North Boulder Creeks as well as the Upper Colorado River basin. CLIRUN-II is the latest model in a family of hydrologic models developed specifically for analyzing the impact of climate change on runoff. Kaczmarek (1993) presents the theoretical development for a single-layer lumped watershed rainfall runoff model-CLIRUN, and Kaczmarek (1998) presents the application of CLIRUN to the Yellow River in China.

Yates (1996) expanded on the basic CLIRUN by adding a snow-balance model and a suite of possible PET models, and packaged it in a tool called WATBAL. WATBAL has been used on a wide variety of spatial scales from small to large watersheds and globally in 0.5 × 0.5° grid (Strzepek et al., 1999; Huber-Lee et al., 2005; Strzepek et al., 2005).

CLIRUN-II (Strzepek et al., In preparation) is the latest in the “Kaczmarek School” of hydrologic models. It incorporates most of the features of WATBAL and CLIRUN but was developed specifically to address extreme events at the annual level, modeling low and high flows. CLIRUN and WATBAL did very well in modeling mean monthly and annual runoff, important for water supply studies, but did not model well the tails of runoff distribution.

CLIRUN-II has adopted a two-layer approach following the framework of the SIXPAR hydrologic model (Gupta and Sorooshian, 1983, 1985) and a unique conditional parameter estimation procedure was used.

Spatial and temporal scale: CLIRUN-II models runoff as a lumped watershed with climate inputs and soil characteristics averaged over the watershed simulating runoff at a gauged location at the mouth of the catchment. CLIRUN-II can run on a daily or monthly time step. For this study, climate and runoff data were available only on a monthly basis, so monthly was used.

Snow-balance model: The snow accumulation and melt model used is based on concepts frequently used in monthly water balance models (McCabe and Wolock, 1999). Inputs to the model are monthly temperature (T) and precipitation (P) The occurrence of snow is computed as function of average watershed temperature and two parameters: Temp_snow and Temp_rain. These two parameters are calibrated for each watershed. Snowmelt is added to any monthly precipitation to form effective precipitation available for infiltration or direct runoff.

Water balance: Figure 3.1 is a schematic of the water flows of CLIRUN-II, showing the mass balance of water in the CLIRUN-II system. Water enters via precipitation and leaves via evapotranspiration and runoff. The difference between inflow and outflow is reflected as change in storage in the soil or groundwater.

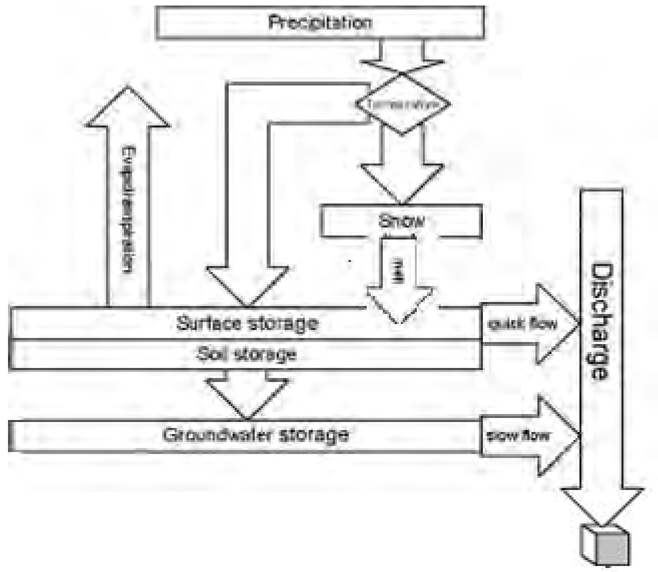

Figure 3.1. CLIRUN-II conceptual hydrologic model schematic.

Evapotranspiration: A suite of potential evapotranspiration models are available for use in CLIRUN-II. For this study, the Blaney-Criddle (temperature based) method (FAO, 1996) was used to be consistent with State of Colorado practices. Actual evapotranspiraton is a function of potential and soil moisture state following the FAO method (FAO, 1996).

Soil water modeling: Soil water is modeled as a two layer system: a soil layer and groundwater layer. These two components correspond to a quick and a slow runoff response to effective precipitation.

1. Quick runoff: The soil layer generates runoff in two ways. First there is a direct runoff component, which is the portion of the effective precipitation (precipitation plus snowmelt) that directly enters the stream systems. The remaining effective precipitation is infiltration to the soil layer. The direct runoff is a function of the soil surface and modeled differently for frozen soil (winter and spring) and nonfrozen (summer and fall).

The infiltration then enters the soil layer. A nonlinear set of equation determines how much water leaves the soil as runoff, how much is percolated to the groundwater, and how much goes into soil storage. The runoff is a linear relation of soil water storage and percolation is a nonlinear relationship of both soil and groundwater storages.

2. Slow runoff. The ground water receives percolation from the soil layer and runoff is generated as a linear function of groundwater storage.

The soil water processes have six parameters similar to the SIXPAR model (Gupta and Sorooshian, 1983) that are determined via calibration of each watershed.

Modeling dry and wet years

When CLIRUN-II is calibrated in a classical rainfall-runoff framework, the results are very good for the 25th to 75th percentile of the observed streamflows, producing R^2 of 0.3 to 0.7.[1] However, for most water resource systems, the tails of the streamflow distribution are important for design and operation planning. To address this issue, a concept developed by Block and Rajagopalan (2008) for hydrologic modeling of the Nile River known as localized polynomial was extended to calibrate rainfall runoff modeling in CLIRUN-II (Strzepek et al., In preparation).

Briefly, each observed year is categorized as to whether it falls into a dry year (0-to 25% of the distribution), a normal year (25% to 75%), or wet year (greater than 75%). A separate set of model parameters were estimated for the three different classes of annual streamflow. This increased the R^2 from 0.7 to 0.92.

Modeling the snowpack and its runoff is critical because three-quarters of the runoff in Boulder Creek above Boulder is from snowpack (see Figure 3.2). Precipitation is at least 40 mm in all months and peaks in April. Runoff, however, is barely above zero in the winter and peaks in June.

CLIRUN-II was calibrated to flow at 14 separate locations using estimated virgin flow (1907-2006). The goal was to model the relationship between climate and flow, so observed climate from 1953 to 2004 from the C1 monitoring station was used.

It was critical to capture extreme dry and wet years, so three versions of the model were calibrated: one for “middle” or normal years, one for drought or relatively dry years, and one for flood or relatively wet years. With the three models, the R^2 for estimating flow at Orodell was 0.91.

1. R^2 is the amount of observed variance explained by a model.

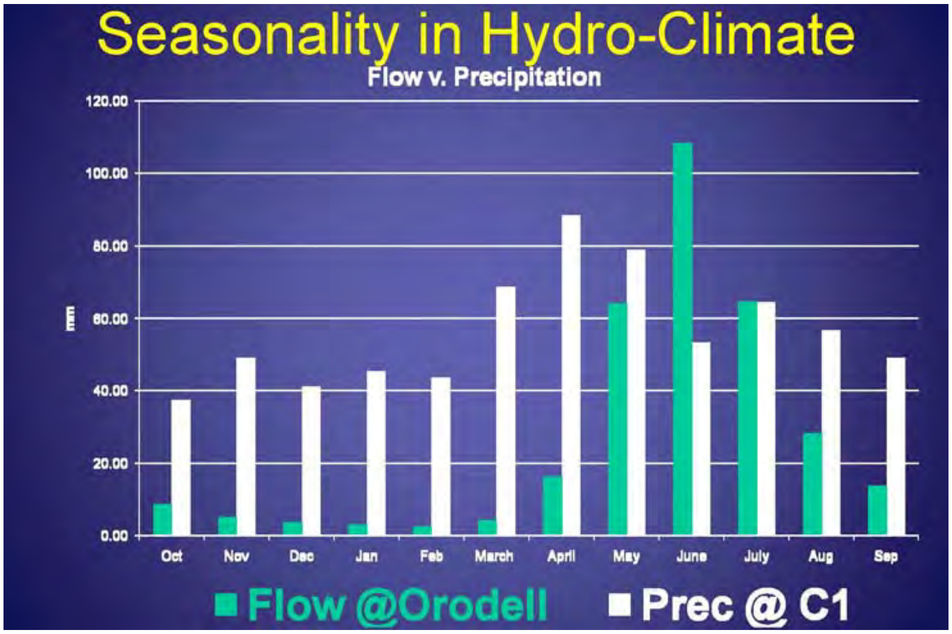

Figure 3.2. Precipitation and runoff for Boulder Creek.

Sensitivity analysis

The model was run assuming arbitrary annual increases in temperature and changes in precipitation (see Figure 3.3). The purpose of this analysis is to examine the sensitivity of annual flow and timing of runoff to changes in temperature and precipitation. Runoff in Boulder Creek currently peaks in June. A 3°C (5.6°F) temperature increase with no change in precipitation results in a 4% reduction in annual flow, but with a 3 % increase in Spring runoff and a 28% decrease in summer runoff. Note that annual water supply in the basin is not very sensitive to temperature because it either precipitates as rain or snow. If it comes as winter or spring rain it runs off quickly because the soil is either frozen or fully saturated due to snow melt. The effective precipitation has little opportunity to evaporate and runs off quickly.

In sensitivity runs, annual precipitation was held constant, runoff increased in winter and decreased in summer. A 20% reduction in winter precipitation results in only an 8% decrease in winter runoff because of the earlier snowmelt. When such a change is combined with a 30% increase in summer precipitation, there is a 1% increase in summer runoff, but a 4% decrease in annual runoff.

If annual precipitation is reduced 20%, 20 % in winter and 18% in summer the annual reduction in runoff is only 13%.

The results show three important features of the Boulder Creek hydrologic system:

1) Due to its altitude runoff response to precipitation is very different between the Winter/Spring season as compared to the Summer/Fall season.

2) Runoff in both seasonal regimes behaves non-linearly with precipitation.

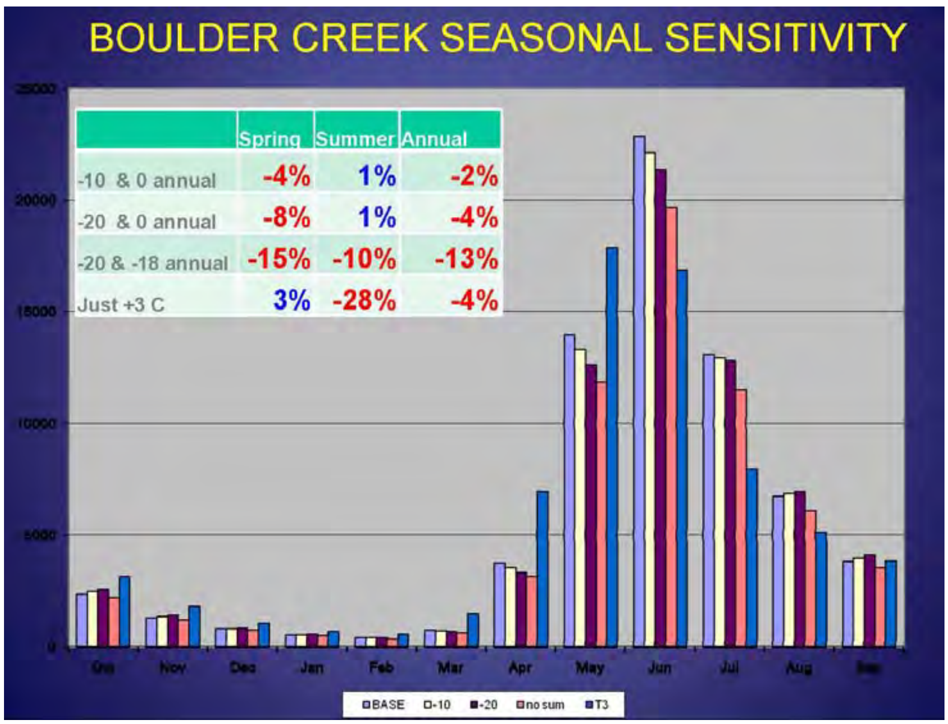

Figure 3.3. Sensitivity of Boulder Creek runoff to climate change.

3) The magnitude of temperature increase estimated by the models for 2070 shifts peak runoff at least one month earlier.

GCM scenarios

Perhaps more important, a 3°C increase in temperature shifts peak runoff from June to May. Indeed, runoff is projected to increase from October through May because more snow is melted off or precipitates as rain. From June through August, however, runoff drops. September remains virtually unchanged.

The effect of the GCMs in 2030 is displayed in Figure 3.4. All the scenarios result in higher runoff in April and May and lower runoff in July and August. There is little change from October through March. For other months, whether runoff increases or decreases depends on change in precipitation.

The effect of the GCM scenarios for 2070 is displayed in Figure 3.5. By 2070, the temperature increase is large enough to shift peak runoff a month earlier than in current conditions.

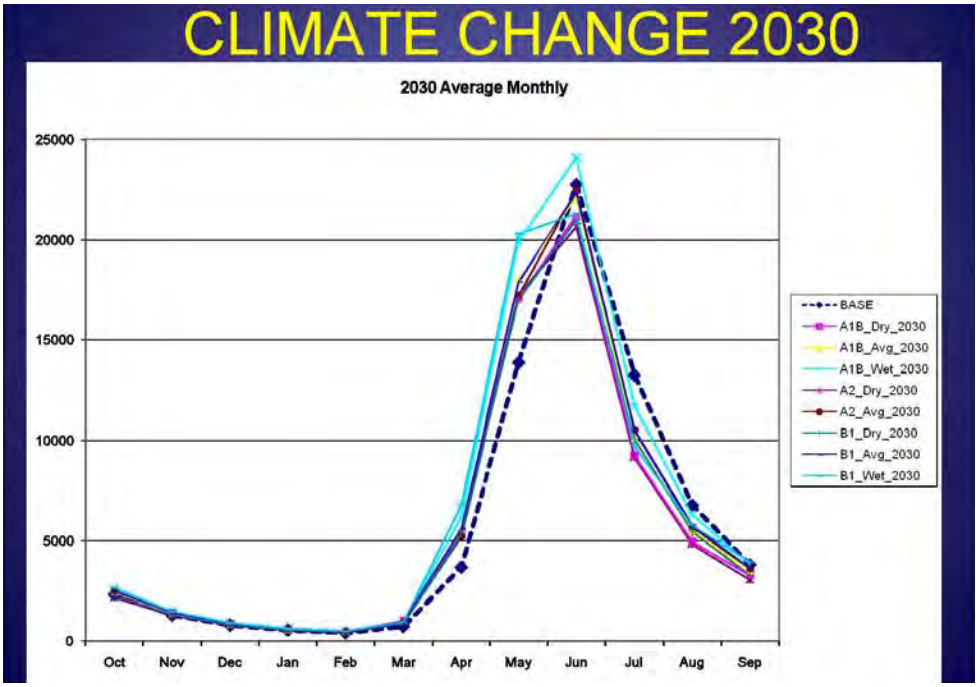

Figure 3.4. Boulder Creek runoff under current climate and climate change in 2030.

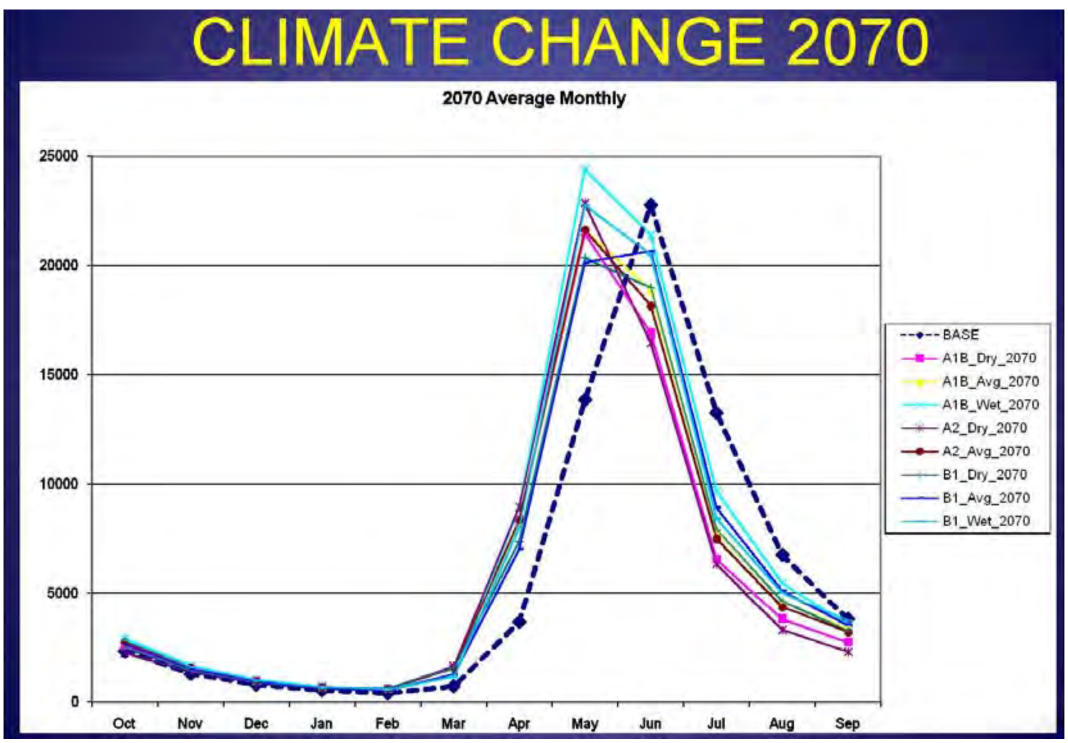

Figure 3.5. Boulder Creek runoff under current climate and climate change in 2070.

Analysis of combination of climate change and prerecorded climate

Figure 3.6 displays the combination of the proxy climate and GCM output compared to simulated runoff assuming no climate change. The wet scenario results in much higher runoff, particularly in very wet years. This is because the additional precipitation goes almost exclusively to runoff as actual evapotranspiration is almost at potential or maximum levels.. The dry scenario results in generally lower runoff. However, in dry years, paradoxically, the effect is less pronounced. This is because in those years the potential evapotranspiraration is so high that

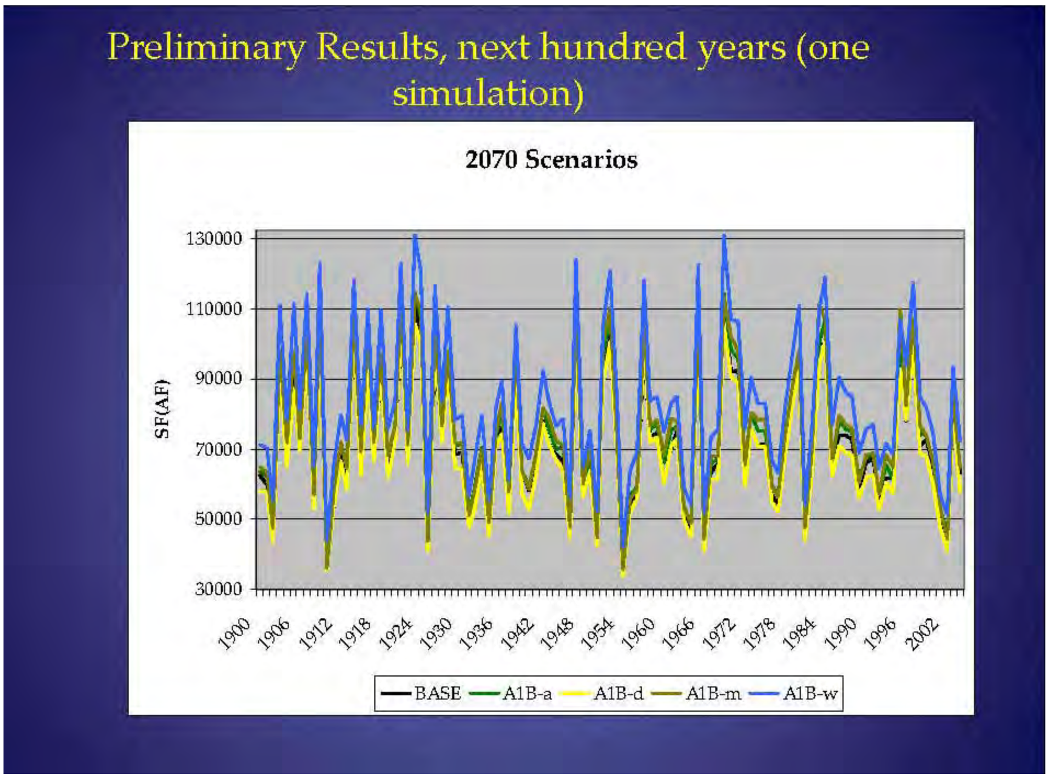

Figure 3.6. Combined reconstruction with 2070 climate change scenarios.

there is little runoff in the basin. Reducing the rainfall makes little difference in runoff since most precipitation has been lost to the atmosphere.

Table 3.1 summarizes annual and seasonal changes in runoff using the combined 437-year and climate change calculations.

Table 3.1. Estimated change in runoff in Boulder Creek

	Seasonal change				
Scenario	**Annual**	**Winter**	**Spring**	**Summer**	**Fall**
Base case	0%	0%	0%	0%	0%
B1 Wet 2030	7%	19%	19%	-18%	15%
B1 Mid 2030	-2%	4%	13%	-28%	-7%
B1 Dry 2030	-3%	9%	7%	-21%	-1%
A1B Wet 2030	12%	21%	24%	-8%	14%
A1B Mid 2030	-2%	5%	13%	-25%	-12%
A1B Dry 2030	-4%	19%	8%	-26%	6%
A1B Dry3 2030	-6%	-3%	2%	-23%	0%
A2 Mid 2030	-1%	8%	10%	-22%	4%
A2 Dry 2030	-5%	8%	7%	-28%	-2%
B1 Wet 2070	9%	38%	27%	-28%	23%
B1 Mid 2070	0%	23%	16%	-27%	2%
B1 Dry 2070	0%	62%	15%	-34%	9%
A1B Wet 2070	16%	45%	35%	-21%	27%
A1B Mid 2070	5%	46%	25%	-35%	16%
A1B Dry 2070	-4%	65%	15%	-44%	12%
A1B Dry3 2070	-3%	32%	13%	-35%	7%
A2 Mid 2070	0%	47%	20%	-41%	11%
A2 Dry 2070	-4%	62%	19%	-49%	0%

Note that annual changes in runoff are relatively insensitive to temperature changes and quite sensitive to precipitation changes. In the table and in some figures, “Dry3” is the alternate scenario with decreased winter precipitation. The wet scenarios result in increased runoff, the dry scenarios decreased runoff, and the middle scenario (with close to no change in annual precipitation) results in little change. All of the scenarios result in increased spring runoff and decreased summer runoff, demonstrating the relative importance of temperature compared to precipitation in affecting the seasonality of flow. Winter runoff increases in all of the scenarios except the 2030 alternate scenario. There, the decrease in winter precipitation more than offsets the higher runoff from increased temperatures. By 2070 even in this scenario, the effect of higher temperature on snow melt more than offsets the decrease in winter precipitation. Figure 3.7

displays the changes in May and July runoff. All scenarios cause an increase in May runoff and a decrease in July runoff.

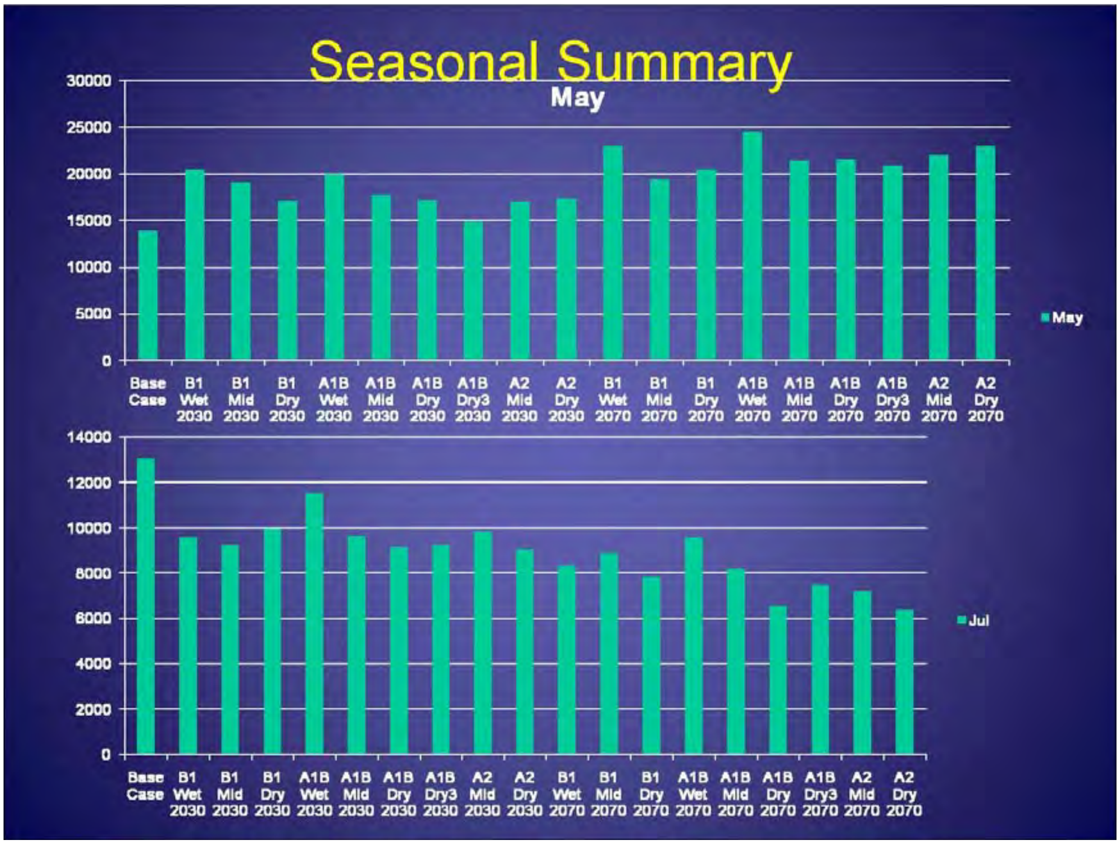

Figure 3.7. May and July runoff in Boulder Creek.

4. Water Management Modeling

The study team evaluated the effects of the climate change scenarios on the City of Boulder's water supply system and on regional water supplies using an existing model of the management of the City's water system, the Boulder Creek Model (BCM). Time series outputs of natural stream flows from CLIRUN-II and temperature and precipitation from the GCMs combined with the 437 year paleo-climate reconstruction of streamflow in Boulder Creek were incorporated into BCM. BCM was used to evaluate each of the 18 climate change scenarios, with each scenario represented by 11 alternate traces of hydrologic and temperature/precipitation time series.

BCM is a water management model developed by Hydrosphere (now AMEC Earth & Environmental) for the City of Boulder to simulate the operation of Boulder's water supply system for a range of planning purposes. It is a well-developed computer model that has allowed considerable evaluation of the adequacy of the city's water rights portfolio. This model simulates operation of the city water system as it meets a specified annual demand level over a variable time series of climate and natural flow hydrology data, and evaluates the ability of the City's water rights and water supply system to meet that demand.

This network model uses a linear programming algorithm to allocate water supplies among competing demands. It optimizes allocation of water based on relative water rights priorities or operating rules as objective function drivers. It incorporates the requirements of mass balance, stream topology, facilities capacities, water rights limits, and demands as side constraints. The model operates on a quarter-monthly time step and uses hydrological inputs (e.g., gauge data or estimated runoff from CLIRUN-II). Each time step is iteratively solved, first to allocate natural stream flows among competing water rights based on relative priorities, then to simulate other aspects of water management including allocation of immediate return flows and operations of exchanges and reservoir releases.

BCM simulates all major physical and institutional aspects of stream flow hydrology, water rights administration, and water use within the 439 square mile Boulder Creek basin. Physical aspects include natural stream flows and stream segments, water imports into the basin, reservoirs, ditches and raw water pipelines, water demands, consumptive use, and return flows. Institutional aspects include water rights, reservoir operating rules, and water supply system operation rules.

Boulder's municipal raw water supply system is represented in detail, including the city's surface water diversions, reservoirs, raw water pipelines, and water and wastewater treatment plants. Customer demands are represented as three separate components, reflecting the city's three distribution pressure zones, which allow water system pressure to be maintained in acceptable ranges across elevation changes from the western foothills area of Boulder to the eastern-most area of the city on the plains. The model emulates Boulder's reservoir operating rules as well as its drought recognition thresholds and response triggers.

Other competing water uses in the Boulder Creek basin are individually and explicitly represented, including irrigation ditches and reservoirs, and other municipal (Lafayette, Louisville, Denver) and industrial (Xcel Energy) water supply systems.

Calls by water rights diverting downstream of the Boulder Creek basin in other parts of the larger South Platte basin are represented in BCM as a time series of unlimited demands at the bottom of the Boulder Creek network with ranks corresponding to the priorities of calls from downstream water rights. When the model is run using historical hydrology, the priorities of such calls reflect historical call records. When the model is run using synthetic hydrology, the priorities of such calls are estimated based on historical relationships between climate and natural stream flow as independent variables and downstream calls as the dependent variable.

BCM simulates deliveries from the Colorado-Big Thompson and Windy Gap projects (from the Upper Colorado River) to project allottees in the Boulder Creek basin using a separate operating module (cooperatively developed with Mr. Andy Pineda of NCWCD) that emulates the operations and quota-setting policies of the those projects based on project inflows. This study assumed adequate CBT replacement supplies in Green Mountain Reservoir and no Colorado River Compact calls.

The principal use of BCM is to assess the reliability of Boulder's water supply system given assumptions regarding climate and associated natural stream flow hydrology, Boulder's municipal water demands, and water rights and facilities available to Boulder. The model attempts to meet a specified annual municipal water demand over given time series of variable natural stream flows, climate data, and transbasin imports. In the model, Boulder's municipal demands are reduced during droughts according to Boulder's adopted drought response triggers and water use reduction goals. Each model run is "scored" based on Boulder's adopted water supply reliability criteria.

The BCM originally operated using 1950-1985 historical natural flow hydrology reconstructed from records of stream gauges and upstream diversions. In 2002, an alternate set of tree ring-derived hydrologic data covering the period of 1703-1987 was developed for use in the model in cooperation with Dr. Connie Woodhouse of NOAA. In 2006, the gauge-based natural stream flow data were extended to cover 1907-2006 and the tree ring-based data were extended to cover 1566-2003 based on the extended periods of available gauge-based natural stream flow data and new tree ring data that had been collected to include three rings laid down during the recent and extreme drought year of 2002.

4.1 Application to this Study

BCM was modified for use in this study to incorporate the following inputs:

- Higher elevation hydrology inputs from CLIRUN-II
- Eleven traces for each scenario
- Temperature, precipitation inputs directly from GCMs
- New temperature and precipitation-driven algorithms developed to generate time series data not obtained directly from CLIRUN-II and GCMs: lower elevation runoff, unit agriculture demands, agriculture return flows, and South Platte calls.

CLIRUN-II estimated runoff in the following locations in the Boulder Creek basin (see Figure 1.1 in Chapter 1):

- North Boulder Creek at Silver Lake
- North Boulder Creek gains at Lakewood
- Middle Boulder Creek at Nederland
- Boulder Creek gains at Orodell
- South Boulder Creek at Gross Reservoir
- South Boulder Creek gains at Eldorado Springs

CLIRUN-II was also run to estimate change in runoff in the Colorado River near Hot Sulphur Springs. That information was used to estimate changes in CBT and Windy Gap deliveries.

Direct output from the GCMs was used to estimate the following:

- Boulder Creek gains at lower elevations (Orodell to 75th Street)
- Irrigation demands and return flows in Boulder Creek Basin
- South Platte calls.

Boulder Creek gains from Orodell to 75th Street are caused by precipitation, local inflows, return flows, and groundwater interactions. These gains are relatively minor compared to Boulder Creek natural flows at Orodell (approximately 17,000 acre-feet per year vs. 71,000 acre-feet per year, respectively), but are important in modeling the allocation of stream flows among water rights. Gains from Orodell to 75th Street can be readily quantified via mass balance analysis using stream flow gage records and diversion records. Historical gains correlate reasonably well ($R^2 = 0.46$) with local precipitation as measured at the Boulder weather station over the period of 1987-2006, for which data are available for all mass balance components. In this study, estimated changes in precipitation from the GCMs were used to estimate the Boulder Creek gains based upon this historical correlation.

In the BCM, irrigation demands in the Boulder Creek basin are calculated on a crop unit basis, applied to crops and acreages served by individual irrigation rights. The calculations employ the modified Blaney-Criddle method (USDA, 1970) which utilizes frost dates, mean monthly temperature and mean monthly precipitation. The growing season is sensitive to changes in frost dates, temperature and precipitation, and crop coefficients are sensitive to changes in temperature and precipitation. Incorporation of climate model output resulted in shifts in seasonal irrigation demand patterns. Because climate model output did not include specific frost dates, frost dates were generated via correlation with monthly mean temperatures from the climate models. Irrigation return flows in the Boulder Creek basin are explicitly modeled based upon historical relationships between irrigation diversions and return flows to lower Boulder Creek, which were quantified via mass balance techniques. The study assumed no changes in crop mixes.

In order to reasonably evaluate the effects of climate change scenarios, South Platte calls in the BCM were based upon historical call patterns but were responsive to climate change. In this study, we generated separate South Platte calls for the irrigation (April through September) and non-irrigation seasons (October through March). For irrigation season calls, we categorized historical Orodell natural flows into six “year types:” very wet, wet, average, dry, very dry, and year following very day. We correlated historical Orodell natural flow year types with South Platte calls during the irrigation season (R^2 = 0.98). This correlation reflects the relationship between supply and demand. Irrigation season calls are more senior and extensive in dry years than in wet years, and natural flows at Orodell are generally indicative of overall stream flow conditions throughout the South Platte basin. We generated irrigation season South Platte calls using this “flow year” type/seasonal call pattern relationship and scenario-derived Orodell natural flows.

South Platte calls during the non-irrigation season are driven by the filling of several large off-channel irrigation reservoirs on the Lower South Platte. These reservoirs begin filling at end of irrigation season (typically October) and reach maximum levels between March and June. The length of time required for the Lower South Platte reservoirs to fill each year is a function of both natural stream flows and irrigation demands over the previous irrigation season or seasons. Lower-than-average stream flows combined with higher-than-average irrigation demands over one or more years typically result in relatively low return flow volumes during the ensuing reservoir filling seasons and vice versa. The date by which the Lower South Platte Reservoirs historically filled each year is reasonably correlated with a “supply index,” comprised of Orodell natural flow and Longmont ET for the two previous years (R2 = 0.49). We generated non-irrigation season South Platte calls using this supply index/”fill date” relationship and scenario-derived Orodell natural flows and Longmont temperature and precipitation.

4.2 Key Assumptions

This study did not consider reduced CBT deliveries resulting from potential Colorado River Compact calls because such an analysis would be beyond the scope and resources of this study. Previous studies such as Christensen and Lettenmaier (2007) found that average runoff in the Colorado River could be reduced by climate change. Whether such a reduction in runoff would eventually lead to a Compact Call is uncertain. Such a call has not happened and there are uncertainties in the "Law of the River" as to how shortages will be handled. Furthermore, the entire State of Colorado would have to address a Compact Call, not Boulder alone. By not considering the possibility of a Compact Call, the results of the particularly dry scenarios may be optimistic.

Other important model run assumptions are as follows:

- Boulder's "build-out" municipal water demand was modeled at 28,600 acre-feet per year, which includes a 10% safety factor, and is based on a build-out demand number from a now-outdated population and employment projection that is probably overstated (conservative).
- Boulder is not allowed to carry over its CBT water in CBT project storage. Such carry-over has been allowed as an operating practice for the last 15 to 20 years but is not an official permanent policy (conservative).
- Boulder's diversions are not allowed to dry up certain segments of Boulder Creek during droughts. In practice, such dry-up practices are allowed and have occurred (conservative).
- No attempt was made to modify Boulder's drought recognition thresholds, drought response targets, or system operating rules to respond to climate change.
- The study did not examine the effect of adaptations within Boulder's water supply system such as conservation measures that can temporarily or permanently reduce demand (e.g., replace bluegrass with no or native vegetation).
- Similarly, the study did not examine the effect of adaptations by irrigated agriculture such as switching to a different crop mix.
- The model does not consider other limitations on CBT's ability to divert entire physical supply except for local bypass requirements.

4.3 Results

Boulder's water supply system appears to be sufficiently robust to meet its more severe reliability criteria, regarding survival of landscaping and supplying essential indoor needs, in most of the future possible climate conditions modeled. About half of the scenarios show an increased likelihood of drought years requiring minor, likely voluntary, water use reductions for the city's water customers if no effort is made to adapt to the changing climate conditions in other ways. The scenarios based on the Canadian climate model (the wettest GCM selected) result in an increase in yield to the city's water system. GFDL0 (the driest GCM scenario) showed that Boulder would have difficulty supplying sufficient water for even a greatly restricted level of municipal water needs during the most severe drought years by 2030. Two of the nine modeled scenarios result in reliability criteria violations for more severe droughts by 2070. The GISS EH model, which estimates very dry winters, showed significant losses in yield for the city's water rights by 2030. However, by 2070, much of this loss was regained because of earlier spring snowmelt allowing the city to capture more runoff in its reservoirs before interruption by calls from downstream senior agricultural water rights.

Figure 4.1 displays the results in terms of the city's reliability criteria under the different climate change scenarios. Cells highlighted in red indicate the reliability criteria are not met. Yellow means reliability is reduced but the criteria are still met and green indicates that the criteria are met more frequently than in the base case. Boulder's reliability criteria are met in most of the scenarios. The more serious 100 and 1,000 year criteria are met in all but three of the scenarios. By 2070, the risks of violating the reliability criteria increase with the A1B and in particular the A2 scenarios. These are higher greenhouse gas emission scenarios than the B1 scenario.

Emission Scenario	Model Type	Year	1-in-20 year criterion met?	1-in-100 year criterion met?	1-in-1000 year criterion met?	% of years with reduced deliveries		# of "events" (1 or more consecutive years with reduced deliveries)		maximum event length, years		maximum delivery reduction (AF)		average of delivery reductions, (AF)	
						Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Drought Plan (300 years)			yes	yes	yes	3%		6		4		6552		3313	
BASE CASE			yes	yes	yes	2%	3%	3	5	4.8	7	2526	5334	1247	1604
B1	Wet	2030	yes	yes	yes	0%	0%	0	2	0.5	2	524	1573	1159	1573
B1	Mid	2030	yes	yes	yes	4%	5%	5	8	6.6	11	2848	5334	1369	1899
B1	Dry	2030	no	yes	yes	5%	7%	7	11	6.3	10	4138	9377	1419	1800
A1B	Wet	2030	yes	yes	yes	0%	0%	0	2	0.3	1	295	1573	719	982
A1B	Mid	2030	yes	yes	yes	4%	5%	5	7	5.8	7	3120	5334	1371	1724
A1B	Dry	2030	no	yes	yes	7%	11%	10	16	7.1	10	3953	5838	1448	1864
A1B	Dry3	2030	no	no	no	23%	27%	27	36	11.3	14	10120	12130	1847	2232
A2	Mid	2030	yes	yes	yes	3%	5%	5	6	5.2	6	2736	5334	1286	1656
A2	Dry	2030	no	yes	yes	13%	18%	16	22	8.5	11	4426	5838	1484	1716
B1	Wet	2070	yes	yes	yes	0%	0%	0	2	0.5	2	426	1573	893	1234
B1	Mid	2070	yes	yes	yes	2%	3%	3	6	4.2	6	2533	5334	1217	1713
B1	Dry	2070	yes	yes	yes	3%	5%	4	6	4.8	6	3098	5838	1414	2044
A1B	Wet	2070	yes	yes	yes	0%	0%	0	2	0.3	1	295	1573	719	982
A1B	Mid	2070	yes	yes	yes	2%	3%	3	6	3.7	6	2531	5652	1106	1818
A1B	Dry	2070	no	yes	no	14%	16%	18	26	8.9	13	9657	11398	1857	2253
A1B	Dry3	2070	no	yes	yes	4%	6%	6	10	5.5	7	3829	5838	1481	1755
A2	Mid	2070	no	yes	yes	5%	6%	7	10	5.8	7	5933	9036	1431	2078
A2	Dry	2070	no	no	no	21%	26%	23	29	12.8	17	10475	12332	2153	2467

Figure 4.1. Summary of model results. Averages and maxima for the eleven 437-year traces in each scenario.

It is interesting to note the Dry3 (alternate) model. In 2030, the pattern of temperature increase is not strong enough to accelerate runoff to a significant degree, but enough to increase irrigation demands in June. The result is that Boulder's reservoirs do not store as often as in current conditions. By 2070, temperatures have increased enough to accelerate runoff to a greater degree than irrigation demands. Consequently, Boulder's reservoirs store more reliably.

Figure 4.2 displays one of the 11 traces in the base case. It shows how reduced deliveries are distributed over time. Note that the occurrences of such reductions are not uniform. None occur during period of record except for 2002 (see far right). Most are in the early part of the reconstruction, i.e., the 16th and 17th Centuries.

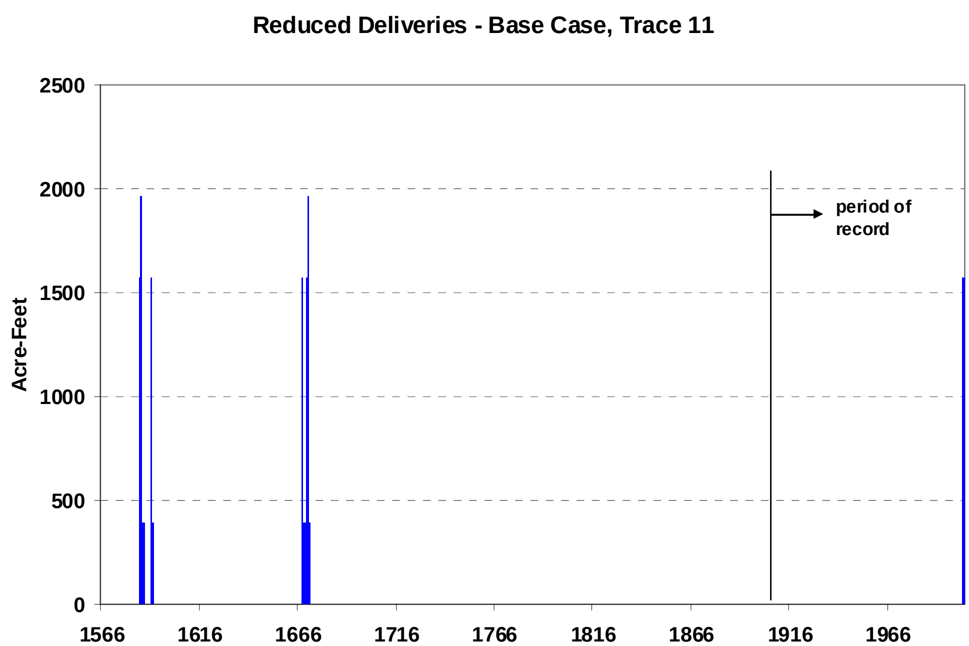

Figure 4.2. Summary of model results. Averages and maxima for the eleven 437-year traces in each scenario.

Figure 4.3 is a wet scenario under the lowest greenhouse gas emissions scenario (B1). There are fewer and less severe shortages, none in period of record.

Figure 4.4 is one of the most negative scenarios. It is the dry scenario under the highest greenhouse gas emissions scenario examined (A2). The 16th and 17th Centuries have the most frequent violations and a substantial increase in violations compared to the base case. There are very few violations in the most recent 100 years.

This analysis shows how looking just at period of record would not show vulnerability nearly as well. It is interesting that the combination of long-term average climate change and the reconstructed streamflow record (long-term climate variability) decreases Boulder's water supply reliability more than considering each one separately. Thus, studies that examine only climate change or long-term climate variability can underestimate vulnerability to a combination of climate variability and climate change.

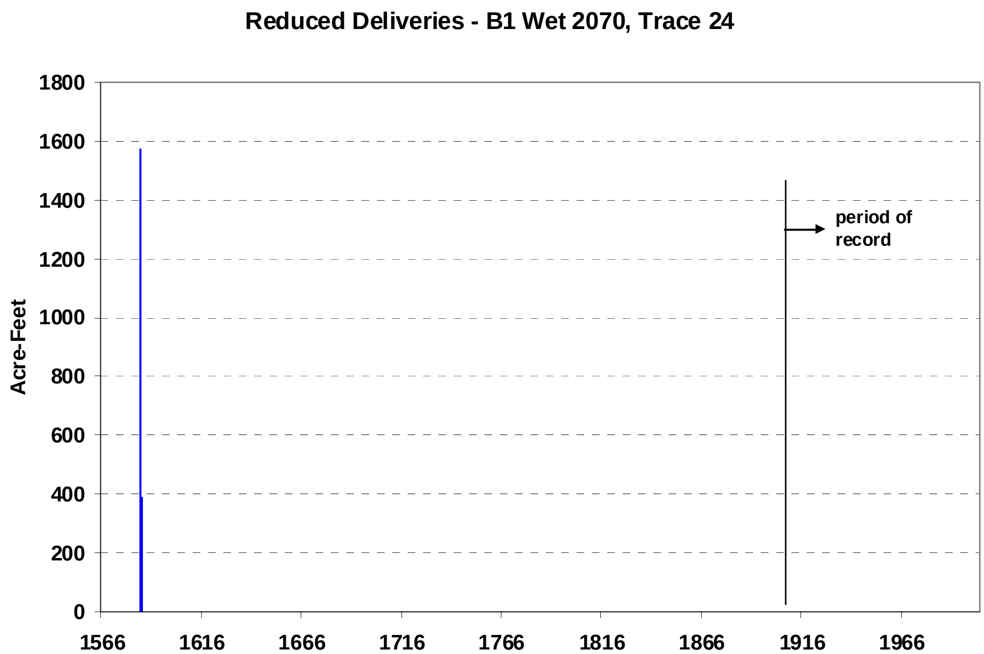

Figure 4.3. B1 2070 wet scenario delivery reductions.

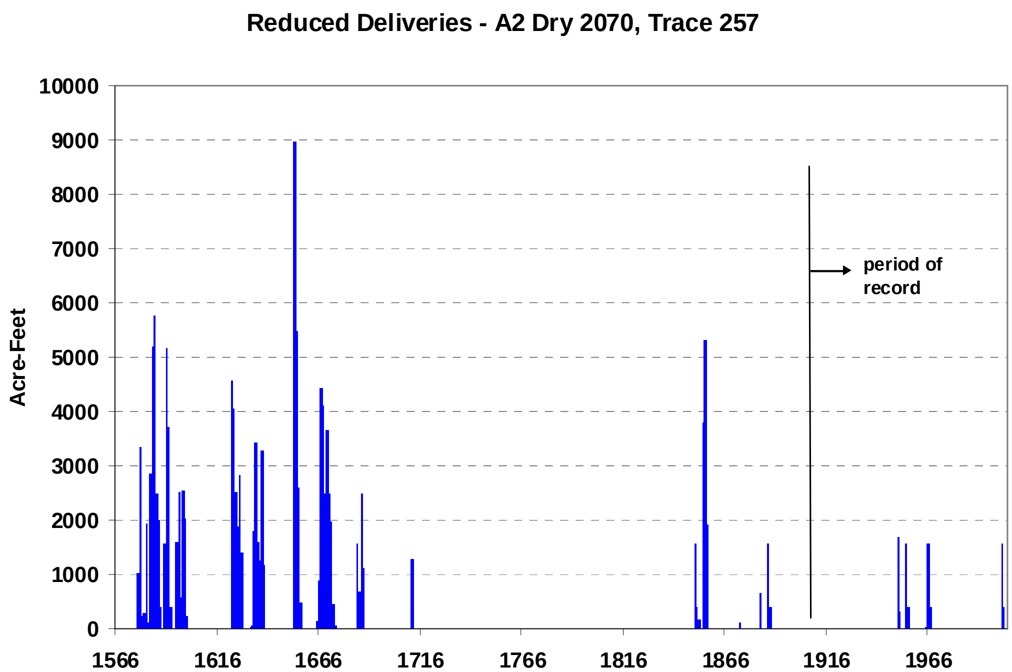

Figure 4.4. 2070 A2 dry scenario delivery reductions.

From an agricultural perspective, irrigation demands were estimated to increase in all scenarios (see Figure 4.5). But the increase varies considerably depending on the amount of temperature increase and change in precipitation. In general, demands in 2070 are estimated to be higher than demands in 2030. But, the A1B wet scenario in 2070 has a lower demand than many of the 2030 scenarios.

One of the most certain effects of climate change is to reduce the “natural overlap” between supplies (natural flow hydrograph) and demands. Figure 4.6 displays the base case, i.e., with June runoff peak. In the base case there is a 72% overlap in the monthly timing of natural flow versus irrigation demand.

Figure 4.7 displays the estimated impact of the alternate (reduced winter precipitation) A1B scenario in 2030. Runoff has increased only slightly in April and May, is unchanged in June, and has declined significantly in July-September. Irrigation demands increase drastically in June. The result is there is now only a 57% overlap in the monthly timing of natural flow versus irrigation demand.

The A1B dry scenario in 2070 (Figure 4.8) would be very negative. The runoff peak is now in May, and irrigation demands are much greater in July through September. There is now only a 38% overlap in the monthly timing of natural flow versus irrigation demand.

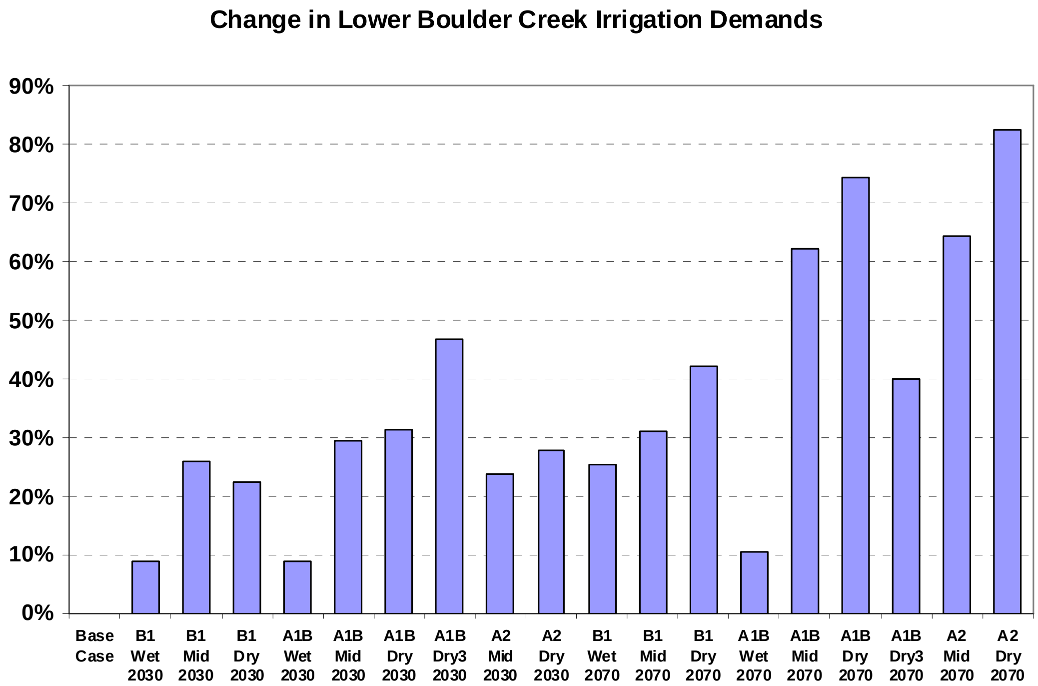

Figure 4.5. Change in lower Boulder Creek irrigation demands.

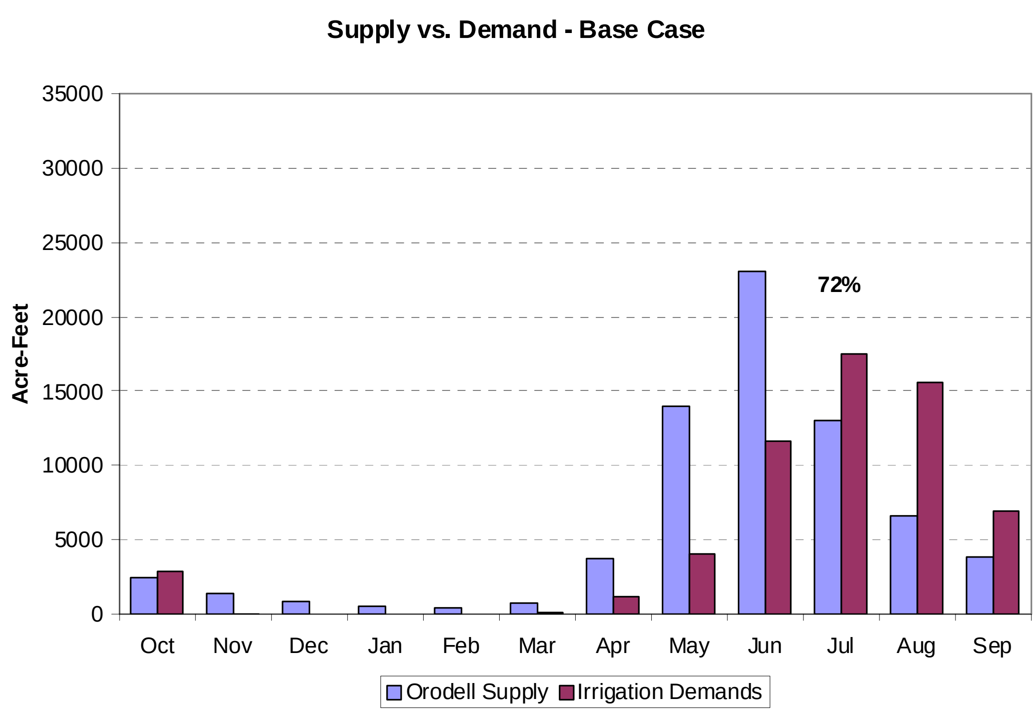

Figure 4.6. Current water supply and irrigation demand.

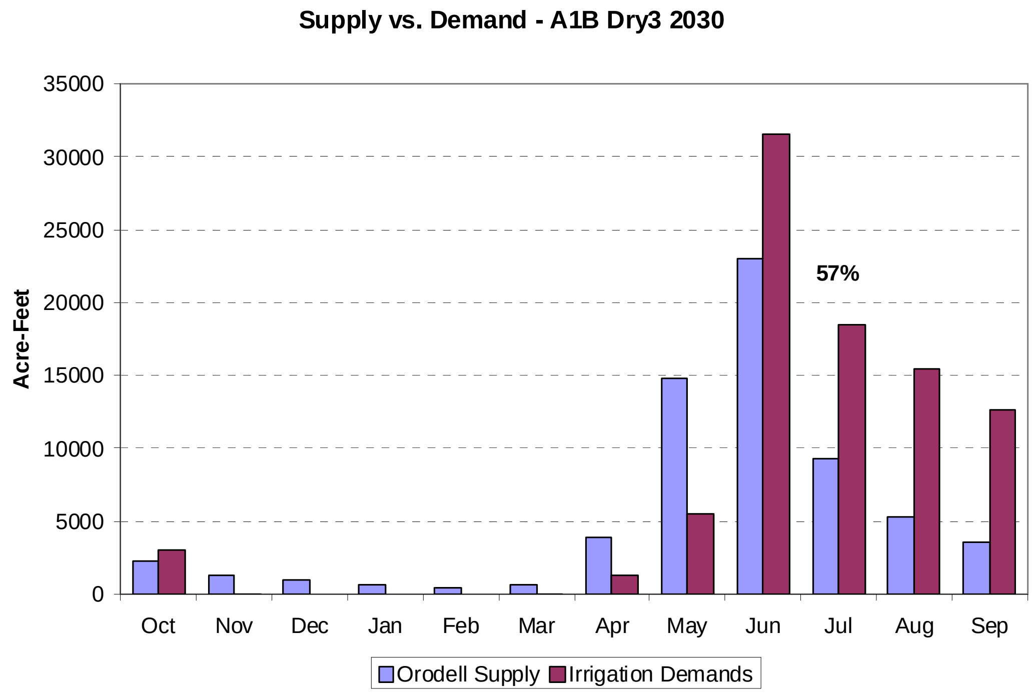

Figure 4.7. 2030 A1B alternative scenario runoff and irrigation demand.

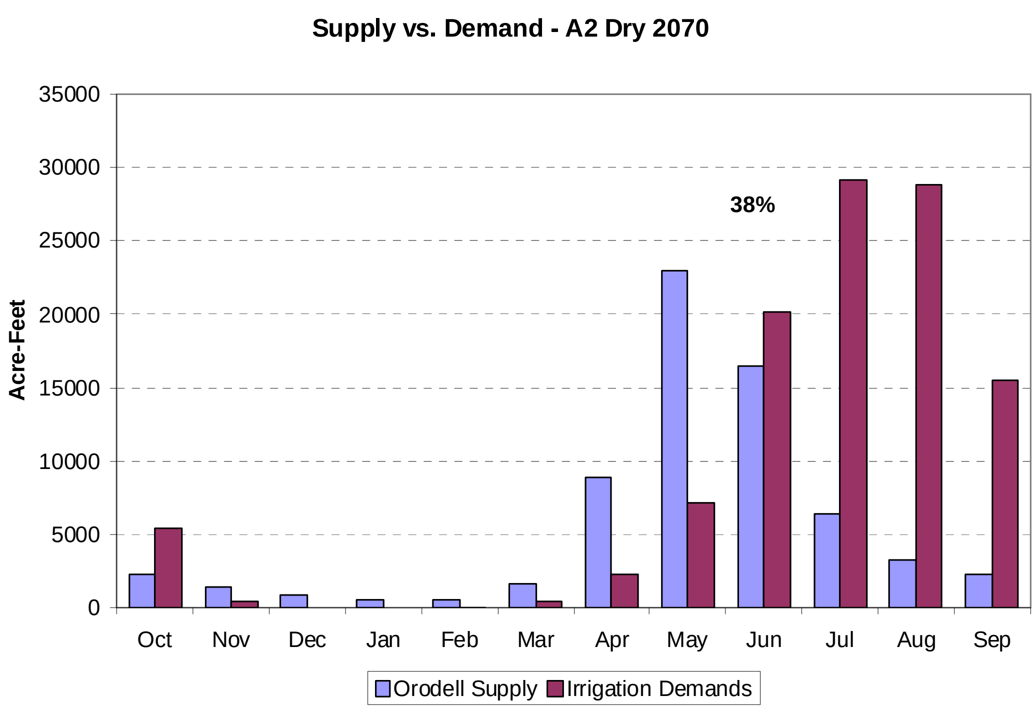

Figure 4.8. A2 2070 alternative scenario runoff and irrigation demand.

Although demands increase significantly, irrigation diversions remain basically the same. There are more diversions in June and less in July-September. This would have significant implications with respect to the proportions of hay-type crops vs. crops requiring a longer irrigation season. Essentially this means that, except for scenarios in which runoff increases, agriculture could receive roughly the same water supplies it currently gets, but with climate change, irrigation demand will be higher and there would be less natural overlap between supply and demand. Effectively, a smaller share of agriculture’s irrigation needs will be satisfied. The implications for crop production and yields, and the potential for irrigators to adapt to such changes, were not studied.

5. Use and Policy Implications of the Climate Study

5.1 Conveying Study Results to Decision-Makers and Public

The results of this study and the 2003 study were presented to Boulder citizens, City Council, the city's Water Resources Advisory Board, and other water users. When discussing the adequacy of the city's water supplies and possible climate change effects on supply reliability, the common concerns expressed by the city's water customers tend to fall into three categories:

- Type of regional changes in the environment that might occur
- Continued availability of water for irrigation
- Cost of water supplies.

In general, the public seemed to appreciate the city's effort to provide specific information on a range of possible futures for Boulder's water supplies, even though perhaps preliminary and uncertain, in preference to dealing with generalized information, which often led to an assumption that higher future temperatures could only result in extreme decreases in future water supplies for the city. Although some citizens wanted a projection of a single scenario, most of the public seemed to appreciate receiving information on a range of possibilities that might only be narrowed from the full spectrum.

The climate studies have given those making decisions regarding Boulder's future water supplies a better understanding of the scope of possible future climate changes, the data that will be necessary to understand the extent of regional climate changes as they occur, and the range of the possible responses that may be required. For the general public, the availability of the studies has helped to moderate extreme views of climate change possibilities. Both groups have gained insight into the complexities of the water system response to changing conditions, including the effects on water rights yields and possible infrastructure limitations.

A few lessons were learned about what could be gained from studies of this nature and how the results should be presented to the public. The study results were very useful in conveying the range of possible future conditions, although some members of the public wanted probabilities assigned to the various scenarios. During presentations, the public was asked not to interpret the results too literally because the future will not look exactly like any one modeled scenario. In distilling the results for presentation, sometimes important elements of the water system response were lost when conveying data in terms of averages. A correlating concern arose when presenting modeled extreme events. Some citizens focused intently on the severe, but very rare events, with the expectation that these events should become the basis for water system changes.

Inclusion of information on modeling strengths and weaknesses could increase understanding that modeled infrequent extremes should be interpreted with caution.

5.2 Water Rights Implications of Possible Climate Change Effects

All of the climate change scenarios could have impacts on water rights yields under Colorado's prior appropriation water rights system, which satisfies senior water rights prior to junior rights during times of shortage. Even if the average annual precipitation amount remains the same, a change in the pattern of streamflows will cause a redistribution of water supplies because of differences in allowable diversion times or places within water rights decrees. A significant unknown factor that could affect about half of Boulder's water supply is changes that might be triggered in the administration of the Colorado River Compact because of decreased streamflow in the Colorado River basin.

The complexity of factors affecting water rights yields and the highly interactive nature of the Colorado water rights administration system can make it difficult to predict the impact of changes in temperature or precipitation patterns on the yield of a particular water right or portfolio of water rights. A change in the timing or amount of available streamflow due to climate change will alter which water rights are satisfied and to what degree. Some water rights decrees, such as older water rights used for the originally decreed purposes, will allow water users to shift diversion practices with changing climatic conditions, while other decrees, such as water rights that have been changed in use and given a fixed yearly start date for diversions, could see water yields shrink. Climate change is likely to create water rights winners and losers, and the question is to what degree water reallocation will occur within the existing Colorado water allocation system.

Given the uniformity with which higher average temperatures are predicted to occur in Boulder's source watersheds, a few changes that could have an effect on the yield of the city's water rights can be predicted with some confidence. One of these likely outcomes is the occurrence of earlier spring snowmelt and runoff in the mountain watersheds feeding Boulder's water system. This change could be beneficial for the city because of the water rights administration issues affecting Boulder's water yields. At present, the city has a four to eight week window in the spring to fill its high mountain reservoirs with the water that will carry the city through the rest of the year once streamflows drop in late summer. This window usually occurs from late April until June between the start of snowmelt in high elevation areas and when the city's relatively junior water storage rights are called out by senior direct flow water right owners using the water for agricultural irrigation. Most of Boulder's reservoir storage water rights do not have a fixed start date to begin accounting for the allowed annual diversion amount, so accounting for the year's fill begins when the reservoir levels start to rise from initiation of snowmelt. Many downstream agricultural water rights do not have a fixed start date for initiation of diversions either, so water must be allowed to bypass the city's reservoirs at the time that growing conditions result in agricultural water users placing water rights calls that are senior to Boulder's reservoir rights. If the start of Boulder's reservoir diversion window occurs earlier, but the onset of irrigation demand does not advance as much because of limitations on crop growth from hours of daylight, then the city may be able to increase its reservoir water yields.

Another change due to higher temperatures could be the form of annual precipitation with more coming as rain than snow. This change might not have as great an impact to the portion of water supplies derived from the lower elevation areas of the South Platte River basin where most water supplies are used. However, it could have a significant impact on the pattern of runoff from the higher elevation areas that feed the entire South Platte River basin. The snowpack that accumulates in the mountains throughout the winter serves as a pseudo-reservoir that releases water throughout the growing season and might need replacement with actual reservoirs under changed conditions.

The combination of earlier runoff and an increased percentage of winter precipitation coming as rain might lead to even lower streamflow levels in late summer because of the snowmelt-driven hydrology of regional streams. This change would trigger an increase in the seniority of calling water rights in late summer and close out diversions by more junior rights that receive some yield under current conditions. For junior water users, the situation could be made worse by greater irrigation water demands caused by higher temperatures. Boulder is fortunate to have some very senior direct flow water rights that should allow continuation of diversions during low streamflow periods.

5.3 Water Policy Adjustments due to Climate Change

Some of the water policy adjustments that might be expected to develop because of climate change can be anticipated now, but others may become apparent only as the extent and character of future climate change effects are revealed. Given the expectation of higher temperatures, changes in landscaping and agricultural practices are likely.

Many municipalities in Colorado have already altered urban landscaping requirements for new development to encourage greater use of drought-tolerant plantings and reduced areas of lawn grass. In the future, low water demand landscapes may gain wider acceptance in established neighborhoods. The increasing cost and effort associated with maintaining large expanses of water-intensive lawn grass under higher temperature conditions may overcome the lack of public acceptance and associated limited use of alternative landscaping and native plantings in some existing neighborhoods. There may be increased pressure to change covenant restrictions that require lawns to be kept very green even in the heat of August.

Agricultural producers may select different crops that have greater spring frost tolerance to make better use of the earlier spring runoff period. However, this adaptive approach will be limited because many crops require a certain number of daylight hours and associated amount of solar energy for germination are early growth, which depends on location and latitude, not climate. Farmers may also look for crops that mature earlier in the season to adapt to extended late summer low streamflow periods. Hay and alfalfa producers may have fewer cuttings each year owing to decreases in irrigation water in the late season. Crop selection may change to favor crops that are less water-intensive, which could lead to fewer locally produced fruits and vegetables. This outcome would hinder efforts by those who are attempting to buy more local produce to reduce the contribution of consumer products transportation to greenhouse gas emissions. Alternatively, locally production of high valued crops such as fruits and vegetables may persist or increase due to more intensive use of highly efficient drip irrigation systems.

A shift to earlier runoff and lower late summer streamflow might create a need for construction of more reservoir storage space for seasonal flow regulation. It could also encourage restoring storage space at existing reservoirs that may have deteriorated or enhancing existing reservoirs by raising dam heights. More dam inspectors and dam safety requirements may be necessary. The higher rate of evaporation caused by higher temperatures may result in more dams being located at higher elevations or more underground water recharge storage projects. An increase in the amount of the spring runoff that is captured in reservoirs could prove beneficial for instream flows by providing a means to redistribute streamflow from times when flows are higher than needed for stream habitat maintenance to times when streamflows would otherwise be too low to support habitat. Taking advantage of this opportunity could require changes in perspective regarding water supply projects for both habitat conservationists and water system managers.

Colorado municipalities may be in a more favorable position to handle hydrologic changes resulting from climate change than other areas because water managers in the state are used to coping with highly variable hydrology and significant uncertainty in water supply availability from one year to the next. Water supply systems in the state have typically have the capability of smoothing annual variations in water availability. Many cities already have drought response plans. In general, citizens have some sense that they live in a semi-arid area and that drought years requiring a reduction in water use will occur occasionally. Larger cities in the state tend to have well-established water conservation programs in place. Most water systems in the state have some reservoir storage capability. Given the high degree of dependence on reservoir storage caused by the existing snowmelt-driven hydrology, many state water managers may be faced with the easier problem of altering reservoir management rather than developing new reservoir systems. Given this current state, the foundation is in place for adaptation to climate changes that may bring greater hydrologic extremes and more fluctuation between wet and dry cycles.

In response to this climate study, Boulder has identified several areas in which current actions are warranted. However, given the uncertainty in study results due to limitations in resolution of current GCMs and the variety of results produced by the selected study GCMs, city decision-makers believe it is premature to dedicate significant sums of money to capital improvements for the water system that may or may not ultimately prove to be necessary. For example, one response to the study result showing an increase in occurrence of minor droughts under some of the modeled scenarios could be acquiring additional water rights and/or building additional reservoir storage to prevent more years with water use restrictions for the city. These actions would be expensive, would have environmental effects, might be unpopular with some members of the public, and could turn out to be unnecessary if the actual outcomes for the city water system prove to be different than these modeled scenarios.

Instead, the city is electing to pursue activities that will increase the reliability and flexibility of the water system and that can easily be incorporated into current projects and operations. Enhanced operational flexibility improves the ability to respond to unexpected system upsets in the present and improves the adaptability of the system to a wide range of future hydrologic changes. Pursuit of these "no regrets" actions, which are useful now and would remain useful under many future conditions, is relatively inexpensive, yet acknowledges the impacts that climate change might produce. Areas in which the city has identified items to pursue at this time are:

- Monitoring
  - Future improvements in climate science
  - Actual climate changes
- Modeling
  - Improve understanding of capabilities of existing water system
  - Identify when climate changes move outside of these capabilities
  - Complete additional water system modeling when improvements in climate modeling provide enhanced regional data
- Plan for adaptation
  - Identify cost-effective reservoir storage space increases or reservoir operations modifications in preparation for possible need
  - Have community dialogue on possibility of long-term demand reduction strategies that alter current water use expectations
  - Investigate changes to the adopted water system reliability criteria to accept more frequent minor water use restrictions
  - Improve drought recognition criteria to avoid unnecessary imposition of water use restrictions despite increase in risk

- No-regrets actions
  - Water system management changes to increase efficiency
  - More integrated use of water rights portfolio
  - Earlier initiation of the water exchanges allowed under city water rights to increase water in city's upper water system reservoirs
  - Facilities improvements that increase operational flexibility whether or not negative climate change effects occur
  - Enhancing existing water conservation programs
- Education
  - Public understanding of efficient water use measures
  - Decision-maker understanding of limits of water supply system.

Boulder's water system and water rights portfolio differ from those of other cities and water users, so some of the study results and selected actions may not be applicable elsewhere. For example, the city's high-elevation reservoirs and diversion points will create a different set of advantages and disadvantages for maintaining water yields than experienced by water users located at lower elevations. Also, the city has access to a large of amount of reservoir storage space and a mixture of source water basins on both slopes of the Rocky Mountains, which might experience differing climate change effects. The city's senior direct flow rights will provide stability for water yields during low streamflow periods. Boulder's water system may have more operational flexibility than some and less than others given the city's two water treatment plants. Finally, Boulder's water demand patterns could vary from other cities because Boulder is at about 90% of its ultimate built-out condition and delivers two-thirds of its municipal water supply for indoor use because of the compact urban form typical of older Colorado cities.

Despite the possible differences between Boulder's situation and that of other water users, some suggestions can be drawn from the climate study that may have general applicability. Most water systems can benefit from improved water system modeling to provide better understanding of system response to changing conditions. Improved modeling should include water rights data for the system and for other water users, an extended hydrologic record using paleohydrology, and modeling of synthetic hydrologic traces or reorganized historical hydrologic data to test system limits. This modeling would form a strong basis for inclusion of climate change data as it becomes available, including climate-driven changes in irrigation water right demands.

If reliability criteria have not been established for a water system, it could be useful to develop performance goals for several purposes. Water shortages are then planned for as a part of the expected performance of the water system. This helps alter the attitudes and perceptions of those served by the water system to create an understanding that water shortages during droughts does not mean that the water system has failed to perform. Educated decisions can be made about the amount of investment to be made to ensure various levels of water supply reliability. Established reliability criteria are useful in educating the public that droughts will occur at some frequency and a full water supply for all possible uses should not be expected under all conditions.

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A. Climate Change Scenarios Data

2030 precipitation, A1B

	Annual	DJF	MAM	JJA	SON
Wet (cccma.t63)	11.4%	20.0%	10.1%	13.1%	3.1%
Dry (gfdl0)	-5.0%	7.8%	-3.2%	-18.4%	-3.0%
Middle (gfdl1)	-3.7%	1.8%	4.1%	-10.4%	-14.0%
Other (giss.eh)	-2.4%	2.8%	-6.8%	-6.4%	5.2%

2030 temperature, A1B

	Annual	DJF	MAM	JJA	SON
Wet (cccma.t63)	1.1	0.9	1.2	1.6	1.3
Dry (gfdl0)	1.7	1.1	1.3	2.6	1.9
Middle (gfdl1)	1.5	1.8	0.6	2.5	1.6
Other (giss.eh)	1.1	0.7	0.8	1.8	1.3

2030 temperature, A2

	Annual	DJF	MAM	JJA	SON
cccma.t63	NA	NA	NA	NA	NA
gfdl0	1.4	1.4	1.1	2.3	1.4
gfdl1	1.3	0.8	0.6	2.3	1.8
giss.eh	NA	NA	NA	NA	NA

2030 temperature, B1

	Annual	DJF	MAM	JJA	SON
cccma.t63	1.1	1.2	1.4	1.5	0.6
gfdl0	1.1	0.7	1.0	1.9	1.1
gfdl1	1.4	1.5	0.8	2.2	1.3
giss.eh	NA	NA	NA	NA	NA

2070 precipitation, A1B

	Annual	DJF	MAM	JJA	SON
Wet (cccma.t63)	15.9%	23.5%	9.4%	17.7%	17.6%
Dry (gfdl0)	-6.6%	11.6%	3.5%	-26.5%	-15.9%
Middle (gfdl1)	1.8%	18.2%	13.9%	-18.7%	-8.4%
Other (giss.eh)	-4.2%	-3.7%	-10.1%	-6.4%	8.6%

2070 temperature, A1B

	Annual	DJF	MAM	JJA	SON
Wet (cccma.t63)	2.2	2.3	2.0	2.3	2.4
Dry (gfdl0)	4.2	3.6	3.0	5.9	4.9
Middle (gfdl1)	3.6	3.1	1.8	5.7	4.0
Other (giss.eh)	2.3	1.6	2.4	3.7	1.9

2070 temperature, A2

	Annual	DJF	MAM	JJA	SON
cccma.t63	NA	NA	NA	NA	NA
gfdl0	4.2	3.0	3.1	6.5	4.5
gfdl1	3.3	2.6	2.4	5.4	3.4
giss.eh	NA	NA	NA	NA	NA

2070 temperature, B1

	Annual	DJF	MAM	JJA	SON
cccma.t63	2.2	2.5	1.9	2.5	1.9
gfdl0	2.8	1.8	2.8	3.8	2.6
gfdl1	2.2	1.8	1.5	2.9	2.6
giss.eh	NA	NA	NA	NA	NA

B. K-Nearest Neighbor (K-NN)

K-Neareast Neighbor is the resampling method used to simulate the 1,000 member ensemble of possible climate scenarios (combinations of monthly T&P) over a 437-year period for which we have reconstructed streamflows.

The resampling technique used in this study may be a new concept to some readers. This appendix describes the technique. First, we provide a general overview of K-NN algorithm. Then, we provide a general description of how we utilized K-NN resampling in this study. Finally, the third section of this appendix provides a more detailed example of how the technique was applied to the data we used.

B.1 General Overview of the K-NN Algorithm

B.1.1 Development of K-NN

Lall and Sharma (1996) developed a K-NN bootstrap method for time series re-sampling and applied it to streamflow simulation. In this approach, “K” is the ***number of points*** in the set from which to re-sample, and the “nearest neighbors” are the ***actual data points*** in the set. The set of “nearest neighbors” can change from one point estimate to the next. To conduct this conditional, re-sampling technique, first, K-NN of each point of interest from the historic data are found. Then the neighbors are re-sampled via a weight function that assigns large weight to the nearest neighbors and a smaller weight to the farthest, thereby generating ensembles. This approach is similar to the more traditional approach of estimating the conditional pdf and simulating from it.

The heuristic scheme for selecting “K” (the number of “nearest neighbors”) suggested by Lall and Sharma (1996) is square-root of N, where N is the number of data points from the historic record that is to be re-sampled.

The neighbors are weighted based on their proximity to the point of interest. Any weight function can be used to provide the weights because the K-NN approach is insensitive to the choice of the weight function. One possible weight function (the one used in our analysis) is the inverse distance weight method. This weight function gives more weight to the nearest neighbor and less weight to the farthest neighbor. The weights are normalized to create a probability mass function or weight metric.

Note: if K is set to N (i.e., the set of points from which to resample is set to all available observation data, and the closest neighbor is assigned a weight equal to one and all other points are assigned a weight equal to zero, this approach collapses to the "single-approach" described earlier.

B.1.2 Limitation to the K-NN approach

This approach is data driven. One limitation of this and other bootstrapping techniques is that there are no "new" data points added to the simulations. The sampling technique can only obtain values from the observed record, so it is not possible to create new extreme lows or highs.

This has been addressed by Rajagopalan and Lall (1999) who present a strategy of nearest neighbor bootstrapping with perturbations of the ensemble.

B.2 K-NN Approach Used in this Study

B.2.1 Why we used this technique

The analysis of the vulnerability of Boulder Creek's water supply to climate change utilized a K-NN bootstrapping technique to simulate annual streamflow ensembles representative of the paleo-record. The K-NN algorithm used in the analysis utilized the observed streamflow record (the modeled natural streamflow record developed by L. Rozaklis, and others at Hydrosphere), the observed temperature and precipitation records from both Boulder and the C1 location at Niwot Ridge (maintained by Mark Losleben, INSTAAR, LTER), and the reconstructed paleo-streamflow record (developed by Connie Woodhouse).

We utilized a non-parametric re-sampling method to generate a 1,000 member ensemble of 437 "years" that, when examined from the perspective of the annual streamflow of each year, reflects the statistical properties of the 437-year long paleo-streamflow reconstruction. Each of the 1,000 members of the ensemble is comprised of a set of 437 "years." The "years" are those for which we had an overlap of:

- Reconstructed annual paleo-streamflow (from Woodhouse)
- Historic, annual, natural streamflow (from Hydrosphere)
- Observed monthly temperature and precipitation from both Boulder and C1-Niwot Ridge.

The time period for which there is an overlap in these data is the 53-year period between 1953 and 2005. Therefore, the "years" from which we can resample are the 53 years from 1953 to 2005.

Each member of the ensemble was generated by re-sampling from the pool of 53 years. In the K-NN approach, the data is re-sampled using a probability metric that gives more weight to the nearest neighbor and less to the farthest. Each "year" that makes up a single member (which has 437 points) is conditioned on the reconstructed paleo-streamflow record. Since there are only 53 years from which to resample and each member of the ensemble is comprised of 437 records, any given year from the 53-year pool will show up multiple times in each member of the ensemble.

The reason that we were interested in generating an ensemble of "years" is that for each year we have an estimate of:

- Annual streamflow from the paleo-reconstruction (1 value)
- Historic, natural annual streamflow (1 value)
- Average temperature for each month of that year (12 values)
- Total precipitation for each month of that year (12 values).

Each "year" is actually a vector of five variables (year, paleo SF, historic SF, T, P). Therefore, each member of the ensemble represents a simulated time series of annual streamflow, temperature and precipitation.

An advantage of the non-parametric re-sampling technique used is that each of the 1,000 members of the simulated ensemble are statistically equally likely.

B.2.2 Limitations to the K-NN approach

A limitation to our approach in particular, is that we had a limited sample size (50) to begin with, but by creating conditional groups of streamflow (low, normal and high), we created three samples that were even smaller. The consequence of this is that we limited the variety in the ensembles.

Another limitation in our study was that there simply are no ideal weather stations. We had to use C1 because it was the only one available with a long enough record, but it is far from ideal.

B.3 Detailed Example from Data used in This Study

The two key steps involved in the resampling technique we used are classification of streamflows and application of the K-NN algorithm.

Classification

First, we classified 53 years (1953-2005) of "historic" streamflows as low, normal or high (see Figure B.1):

- Low: streamflow of interest < 60,000 acre-feet (15 instances in observed record; approximately 25%)
- Normal: 60,000 acre-feet < streamflow of interest < 84,000 acre-feet (25 instances in observed record; approximately 50%)
- High: streamflow if interest > 84,000 acre-feet (13 instances in observed record; approximately 25%).

[15 years are "low" (28%); 25 years are "normal" (47%); 13 years are "high" (25%)]

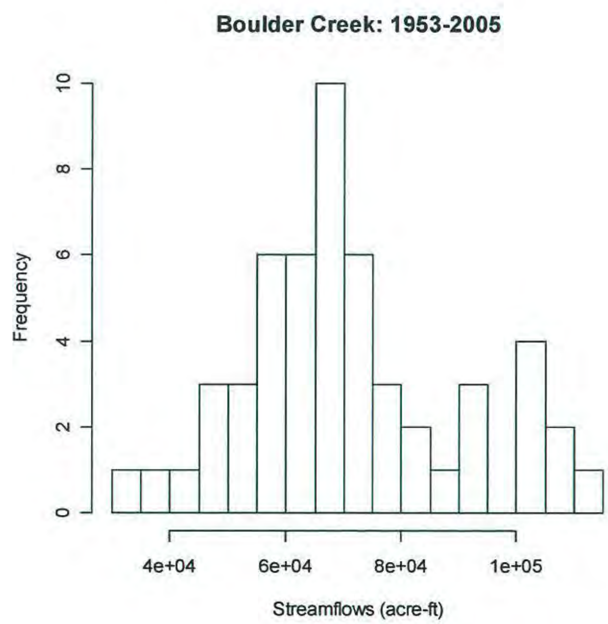

Figure B.1. Frequency of observed runoff.

Then, we examined the condition of each year in the hybrid-paleo-streamflow reconstruction. Consider the streamflows from the reconstruction (1566 to 2002; see Figure B.2). Using the same criteria, classify each year as low, normal or high. Ideally, approximately the same percentage of years would be categorized as "low," "normal," and "high." In this 437-year record, the results are: 98 years are "low" (22%), 259 years are "normal" (59%), and 82 years are "high" (18%).

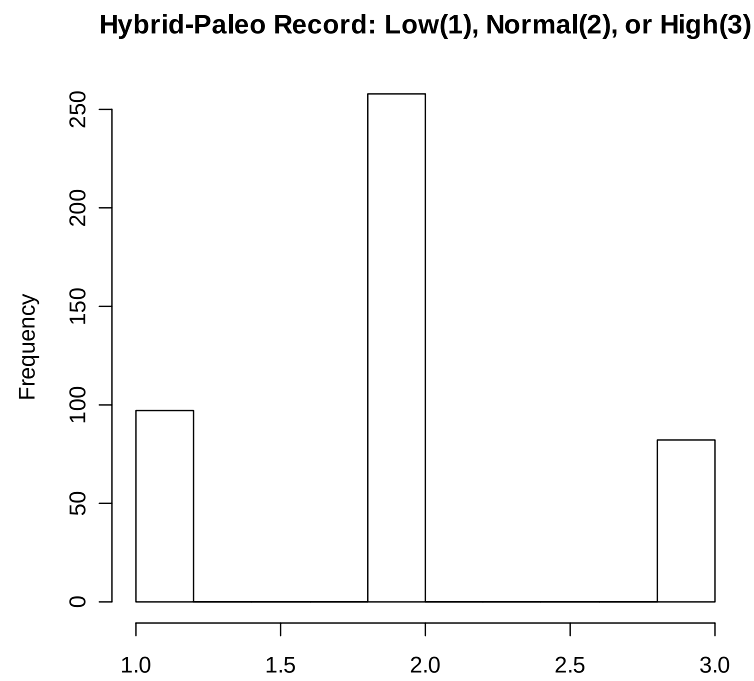

Figure B.2. Distribution of low, normal and high flows.

Apply K-NN algorithm

Once the nearest neighbors have been identified, the simulation begins. Starting with the streamflow value for year one, 1566, one of the K-NN (from the observed record) is selected according to a probability metric where the nearest neighbor has been assigned the most weight, and therefore gets picked the most frequently and the furthest neighbor has been assigned the least weight and gets picked the least frequently. The "bootstrapped" value (i.e., the streamflow value from the observed record that was selected) and the year from the observed record during which that streamflow occurred, are added to the ensemble for "year one" This continues for each year (437 years total). This is repeated for a total of 1,000 simulations in the ensemble.

1. Consider year of the hybrid-paleo-streamflow reconstruction.

   Was that year classified as low (1), normal (2) or high (3)?

   E.g., year 1 = 1566, classification = 2 (normal).

2. This classification determines from which of the three categories (low, normal or high) of the **gauged streamflow** record we can bootstrap a streamflow value to add to our simulated (or synthetic) record

   E.g. the simulated value must come from the "normal" (class = 2) subset of gauged streamflows (there are 25 possible values)

3. What was the streamflow value (from the reconstruction) for that year?

   E.g. for year 1 = 1566, SF = 67,870 acre-feet.

4. Find the "nearest neighbor" streamflow values from within the appropriate category of gauged streamflows.

   E.g. the appropriate category is "normal;" we are concerned with the 5 (K = 5) values (5 "nearest neighbors" out of 25 values) in that category that are closest to 67, 870 acre-feet.

   These are: 67,769 (1990), 68,275 (1953), 67,212 (1985), 65,359 (1991), and 64,614 (1968).

5. Weight those "nearest neighbor" values such that the closest value is weighted the most and the farthest value is weighted the least.

   E.g., 67,769 (weight = 43%,W = 0.43), 68,275 (weight 22%, W = 0.65), 67,212 (weight 15%, W = 0.80), 65,359 (weight 11%, W = 0.91), and 64,614 (weight 9%, W = 1.00).

6. Generate a random uniform number between 0 and 1, e.g., 0.696.

7. Select the "nearest neighbor" streamflow value that is weighted such that the random uniform number is ***less*** than the "W" for that streamflow value.

   E.g. 0.696 > W = 0.43, so *do not* select 67,769; 0.696 > W = 0.65, so *do not* select 68,275; **but 0.696 < W = 0.80, so we select 67,212** as the streamflow for the given year of the simulation.

8. Record the year to which this selected streamflow corresponds.

   E.g. 1985.Repeat steps 1-8 for each subsequent year (2-437) of the hybrid-paleo-reconstruction.

   E.g. repeat for years 1567-2004.

Steps 1-9 will yield a simulated annual streamflow record (synthetic streamflow time series, or 1 member of the ensemble) that is comprised of 437 pairs of values (these pairs of values are streamflow values and the corresponding year from the observed record in which the streamflow occurred). Each pair of values in the simulated record was selected from the 50-year observed/historic record, and therefore the corresponding monthly temperature and precipitation values for each year are known. Corresponding to the simulated 437-year long record is a climate record of 5,268 monthly temperature values (437 years × 12 months) and 5,268 precipitation values.

This process is repeated to create a 1,000 member ensemble of synthetic records (each is 437 ”years” long).

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and Tailored Collaboration partners:

Denver Water
Colorado Springs Utilities
Boulder Department of Public Works
City of Aurora Utilities
Fort Collins Utilities
Northern Colorado Water Conservancy District

Published by:

WATER RESEARCH FOUNDATION℠

DISCLAIMER

This study was jointly funded by the Water Research Foundation (Foundation) and Denver Water, Colorado Springs Utilities, Boulder Department of Public Works, City of Aurora Utilities, Fort Collins Utilities, and Northern Colorado Water Conservancy District. The Foundation and the co-funding utilities assume no responsibility for the content of the research study reported in this publication or for the opinions or statements of fact expressed in the report. The mention of trade names for commercial products does not represent or imply the approval or endorsement of the Foundation or the co-funding utilities. This report is presented solely for informational purposes.

ISBN 978-1-60573-168-1

Printed in the U.S.A.

Printed on recycled paper

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FOREWORD

The Water Research Foundation (Foundation) is a nonprofit corporation that is dedicated to the implementation of a research effort to help utilities respond to regulatory requirements and traditional high-priority concerns of the industry. The research agenda is developed through a process of consultation with subscribers and drinking water professionals. Under the umbrella of a Strategic Research Plan, the Research Advisory Council prioritizes the suggested projects based upon current and future needs, applicability, and past work; the recommendations are forwarded to the Board of Trustees for final selection. The Foundation also sponsors research projects through the unsolicited proposal process; the Collaborative Research, Research Applications, and Tailored Collaboration programs; and various joint research efforts with organizations such as the U.S. Environmental Protection Agency, the U.S. Bureau of Reclamation, and the Association of California Water Agencies.

This publication is a result of one of these sponsored studies, and it is hoped that its findings will be applied in communities throughout the world. The following report serves not only as a means of communicating the results of the water industry's centralized research program but also as a tool to enlist the further support of the nonmember utilities and individuals.

Projects are managed closely from their inception to the final report by the Foundation's staff and large cadre of volunteers who willingly contribute their time and expertise. The Foundation serves a planning and management function and awards contracts to other institutions such as water utilities, universities, and engineering firms. The funding for this research effort comes primarily from the Subscription Program, through which water utilities subscribe to the research program and make an annual payment proportionate to the volume of water they deliver and consultants and manufacturers subscribe based on their annual billings. The program offers a cost-effective and fair method for funding research in the public interest.

A broad spectrum of water supply issues is addressed by the Foundation's research agenda: resources, treatment and operations, distribution and storage, water quality and analysis, toxicology, economics, and management. The ultimate purpose of the coordinated effort is to assist water suppliers to provide the highest possible quality of water economically and reliably. The true benefits are realized when the results are implemented at the utility level. The Foundation's trustees are pleased to offer this publication as a contribution toward that end.

Roy L. Wolfe, Ph.D.
Chair, Board of Trustees
Water Research Foundation

Robert C. Renner, P.E.
Executive Director
Water Research Foundation

ACKNOWLEDGMENTS

The research team acknowledges the modeling groups, the Program for Climate Model Diagnosis and Intercomparison (PCMDI) and the WCRP's Working Group on Coupled Modeling (WGCM) for their roles in making available the WCRP CMIP3 multi-model dataset. Support of this dataset is provided by the Office of Science, U.S. Department of Energy.

We acknowledge the support of the Missouri Basin River Forecast Center (MBRFC), the Colorado Basin River Forecast Center (CBRFC), and the Arkansas-Red Basin River Forecast Center (ABRFC), which provided data and hydrologic models used in their calibration and operational forecast systems for use in this study.

We acknowledge the gridded 1/8th degree data as a primary source of climate forcing data for the WEAP model (Maurer, E.P., A.W. Wood, J.C. Adam, D.P. Lettenmaier, and B. Nijssen, 2002).

Special thanks go to Chris Anderson, formerly with the Western Water Assessment and now at Iowa State University, who was key in climate scenario selection and presentation. Special thanks also go to regional experts who helped the group come up with a defendable yet understandable approach, including Brad Udall, Joel Smith, Ben Harding, Levi Brekke, David Raff, Balaji Rajagopalan, Joe Barsugli, and Jessica Lowrey

EXECUTIVE SUMMARY

The Joint Front Range Climate Change Vulnerability Study has been a collaborative effort between water utilities along Colorado's Front Range, the Colorado Water Conservation Board, the Western Water Assessment, the Principal Investigators, and the Water Research Foundation. It has focused on developing and applying procedures for combining the results of the latest climate science with the best available hydrologic simulation capabilities to gain insight into future streamflow trends that could be expected under possible climate change. The collaborative approach allowed participants to identify and support a common assessment methodology, develop a coordinated set of evaluation tools, and combine and efficiently utilize resources rather than pursuing independent, duplicative and more costly studies. An educational component was included and has been essential to developing the methodology, interpreting the results, and understanding needs for future research and investigation. Although the study results indicate broad variability and uncertainty about future streamflow, the results are consistent with the variability and implicit uncertainty associated with the results of the climate models that were used as inputs. The specific findings of this study point toward future research that will improve estimates and enhance understanding of streamflow response to climate change.

OBJECTIVES

The primary objective of this study was to analyze the sensitivity of streamflow to climate change for three watersheds in Colorado and to develop streamflow sequences that represent the effects of projected climate change on a baseline streamflow. This study assesses climate change by comparing average climate conditions between two periods, which may be referred to as a "Delta" approach. Two future time periods were assessed using available climate model outputs to support near-term as well as long-term planning horizons. Each provider will be able to use these future streamflow scenarios in conjunction with its own water rights allocation (water system) model to estimate the impacts of various climate change scenarios to its current and future water supply. In addition to the climate adjusted streamflows, the output of this process is a variety of tables and graphics describing the characteristics of the streamflow response to projected climate change.

A second objective was to bring project participants together to collaborate on this study. Potential benefits of the regional collaboration include resource sharing, coordinated agreement on a study approach, development of a set of evaluation tools that can be applied throughout the region, development of consistent hydrology data available for future planning efforts, utilization of regional experts to educate the participants and ensure a scientifically robust approach, and opportunities for participants to continue working together on climate change planning. This model can provide an example for other regional collaborations.

BACKGROUND

Colorado's Front Range Metropolitan water providers are concerned about the impact climate change may have on future water supply. Depending on the direction, timing, and magnitude of future temperature and precipitation changes, the volume of water available could increase or decrease. Additionally, peak runoff timing could change, possibly leading to water rights complications or the need for operational changes for water utilities that depend on snowmelt for water supply. To better understand the possible impacts of climate change, several Front Range providers are working together to establish the education, tools, and methodology needed to study these potential effects. This project was designed to enable entities that obtain water from the upper Colorado, South Platte, Arkansas, Cache la Poudre, St. Vrain, Boulder Creek, and Big Thompson River Basins to examine the potential effects climate change may have on these supplies. This study involved a complex integration of climate model analysis, water accounting, and hydrologic modeling.

Traditional approaches to water supply planning use historical streamflow records to simulate the operation of existing and planned water supply systems and to evaluate system reliability for meeting current and forecasted demands. This approach considers the climate to be dynamic only to the extent that variability is represented in the observed record, and assumes that discharge patterns will be stationary according to the historic record. Until recently, variability and changes in climate statistics typically have not been explicitly integrated into water resources planning processes. As climate science improves, it enables another element to be included in water supply planning – the effect of projected climate change on streamflow. One source of information that offers insight into climate impacts on future water supply is the output from global climate models (or general circulation models [GCM]) used to project the impact of greenhouse gas emissions on global climate. The study participants, in conjunction with expert guidance, identified an approach for selecting climate model runs and a method for adjusting inputs to hydrologic models based on the climate models. The hydrologic models, in turn, project the streamflow that would result under the selected climate change conditions, indicating the sensitivity of streamflow to climate change.

APPROACH

The approach taken to assess the sensitivity of streamflow to climate change was to:

- Select specific climate projections representative of the range of outputs from multiple climate models;
- Identify a climate change "signal" (the change in temperature and precipitation between a reference period and a selected future period) from each model;
- Apply that climate change signal to the historical inputs for two hydrologic models for the basins noted previously;
- Simulate the hydrologic response from each hydrologic model to produce time series of climate-adjusted natural runoff; and
- Compare the simulation of climate adjusted natural runoff with an unadjusted baseline simulation of runoff to identify potential impacts of climate change.

Applying this approach to the three large-scale river basins of interest to the study participants led to the following four major tasks:

Task 1: Selection of climate model projections

A subset from a catalog of 112 available climate projections was selected to use in the sensitivity assessment. It included five projections of climate for the 30 years surrounding 2040 and five projections of climate for the 30 years surrounding 2070. The five projections were selected to represent the range of outputs of the climate models without extending to the extremes of the results. Qualitative scenario names were given to the projections (for each future period) as follows:

- Hot & Dry,
- Hot & Wet,
- Warm & Dry,
- Warm & Wet, and
- Median.

Task 2: Historical undepleted streamflow data development

Assessing the potential impact of climate change on water supply requires an estimate of the historical streamflow both as a baseline for comparison and also for use in calibrating hydrologic models. Streamflow sequences that have been adjusted to remove the effects of diversions from rivers, reservoir storage, reservoir releases, and agricultural return flows represent the natural streamflow of the rivers and are referred to as *undepleted* flows. The second task of this study was to compile or develop historical undepleted flows for 18 gauge locations of interest.

Task 3: Hydrologic model development

To accurately simulate the impact of climate change on streamflow using a hydrologic model requires a model that properly represents the response of the basin to the climate inputs (specifically temperature and precipitation). In an attempt to distinguish between trends attributable to a fundamental hydrologic response from trends that might be peculiar to a particular hydrologic model, two hydrologic models were selected for use in this study - the Water Evaluation and Planning (WEAP) model from Stockholm Environment Institute (Yates et al. 2005a,b), and the Sacramento model found in the National Weather Service River Forecast System (NWSRFS). The effort began with previously developed historical climate datasets and calibrated hydrologic models, where available, and then updated the model calibrations by adjusting model parameters based on a comparison of model-simulated streamflow and the historical undepleted streamflow at 18 gauge locations distributed among the three watersheds.

Task 4: Assessment of Streamflow Sensitivity to Climate Change

The analysis of streamflow sensitivity to climate change was performed in two stages. In the first stage, a simple sensitivity analysis was used to demonstrate the hydrologic simulation approach and to test the sensitivity of each model and each gauge location to a uniform temperature increase (with no change to precipitation) and to a uniform precipitation adjustment (with no change to temperature). The second stage was to perform a GCM-based sensitivity analysis to assess model response to possible climate change represented by the selected projections in which the temperature and precipitation adjustments vary spatially over the study area and temporally from month to month. In both cases, adjustments were made to the historical climate data inputs to represent climate change, while maintaining the variability associated with the historic record.

To aid in the organization and evaluation of the results of the hydrologic simulations, an automated spreadsheet tool for reviewing and analyzing the results was created. Together, the climate adjusted undepleted flows derived from both the WEAP and Sacramento model simulations for multiple GCM projections represent a sample of possible future streamflow sequences compiled and provided to the study stakeholders. The sequences will allow water resources planners in Colorado to evaluate system responses to a range of possible changes in future streamflow.

STUDY GOALS

As these tasks were identified and defined, specific study goals emerged in an effort to enhance the potential benefits of the study and guide execution of the tasks. The study goals that were identified and achieved as part of the above tasks were to:

- Identify and apply a procedure for selecting multiple climate model projections (Task 1);
- Develop a consistent sequence of historical undepleted flows for the period 1950-2005 (Task 2);
- Develop and calibrate two hydrologic models for use in computing the hydrologic response to temperature and precipitation climate changes. (Task 3);
- Report on the differences in hydrologic model accuracy for water years of differing types, including wet, normal, and dry years (Task 3);
- Test and demonstrate an approach for evaluating hydrologic response to variations in climate using uniform adjustments to temperature and precipitation (Task 4);
- Simulate the hydrologic response to possible climate change in temperature and precipitation by using multiple GCM projections (Task 4);
- Evaluate the hydrologic responses to possible climate change to assess change in runoff volume, timing of runoff, spatial variability of change, elevation impacts, and hydrologic model differences (Task 4); and
- Describe a clear, repeatable procedure for future use in the region or in other parts of the country (documented in this report).

FINDINGS

The pool of 112 GCMs from which 10 scenarios were selected for hydrologic simulation showed broad variability in projected future temperature and precipitation for the North-Central region of Colorado. Though all projections showed warming, the average annual temperature changes ranged from just over 1^{o} to nearly 6^{o} Fahrenheit for the 2040 time period and from about 2^{o} to nearly 10^{o} Fahrenheit for the 2070 time period. Meanwhile, average annual percent change in precipitation ranged from -15% to +17% for the 2040 time period and from -18% to +28% for the 2070 time period (See Table 2.2).

Likewise, there are significant variations in hydrologic responses simulated from the selected GCM projections. For example, average annual change in streamflow volume for the South Platte below Henderson ranges from +33% (Warm & Wet scenario) to -35% (Hot & Dry scenario) for the 2040 period. Analysis of the change in timing for the scenarios considered indicates that the annual runoff could arrive 1 to 14 days earlier in the 2040 simulations and 7 to 17 days earlier in the 2070 simulations.

This range results from the differing average annual changes in temperature and precipitation, from the difference in the monthly distribution of those changes in each projection, and from differences in the spatial distribution of the changes. One of the most important findings of this study is that each climate projection that was considered has a unique impact on runoff volume, and in order to grasp the broad picture of future possible changes in streamflow, the range of impacts from multiple scenarios needs to be considered, as opposed to looking for a central tendency or averages of simulation results. Within this context, the following are key observations drawn from this study:

- GCM model output encompasses a broad range of projected changes to future temperature and precipitation across North-Central Colorado.
- There is substantial variability in projected future streamflow based on the range of climate model projections that were used for streamflow simulation.
- Although the results indicate both increases and decreases in annual streamflow volume, more of the climate projections that were selected resulted in decreases rather than increases.
- Where decreased annual streamflow volume is indicated for a given projection, it is a result of the computed increase in evapotranspiration due to increased temperatures, coupled with either a decrease in precipitation or else a small increase in precipitation that is insufficient to offset the increased temperature effect.
- Where increased annual streamflow volume is indicated for a given projection, it is a result of increased precipitation that is sufficient to offset the increased temperature effect for that projection.
- Spatial and temporal distribution of temperature and precipitation changes across multiple sub-basins and over the twelve-month period has considerable influence on hydrologic model results.
- The two hydrologic models responded similarly to climate change inputs in terms of both annual streamflow volume and timing of runoff.
- At the scale of the river basins evaluated in this study, there does not appear to be a consistent tendency among GCMs regarding elevation-based differences in climate change patterns. Similarly, there are no clear tendencies regarding elevation-based differences in simulated hydrologic response that are evident from the results of both hydrologic models for multiple river basins.
- While increased temperatures are shown to reduce simulated average annual streamflow, the reductions are not uniform across the study area, with the driest basins, such as those in the South Platte, experiencing the greatest percent reduction in streamflow due to warmer conditions, while the wetter basins, including the upper areas of the Colorado, show a smaller percent reduction.

STRENGTHS AND LIMITATIONS IN APPLYING THE STUDY APPROACH

One of the strengths of the overall approach employed in this study is that it allowed a spatial and temporal climate change signal to be incorporated into the hydrologic simulation while preserving the spatial and temporal structure and variability of the historical climate. By selecting specific GCM projections to represent the climate change signal on an average monthly basis instead of using average annual temperature and precipitation adjustments, the results of this study highlight the range that can result from particular combinations of monthly distributions of temperature and precipitation change.

Several limitations in the application of the study approach became apparent over the course of the investigation. First, the study approach does not provide any insight into the potential for increased or decreased intensities of rainfall outside of the average monthly change, or for variation in the diurnal distribution of temperature increases, or for any other characteristic of the GCMs that may indicate fundamental changes in climatic characteristics beyond the average monthly change in temperature and precipitation. This was not a serious limitation for the purposes of this study, but might be important in areas where changes in peak flows are of greater interest. Any efforts to overcome this particular limitation would have to overcome the lack of GCM output available in a format that would support more detailed analysis and would have to be justified with confidence that the climate models are in fact capable of representing those changes in a meaningful way. Second, while perhaps the most important element in determining changes in annual runoff volume is the simulated response of evapotranspiration (ET) to temperature change, there are additional variables beyond temperature that influence ET that were not part of the downscaled GCM outputs and could not be incorporated into the study approach.

LESSONS LEARNED

Two primary considerations in assessing future water availability for Front Range water providers are average annual volume and the timing of runoff. Because the water supply for these agencies is primarily stored in the snowpack, permanent changes in the timing and volume of this important resource would have major impacts on water availability and could force changes in water management strategies. The change in annual runoff volume and timing of runoff are the outputs of the study of greatest interest to the study participants and their constituents.

Runoff timing is most sensitive to temperature, due to its effect on the form of precipitation (rain or snow) and on snowmelt. Precipitation changes alone have a minor influence on runoff timing as shown in the figure on page 68. Even changes in the timing of precipitation have little impact on runoff timing, because of the dominance of snowmelt in the annual runoff cycle, and the controlling impact of temperature on snowmelt. Because all of the climate scenarios indicate increased temperature, nearly all of the scenarios simulated indicate earlier runoff, with the effect being more pronounced in the 2070 period. While the range of projections regarding the number of days earlier that runoff will occur is broad, the tendency to earlier runoff is uniform.

Simulated runoff volume is sensitive to both precipitation and temperature change. The sensitivity to temperature change is because of the influence of temperature on ET in the hydrologic model formulations. Because all of the climate scenarios indicate increased temperature, all of the climate-adjusted runoff simulations are impacted by an increase in ET and a corresponding reduction in volume. Many of the climate projections show a slight increase in precipitation, which partially or wholly offsets the reduction in runoff caused by increased ET. Those projections that show reduction in precipitation accentuate the reduced runoff volume resulting from increased temperature. The occurrence of both increases and decreases in precipitation accentuates the spread of volume changes simulated from the selected climate scenarios.

Based on these observations, study participants may wish to prepare for the impacts of climate change on water availability with the following considerations:

- Expect runoff to occur earlier.
- Consider contingency plans for both increases and decreases in average annual runoff.
- Monitor evolving indicators of climate change at both global and regional scales to identify trends.
- Broaden the scope of selected climate models to use in hydrologic simulation to more fully explore the range of impacts on streamflow.
- Be prepared to incorporate updated climate model outputs in planning processes based on forthcoming advances in climate science.
- Encourage advances in climate science that will facilitate accurate hydrologic assessment.

Climate adaptation is about preparing for change and new conditions in the future. This study provides important information to water utilities and managers to aid in identifying and assessing the hydrologic response to possible climate change.

APPLICATIONS FOR WATER UTILITIES

The methodology of GCM selection, development of adjusted historical climate sequences, and hydrologic simulation developed in this study can be widely applied to assess climate impacts on water supplies both for additional projections in the basins studied or for other locations where there is access to downscaled GCM datasets. Although applying this methodology does not require a thorough understanding of climate science, users of the methodology should be informed about the capabilities and limitations of climate science and models. An important application note is that because of the uncertainty in all of the climate models, it may be valuable and important to simulate water systems operations using multiple climate projections to reveal potential vulnerabilities specific to the hydrologic response to each projection, as discussed in the findings beginning on page 97 .

Finally, it is important for the water utility community to communicate its needs regarding developments in climate science and required outputs from the models to the climate research community so that future efforts might evolve towards methods and information most helpful in understanding and assessing local hydrologic impacts of climate change.

RECOMMENDATIONS FOR ADDITIONAL INVESTIGATION AND RESEARCH

The findings and lessons learned from this study indicate opportunities to improve understanding of the issues surrounding hydrologic response to climate change. Additional investigation efforts should seek to better understand and assess climate variability, while refining aspects of the procedure that can help to reduce uncertainty, as discussed in the recommendations on page 103. The following specific suggestions for additional investigation and research respond to that objective.

1. Climate Model Investigation and Development – output from climate models formed the basis for the evaluation of changes in runoff volume and timing in this study. In the short term it would be helpful to develop a better understanding of the nature of precipitation projections in climate change modeling, including the degree of confidence that might be lent to them, and potential differences between models in accurately simulating precipitation trends. It would also be helpful to investigate and apply possible methods to extract information from the climate models about changes in inter-annual and daily climate characteristics to better understand impacts of climate change on floods and droughts.
2. Additional Scenarios – This study considered just five scenarios from a dataset of 112 possible projections for analysis for each of two future periods. Using the methods and procedures developed for this study, a subsequent analysis based on a simulation of *all* of the available GCM projections would be instructive to better understand the distribution of variability among the streamflow responses to the GCMs.
3. Demand – In using the results of this study in water system models, methods and procedures could be formulated and applied to simulate the impact to corresponding climate change scenarios on demand as done by CWCB in the Colorado River Water Availability Study.
4. Evapotranspiration – A major factor in projecting reduced average annual streamflow volumes in this study is the simulation of increased ET resulting from warmer temperatures. It would be helpful to work with climate model experts to identify elements of climate models corresponding with variables that impact ET (such as wind speed, solar radiation, and relative humidity), evaluate climate model skill in predicting these variables, and determine the feasibility of extracting this information from climate models and including them in the hydrologic modeling procedure.

Many of the participants in this study began with limited experience regarding climate science, climate modeling, and how climate model outputs might be applied to hydrologic models to gain insight into changes in runoff volume and timing under the influence of climate change. Participation in this study has both broadened and deepened the understanding of the participants, and the study methodologies are developed sufficiently such that many of the suggestions for additional investigation and research noted above should now be more accessible to the participants.

MULTIMEDIA

It was important for the study participants to have access to the complete set of results of the study for subsequent efforts. Because of the large amount of data compiled and generated and the difficulty of presenting all of the results of this study in a report, a spreadsheet was prepared as a repository and display tool for the data generated by the models. The spreadsheet was distributed to the study participants and can be made available upon request to the Foundation.

BENEFITS OF REGIONAL COLLABORATION

Regional collaboration was a key to the success of this project and was a valuable component for a number of reasons. Instead of each participant independently embarking on a study to assess climate change impacts to its individual water systems, the collaborative approach allowed participants to work together to develop the tools necessary for an assessment, agree upon a reasonable set of climate scenarios and time periods to examine, and share both data and financial resources. This was particularly useful for Front Range utilities as their water supplies originate from many of the same sources and collaboration reduced duplication. Furthermore, because many utilities in Colorado plan for the future using historic hydrologic records, there was a common need for a hydrology model to convert GCM projections of temperature and precipitation into streamflow and this further enhanced the benefits of regional collaboration.

Another important benefit to regional collaboration on this study was the ability to draw the interest of the academic, scientific, and research communities. Members from each of these communities participated and advised the research team as the study progressed. A single utility, acting alone, would not likely attract the same attention. This partnership resulted in a strong, scientifically defensible, and rigorously reviewed approach, as well as significantly increasing participants' knowledge base through monthly education session with leading experts in climate, water, modeling, and planning. This model is one that can be continued in Colorado and duplicated in other regions of the country.

RESEARCH PARTNERS AND PARTICIPANTS

Funding and/or technical assistance for this study was provided by the following water utilities and water agencies from the Colorado Front Range:

Participating Water Utilities:

Aurora Water
City of Boulder
Colorado Springs Utilities
Denver Water
City of Fort Collins
Northern Colorado Water Conservancy District

Participating Water Agencies:

Colorado Water Conservation Board (CWCB)
Western Water Assessment (WWA) (technical assistance)

These participants, together with others noted below who joined during the course of the study, provided overall direction for the study and collaborated through participation in educational sessions and regular project meetings.

Additional Participants

City of Westminster
City of Cheyenne Utilities
City of Longmont Utilities

CHAPTER 1
INTRODUCTION

Colorado's Front Range metropolitan water providers are concerned about the impact climate change may have on future water supply. Depending on the direction, timing, and magnitude of future temperature and precipitation changes, the volume of water available could increase or decrease. Additionally, peak runoff timing could change, possibly leading to water rights complications or the need for operational changes for water utilities that depend on snowmelt for water supply. To better understand the possible impacts of climate change, several Front Range providers are working together to provide the education, tools, and methodology needed to study these potential effects. This project was designed to enable entities that obtain water from the upper Colorado, South Platte, Arkansas, Cache la Poudre, St. Vrain, Boulder Creek, and Big Thompson river basins to examine the potential effects that climate change may have on these supplies. This study involved a complex integration of climate model analysis, water accounting, and hydrologic modeling. Figure 1.1 shows a general map of the study area. The study participants included Aurora Water, the City of Boulder (Boulder), the City of Fort Collins (Fort Collins), Colorado Spring Utilities (Colorado Springs), Denver Water, and the Northern Colorado Water Conservancy District (Northern Water). The following introduction briefly presents the background, objectives, approach, and specific aims of this study to provide the reader with context for the detailed descriptions of the individual study components that follow in subsequent sections of this report.

Figure 1.1 General map of study area

Traditional approaches to water supply planning use historical streamflow records to simulate the operation of existing, planned, and potential water supply systems and to evaluate their reliability for meeting current and projected demands. Many utilities have used tree ring data to extend streamflow records, and some have used re-sequencing techniques to further understand their water system vulnerabilities. Until recently, variability and changes in climate statistics have not typically been integrated into water resources planning processes.

The study participants wanted to understand the possible effects that climate change may have on streamflow, and to be able to represent those changes in the context of historical streamflow sequences. In developing this concept, the participants were working in the context of a larger decision framework that addresses the uncertainty of future climate and that could be repeated by other water providers. The framework consists of four elements (partially adapted from a report titled, "Decision Support Planning Methods: Incorporating Climate Change into Water Utility Planning," [Means et al. 2010]), as follows:

1. Increase understanding of climate science, climate modeling, downscaling, hydrologic response to change, planning with new uncertainties, and future climate research directions.
2. Assess climate impacts on hydrologic response and on the vulnerability of water systems.
3. Integrate vulnerability assessment results into water utility planning processes.
4. Make and implement appropriate decisions for infrastructure, operations, supply and demand investments, and policy strategies.

This study addressed one part of the second element of the framework listed above – the assessment of climate impacts on natural water supplies. One source of information that can be used to gain insight into climate impacts on future water supply is the output from global climate models (or general circulation models [GCM]) used to project the impact of greenhouse gas emissions on global climate. Many of these models were compiled and assessed in the Intergovernmental Panel on Climate Change Working Group 1, Fourth Assessment Report (IPCC 2007). The output of these models included time series of temperature and precipitation used to adjust the inputs to hydrologic models. The hydrologic models were then used to estimate the effect the adjusted temperature and precipitation sequences would have on streamflow. The study's participants, in conjunction with expert guidance, identified an approach (described in subsequent sections) for selecting climate projections to be used for this study and a method for adjusting inputs to hydrologic models based on the output from the climate models.

The primary objective of this study was to analyze the sensitivity of streamflow to climate change for three watersheds and to develop streamflow sequences that represent the effects of climate change on the baseline streamflow. Two future time periods were assessed using available climate model outputs to support near-term as well as long-term planning horizons. The change in annual runoff volume and timing of runoff are the key outputs of the study of interest to the participants. Each provider will be able to use the future streamflow scenarios in conjunction with its own water system model to estimate the impacts of various climate change scenarios to its current and future water supply.

A secondary objective related to this study was to give participants an opportunity to learn about regional climate conditions, current observations, climate science, climate modeling, techniques for downscaling climate model output, hydrologic modeling, and the impact of climate change on streamflow. This second objective was achieved through monthly educational sessions conducted by climate science and hydrologic modeling experts.

This report addresses the specific objectives, methods, and results of the streamflow sensitivity analysis and does not present a detailed discussion of the educational aspect of this study.

APPROACH

The approach presented below combines outputs from climate models with hydrologic modeling to achieve the objective of analyzing the sensitivity of streamflow to climate change as outlined above. The approach taken was to:

- Select specific climate projections representative of the range of outputs from multiple climate models;
- Identify a climate change "signal" (the change in temperature and precipitation between a reference period and a selected future period) from each model;
- Apply that climate change signal to the historical inputs for two hydrologic models for the basins noted previously;
- Simulate the hydrologic response from each hydrologic model to produce time series of climate-adjusted natural runoff; and
- Compare the simulation of climate adjusted natural runoff with an unadjusted baseline simulation of runoff to identify potential impacts of climate change.

Applying this approach to the three large-scale river basins of interest to study participants required several preparatory activities in addition to the steps above, and ultimately led to four major tasks, which are introduced below and described more fully in the *Methodology* section of this report.

Task 1: Selection of climate model projections

The primary objective of this study included developing streamflow sequences that represent a range of potential effects of climate change on natural streamflow. Because there are a large number of climate model projections available to represent possible future climate conditions, and because resources did not permit the processing and analysis of the complete set of projections available from the IPCC, a subset of climate projections was selected to use in the sensitivity assessment.

Ten GCM projections were ultimately selected to represent future climate scenarios. Two future periods were considered, with five GCM projections chosen for each future period. Rather than evaluating and using the direct output from each GCM, a dataset provided by the Bureau of Reclamation was used for this study. This dataset provided access to output from a broad selection of GCMs in a consistent format and spatial resolution, as described beginning on page 10. The first future period selected was a period representing conditions in 2040. Because of the annual variability in climate, which is replicated in the climate models, the 30 years surrounding 2040 (2025-2054) were chosen as representative. The second period was chosen to represent conditions in 2070, and corresponds to the 30 years surrounding 2070 (2055-2084). To capture the range of variability in available model results, the outputs from individual GCMs were selected for input to the hydrology models instead of averaging outputs from multiple

GCMs. The climate change signal for each GCM was defined by the average monthly change in precipitation (percent) and temperature (absolute) from the baseline period (1950-2000) to the selected future period (2040 or 2070). The selected GCMs were chosen to represent five qualitative scenarios that describe the general range of temperature and precipitation change found in the larger set of GCM model results for the two future periods. The naming of these scenarios is as follows:

- Hot & Dry,
- Hot & Wet,
- Warm & Dry,
- Warm & Wet, and
- Median.

All of the ten selected projections show a warming trend, with some warmer than others (leading to the designation of "hot"). The precipitation trend is less consistent, with some projections leaning toward an increase (wet scenarios), and some to a decrease (dry scenarios) in future precipitation.

Task 2: Historical undepleted streamflow data development

Assessing the potential impact of climate change on water supply required an estimate of the historical streamflow for use in calibrating hydrologic models which were used to develop a baseline for comparison with climate adjusted flows. Historical observations of streamflow in Colorado include the effects of diversions from rivers, reservoir storage, reservoir releases, and agricultural return flows. Streamflow sequences that have been adjusted to remove these effects represent the natural streamflow of the rivers and are referred to as *undepleted* flows. The second task of this study was to compile or develop historical undepleted flows for 18 gauge locations of interest.

Task 3: Hydrologic model development

To accurately simulate the impact of climate change using a hydrologic model requires a model that properly represents the response of the basin to the climate inputs (specifically temperature and precipitation). It is assumed that if a hydrologic model has been calibrated to effectively represent historical patterns of runoff in response to historical climatological inputs, then it should be able to accurately simulate the runoff that would occur if those inputs are adjusted to reflect potential climate change, as long as the adjustments do not result in climatological patterns that are far outside of any historically observed year.

In an attempt to distinguish between trends attributable to a fundamental hydrologic response from trends that might be peculiar to a particular hydrologic model, two hydrologic models were selected for use in this study. The hydrologic models used in this study were the Water Evaluation and Planning (WEAP) model from Stockholm Environment Institute (Yates et al. 2005a,b), and the Sacramento model found in the National Weather Service River Forecast System (NWSRFS).

David Yates (co-principal investigator) has contributed to the development of the WEAP model, partially funded through the Water Research Foundation and made available to subscribers free of charge. In addition, it has been used throughout the country by water resource planners for conducting climate change studies. Most notably, Colorado Springs Utilities, through another Foundation project (#3132), has been developing a WEAP application to model its water system.

The Sacramento model has a long history of use in the study region by the National Weather Service (NWS) for both short and long-term operational streamflow forecasting. Each model requires its own representation of the historical climate, which is used to simulate the effects of precipitation and temperature on natural runoff processes.

Hydrologic model development and calibration generally involves the following basic activities:

- Model parameterization, in which the geographic area of interest is subdivided to represent sub-watersheds with their respective areas, physical characteristics, and connectivity.
- Historical climate data development, in which historical climate data are compiled and organized in a format that can be used by the respective models. These data are known as the "forcing" data for the model.
- Model calibration, in which various parameters of the models are adjusted to improve the correlation between observed and simulated runoff.

The approach followed for this task began with previously developed historical datasets and calibrated models, where available, and then updated the model calibrations by adjusting model parameters based on a comparison of model-simulated streamflow and historical undepleted streamflow at 18 gauge locations distributed among the three watersheds.

Task 4: Assessment of streamflow sensitivity to climate change

The analysis of streamflow sensitivity to climate change was performed in two stages. In the first stage, a simple sensitivity analysis was used to demonstrate the hydrologic simulation approach and to test the sensitivity of each model and each gauge location to a uniform temperature increase (with no change to precipitation) and to a uniform precipitation adjustment (with no change to temperature).

The second stage was to perform a GCM-based sensitivity analysis to assess model response to possible climate change represented by specific projections in which the temperature and precipitation adjustments vary spatially over the study area and temporally from month to month. The hydrologic modeling approach required the historical climate time series inputs to the WEAP and Sacramento models to be adjusted according to the monthly climate change signals from each GCM projection. Using the adjusted climate inputs, the hydrologic models generate simulations of climate-adjusted streamflow sequences that can be compared to a baseline sequence to determine the streamflow response to a particular climate change signal.

To aid in the organization and evaluation of the results of the hydrologic simulations, an automated spreadsheet tool for reviewing and analyzing the results was created. Together, the climate adjusted undepleted flows derived from both the WEAP and Sacramento model simulations for multiple GCM projections represent a sample of possible future streamflow sequences that were compiled and provided to the study stakeholders. The sequences will allow water resources planners in Colorado to evaluate system responses to a range of possible changes in future streamflow.

STUDY GOALS

The tasks outlined above were performed with the purpose of achieving the overall objective of analyzing the sensitivity of streamflow to climate change for Front Range water supplies. As these tasks were identified and defined, specific study goals emerged in an effort to enhance the potential benefits of the study and guide execution of the tasks. The study goals that were identified and achieved as part of the above tasks were to:

- Identify and apply a procedure for selecting multiple climate model projections for use in hydrologic simulation (Task 1);
- Develop a consistent sequence of historical undepleted flows for the period 1950-2005 for 18 key gauge locations to use in hydrologic model calibration and as a set of baseline flows for comparing against climate adjusted streamflow simulations (Task 2);
- Develop and calibrate two hydrologic models for use in computing the hydrologic response to temperature and precipitation climate changes. This includes establishing input datasets (i.e., climate-forcing datasets) of historical temperature and precipitation for each hydrology model (Task 3);
- Report on the differences in hydrologic model accuracy for water years of differing types, including wet, normal, and dry years, to assist in understanding the effectiveness of models in reflecting change in runoff in response to climate change (Task 3);
- Test and demonstrate an approach for evaluating hydrologic response to variations in climate using uniform adjustments to temperature and precipitation (Task 4);
- Simulate the hydrologic response to possible climate change in temperature and precipitation by using multiple GCM projections, hydrologic models, and future periods of interest (Task 4);
- Evaluate the hydrologic responses to possible climate change to assess:
  - Change in annual runoff volume,
  - Change in the timing of runoff,
  - Spatial variability associated with these changes,
  - Impact as a function of basin elevation,
  - Differences between two hydrologic models in representing the response to climate change.

  (Task 4); and
- Describe a clear, repeatable procedure for subsequent use in the region or in other parts of the country (documented in this report).

CHAPTER 2
METHODOLOGY

The study methodology incorporates four principal activities or tasks: selection of climate model projections, historical undepleted streamflow data development, hydrologic model development, and assessment of streamflow sensitivity to climate change. The following sections describe the methodology and procedures that were followed for each task in conducting this study. Intermediate results of each task are presented as part of the methodology in this section, while results of this study are presented in a separate section titled *Results and Discussion*.

TASK 1: SELECTION OF CLIMATE MODEL PROJECTIONS

Assessing all available temperature and precipitation information from the currently available GCMs was not the objective of the participants. For many of them, this was their first climate change investigation and the main purposes were to develop an understanding of the science, develop the tools necessary to translate current information into streamflow, and assess the impact associated with a representative range of projections. With a better understanding of the science and assessment tools in place, participants can consider additional GCM projections or other new information as required.

By selecting a subset of GCM model projections to assess, the participants developed an easily repeatable and objective model selection approach. Not all water users across the country have access to or the resources for working with climate change experts and modelers to determine which of the many available GCM runs should be used in their assessments. This approach can be used as a systematic way to consider climate information in planning. To date, there are no widely accepted procedures in place within the scientific community for assigning confidence to, or choosing between, the available GCMs (Tebaldi 2005). The model selection procedure used in this study, therefore, does not assume that any single GCM run is more likely to occur than another. The methodology for selecting between GCM runs and developing adjustments to perturb historical climate inputs included the following steps:

1. Selecting among CO_2 emissions scenarios;
2. Identifying GCM projections for which temperature and precipitation output are available for the selected emissions scenarios;
3. Obtaining downscaled GCM output for the GCM projections identified in step 2;
4. Computing average monthly temperature shifts and precipitation adjustment factors (offsets) between the baseline climate period and each of the two future evaluation periods for the downscaled GCM output obtained in step 3; and
5. Selecting a subset of GCM projections based on the offsets computed in step 4 that represent a reasonable range of possibilities over the study region.

Step 1. Select emission scenarios

The Intergovernmental Panel on Climate Change (IPCC) created a Special Report on Emissions Scenarios (SRES) in 2000 created a suite of socioeconomic scenarios of the future which would reflect different development paths and lead to a range of different greenhouse gas emissions profiles. The scenarios differ in demographic, socioeconomic, and technologic development (IPCC SRES 2000). This study assessed the three most extensively examined emissions scenarios, A2, A1B, and B1. The scenarios represent three possible paths that atmospheric greenhouse gas emission concentrations could follow in the future. These paths include a continued rise in CO_2 emissions with no reduction (A2), a continued rise in CO_2 emissions with a leveling-off by mid-21st century followed by reductions (A1B), and a slight rise in CO_2 emissions through mid century followed by substantial declines (B1). These three emission scenarios were simulated at least once, and in some cases multiple times, by 16 of the developed GCMs.

Step 2. Identify global climate models

Many research institutions worldwide have combined atmospheric, oceanic, land, and ice models to develop GCMs. GCMs are used to simulate past, present, and future global climate conditions. The models produce future projections (as opposed to predictions) based on a number of assumptions and do not imply outcome confidence; rather they reflect the relationship between adjusted inputs and model outputs. The simulations considered here are based on the time-adjusted greenhouse gas emissions scenarios (step 1), with various sets of initial conditions.

While the model projections are in general agreement about trends in future temperature, there is much less agreement about future precipitation. For a given emissions scenario, projected temperature and precipitation changes at the regional level vary significantly across GCMs. Also, there are variations in the output from the same GCM driven by the same emission scenario, but with altered initial conditions. Selecting a single GCM projection for evaluation, therefore, cannot represent the range or the uncertainty in current understanding of future climate trends. A better approach for investigating climate change impacts and adaptation strategies for water managers is to evaluate results of a number of GCM simulations to capture a wide range of model projections. The Program For Climate Model Diagnosis and Intercomparison (PCMDI) at Livermore National Laboratories has assembled an archive of climate model output for the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset served at http://www-pcmdi.llnl.gov/ipcc/about_ipcc.php. A list of the GCMs selected from this archive for consideration in this study, including the associated emissions scenarios, and the specific projections developed for those scenarios, is shown below in Table 2.1.

Table 2.1 Climate models included in the selection set. Numbers under emission scenario columns represent different ensemble runs from particular GCMs and emission scenarios.

#	WCRP CMIP3 Model I.D.	Available Projections			Country
		# A1b	# A2	# B1	
1	BCCR-BCM2.0	1	1	1	Norway
2	CGCM3.1 (T47)	1-5	1-5	1-5	Canada
3	CNRM-CM3	1	1	1	France
4	CSIRO-MK3.0	1	1	1	Australia
5	GFDL-CM2.0	1	1	1	U.S.
6	GFDL-CM2.1	1	1	1	U.S.
7	GISS-ER	1	2, 4	1	U.S.
8	INM-CM3.0	1	1	1	Russia
9	IPSL-CM4	1	1	1	France
10	MIROC3.2(medres)	1-3	1-3	1-3	Japan
11	ECHO-G	1-3	1-3	1-3	Germany
12	ECHAM5/MPI-OM	1-3	1-3	1-3	Germany
13	MIR-CGCM2.3.2	1-5	1-5	1-5	Japan
14	CCSM3	1-4	1-3, 5-7	1-7	U.S.
15	PCM	1-4	1-4	2, 3	U.S.
16	UKMO-HadCM3	1	1	1	U.K.

Columns labeled A1B, A2, and B1 refer to the future SRES scenarios described previously. The numbers in the columns indicate the available ensemble members from a particular GCM and emission scenario. An ensemble member is generated each time a model is started from a different condition. As a result, the time series of model variables (i.e. temperature, precipitation, pressure, etc.) of each ensemble member is different, and each ensemble member is considered a "sample" from which climate statistics may be estimated. In some cases, multiple ensemble members have been developed for a given model and emissions scenario, reflecting differing initial conditions, but only a subset of those were available in the dataset used for this study. The numbering of ensemble members was chosen by individual climate modeling groups before the results were submitted to the CMIP3 archive (Barsugli et al. 2009). For example, the researchers running CGCM3.1 submitted five ensemble members for each of the three scenarios, while the GISS-ER researchers submitted only two ensembles for A2, named 2 and 4. Also shown is the country in which the modeling center that developed the model is based. A total of 112 simulations were identified for evaluation.

Study participants decided early on in the process to use downscaled data instead of direct GCM output. The decision was partially based on the accessibility of the downscaled datasets, which are easy for other water managers to obtain and use, but also because the GCM output was already spatially and temporally formatted to a consistent scale, bias corrected for our region, and translated to a higher resolution.

Step 3. Obtain downscaled data

Downscaling is a generic term used to describe the translation of low-resolution climate model output to higher resolution output using additional physical information to create corrected climate data. Output from different climate models varies in its spatial resolution and in the degree to which a given model can accurately reflect historical values in specific regions. It typically has a coarse spatial resolution with some models representing the entire state of Colorado with just a few grid cells. The 112 climate scenario simulations are too coarse to represent the variable climate across Colorado, but are capable of identifying patterns of broad-scale climate change.

This study did not undertake its own downscaling procedure, but instead made use of bias-corrected and spatially downscaled climate projections derived from CMIP3 data and served at: http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/, described by Maurer et al (2007). These datasets were generated through a spatial interpolation technique made available through the Bureau of Reclamation Technical Service Center, Santa Clara University Civil Engineering Department, and The Institute for Research on Climate Change and its Societal Impacts at Lawrence Livermore National Laboratory. That team statistically downscaled results of the selected GCM projections (Table 2.1) using a percentile mapping technique that substitutes real-world data for climate data while retaining the broad-scale climate change signals (Wood et al. 2004 and Maurer 2007). As part of the procedure the climate model grids were resampled to a regular 2° grid to put the wide variety of GCM grid layouts onto the same scale, and then the climate change signals were interpolated from a 2° latitude-longitude grid to a 1/8° latitude-longitude grid using a monthly time step. The procedure included both a bias correction component (more accurately described as a correction of the entire climatologic distribution) and a mapping onto local climatology that implicitly includes an adjustment for terrain.

For this study, downscaled model output was obtained for all of the GCM projections identified for evaluation. These data provided the framework for selecting GCM projections to be used in the streamflow sensitivity study and provided the data used to adjust inputs to the hydrologic models for the study.

Step 4. Compute offsets

The study approach applies the "delta" method, which compares average climate conditions at one time period with a reference time period known as the baseline. The baseline climate period selected was 1950 to 1999. A fifty-year period was selected for the baseline climate to minimize any biases caused by cyclical physical processes and multi-decadal variability. Although the later part of the baseline includes a slight warming trend towards the end of the 20th century for some locations, it is still a useful baseline for comparison with future periods. It also generally frames the various periods currently used by participants for planning purposes.

The baseline climate period (1950-1999) differs from the baseline streamflow period (1950-2005) described in Task 2: Historical undepleted streamflow data development. This is because the year 1999 is the last year in GCM simulations of observed greenhouse gas emissions and the developed emission scenarios take over in the GCMs after this date, whereas the additional six years associated with the undepleted streamflow period include important events that participants wanted to be included in the hydrologic analysis.

Two future evaluation periods were selected, 2025-2054 (representing potential conditions in 2040) and 2055-2084 (representing potential conditions in 2070), for comparison to the baseline period. These periods were selected for consistency with other regional investigations (Smith et al. 2009), and to meet near and long-term planning horizons of the participants. Additionally, the climate model community recommended against using GCM projections near the end of the 21st century because of reduced confidence in the capabilities of the GCMs to simulate global conditions far into the future. Thirty-year averages were selected for the future periods for consistency with the World Meteorological Organization's definition of an appropriate climate time frame and to further minimize the effects of multi-decadal variability inherent to GCM simulations.

Statistically downscaled data were downloaded for a region that covered the entire study area. Boundaries of the study region were 107.526-104.4375 W and 38.5625-40.5625 N, as shown previously in Figure 1.1. This area is described by a 1/8th-degree grid with 17 rows from North to South, and 26 columns from West to East. Outputs from the grid were averaged over the complete study region for the climate model run selection process, although when the climate model outputs were later applied to the hydrologic models, data at 1/8th-degree grid scales were used.

Next, a monthly temperature and precipitation average was computed for the baseline time period using the obtained downscaled data over the entire study region. That is, all Januarys in the 1950-1999 baseline period for each climate model projection were averaged, then all Februarys, etc. This process was then repeated for the 2040 period and for the 2070 period. From the resulting monthly data, monthly differences were computed between 2040 and the baseline, and between 2070 and the baseline to create a temperature change signal for each of the 112 climate simulations. A similar analysis was completed for precipitation, though percent change was computed instead of absolute change. The computed temperature and precipitation changes are referred to in this study as climate change signals, climate adjustments, or climate perturbations representing 2040 and 2070 potential conditions. This approach was developed with guidance from the participants, Principal Investigators, the Western Water Assessment and other local experts.

Step 5. Select scenarios and associated projections for computing adjustments

The selection of a subset of climate model projections to use to assess hydrologic changes was the final step of this part of this study. Though considering all 112 runs for each time period would provide the greatest amount of information, it would have been infeasible for the participants to incorporate so many different sets of adjusted hydrologic patterns in their own planning. The following procedure, developed in cooperation with a team working on a complimentary study (the Colorado River Water Availability Study) with the Colorado Water Conservation Board, was used to identify a set of five GCM projections for each future period for evaluation.

Figure 2.1 shows the annual temperature and precipitation changes over the entire study region for both considered time frames of all 112 downscaled GCM runs (together with the idealized scenario points that were subsequently selected, as described below, for simulation in hydrologic models). From this scatter plot it was apparent that all model runs considered showed warming, though the magnitudes varied across models and emission scenarios. Precipitation changes, on the other hand, were less consistent for the region evaluated, with nearly half showing wetter and half showing drier conditions.

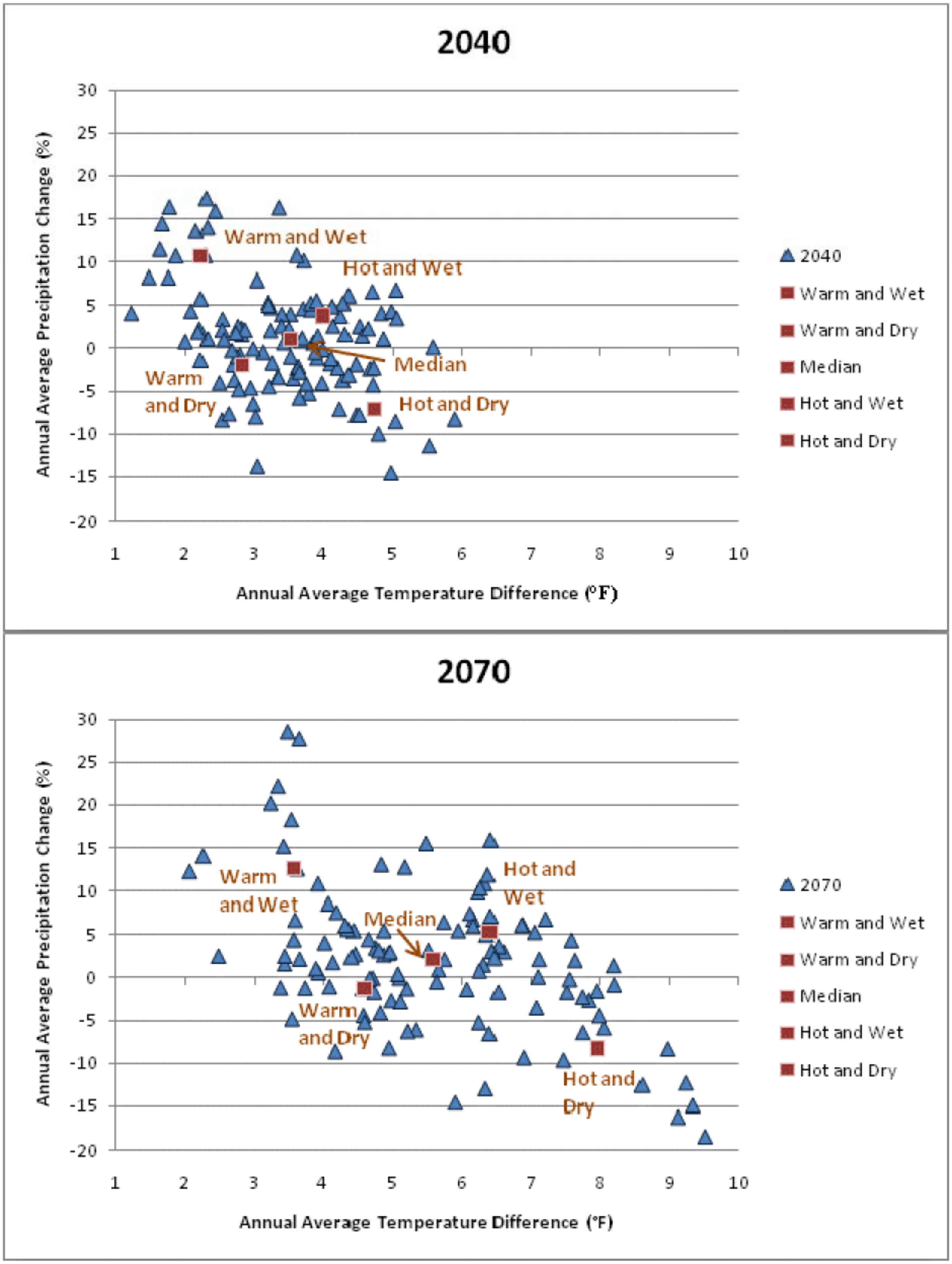


Figure 2.1 Annual Temperature and Precipitation Changes for 112 individual GCMs, with Idealized Qualitative Scenarios as compared to 1950-1999 annual averages. The top graph represents 2040 climate change signals, and the bottom 2070.

The results shown in Figure 2.1 were presented to the participants, and the group chose the following criteria for selecting between the climate model runs:

1. Five scenarios should be selected to represent the corners and middle of the scatter plot;
2. The selected scenarios should represent the general range of the results; and
3. The model selection method should not be biased and should be easy to repeat by other water managers.

Specific GCM runs were then selected as follows: First, five qualitative scenarios were created (criteria 1) to describe the five regions considered. The naming of these scenarios was based on the general observation that all of the projections show a warming trend on an annual basis, with some warmer than others, leading to the designation of "warm" and "hot". Projections for precipitation showed both increases ("wet") and decreases ("dry").

Next, a characteristic value was determined for each qualitative scenario. This step located the qualitative scenario on the scatter plot. The scenarios were intended to incorporate 80% of the annual climate signal spread (criteria 2). The characteristic values were defined as shown in Table 2.2.

Table 2.2 Characteristics of selected five qualitative climate scenarios

Scenario Description	Characteristic Temperature	Characteristic Precipitation
Warm & Wet	10th Percentile	90th Percentile
Hot & Wet	70th Percentile	70th Percentile
Median	50th Percentile	50th Percentile
Warm & Dry	30th Percentile	30th Percentile
Hot & Dry	90th Percentile	10th Percentile

Based on these percentiles, idealized scenario points were plotted on the temperature and precipitation change scatter plot as shown in Figure 2.1.

For each of the two future periods evaluated, a single projection was selected to represent each of the five qualitative scenarios. Ten total projections were ultimately chosen (five for each future period). Actual projections were selected based on their proximity (in terms of Euclidean distance in the T and P dimension space) to the characteristic values for the five scenario points on an annual scale. Five neighbors were selected as candidate projections for each scenario point. One of these five candidate projections was selected based on having a monthly precipitation pattern representative of the mean pattern of the five nearest neighbors. The patterns were assessed according to a root mean square error (RMSE) analysis.

The monthly RMSE analysis was conducted across precipitation patterns rather than temperature patterns because of the large variability in precipitation patterns across each model run. For example, Figure 2.2 illustrates the selection of the National Center for Atmospheric Research's (NCAR) Parallel Climate Model (PCM) driven by emission scenario A2, ensemble 3 (ncar_pcm1.3_A2). The model was the most representative of the mean monthly precipitation percent change pattern in terms of least RMSE of the five monthly projection patterns nearest the Warm & Wet qualitative scenario for the 2040 period. This approach selected the model with the most representative precipitation pattern for the mean of the group of models surrounding the qualitative scenario point.

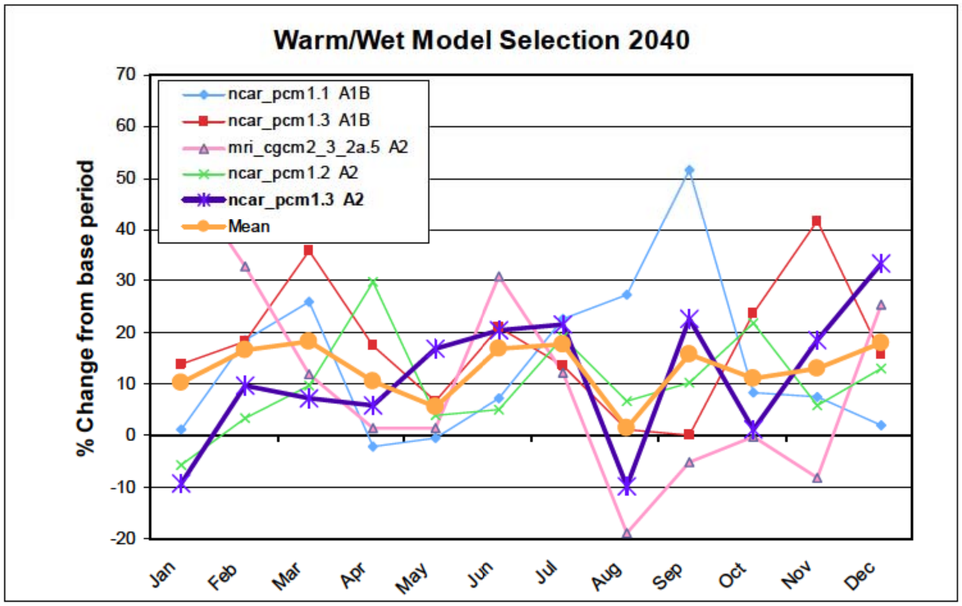


Figure 2.2 Monthly precipitation percent change patterns for five nearest neighboring GCM runs for the 2040 warm & wet qualitative scenario. The NCAR PCM 1.3 model was selected

Figure 2.3 uses the scatter plot to show the resulting climate model runs selected using the procedure described above, as well as the qualitative scenarios for both the 2040 and 2070 periods.

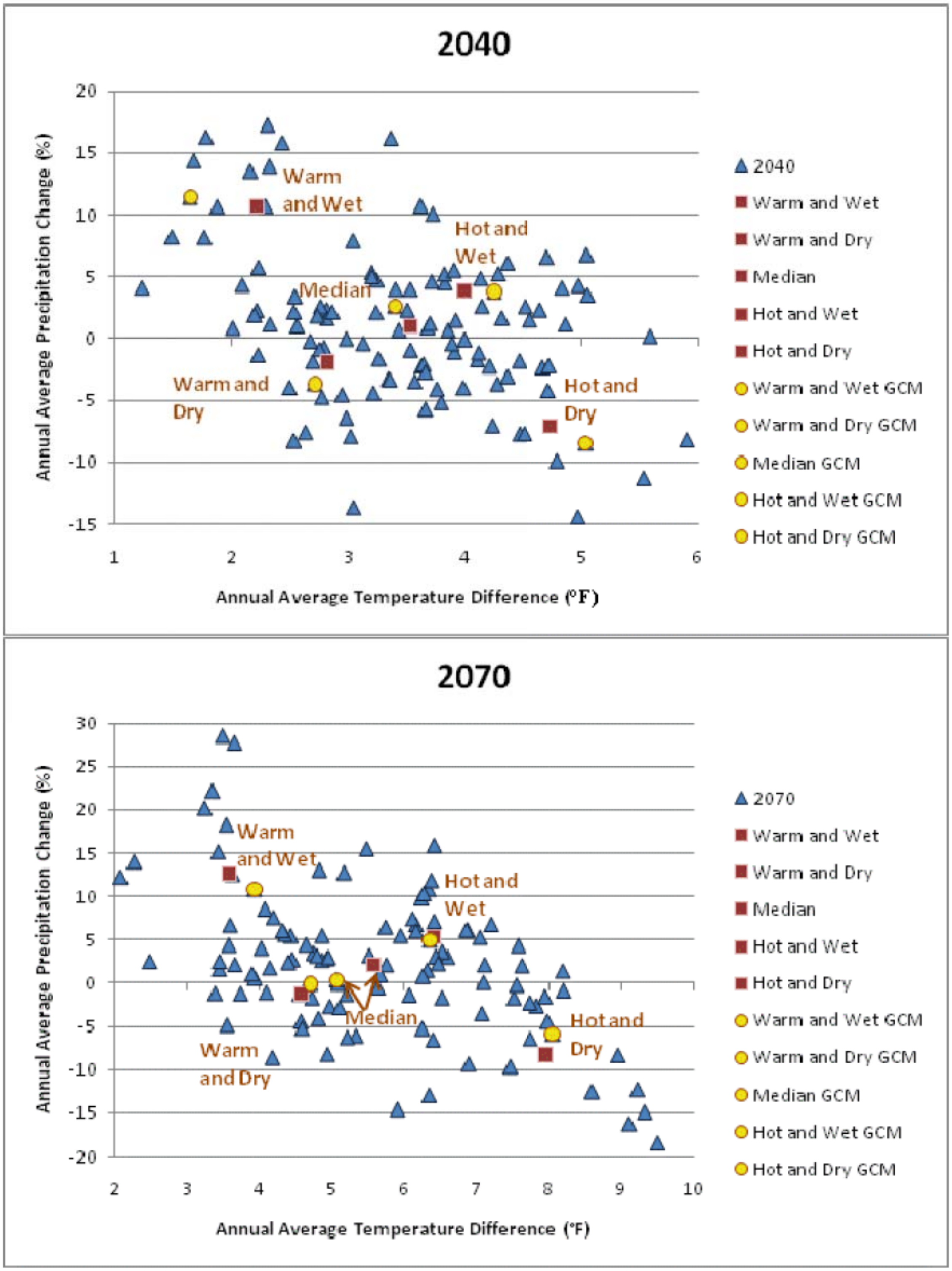


Figure 2.3 Annual Temperature and Precipitation Changes for 112 individual GCMs, with selected model runs and idealized qualitative scenarios as compared to 1950-1999 annual averages. The top graph represents 2040 climate change signals, and the bottom 2070. Red squares represent qualitative scenarios, yellow circles are the selected GCM runs

For simplicity and consistency, the climate models selected are referenced by their qualitative scenario names throughout the remainder of the report (e.g. Warm & Wet).

Table 2.3 and Table 2.4 list the GCM/emissions scenario/ensemble combinations that were chosen to represent each of the qualitative scenarios. For the Warm & Wet and the Hot & Wet scenarios the procedure resulted in the selection of the same GCM/Ensemble and SRES combination for 2040 and 2070. For the remaining three scenarios, a different projection was selected in each period. Average monthly precipitation and temperature offsets were computed for each of these models for each grid point over the study area for use in the hydrologic simulation.

Table 2.3 Year 2040 GCM Model Selection. Temperature and precipitation are average annual changes between baseline and future periods.

Scenario	GCM/Ensemble	SRES	Annual Temperature Increases (°F)	Annual Precipitation Change (%)
Warm & Wet	ncar_pcm1.3	A2	1.64	11.43
Hot & Wet	ncar_ccsm3_0.2	A1B	4.25	3.77
Median	cccma_cgcm3_1.2	B1	3.40	2.60
Warm & Dry	Mri_cgcm2_3_2a.1	A2	2.71	-3.67
Hot & Dry	Miroc3_2_medres.1	A2	5.04	-8.51

Table 2.4 Year 2070 GCM Model Selection. Temperature and precipitation are average annual changes between baseline and future periods.

Scenario	GCM/Ensemble	SRES	Annual Temperature Increases (°F)	Annual Precipitation Change (%)
Warm & Wet	ncar_pcm1.3	A2	3.93	10.81
Hot & Wet	ncar_ccsm3_0.2	A1B	6.35	4.95
Median	mpi_echam5.1	B1	5.06	0.38
Warm & Dry	mri_cgcm2_3_2a.4	A1B	4.70	-0.10
Hot & Dry	gfdl_cm2_0.1	A1B	8.06	-5.90

Figure 2.4 and Figure 2.5 illustrate the average monthly temperature and precipitation change patterns for each GCM run selected to represent the 2040 and 2070 qualitative scenarios, respectively. Monthly temperature and precipitation adjustments based on the selected GCM runs were used to adjust the historical temperature and precipitation datasets used to drive each hydrologic model. This process is explained in more detail in Task 4. Seasonal characteristics of the climate change signals are discussed further in the *Results and Discussion* section of the report.

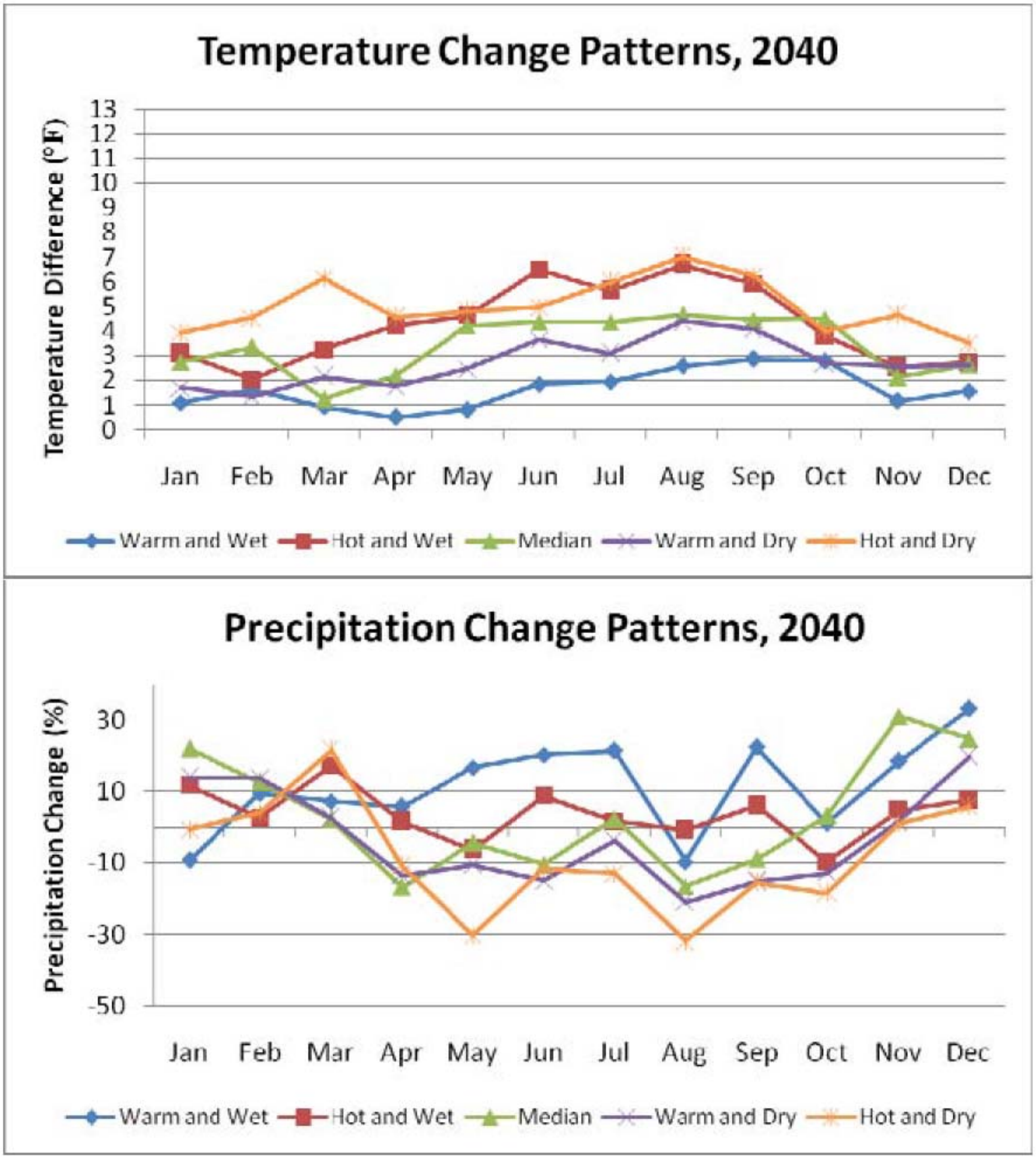


Figure 2.4 Monthly Change Patterns for Temperature and Precipitation, 1950-1999 versus 2025-2054 (2040)

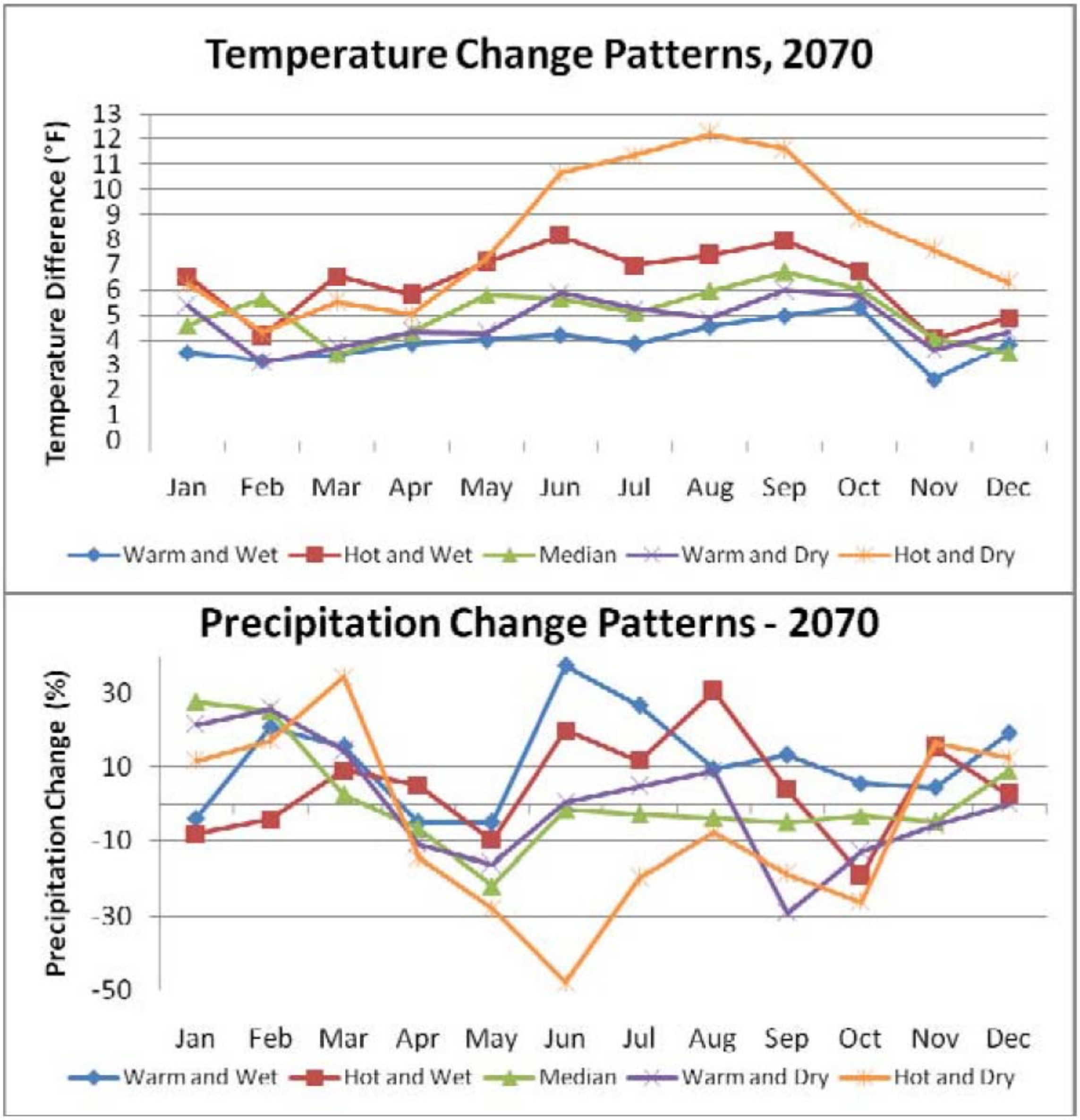


Figure 2.5 Monthly Change Patterns for Temperature and Precipitation, 1950-1999 versus 2055-2084 (2070)

TASK 2: HISTORICAL UNDEPLETED STREAMFLOW DATA DEVELOPMENT

This study included a compilation of undepleted streamflow at eighteen points of interest to the participants: nine points in the Upper Colorado, eight points in the South Platte and its tributaries, and one point in the Arkansas. Undepleted flow refers to the flow that would be observed at a gauging station if the effects of diversions from rivers, reservoir storage, reservoir releases, and agricultural return flows were removed from the observed flows. While undepleted flow is an estimate of naturally occurring flow, it is assumed that some man-made effects, such as changes in water table and changes in land use cannot be accounted for in the undepleted flow calculation, because they are not easily quantified. Estimates of undepleted flow provide a good baseline for assessing the impact of changes in precipitation, temperature, or other factors on the flow available to water users in a basin. All 18 gauging stations are influenced by streamflow regulation at upstream locations, including reservoir storage and release, transbasin imports and exports, and diversions for municipal, industrial, and agricultural uses. The development of historical, undepleted streamflow as part of this study had three important purposes:

1. To have a common set of undepleted flow sequences to use as the basis for calibrating hydrologic models that would be used to simulate the change in hydrologic response due to potential changes in climate;
2. To provide a baseline dataset against which climate adjusted flow sequences could be compared in order to assess the impact of potential climate change; and
3. To give water providers an undepleted flow dataset for use in simulating the operation of existing and planned water supply systems and evaluating their reliability for meeting current and projected demands.

For this study, the period from 1950 through 2005 was used for analysis and evaluation. It corresponds with much of the period used for the climate change analysis (1950-1999), it is a period for which streamflow data are generally available at the points of interest, and it corresponds to the period for which temperature and precipitation data are available for calibration of hydrologic models. Development of undepleted streamflow time series requires careful accounting of diversions, changes in reservoir storage, reservoir surface evaporation, trans-basin imports, and return flows. Prior to this study, the state of Colorado and several of the water providers had developed time series of undepleted streamflow for many of the basins of interest for significant portions of the study period. Developing undepleted streamflow datasets for this study involved the following principal activities:

1. Compiling and reviewing existing historical undepleted flow datasets obtained from project participants and identifying any gaps that may have existed in the datasets in relation to the study period;
2. Evaluating the quality of undepleted flow records and coordinating with project participants to select and agree on the final undepleted flow datasets; and
3. Documenting the undepleted streamflow dataset development process, including the general procedures used in developing the individual undepleted flow datasets from each source, as well as criteria used in selecting the data sources.

A list of the gauges defined for evaluation in this study is presented below in Table 2.5 through Table 2.8. Because it would have been difficult to present detailed results throughout this report for all 18 points, 6 points were selected for which detailed results are presented in subsequent sections in the body of this report. *The six gauges selected are highlighted in bold text in the tables.* They were chosen to represent the three watersheds analyzed in this study and to represent both higher and lower elevation gauges and both headwater areas as well as downstream points. These tables include the watershed's contributing area to the gauge, the undepleted flow in acre-feet, and the undepleted flow per unit area in acre-feet per acre.

Table 2.5 Upper Colorado Undepleted Flow Locations and Data Availability

Basin	Point	Station	Average Annual Undepleted Flow (Acre-feet)	Average Elevation (ft) upstream of point	Contributing area to gauge (1000's of acres)	Avg Ann flow (acre-feet/acre)
Upper Colorado	1	Fraser River at Granby (09034000)	152,000	9,734	190	0.80
	2	Williams Fork near Leal (09035700)	75,500	10,876	57	1.32
	3	Blue River below Green Mountain Reservoir (09057500)	384,000	10,513	383	1.00
	4	**Blue River below Dillon, CO (09050700)**	222,000	10,935	214	1.04
	5	Colorado River near Granby, CO (09019500)	271,000	10,194	207	1.31
	6	Colorado River near Dotsero (09070500)	2,016,000	9,288	2,812	0.72
	7	**Colorado River near Cameo (09095500)**	3,468,000	8,782	5,152	0.67
	8	Homestake Creek at Gold Park (09064000)	43,500	11,295	23	1.89
	9	Roaring Fork River near Aspen (09073400)	109,000	11,252	69	1.58

Table 2.6 Upper South Platte Undepleted Flow Locations and Data Availability

Basin	Point	Station	Average Annual Undepleted Flow (Acre-feet)	Average Elevation (ft) upstream of point	Contributing area to gauge (1000's of acres)	Avg Ann flow (acre-feet/acre)
Upper South Platte	10	**S.Platte River above Spinney Mountain Reservoir (06694920)**	78,000	9,978	463	0.17
	11	South Platte River below Cheesman Reservoir	152,500	9,603	1,114	0.14
	12	**South Platte River at South Platte**	277,000	9,382	1,343	0.21
	13	South Platte River at Henderson (06720500)	517,400	8,322	3,052	0.17

Table 2.7 Upper South Platte Tributaries Undepleted Flow Locations and Data Availability

Basin	Point	Station	Average Annual Undepleted Flow (Acre-feet)	Average Elevation (ft) upstream of point	Contributing area to gauge (1000's of acres)	Avg Ann flow (acre-feet/acre)
Cache la Poudre	14	**Cache la Poudre River at Mouth of Canyon (06752000)**	277,300	8,003	675	0.41
St. Vrain	15	St. Vrain Creek at Canyon Mouth near Lyons	115,300	8,939	138	0.83
Big Thompson	16	Big Thompson River at Mouth of Canyon near Drake (06738000)	123,600	9,588	195	0.63
Boulder Creek	17	Boulder Creek at Orodell	71,200	9,481	65	1.09

Table 2.8 Arkansas Tributaries Undepleted Flow Locations and Data Availability

Basin	Point	Station	Average Annual Undepleted Flow (Acre-feet)	Average Elevation (ft) upstream of point	Contributing area to gauge (1000's of acres)	Avg Ann flow (acre-feet/acre)
Upper Arkansas	18	**Arkansas River at Salida (07091500)**	418,600	10,335	780	0.54

Daily flows were compiled, where possible, for subsequent use in calibrating hydrologic models, although the final results of this study were reported at a monthly time step. The Colorado Decision Support System (CDSS) dataset is derived from monthly records of streamflow, diversions, and reservoir operations. CDSS can disaggregate monthly undepleted streamflow using the daily flow pattern found at nearby gauges that reflect minimal man-made impact, but monthly data are considered more reliable than disaggregated daily data. Monthly undepleted streamflows have been generated for the 1906-2006 period, but the data are more reliable for the years 1975-2005 when there are good monthly diversion records and when daily streamflow records are complete. The advantages of the CDSS data include its availability at many gauge locations, its general acceptance within the state, and that it provides the most up-to-date period of record for recent data.

The Denver Water undepleted daily flow dataset is widely available at many gauge locations, including some for which data are not available in CDSS, and typically extend farther back in time, although data are not available for more recent periods. Data from the recent period of record show the effects of reservoir regulation and might benefit from some data smoothing for future studies.

Data from Northern Water were available only on a monthly time step. Staff from Fort Collins participated in the review and approval process for some of these data. Data were also provided by Boulder and the Colorado Springs Utilities. Figure 2.6 illustrates graphically the availability of the various sources of data.

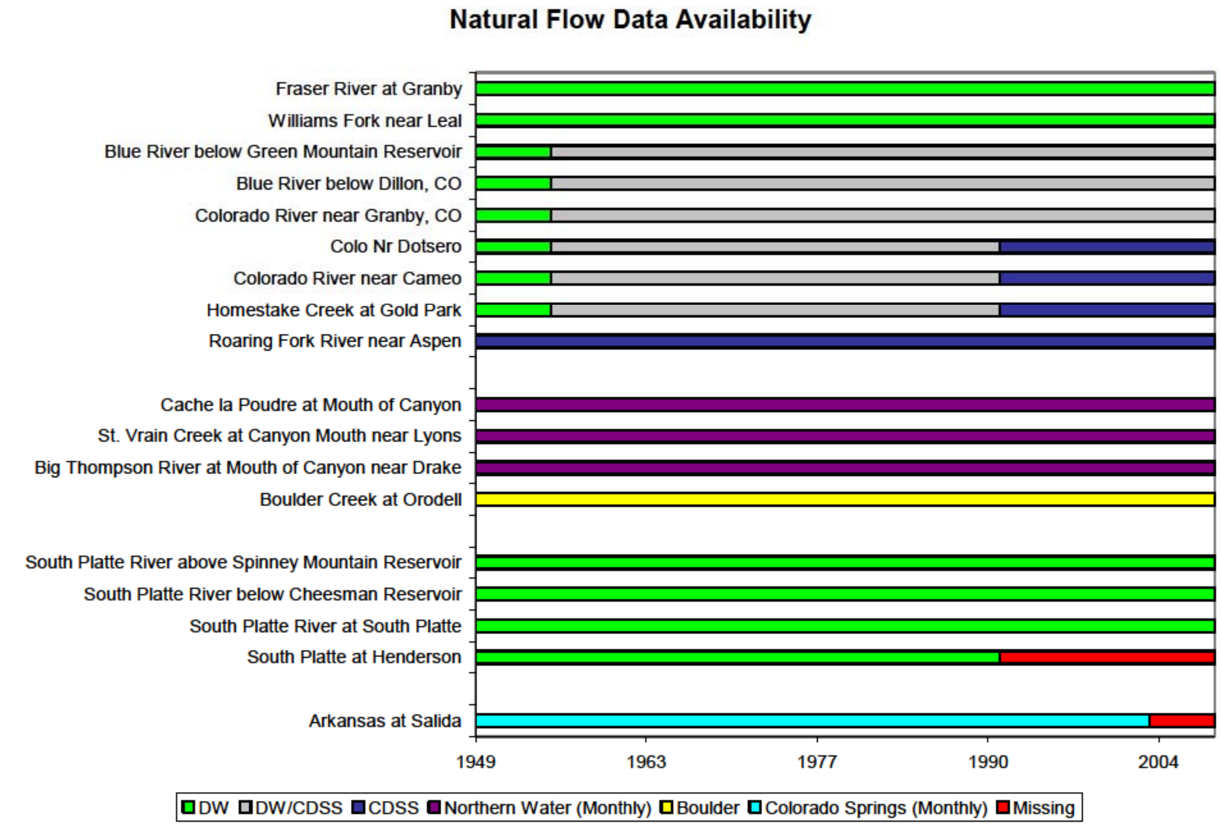


Figure 2.6 Sources of Undepleted Streamflow Data at a Daily Time Step.

Because of its wide acceptance and availability, the CDSS data were used as the default dataset wherever available. At some gauges where the CDSS data overlapped with Denver Water data, a visual inspection of the time series values suggested that for certain months, the Denver Water data were more consistent with the general historical undepleted flow patterns at the gauge. In these cases, the Denver Water data were adopted. Figure 2.7 illustrates a case where Denver Water data were selected in preference to the CDSS data for February, April, May, June, and November for that year. In this figure, the CDSS data (shown in blue triangles) for February, May, and November are inconsistent both with historical monthly values for years not shown, and with preceding and following months for the year shown. In contrast, the Denver Water data (indicated with red circles) show general consistency between months in the year shown and with average monthly values for other years in the historical record.

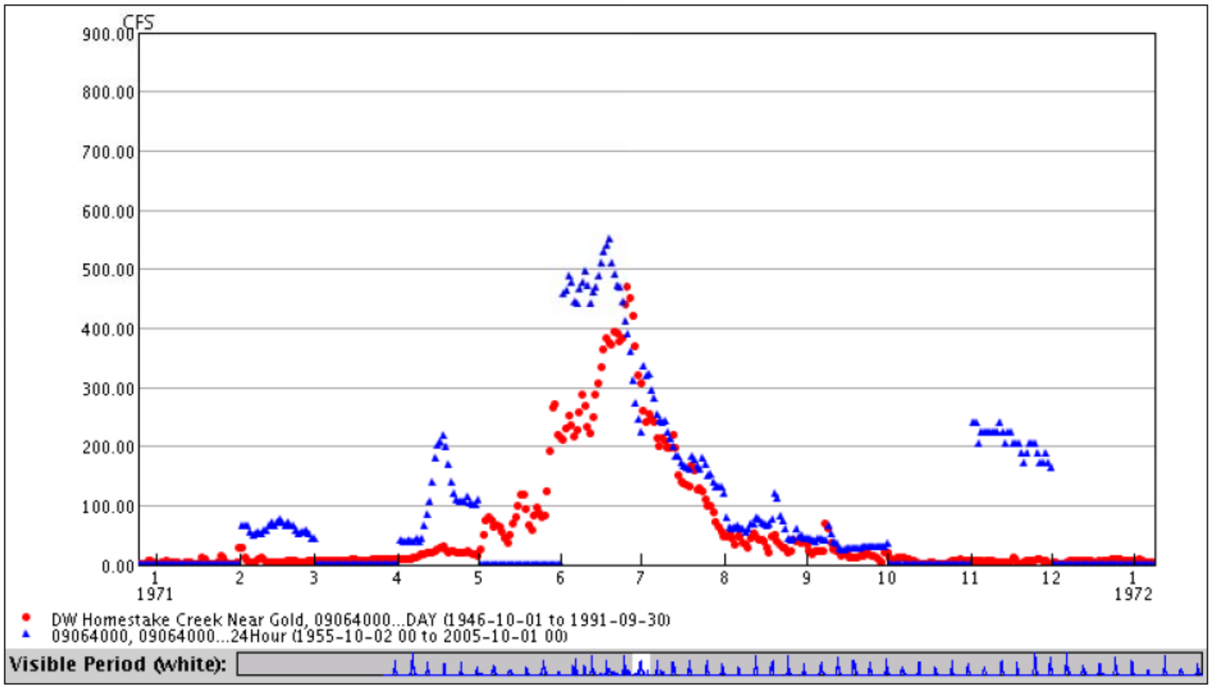


Figure 2.7 Comparison of Undepleted Flow Data Sources at Homestake Creek near Gold Park, 09064000

Colorado Springs Utilities provided a preliminary monthly time series of undepleted streamflows for the Arkansas River (e.g. Arkansas River at Salida [07091500]). In the process of making these calculations, it was noted that some data were missing and it was difficult to reconcile different flow records. Where multiple data sources were available the annual operating plans (AOP) of the Bureau of Reclamation were used, as suggested by Colorado Springs. In some cases, missing diversion data were filled with average monthly values and in some cases where diversion records ended, the diversion was assumed to end as well. Colorado Springs staff noted these challenges associated with the process of undepleted streamflow development for the Arkansas River and indicated a need for additional investigation to improve these estimates.

Annual time series of undepleted flow for the six representative gauge locations are presented in Figure 2.8 through Figure 2.13. Because of the variation in flow magnitude between gages, each of the figures uses an independent scale for flow.

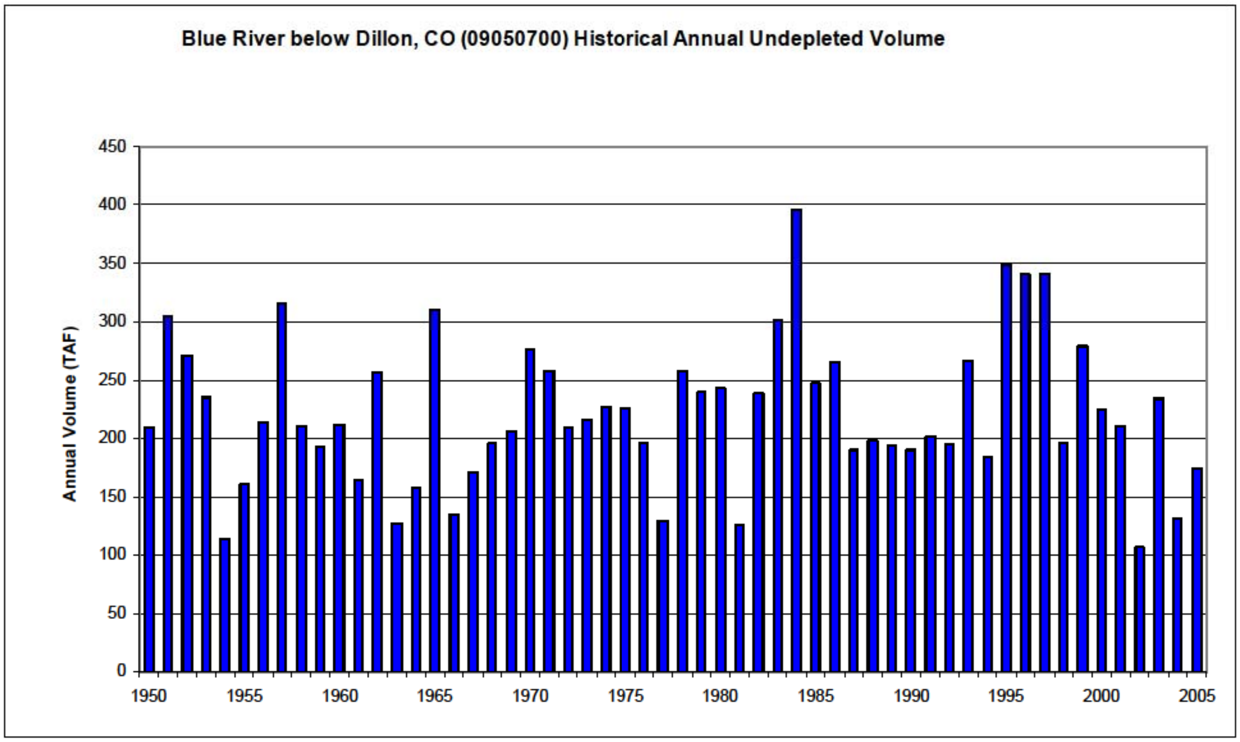


Figure 2.8 Estimated Annual Undepleted Flow, Blue River Below Dillon

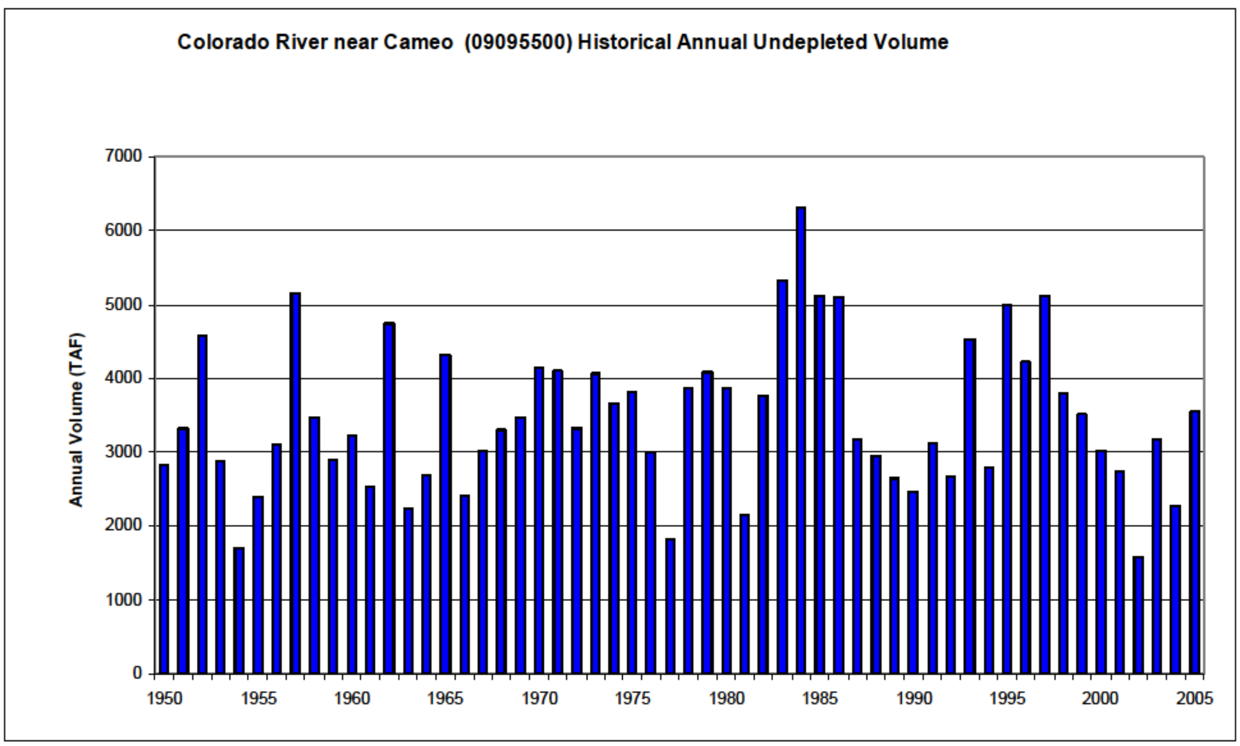


Figure 2.9 Estimated Annual Undepleted Flow, Colorado River near Cameo

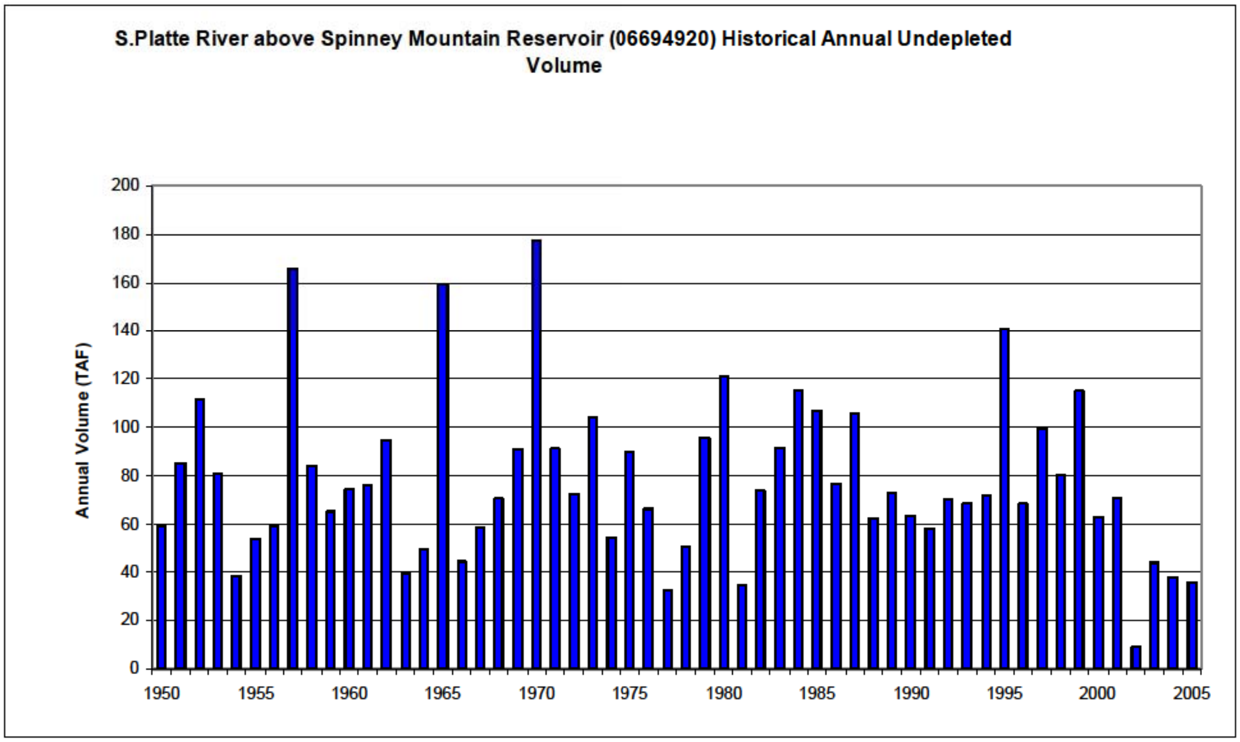


Figure 2.10 Estimated Annual Undepleted Flow, South Platte River above Spinney Mountain Reservoir

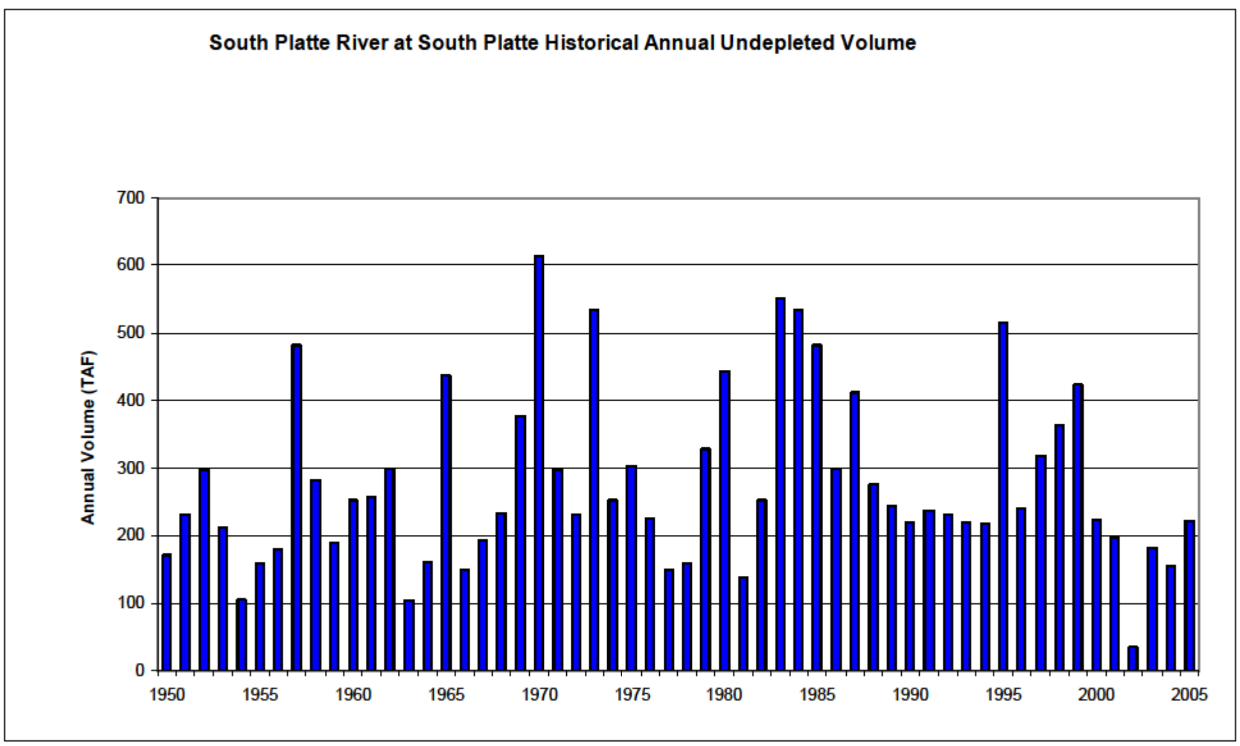


Figure 2.11 Estimated Annual Undepleted Flow, South Platte River at South Platte

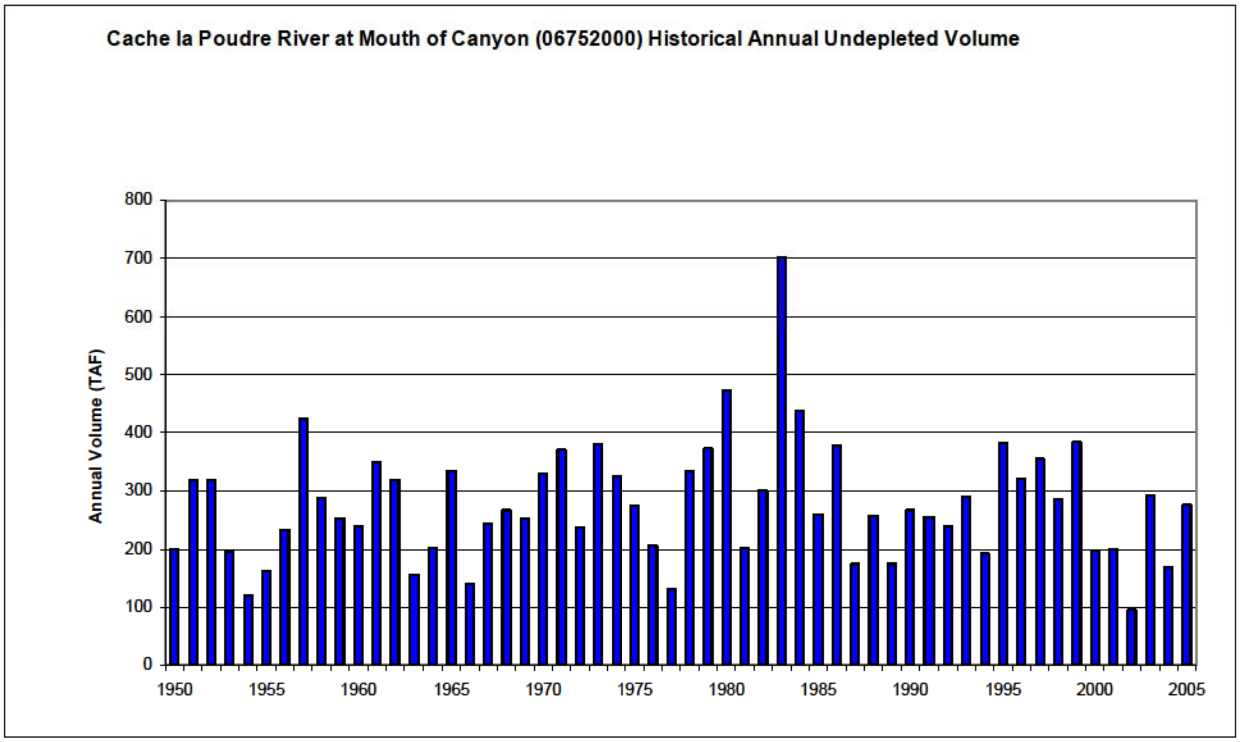


Figure 2.12 Annual estimated undepleted flows for the Cache la Poudre River at the mouth of the canyon

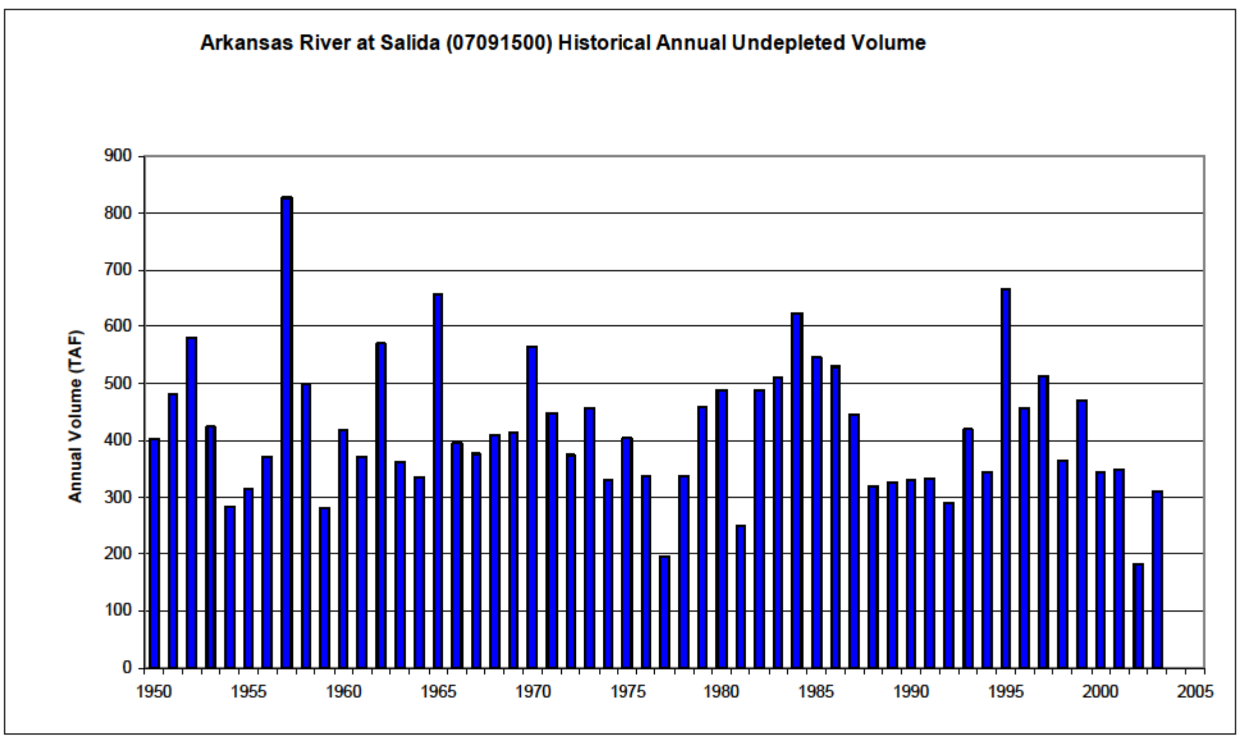


Figure 2.13 Estimated Annual Undepleted Flow, Arkansas River at Salida

Figure 2.6 showed that undepleted flow estimates were not available for some periods for the South Platte at Henderson and the Arkansas River at Salida. As noted previously, the purpose of compiling the undepleted flow datasets was to calibrate hydrologic models, create a dataset to compare against climate change simulations, and for subsequent simulation of water supply system operations. Where there were missing data, the calibration focused on periods with data. For the development of a baseline dataset and for subsequent simulation of water supply system operations, the missing data periods were filled with simulated data from the Sacramento model after its parameters had been calibrated to the available data.

The monthly average undepleted flow for the period 1950 through 2005 was divided by the contributing area (see Tables 2.5 through 2.8), to yield a summary of average monthly flow in units of acre-inches per acre. The resulting data for the six selected gauges are depicted in Figure 2.14. These flow comparisons highlight important differences between the basins. The streamflow generation on the South Platte is quite low relative to all the other basins. The high elevation headwater basins represented by the Blue River below Dillon exhibit higher unit runoff (which is why they are so heavily diverted). The Arkansas Basin shows a slightly later runoff timing than the other basins.

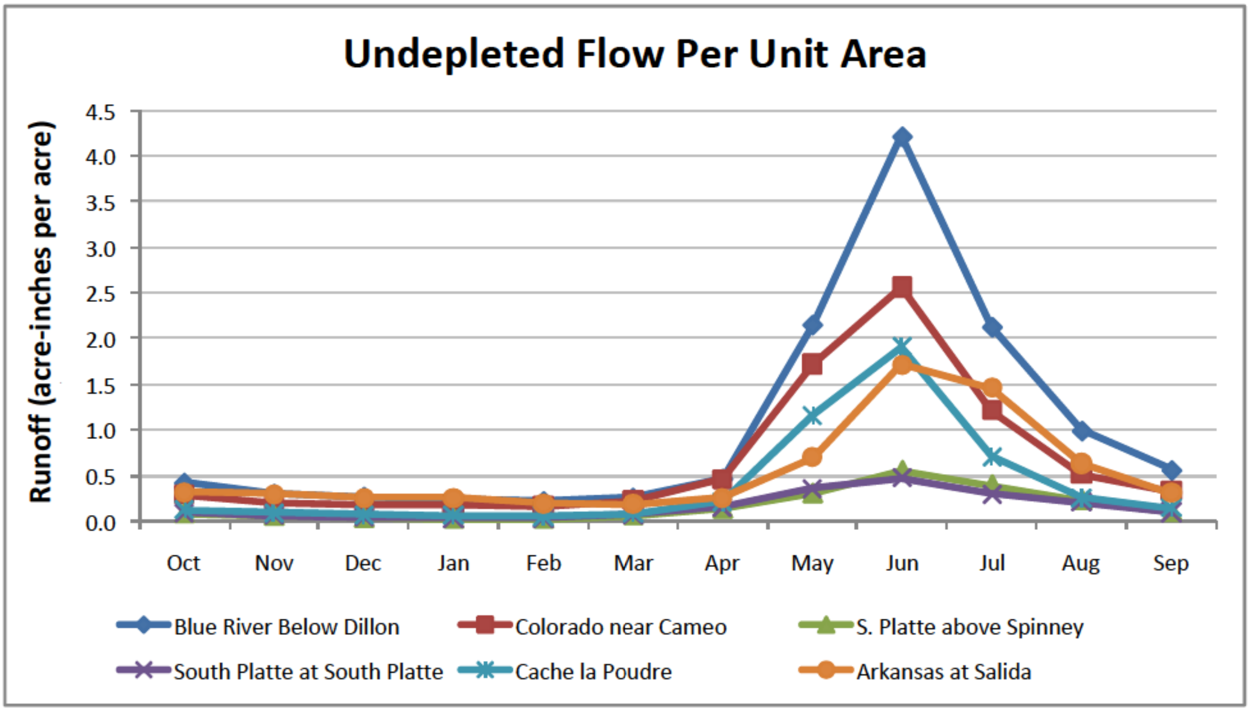


Figure 2.14 Estimated monthly average undepleted flow per unit area

TASK 3: HYDROLOGIC MODEL DEVELOPMENT

As noted in the study approach, simulating the hydrologic impact of climate change requires hydrologic models calibrated to adequately represent historical patterns of runoff in response to climatological inputs. While the intent of this study was to use previously developed historical datasets and calibrated models where available, it was expected that refinement of the calibrations would be required for the models to be consistent with the baseline undepleted flow dataset established in Task 2.

Two independent hydrologic models were configured, calibrated, and applied to assess the relative change in simulated hydrologic response resulting from changes to climate inputs. The selected models were the Water Evaluation and Planning (WEAP) model from the Stockholm Environment Institute (Yates et al. 2005a,b), and the Sacramento model developed by the National Weather Service. Both are conceptual, lumped parameter models that include snowmelt and runoff parameterizations. Overall model attributes are summarized in Table 2.9.

Table 2.9 Summary table showing broad comparison of Sacramento and WEAP models.

Attribute	Sacramento Model	WEAP Model
Time step	6-hourly	Weekly
Topographic Representation	Area-Elevation Curves	1000 foot, banded catchments
Soil Parameters	2 soil moisture zones, water balance solved with mix of discrete and continuous functions	Soil Water Capacity and saturation conductivity, water balance solved as single, continuous formulation
Snow Parameters	Temperature index	Temperature index, radiation based melt-rate
Vegetation	Forest cover and riparian vegetation	Four land classes (urban, forest, non-forest, barren)
Evapotranspiration (ET)	Calibrated monthly Potential ET curve based on Penman Monteith	Weekly Penman Monteith computation based on climate forcing
Historical climate input data	NWS river forecast center time series of mean-areal temperature and precipitation from quality controlled historical climate data	1/8 degree gridded temperature and precipitation mapped to banded catchments (Maurer et al. 2002)

Each model requires a representation of the historical climate (at a minimum, time series of temperature and precipitation) to simulate the effects of climate variability on runoff generation, producing an estimate of undepleted streamflow. Undepleted streamflow is defined as the runoff that would occur in the absence of diversions (including trans-mountain diversions), reservoir storage, and reservoir release. The models were calibrated by adjusting parameters to improve the correlation between simulated streamflow and historical undepleted streamflow developed in Task 2. A summary of each model and its application to the river basins in the study area is presented in the sections that follow.

Sacramento Model Description

In this report the "Sacramento Model" refers to a suite of models used for hydrologic simulation and forecasting by the NWS River Forecast Centers. The specific models used to simulate the impact of climate change in this study are the Snow-17 snow accumulation and ablation model (also known as the Anderson snow model) and the Sacramento Soil Moisture Accounting model (SAC-SMA).

The SNOW-17 model explicitly includes most of the important physical processes that take place within the snowpack. Air temperature is used as the sole index to determine the energy exchange across the snow-air interface, as other climatic variables that impact the snowpack can be reasonably estimated from air temperature. The only other input variable needed to model snow accumulation and melt in the model is precipitation (Anderson 1973, 1976).

SNOW-17 represents the physical processes that occur in a column of snow, but incorporates additional methods to allow application to an area. The main processes included in the model for a column of snow are:

- *Form of precipitation*

  SNOW-17 computes a rain-snow elevation time series and then computes the fraction of the area where rain is occurring and the fraction where it is snowing based on an area-elevation curve.
- *Accumulation of the snow cover*

  SNOW-17 uses a snowfall correction factor, parameter SCF, to adjust all new snow amounts before they are added to the existing snow cover. The temperature of new snow is assumed to be equal to the air temperature or 0°C, whichever is less. When the temperature of the new snow is less than 0°C, the "heat deficit" of the existing snow cover is increased. The "heat deficit" is the amount of heat that must be added to the new snowfall in order to bring it up to a temperature of 0°C.
- *Energy exchange at the snow-air interface*

  The SNOW-17 model calculates the energy exchange at the snow-air interface in different ways depending on whether rain is occurring or not. When sufficient rain occurs, the model uses the energy balance to compute surface melt by making several assumptions:
  - incoming solar radiation is negligible because overcast conditions generally prevail;
  - incoming longwave radiation is equal to black body radiation at the temperature of the cloud layer which should be reasonably close to the air temperature:
  - relative humidity is quite high (90% is assumed); and
  - the snow surface temperature is 0°C (273°K).

When there is no or very light rainfall and the air temperature is above a base value, SNOW-17 uses a melt factor to estimate the amount of surface snowmelt. The melt factor itself varies seasonally between maximum and minimum values that depend on the MFMAX and MFMIN model parameters with units of mm/(^{o}C*6hr).

SNOW-17 uses a heat deficit to keep track of the net heat loss from the snow cover due to energy exchange across the snow-air interface,

• *Internal state of the snow cover*

SNOW-17 treats the snow cover as a single lumped entity. The model calculates the temperature and liquid water or density profile within the pack. It assesses the overall state of the snow cover by accounting for snow cover ripeness through the snow's heat deficit and liquid water storage.

• *Transmission of water through the snow cover*

SNOW-17 uses empirically derived equations to calculate the lag and attenuation of water through a ripe snow cover.

• *Heat transfer at the soil-snow interface*

SNOW-17 includes a daily ground-melt parameter, DAYGM, which is a fixed estimate of the average melt that occurs at the snow-soil interface throughout the period when snow is on the ground.

To apply SNOW-17 to an area, the model must calculate the areal extent of the snow cover. To do so, the model keeps track of average areal values of state variables, energy exchange, and water balance quantities, and adjusts results by the areal extent of the snow cover before computing mean areal values. The areal extent of snow cover is computed as a function of snow depth from the areal extent of snow cover (AESC) curve parameter.

The output of the SNOW-17 model is a 6-hour time series of rainfall plus melt depth over a sub-basin, as well as a time series of the percent of the basin that is snow covered. These time series are used as input to the SAC-SMA model, which ultimately computes the amount of runoff that enters the river drainage network.

The SAC-SMA runoff model parameterizes soil moisture characteristics such that applied moisture is distributed in various depths and energy states in the soil, there are rational percolation characteristics, and that streamflow is effectively simulated. This is achieved by explicitly modeling the following water balance components in a soil column:

- Tension water,
- Free water,
- Surface flow,
- Lateral drainage,
- Evapotranspiration or ET, and
- Vertical drainage (percolation).

The soil column is divided into upper and lower zones, each with its own tension and free water compartments. (See Figure 2.15). The following runoff components are included in the model:

- *Impervious runoff*
  Impervious runoff is derived from rainfall over permanent impervious areas of the basin that drain directly to the stream channel, and is directly added to the channel inflow. It is determined based on the percentage of impervious area in the basin, parameter PCTIM.
- *Direct runoff*
  In the permeable portion of the basin, rainfall (or snowmelt) first enters the Upper Zone Tension Water, which must be totally filled before water becomes available to enter other storage zones. Once this zone is filled, additional impervious areas (determined by parameter ADIMP) can develop and produce direct runoff, which is directly added to the channel inflow. The capacity of the Upper Zone Tension Water is defined by the UZTWM parameter.
- *Interflow*
  Excess water from the Upper Zone Tension Water passes to the Upper Zone Free Water, with some water percolating to deeper soils at a rate controlled by the contents of the Upper Zone Free Water zone and the deficiency of lower zone water volumes. This "percolation demand" is also affected by two model parameters (ZPERC, REXP) that define maximum percolation demand and a reduction exponent, or by an optional module reducing percolation and interflow rates due to frozen ground. Water not percolating to deeper zones can run off as interflow. The SAC-SMA model includes a recession parameter (UZK) which controls the rate at which interflow is produced based on the excess contents of the Upper Zone Free Water.
- *Surface runoff*
  The capacity of the Upper Zone Free Water zone can be defined by the UZFWM parameter). Heavy precipitation or significant snowmelt can fill the Upper Zone Free Water zone, which causes additional water to run off as surface runoff.
- *Short-term and Long-term baseflow*
  Water reaching the lower soil zones is divided between the Lower Zone Tension Water and two Lower Free Water zones based on a parameter called PFREE. Water contained in the Lower Zone Tension Water will not produce baseflow, but is subject to ET. Baseflow is produced from Lower Zone Primary drainage (controlled by parameter LZPK) and Lower Zone Supplemental drainage (controlled by a parameter LZSK). The sizes of the three lower soil zones are defined individually (parameters LZTWM, LZFPM, and LZFSM).

All soil zones are subject to ET. Evaporation demand can be specified in the SAC-SMA model either as mid-monthly averages or as time series. Actual ET (AET) is computed by the model as a function of demand and availability.

Output from the SAC-SMA is a 6-hour time series of total channel inflow and is composed of the sum of the flow components listed above minus losses to groundwater (parameter SIDE) and losses due to ET from riparian vegetation (parameter RIVA). A unit hydrograph model is required to convert the total channel inflow into discharge at the basin outlet. The UNIT-HG model in NWSRFS performs this function.

Figure 2.15 depicts the SAC-SMA soil zones and the conceptual paths of moisture in the soil column.

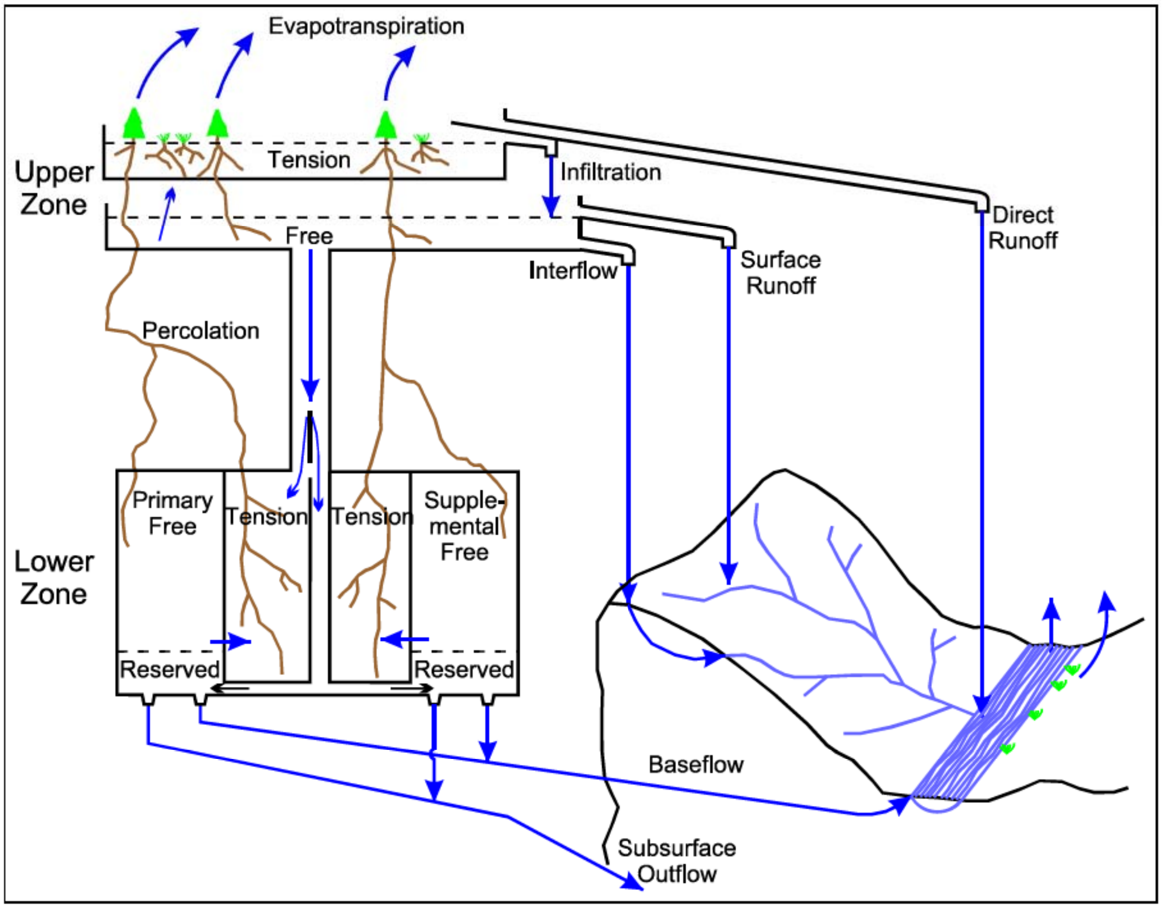


Figure 2.15 Soil Zones of the SAC-SMA model

The SAC-SMA model is capable of estimating runoff for many climate regimes and model configurations. However, the following limitations apply.

- The model's conceptual soil moisture zones are lumped over large areas. Therefore, the model does not account for uneven filling of soil moisture zones during localized events and subsequent local runoff.
- The SAC-SMA does not account for the infiltration capacity of the upper zone. Therefore, it does not accurately simulate situations when very large precipitation rates exceed the infiltration capacity of unsaturated soil and lead to direct runoff.

Because the SNOW-17 and SAC-SMA models are used by the NWS for developing real-time hydrologic forecasts (including flood forecasting), they are designed to be executed at time steps of less than a day (six-hour time steps are most common). Processes that vary at time scales smaller than the defined model time step may not be simulated accurately, while processes of interest at larger time scales, including those of interest to this study, can be adequately represented by accumulating model output to the larger time step.

Sacramento Model Implementation

The Sacramento model was calibrated previously by the NWS for the South Platte, Colorado, and Arkansas River Basins, based on time series of undepleted streamflow that were available at the time the calibrations were performed. One of the purposes of this study was to refine the hydrologic model calibrations based on the undepleted streamflow time series developed in Task 1. The hydrologic models and historical climate data associated with each of the three river basins involved in this study are managed by three different NWS forecast centers and the procedures used in the previous model development and calibration varied among the three river basins.

The hydrologic model configurations used by the NWS River Forecast Centers subdivide the river basins into multiple sub-basins and elevation zones to account for spatial variability in precipitation, temperature, and basin snowmelt and runoff characteristics, as well as to correspond to required forecast points. The historical temperature and precipitation time series developed by the NWS offices for use in model calibration were the same ones used in this study and represent the mean areal characteristics of each sub-basin. The resulting time series are defined at 6-hour time steps.

The locations where undepleted flows have been developed for this study correspond with forecast points in the NWS models, but the NWS models include additional subdivisions of basins upstream of each of the undepleted flow/calibration points used in this study. Figure 2.16 illustrates the calibration points in the Colorado River basin used in this study.

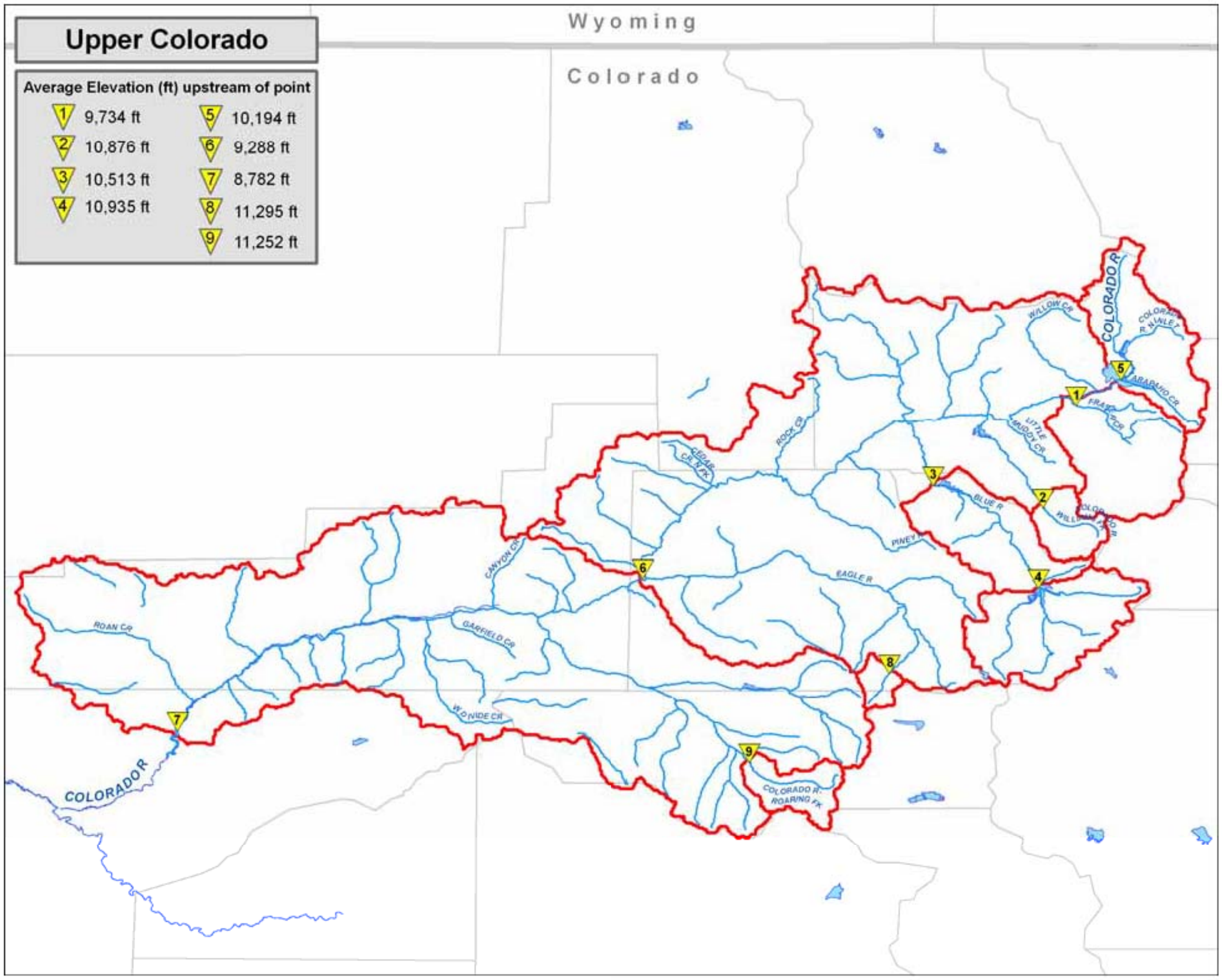


Figure 2.16 Upper Colorado Basin Study Points

The basins are numbered to correspond to the undepleted flow points listed previously in Table 2.5 through Table 2.8. Figure 2.17 and Figure 2.18 show the calibration points in the South Platte and Arkansas River basins. The calibration effort for this study required model parameters in multiple upstream sub-basins and sub-areas to be adjusted in a consistent fashion to meet calibration objectives at downstream points.

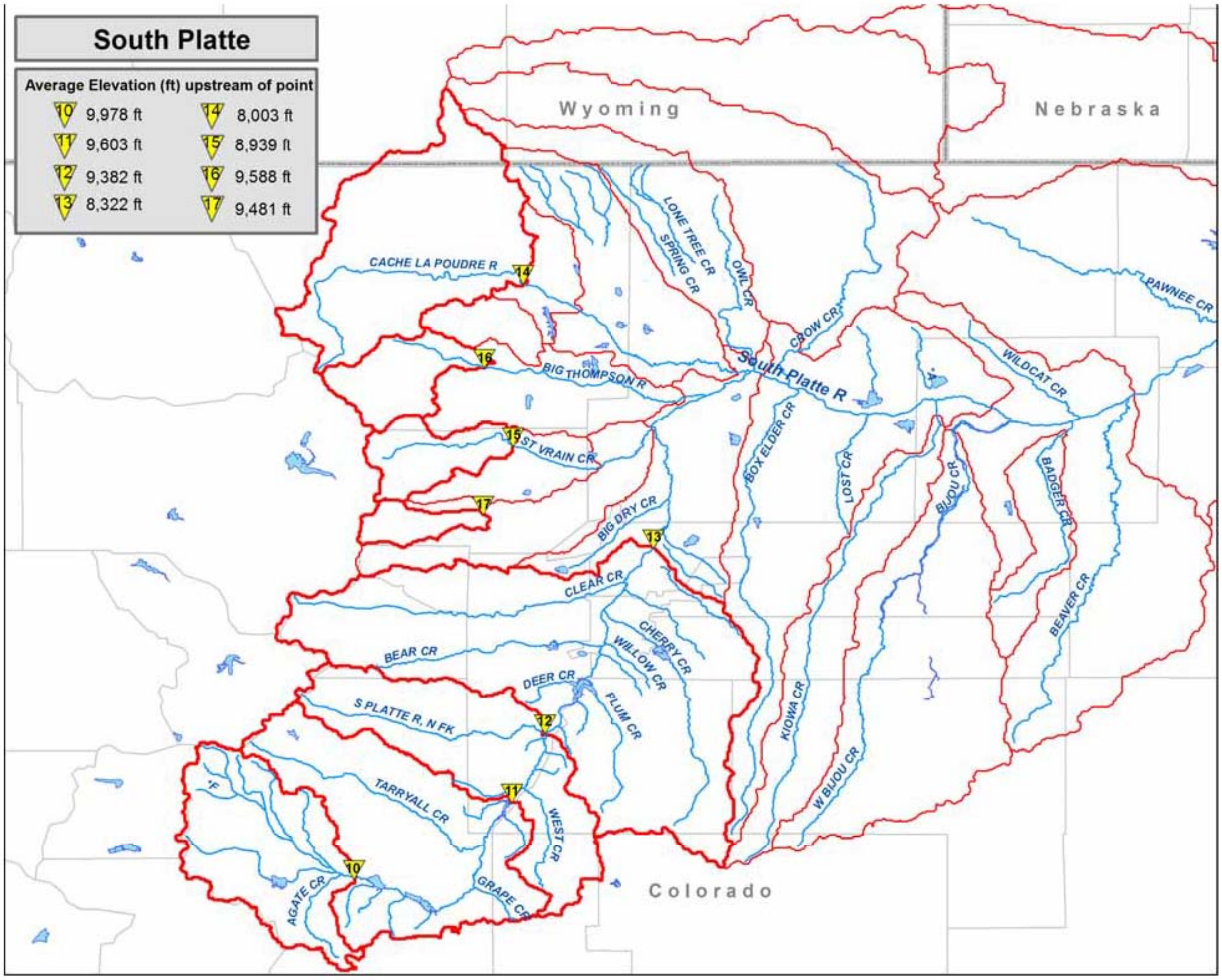


Figure 2.17 South Platte Study Points

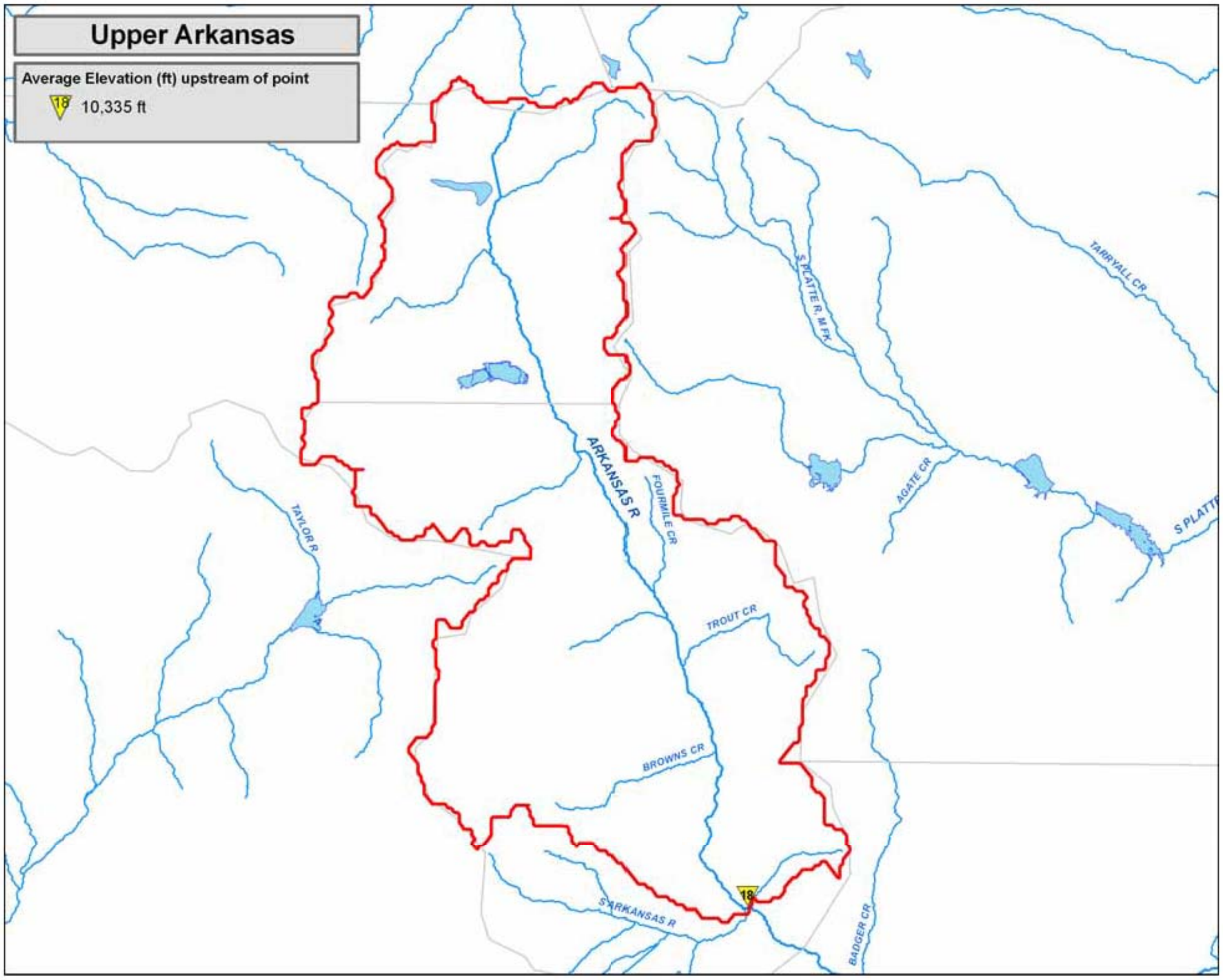


Figure 2.18 Arkansas Basin Study Point

Potential Evaporation Curve – Sacramento Model

The monthly potential evapotranspiration (PET) curve for natural vegetation is a calibration component of each sub-basin in the Sacramento model and represents the monthly variation in the maximum ET that would occur if soil moisture were unlimited. Actual ET (AET) is computed at each time step in the model as a function of PET and soil-moisture, with reduced soil moisture corresponding to reduced AET. The PET curve, along with other calibration parameters and model states such as the capacity of soil zones for holding water, the percentage of forest cover, and the amount of ground covered by snow are key parameters of model simulated ET. Temperature is not explicitly considered in the ET computation in the Sacramento model as changes in ET caused by increased temperature are represented as adjustments to the calibrated PET curve. The PET curve is, however, related to prevailing temperatures and land cover in the area. As such, PET is typically estimated using temperature-driven ET estimation methods, such as Penman-Monteith.

Because each basin was developed and calibrated independently by different NWS offices, the methods used to develop PET curves were different across the basins. In the South Platte basin, the Penman-Monteith method was used to estimate the PET curve for each sub-basin, with adjustments for calibration. In the Colorado basin, a single PET curve was developed and then adjusted for elevation using factors for each sub-basin. In the Arkansas basin, a general PET time series was developed, and a scaling factor was applied to each sub-basin to take into account unique sub-basin characteristics.

By making minor adjustments to the PET curve, a modeler can calibrate the effects of natural vegetation and other unique physical characteristics of the basin that govern ET and the resulting simulated surface runoff. Curve values are typically similar in shape across watersheds, with some modification for local effects such as elevation or differences in vegetation types.

Calibration Approach

The calibration effort balanced accurate simulation of the monthly water balance with accurate representation of daily hydrograph shapes and magnitudes of flows. Where only monthly flow data were available, the approach to calibrating the models relied on matching the volume represented by the monthly accumulation of simulated daily flows. The updated simulation at Homestake Creek after calibration is shown in Figure 2.19**.** In this basin the annual bias was improved by increasing and better simulating the flow in June, which is the peak volume month. It is possible that the flow time series used in the previous calibration, which were not available for comparison, may not have accounted for all of the diversions that have been identified in the undepleted flows developed for this study, resulting in parameters that produced less runoff in the summer months. It may be noted from the figure, however, that the previous calibration matched very nearly the computed undepleted flow and that there was only minor opportunity for improvement in the updated calibration.

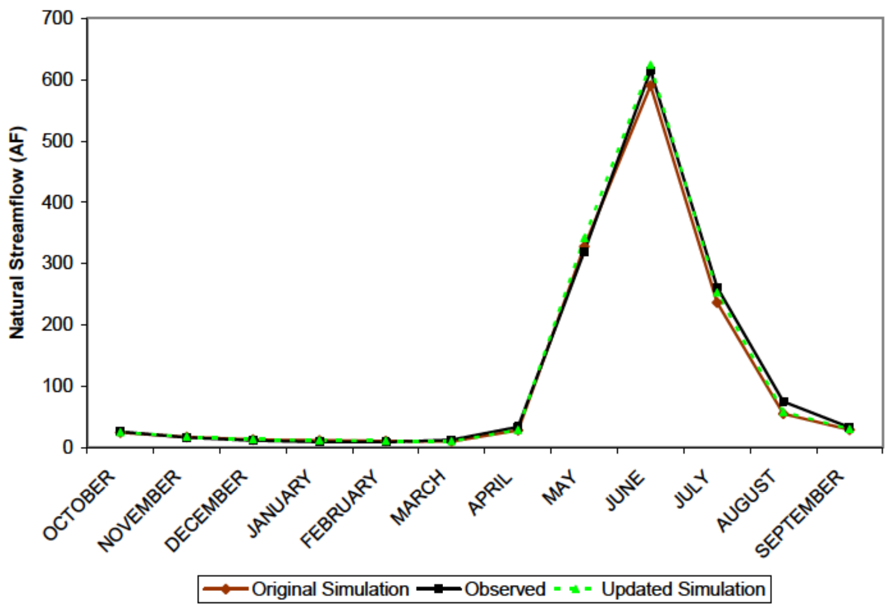


Figure 2.19 Calibration Improvement at HMSC2 (Homestake Creek at Gold Park)

WEAP Model Development

The WEAP21 Decision Support System (DSS) makes use of an internal, lumped parameter hydrologic model that simulates the hydrologic cycle, including surface and sub-surface flows, ET, and groundwater-surface water interactions. Figure 2.20 is a simplified schematic of the rainfall-runoff model in WEAP. The associated parameters used to represent the hydrologic cycle are: Fractional area, *fa*; Relative storage, *Z*; Potential ET, *PET*; Observed Precipitation, *PObs*; actual ET, *Et*; relative storage for each land use fraction, z_{fa}; irrigation threshold, T_{fa}; hydraulic conductivity, *HC and* HC_{fa}; crop coefficient, kc_{fa}; *runoff resistance factor,* rr_{fa}; partitioning fraction, *f;* and total water capacity, *Wc and* Wc_{fa} .

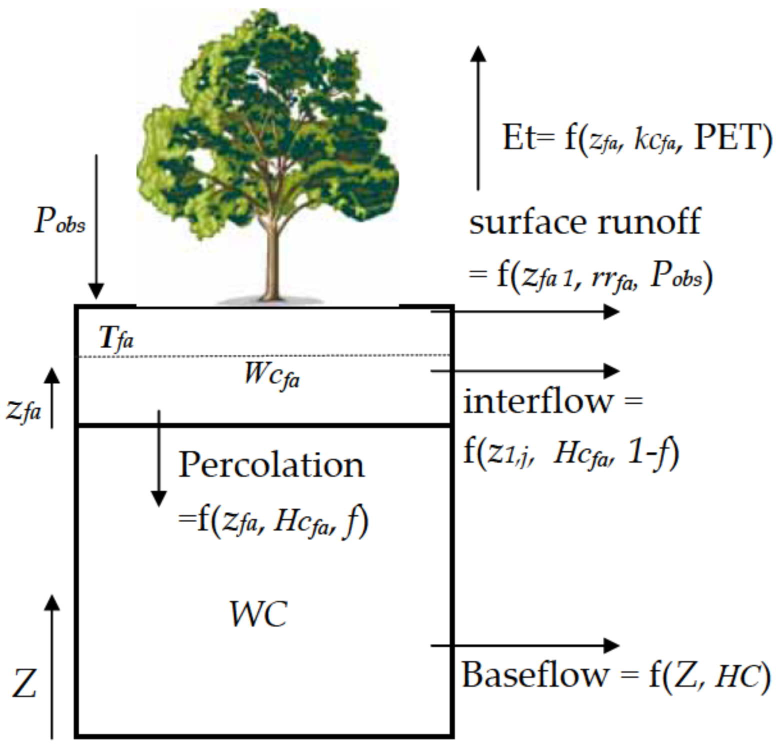


Figure 2.20 Elements of the lumped-parameter hydrologic model in WEAP

A WEAP21 model is spatially oriented, with a study area configured as a set of contiguous catchments, each assigned a unique climate forcing dataset, and in this study, adopts a weekly time step. The study area was configured as a set of contiguous catchments defined along elevation zones using GIS. The catchment can be further subdivided into an arbitrary number of fractional areas (*fa*'s) according to soil and/or land use, and can be overlaid with a network of rivers, canals, reservoirs, demand centers, and other water features, although these objects are not used in this study (Figure 2.21). The hydrologic response of each fractional area is depicted by a two-bucket water balance model that tracks relative storages, z_{fa} and *Z*, by partitioning water into ET, surface runoff, interflow, percolation, and baseflow (Figure 2.20). Each fractional area *(fa)* includes a plant/crop coefficient (kc_{fa}); a conceptual canopy density

(cd_{fa}) parameter (Kergoat 1998); water holding capacities (WC and Wc_{fa}, mm) and hydraulic conductivities (HC and Hc_{fa}, mm/time); and a partitioning fraction (f) that determines whether water moves horizontally or vertically.

An energy-temperature snowmelt algorithm, which includes liquid and solid temperature threshold parameters, Tl and Ts, is used to estimate effective precipitation (Pe) for each catchment.

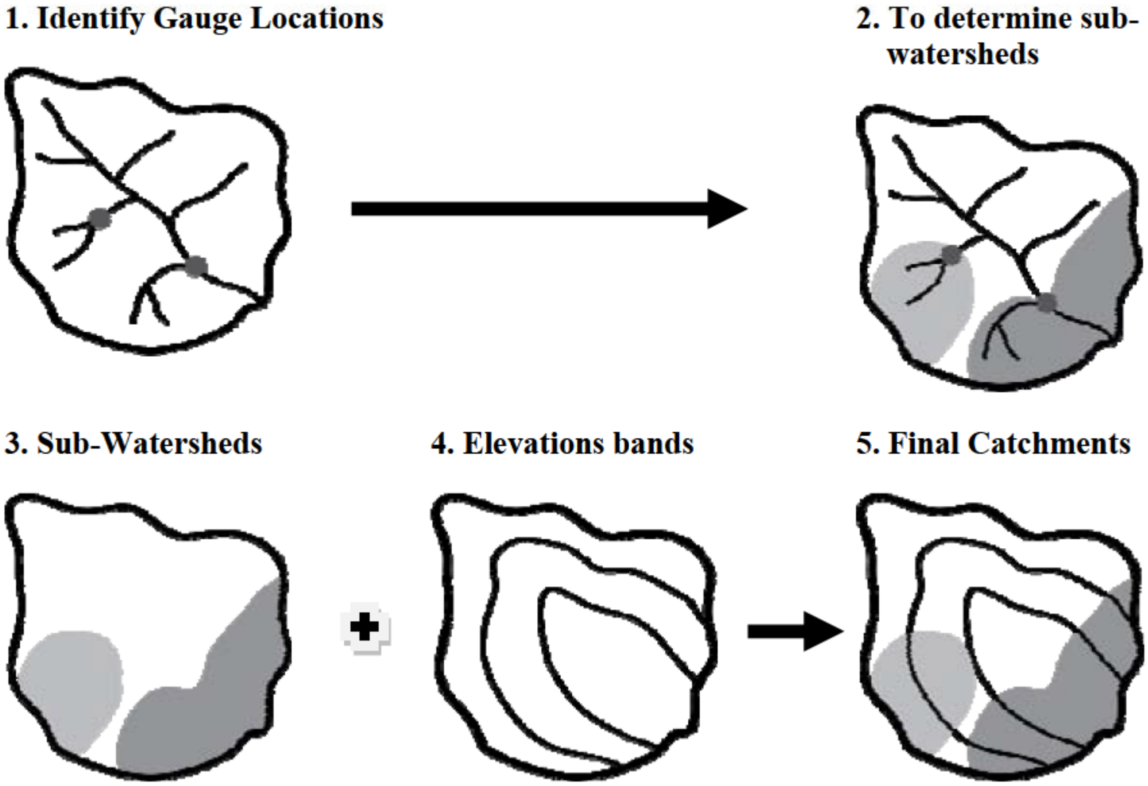


Figure 2.21 Characterization of Watersheds and banded sub-catchments

Due to the importance of snow processes in Rocky Mountain hydrology and modifications to the WEAP21 algorithm used in this effort and not presented in Yates, et al. (2005a, 2005b), the snow accumulation and melt module is described here. WEAP21 includes a simple temperature-index snowmelt model which computes an effective precipitation (P_e). The model estimates snow water equivalent and snowmelt from an accumulated snowpack in the catchment, where m_c is the melt coefficient given as,

$$m_c = \begin{cases} 0, & T_i < T_s \\ 1, & T_i > T_l \\ \dfrac{T_i - T_s}{T_l - T_s}, & T_s \le T_i \le T_l \end{cases} \qquad \text{Eq. 1}$$

with T_i the observed temperature for period *i,* and T_l and T_s are melting and freezing temperature thresholds, with the melt rate given as

$$m_i = \min(Ac_i m_c, Em) \qquad \text{Eq. 2}$$

Snow accumulation, Ac_i is a function of m_c, m_i, and the observed total precipitation, P_i

$$Ac_i = Ac_{i-1} + (1 - m_c)P_i - m_i \qquad \text{Eq. 3}$$

E_m is the available melt energy converted to an equivalent water depth/time, and is a function of the net radiation and latent heat of fusion.

The calculation for net radiation considers the albedo which is modeled using a simple algorithm that decreases albedo through time to represent the "ripening" of the snow surface (USACE 1998). The model user specifies a "new" snow albedo value, A_N, and the minimum albedo of a snow-free surface, A_O. Albedo is set at the "new" value following snowfall; it is then decreased by approximately 0.05 for each simulation week until it reaches the minimum albedo value, typically set at 0.15.

WEAP Model Implementation

Four independent WEAP applications were developed, consistent with the basins identified in Table 2.5 through Table 2.8. These include 1) The Upper Colorado River Basin with aggregate flows to Cameo, 2) the Upper South Platte Basin with aggregate flows to Henderson; 3) the Arkansas River Basin with aggregated flows to Salida; and 4) the four individual basins of the Northern South Platte, including Boulder Creek, the Saint Vrain; the Big Thompson, and the Cache La Poudre River. Each model was calibrated against the same undepleted flow estimates used by the Sacramento Model for the period 1950 through 2005. In addition to the 18 gauge locations where undepleted flows were simulated, several other simulation points were included that correspond to important management locations throughout the watersheds. Most notably, this is the case in the Upper Platte Basin, where the locations of the main reservoirs on the system are identified, including Antero, Spinney, Eleven Mile, Cheesman, and Chatfield.

Each of the four WEAP basin applications used a weekly time step for the period 1950 through 2005. The climate forcing data included precipitation, temperature, and relative humidity, which are provided on a 12-km grid from the daily dataset of Maurer et al. (2002). This gridded dataset is based on station data across the country, where a topographic adjustment is used to create the regularly spaced, climate forcing dataset for the contiguous US. Individual watersheds are a collection of sub-watersheds that are principally defined by elevation band and land use, with a single climate forcing defined for each sub-watershed from the Maurer gridded dataset. Average net radiation is computed internally based on latitude, day-length, and surface albedo, which is used to estimate PET and snowmelt.

A GIS process was used to compute the total area of each banded sub-catchment and the fractional land cover it contained according to eight land cover classes that include: agriculture, barren, forest, rangeland, tundra, urban, water, wetlands. The latitude-longitude centroid of each sub-catchment was approximated by visual inspection, and then used to retrieve the daily climate record from the Maurer dataset (Maurer et al. 2002). For each of the banded catchments, a climate forcing dataset was constructed from a single 1/8th degree Maurer grid point. A weekly average of temperature and humidity, and total precipitation were then computed for each banded sub-catchment and entered into WEAP. The resulting disaggregation of the watersheds resulted in more than 150 individual catchment objects. Since climate data are needed through 2005 and the Maurer dataset ends in 2000, a simple scaling procedure was used to generate weekly time series from 2001 through 2005. For each banded catchment, a weekly mean climate forcing dataset was multiplied by an annual scaling factor to shift mean precipitation either upward or downward to reflect wet or dry years. In this way, the severe drought of 2002 was represented. Only precipitation was scaled, as the other climate variables (temperature, windspeed, and humidity) simply repeated the weekly average values of the historical period for the years 2001 through 2005.

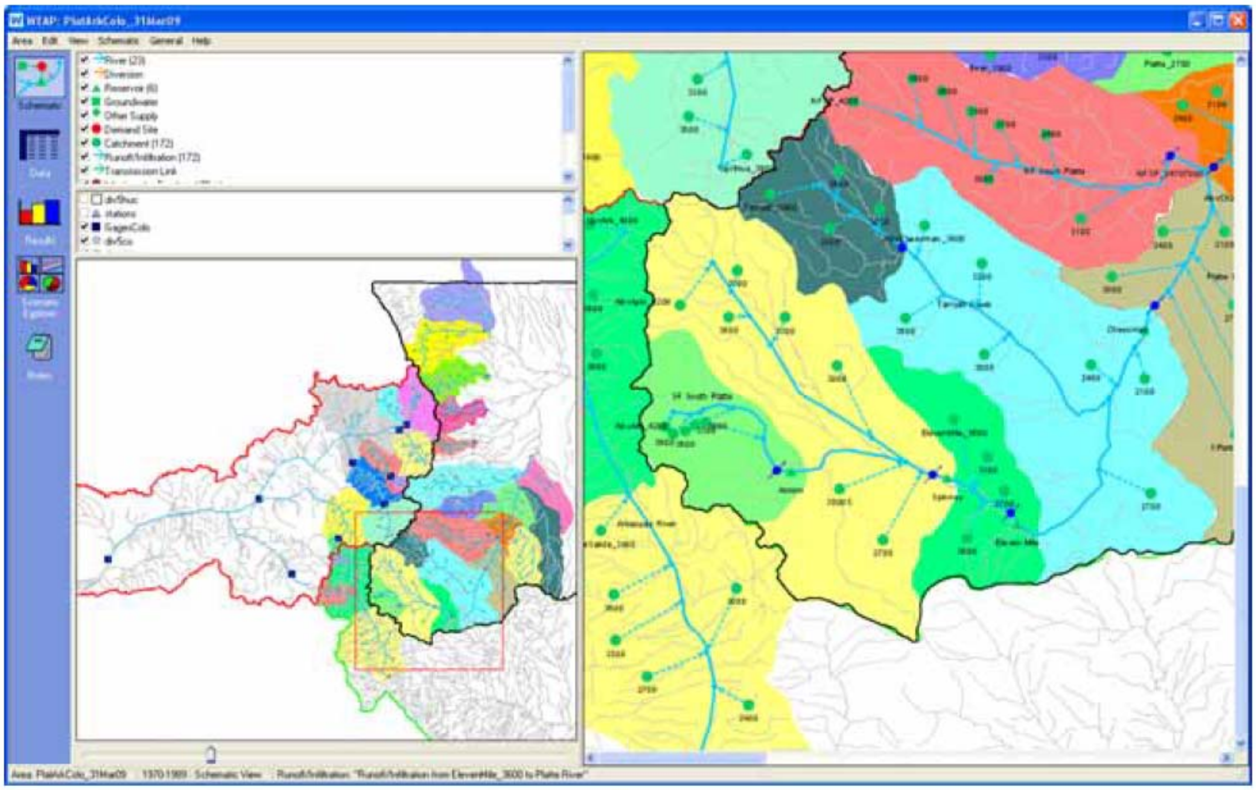


Figure 2.22 The WEAP application of the Platte, Arkansas, and Upper Colorado River Basin, with area enlarged over the Upper South Platte Basins

Figure 2.22 shows the combined WEAP application for the Platte Basin, where the catchment (that is the South Fork of the South Platte above Antero Reservoir) consists of 5 sub-catchments defined along the 2400 to 4200-meter elevation bands and are referred to as AbvAnt_2400, AbvAnt_2700, and AbvAnt_4200. Using the land cover dataset, each sub-catchment was characterized with four possible land uses including Barren, Forested, Non-Forested and Urban. As an example, the AbvAnt_3300 sub-catchment is 113 km^2 in size, and is 76% forest, 23% non-forest, and 1% urban, as shown in Figure 2.23. This number of land use categories is arbitrary, and based on user choice.

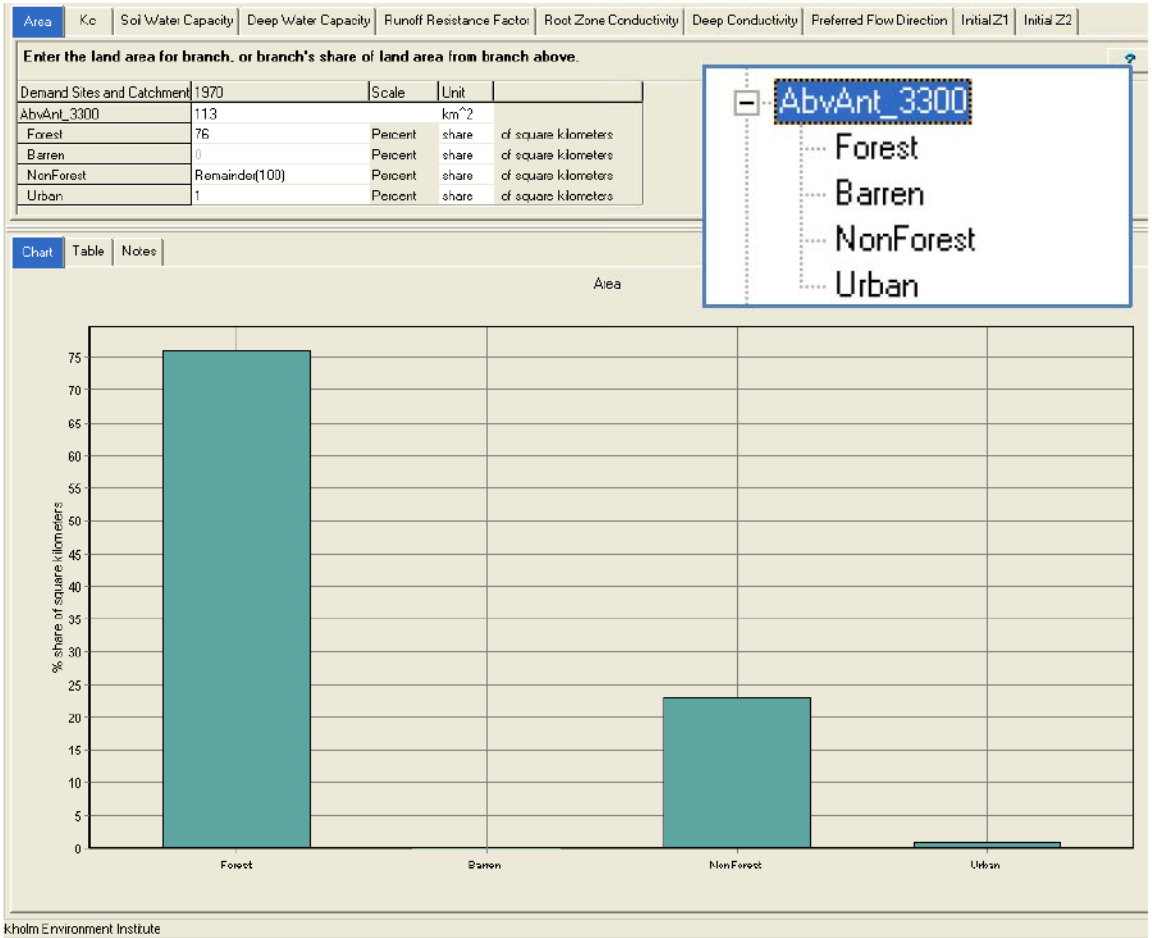


Figure 2.23 Land use specification for the AbvAnt_3300 sub-catchment

The elevation banding procedure resulted in 209 unique sub-catchments that comprise the primary basins of the South Platte, Arkansas, and Colorado Rivers. These three primary basins are composed of 36 unique sub-watersheds each with a number of banded catchments, which contribute to the flow estimates at the 18 gauge locations of interest (Table 2.10). In summary, the watershed delineation procedure for the WEAP model included the identification of sub-catchments according to elevation band and land use, with a unique climate forcing dataset identified for each. Each sub-catchment was assigned a set of hydrologic parameters used by WEAP to simulate snow accumulation and melt process, track soil moisture, and simulate runoff processes.

Table 2.10 Watershed name and model information

Watershed Calibrations	CODE	Sub-watersheds	banded-catchments	Area (1000's acres)
South Platte at South Platte	PLT	7	37	
South Platte at Henderson*	HND	14	75	2964
Boulder Creek at Orodell*	BLD	1	7	58
St. Vrain at Canyon Mount*	VRA	1	8	126
Big Thompson at Canyon Mouth*	BGT	1	7	152
Cache La Poudre at Canyon Mouth*	CLP	2	12	669
Upper Colorado at Granby	UCG	1	5	
Fraser River at Granby	FRG	1	5	
Williams Fork Nr. Leal	WFL	1	4	
Blue River at Dillon	BLU	1	4	
Blue River at Green Mountain	BGR	2	5	
Homestake at Gold Park	HMS	1	4	
Roaring Fork nr Aspen	ROF	1	7	
Colorado at Cameo*	COC	13	81	4668
Arkansas at Salida*	ARK	4	19	743
Total sub-watersheds and catchments		36	209	9386

*Total upstream area is computed only for these watersheds

Model Calibration

The WEAP model was calibrated against historical, undepleted flows at the 18 gauges, primarily using the trial-and-error approach. The calibration criteria included the ability of the model to conserve total annual volume, match the weekly timing and distribution, and preserve the low-flow conditions from late summer through mid-winter. The key model parameters adjusted during the calibration process included those associated with snow accumulation and melt, such as liquid and freezing temperature thresholds, and the magnitude of net radiation during melt reflected through the albedo decay parameter. Other adjusted parameters include hydraulic conductivity, soil-water capacity, and surface runoff resistance. Initial values were estimated for all land use categories based on a broad understanding of hydrologic response. Because the hydrology model in WEAP is conceptual and can be applied across varying time steps, there are no predefined values for model parameters like soil-water holding capacity or water conductivity. Rather, those values vary with the length of the time step, such that parameters for a daily time-step model represent rapid hydrologic responses, while a weekly or monthly formulation with the WEAP model will represent longer-term hydrologic responses.

An initial set of soil-related hydrologic parameters was developed that could be applied across all the watersheds and captured the seasonal and inter-annual variability of flow measurements across all catchments. These parameters included soil-water holding capacity (mm), hydraulic conductivity (mm/week), and a unitless surface runoff resistance factor (*Rrf*)

The most sensitive model parameters were then adjusted on a watershed-by-watershed basis, including soil-water capacity, hydraulic conductivity, melt and freeze temperatures, additional radiation factor, and preferred flow direction to account for fine-scale differences in watershed characteristics not captured by the aggregated parameters. Table 2.11 summarizes both the uniformly applied and basin varying parameters used in all four WEAP applications.

Table 2.11 The range of the calibration parameters

Model Parameter	Value
Crop Coefficient*, *kc*	1.1 (Forest; Urban); 1.2 (non-Forest; barren)
Runoff resistance factor*, *Rrf*	Barren = 3, Non-Forest = 8, Forest = 12, Urban = 1
Albedo, new snow*, A_N	0.80
Albedo, old snow*, A_O	0.15
Soil Water Capacity, Wc_{fa}	125 to 320 mm
Hydraulic Conductivity, Hc_{fa}	20 to 100 mm/week
Runoff Resistance, rr_{fa}	1.0 to 6.0
Temperature Thresholds, T_s *and* T_l	-5°C to +6°C

*These parameters were applied uniformly across all watersheds

Climate Forcing Datasets for each Model

Both the WEAP model and the Sacramento model simulate historical streamflow sequences based on historical temperature and precipitation inputs. These inputs are known as climate forcings for the models. As noted previously, the independent climate forcing datasets were developed for each model based on their historical applications and unique model characteristics and needs. Although the simulation process is similar, the temperature and precipitation data are from different sources.

For the Sacramento model, the NWS prepared historical time series of Mean Areal Precipitation (MAP) and Mean Areal Temperature (MAT) data for each sub-basin and for specific elevation zones within sub-basins that exhibit significant elevation changes. These time series were based on individual weighting schemes for gauges in and near each basin or elevation zone. All the temperature and precipitation data were compared between nearby gauges to identify and fix poor input data. The process is typically automated with some help from database tools, comparing for error conditions such as minimum daily temperature greater than maximum daily temperature (Tmin > Tmax), stations with temperatures that are significantly different than surrounding station temperatures, and excessively large local precipitation events. In the case of the Maurer et al. (2002) dataset used by the WEAP model, the process was similar, although it is important to note that this is a national dataset, with no location specific corrections.

A comparison of these datasets was performed to determine whether either dataset showed a major bias that could introduce large streamflow simulation differences between the models. To some extent, the calibration process compensates for bias in the datasets as model parameters are adjusted to more accurately simulate observed streamflow response. Modeled sub-basin boundaries are similar for both models, defined by major geographical features and gauge locations. Direct climate data comparisons could only be performed by summarizing data for areas above the gauge locations used in this study. The selected comparison regions are outlined in Table 2.12.

Table 2.12 Forcing Data Comparison Regions

Basin	Region
South Platte	Spinney Mountain Reservoir and above
	Cheesman to Henderson
Upper Colorado	Lake Granby and above
	Dillon and above
	Dotsero to Cameo
Arkansas	Salida and above

For each region, the climate forcing data was compared for both temperature and precipitation. In all cases, the precipitation data compared well with the Maurer et al. dataset tending to be slightly wet and having warmer summers. These small differences suggest that the two different climate forcing datasets will not lead to large differences between the SAC-SMA and WEAP-simulated streamflows. In Figure 2.24, the area-weighted average monthly temperature pattern for the basins above the Colorado near Granby are shown for each model. The Maurer dataset shows higher average temperature values for each month of the year. Figure 2.25 compares the monthly precipitation between the model forcing datasets at the same location. The monthly trend, as well as average annual values, are consistent, although specific months can show larger differences. Similar results were found for the other basins evaluated, with consistently high correlation between monthly values for each model.

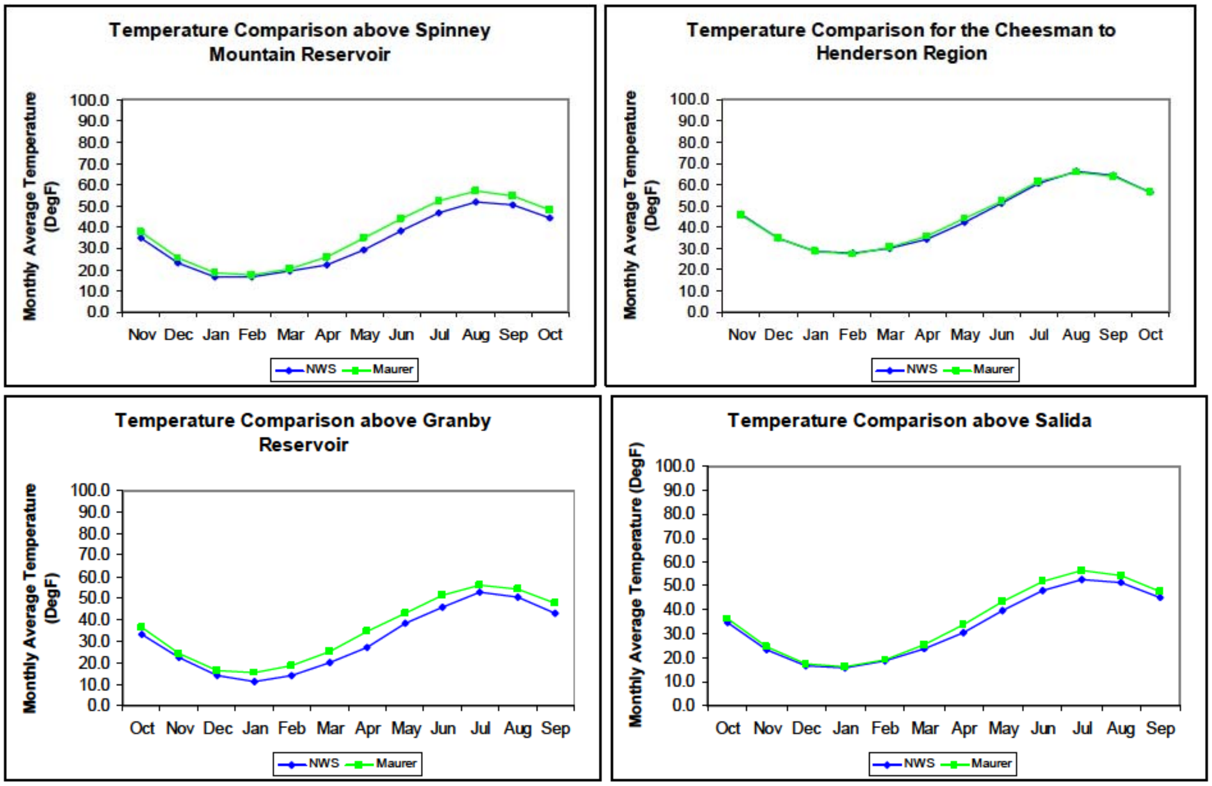


Figure 2.24 Monthly temperature comparison between, the NWS and Maurer datasets for the South Platte above Spinney, the South Platte between Cheesman and Henderson, the Colorado including Granby Reservoir, and the Arkansas above Salida

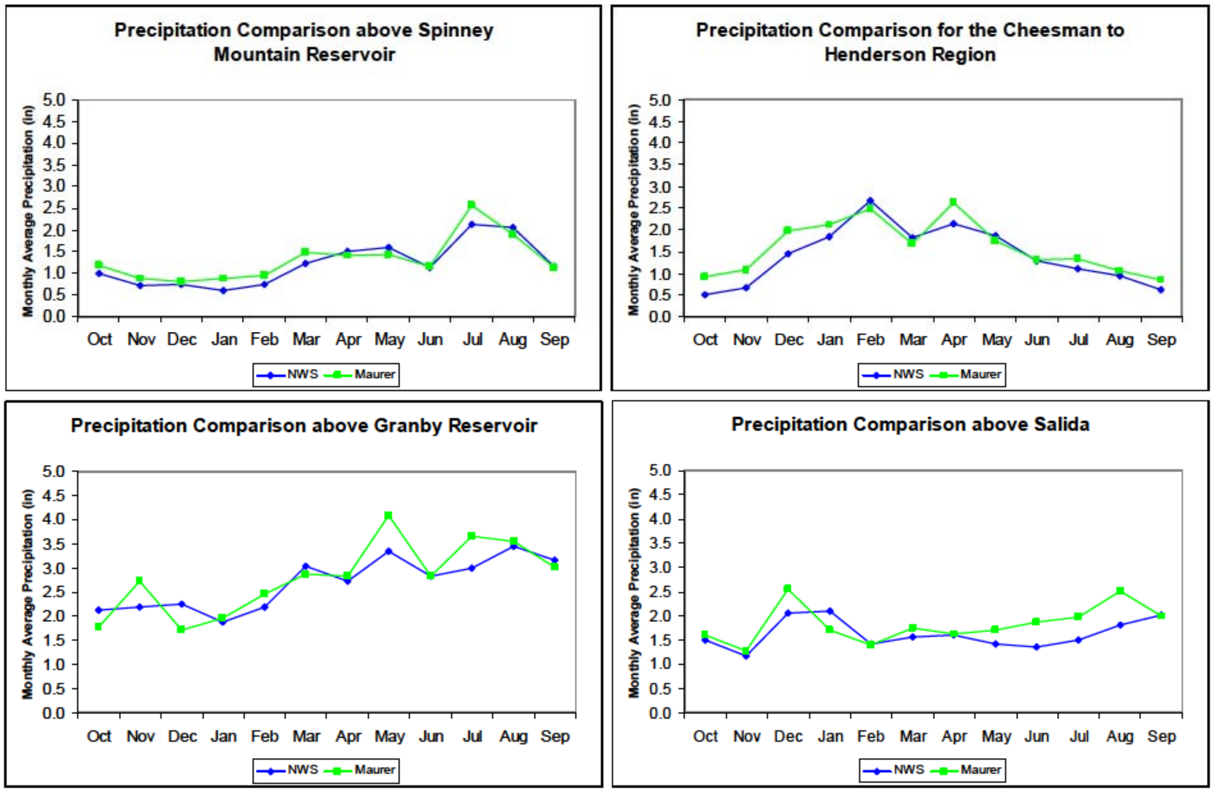


Figure 2.25 Monthly precipitation comparison between, the NWS and Maurer et al. datasets for the South Platte above Spinney, the South Platte between Cheesman and Henderson, the Colorado including Granby Reservoir, and the Arkansas above Salida

Input Data Extension for SAC/SMA in the Arkansas

The original MAP and MAT data for the Sacramento model in Arkansas basin ended in water year 1999. Because of the importance of the post-year-2000 drought period, the climate forcing dataset was extended as part of this study using a similar methodology to that used by the NWS in developing the original dataset. Temperature and precipitation gauge data were obtained and quality controlled for the Arkansas basin. Data anomalies were compared and outliers that were inconsistent with data from surrounding stations were removed from the dataset by setting the values to missing. The resulting quality-controlled station data were applied to each sub-basin using station weights to calculate the average temperature and precipitation across the entire basin. This procedure resulted in MAP and MAT datasets for the Arkansas basin extending from January 1951 through the end of water year 2005.

Input Data Extension for the 1950-2005 Water Years

Several periods of missing data remained in the climate dataset for each model, as shown in Figure 2.26. The Maurer dataset does not extend beyond 1999. The NWS datasets for the Colorado and the Arkansas do not begin until calendar year 1951. The NWS dataset for the South Platte ends after September, 2004.

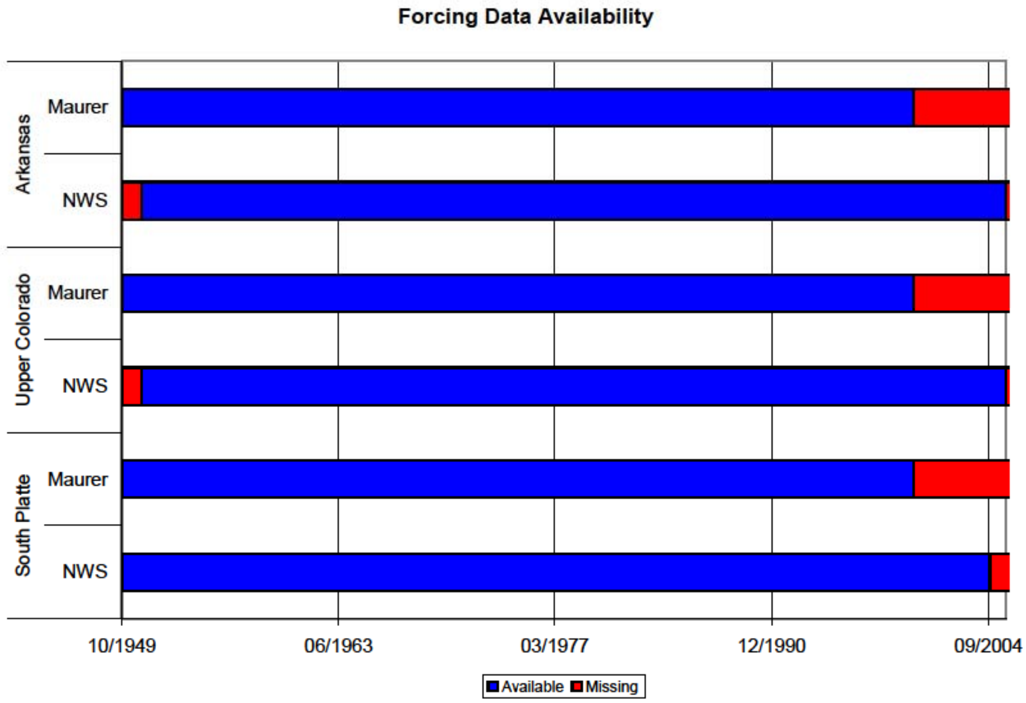


Figure 2.26 Forcing Data Availability by Basin and Source

It was important to the participants that the forcing datasets include the complete period of interest to enable comparisons for a consistent period and to have complete simulated datasets of climate-adjusted streamflow. In the absence of available historical data, climate forcing data from years with similar hydrologic response to the years with missing climate data were chosen to fill the missing periods. Historical undepleted flow at key gauge locations was used to determine the best replacement year for the missing data. For each missing year, the five years with similar annual undepleted streamflow were selected for comparison. Of those five years, the year with the best fit (based on the Nash-Sutcliffe Efficiency statistic for monthly flow) was selected as the replacement year for the missing data. All input data from the source year were used as a proxy for the missing data. Use of this data in subsequent analysis has the effect of repeating a historical year that produces a similar monthly and annual correlation of undepleted flow to the missing year.

Comparison of Simulated Streamflow for Each Model

For each model, the calibration statistics were compared on a monthly basis to the calculated historical undepleted streamflow. These statistics provide measures of goodness of fit, while highlighting different aspects of the fit. Several statistical measures were used to evaluate the skill of each hydrologic model and its ability to simulate the historical streamflow for each of the gauge locations. These included the correlation coefficient, the root mean square error (RMSE) and the Nash Sutcliffe Efficiency (NSE). $Q_{s,i}$ and $Q_{o,i}$ are simulated and observed streamflow for each time step *i*, while *n* is the total number of time steps for the simulation period.

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(Q_{s,i} - Q_{o,i})^2}{n}},$$

The RMSE is a quadratic scoring rule that measures the average magnitude of the error, with the difference between simulated and corresponding observed values each squared and then averaged over the sample. Finally, the square root of the average is taken. Because the errors are squared before they are averaged, the RMSE gives a relatively high weight to large errors. This means the RMSE is most useful when large errors are particularly undesirable. The RMSE can range from 0 to ∞, and is a negatively oriented score meaning lower values are better. The NSE metric is given as

$$E_f = 1 - \frac{\sum_{i=1}^{n}(Q_{s,i} - Q_{o,i})^2}{\sum_{i=1}^{n}(Q_{o,i} - \overline{Q_o})^2}.$$

where $\overline{Q_o}$ is the simulated average and other terms are defined above. This NSE is a measure of a model's ability to simulate flow, as opposed to just using the average value of the measured data. Typically, an acceptable value should be greater than 0.5 while a good value should be greater than 0.7. A value of 0.0 means that the model performs no better than a simple average of the observed time series. Other statistics compared include the mean annual flow volume, the mean annual volume bias, and the standard deviation of the monthly volume, with tables of computed statistics for the eighteen calibration points provided in Appendix A.

To determine the effectiveness of each model in simulating a broad range of climatological conditions, calibration statistics were computed separately for wet, dry, and normal years, defined as follows: for the 56-year period, the years with the highest 25% of flows were classified as wet, those with the lowest 25% of the years were classified as dry, and the those with the remaining 50% were classified as normal. The classification of wet and dry years was performed separately for each gage location. The statistics presented in Appendix A include these breakdowns. Graphical representations of the model performance on an average monthly basis are provided in Figure 2.27 through Figure 2.32, below, at six selected calibration points: the Blue River below Dillon; the Colorado at Cameo; the South Platte above Spinney Mountain Reservoir; South Platte at South Platte; the Cache la Poudre at Mouth of Canyon; and the Arkansas at Salida. Each figure compares model simulations against historical undepleted flow for the three categories (wet years, normal years and dry years). Note that the range of the y-axis in each of these figures is different to help emphasize model differences.

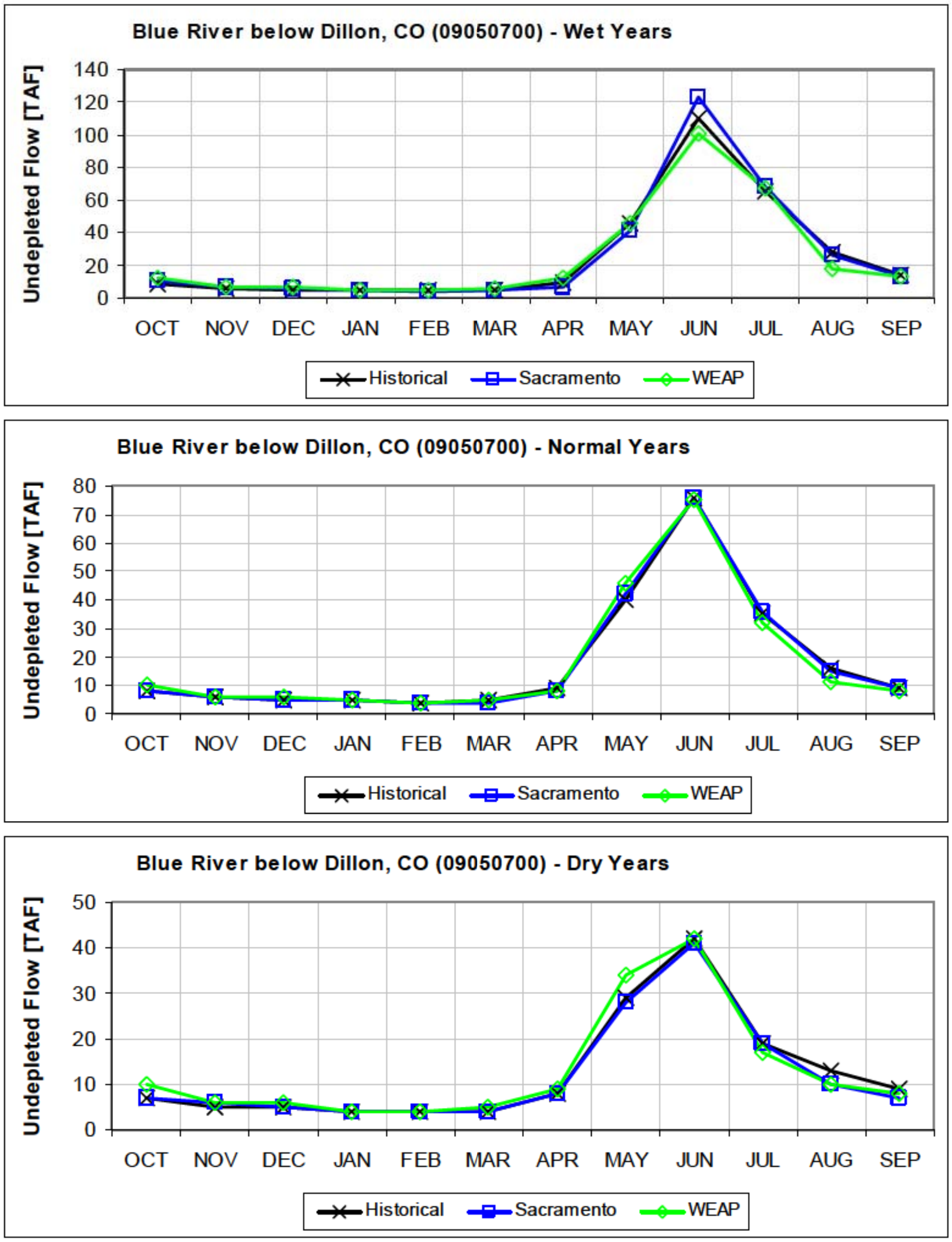


Figure 2.27 Calibration Comparison for the Blue River below Dillon (Monthly Average)

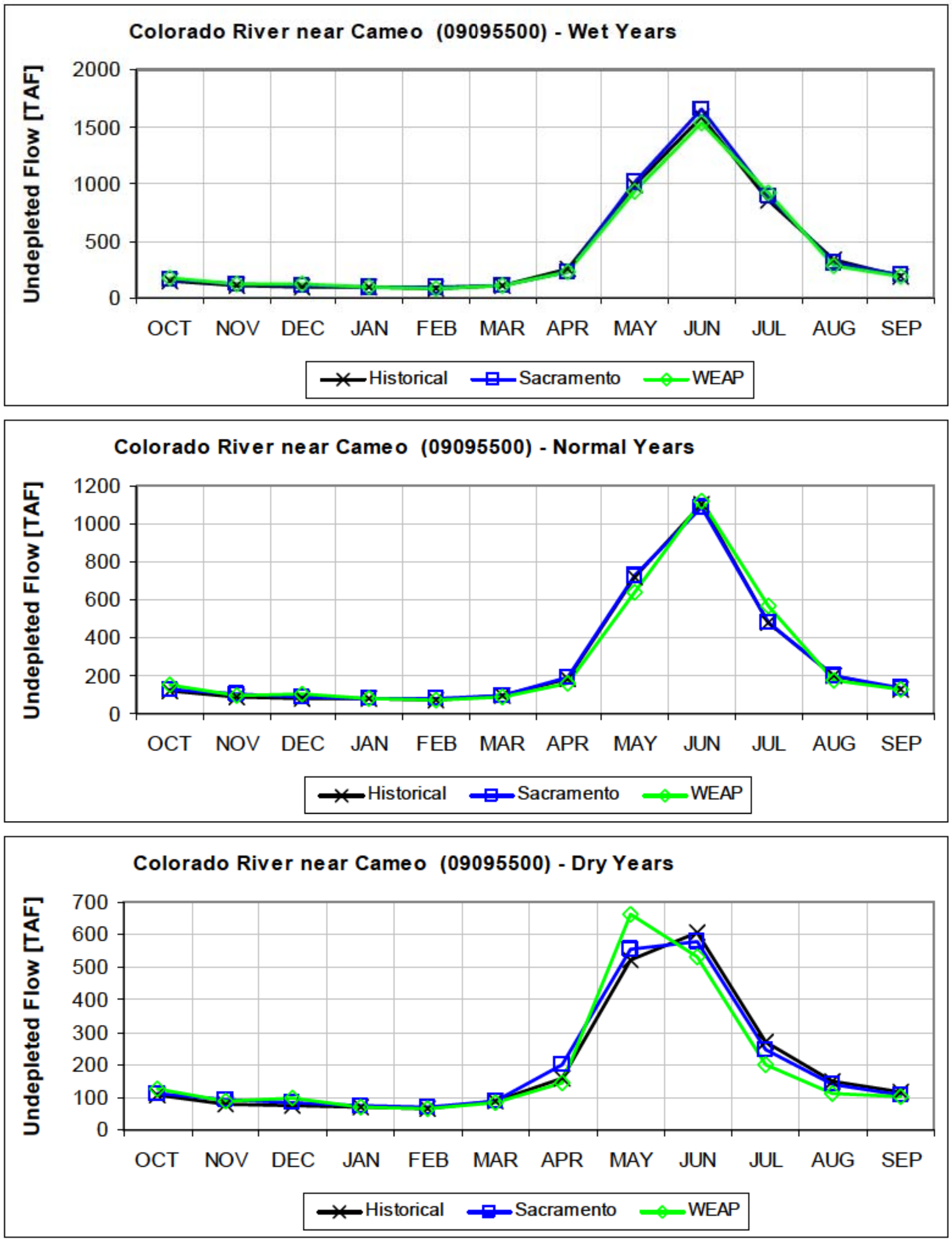


Figure 2.28 Calibration Comparison for the Colorado River at Cameo (Monthly Average)

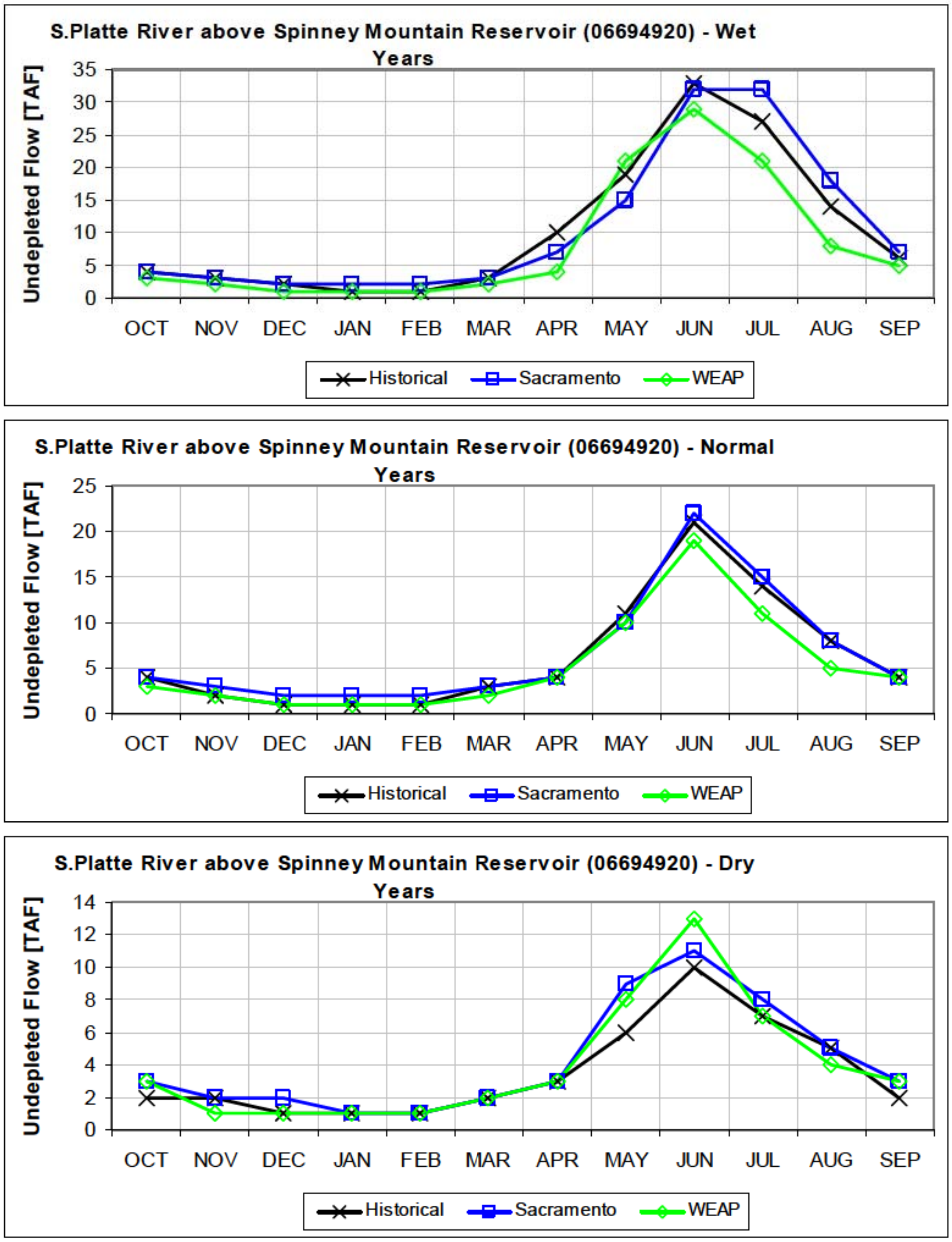


Figure 2.29 Calibration Comparison for the South Platte above Spinney Mountain Reservoir (Monthly Average)

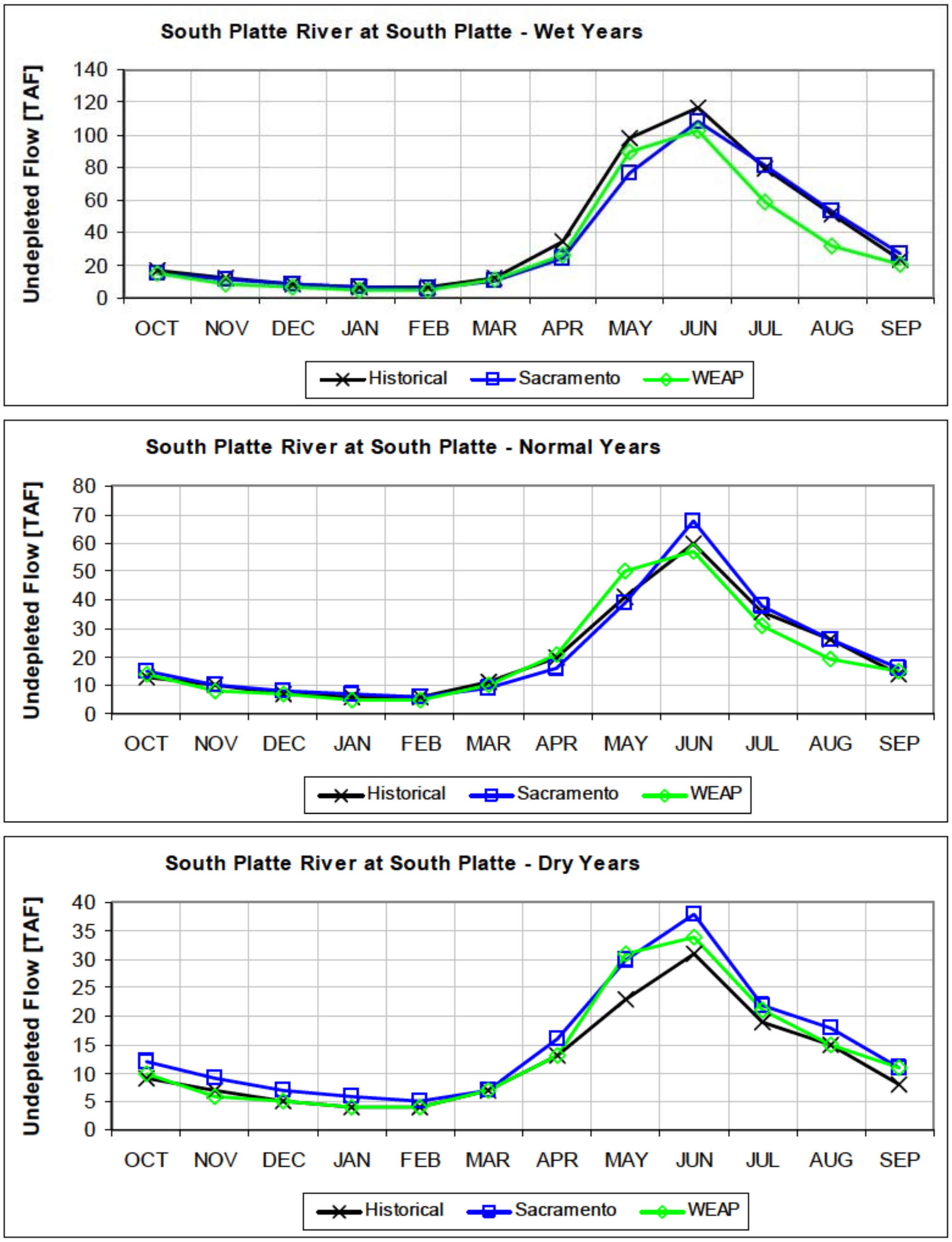


Figure 2.30 Calibration Comparison for the South Platte at South Platte (Monthly Average)

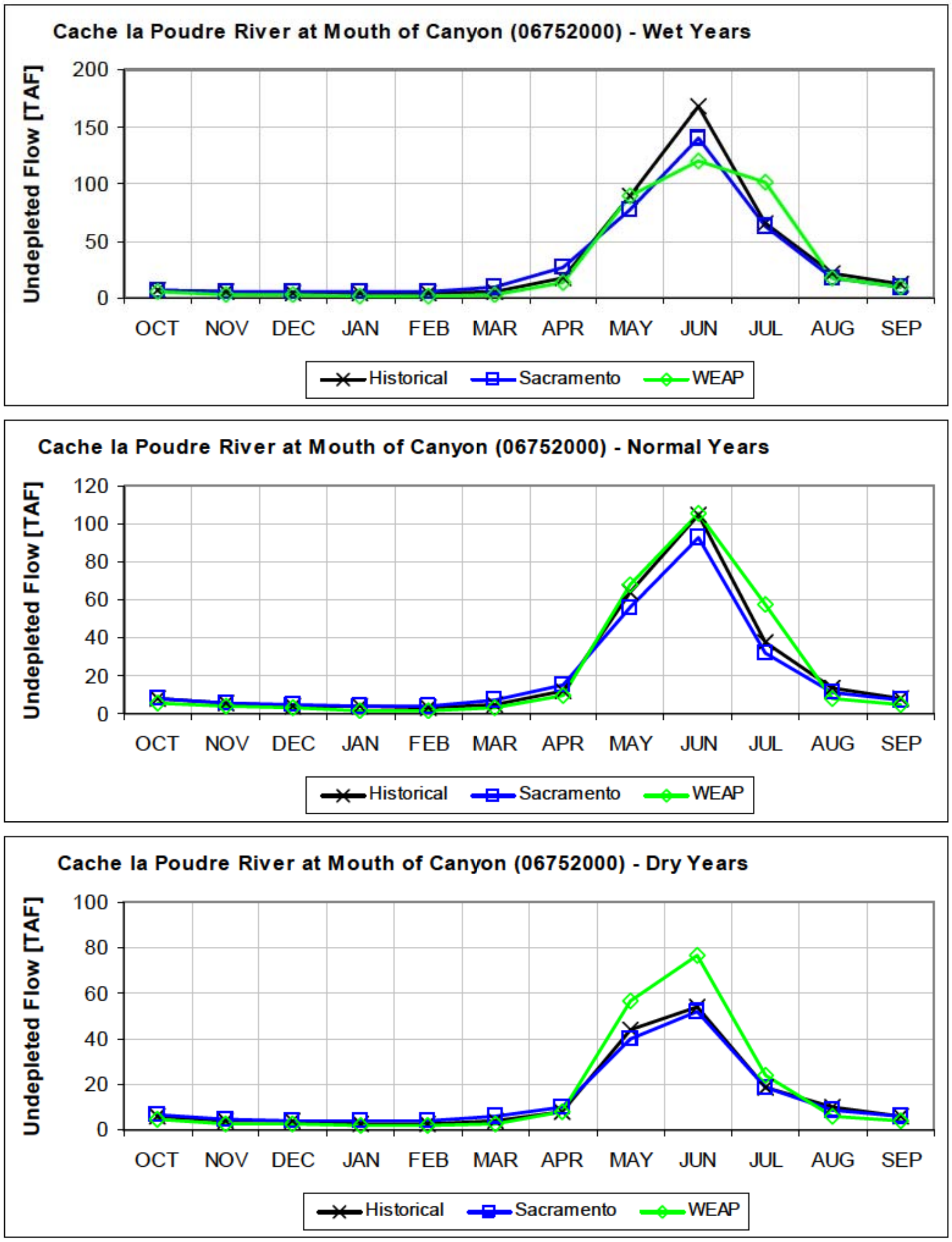


Figure 2.31 Calibration Comparison for the Cache la Poudre at Mouth of Canyon (Monthly Average)

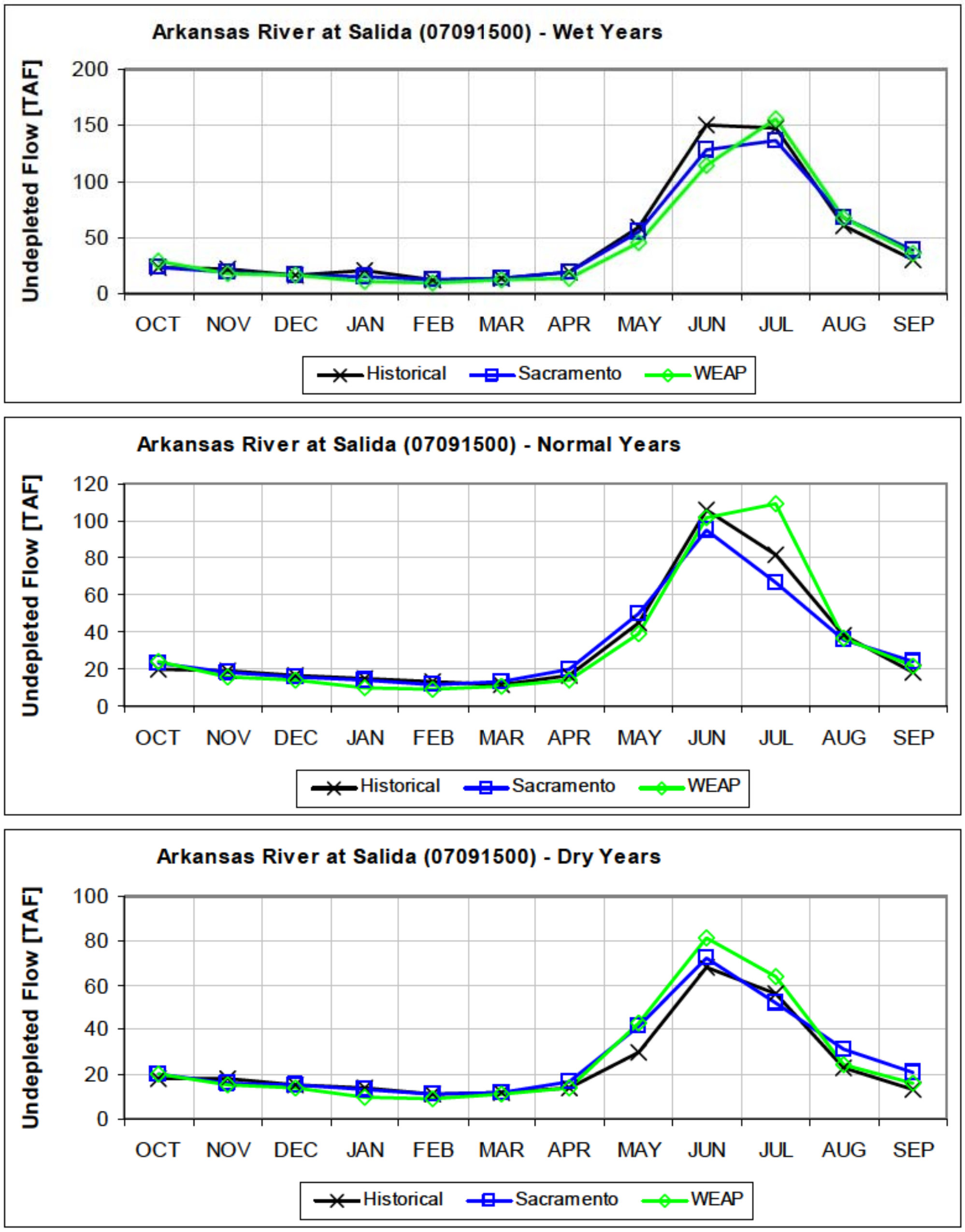


Figure 2.32 Calibration Comparison for the Arkansas at Salida (Monthly Average)

Both the Sacramento and the WEAP model show similar skill in reproducing the monthly mean pattern of runoff in wet, normal, and dry years. In some cases, the Sacramento model and WEAP models produce different runoff patterns and timing (e.g. Sacramento is greater in mean June runoff in wet years; WEAP's peak runoff in dry years is earlier than observed and Sacramento simulated; WEAP tended to have less runoff and Sacramento more runoff in late spring in the South Platte in wet years). For the Poudre and Arkansas Basins, WEAP showed greater July streamflow. In general, WEAP tends to produce more spring runoff in dry years, while the Sacramento model's calibration statistics (e.g. the NSE values of the Sacramento model given in Appendix A) tended to be higher than WEAP's NSE values, suggesting better calibration in many cases.

TASK 4: ASSESSMENT OF STREAMFLOW SENSITIVITY TO CLIMATE CHANGE

The analysis of streamflow sensitivity to climate change was performed in two stages. In the first stage, a simple sensitivity analysis was used to test and demonstrate the hydrologic simulation approach and also to test the sensitivity of each model at each gauge location to a uniform temperature increase (with no change to precipitation) and to a uniform precipitation adjustment (with no change to temperature).

The second stage was to perform a GCM-based sensitivity analysis to assess model response to possible climate change represented by specific projections in which the temperature and precipitation adjustments vary spatially over the study area and temporally from month to month.

The Response of Potential Evapotranspiration to Temperature Change

An important component of the hydrologic simulation requiring special treatment in the Sacramento model is the response of Potential Evapotranspiration (PET) to temperature change. The way in which this response was represented in the first stage of the assessment was also applied in the second stage, and is therefore applicable to both stages. As noted previously, the PET is an estimate of the upper limit on moisture that the natural vegetation may remove from the surface water and the soil column through ET. Because the procedure for estimating ET demand parameters incorporates prevailing temperature, a general procedure for adjusting the ET demand parameters in response to a given change in prevailing temperature was applied using shifted minimum and maximum characteristic temperatures applied at each basin temperature gauge. Changes in estimated PET in response to changes in projected temperature were modeled as follows:

1. For each sub-basin, average baseline monthly PET was estimated using the Penman-Monteith method and temperature characteristics for each contributing temperature gauge for the calibration period.
2. For each sub-basin, a climate-adjusted monthly PET was estimated using the Penman-Monteith method and applying the modeled climate change temperature shifts to the temperature characteristics for each contributing temperature gauge.
3. The adjustment to PET predicted by the change to PET computed in step 2 was identified, generating monthly percent changes between the baseline and climate-adjusted PET values.
4. The PET adjustment factors were applied to the calibrated PET curve, arriving at a calibrated, climate-adjusted PET curve specific to the given change in prevailing temperature.

The ET demand adjustment procedure was automated as a part of the model run process, tying individual gauges to their characteristic monthly average T_{min} and T_{max} values used in the Penman Monteith equation. Additional information, such as gauge station latitude and weighting factors used by the NWS for station weights, was used to estimate the effects of each station on the overall PET curve. Figure 2.33 illustrates the average increase in PET for the basins in the Colorado River above Cameo resulting from increased temperatures for a given climate scenario. The change in simulated AET is also shown. AET is always less than PET because as the soil dries by the action of ET, there is less water available subsequently to satisfy the full potential until additional precipitation occurs. It can be seen from the figure that the ratio of AET to PET is greater in the wet spring months and smaller in the dry summer months. The figure also illustrates that although the potential may have increased in every month due to increased temperatures, the simulated actual ET is only higher in the winter and spring months when the soil moisture is sufficient to meet a portion of the additional demand, and that in the summer months the reduced availability of water in this scenario results in lower ET.

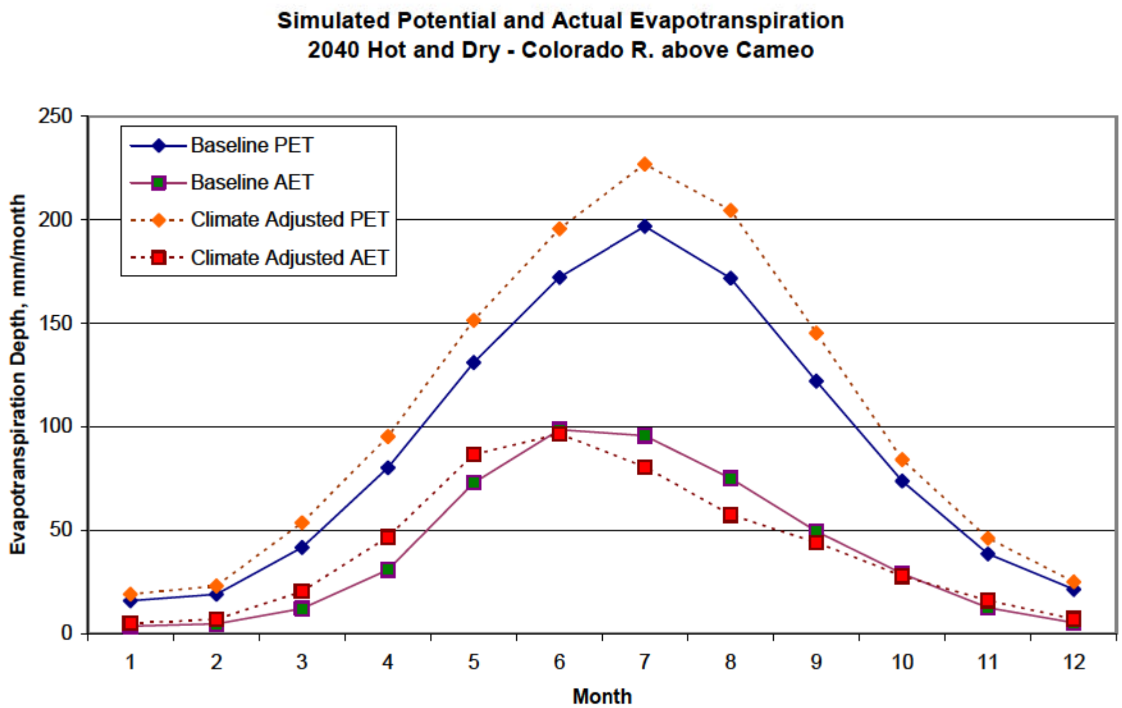


Figure 2.33 Climate Change Adjustments to the Sacramento Model PET Curve

In the WEAP model, the Penman-Monteith equation is embedded directly in the ET computation method and uses the temperature input to the model, instead of using calibrated monthly values. No additional procedure was needed to adjust the model to account for temperature-based changes to PET. It should be noted that the Penman-Monteith reference ET equation is only an estimate of the ET demand, and it does not take into account second-order effects, such as the reduction in natural vegetation in response to prolonged drought or changes in other climate variables such as relative humidity, wind speed, and solar radiation.

Simple Sensitivity Analysis (Stage 1)

The simple sensitivity assessment examined model sensitivity to simple deviations in temperature and precipitation to understand each model's sensitivity to a simple climate perturbation, to ensure that model results were reasonable and consistent with expectations, and to gain insight into model response to climate-change inputs without the complexities of temporal and spatial variability in the climate-change signal that is characteristic of GCM based sensitivity analysis.

The study team and participant representatives decided on four independent climate perturbations to test model sensitivity to a simple, uniform change in climate including two temperature and two precipitation change scenarios. The changes were chosen to reflect much of the range in the projected changes expected through 2099 (IPCC AR4 Global "Best Estimates"). For each scenario, temperature or precipitation changes were applied uniformly across all basins at each time step.

The chosen uniform temperature increases to be applied to each model were:

- an increase of 1.8 ºF (1 ºC), and
- an increase of 7.2 ºF (4 ºC).

The chosen uniform precipitation factors to be applied to each model were:

- an increase of 7.5%, and
- a decrease of 3%.

For both the Sacramento and WEAP models, the uniform temperature change was simulated by adding the chosen temperature increase to the individual temperature time-series values for each sub-basin in the model. For the Sacramento model, the PET adjustment procedure described previously was performed using the selected temperature increase for the two temperature sensitivity simulations. The models were then run to simulate streamflow using the adjusted input time series, and in the case of the Sacramento model, the changed PET parameters. The uniform precipitation change scenarios were executed by multiplying the individual precipitation time series values for each sub-basin in the model by the change factor.

GCM-Based Streamflow Sensitivity (Stage 2)

The GCM-based streamflow sensitivity analysis required the historical climate time-series inputs to the WEAP and Sacramento models to be adjusted with the monthly climate-change signals from each GCM projection, and hydrologic model simulations to be performed to compute undepleted streamflow sequences that could be compared to a baseline simulation to determine the climate change signal in streamflow response. The temperature and precipitation offsets computed previously for each GCM projection represented an average offset for the entire study area. For purposes of applying the climate change signal of a given GCM to the hydrologic models, it was necessary to prepare a gridded representation of the climate-change signal to compute individual temperature and precipitation offsets for each sub-basin in the hydrologic models.

The gridded climate change signal was prepared separately for each selected GCM projection by computing the average monthly precipitation and temperature from the GCM for each grid point for the historical period (1950-1999) and for the future period considered and computing the difference for temperature or the percent change for precipitation (recall that the two future periods considered were the 30 years surrounding 2040 and the 30 years surrounding 2070). This resulted in twelve grids (one for each month) of temperature change "deltas" and twelve grids of precipitation adjustment factors for each GCM projection that could be used to compute individual sub-basin adjustment factors for the particular projection. The climate-change simulations involved incorporating these change signals into the hydrologic models, simulating the resulting runoff, and comparing with the baseline simulation. The procedures used in applying the change signals to the hydrologic models were specific to each model.

The Sacramento Model

The following procedures were followed for each sub-basin in the Sacramento model and for each GCM projection evaluated. The precipitation change factors for all grid points covering the sub-basin were averaged for each month and for each GCM projection. Then the historical precipitation time-series values for the sub-basin were multiplied by the monthly precipitation factors for the associated months. For example, the precipitation change factors for all grid cells covering the sub-basin above Antero Reservoir from the "January" grid from the 2040 Warm-Wet GCM projection were averaged to compute a "January" precipitation adjustment factor. This factor was then applied to all of the time-series values that fall in the month of January in the Antero precipitation time series, which extends from 1950 to 2005. Similarly, the temperature changes for all grid points covering the sub-basin were averaged for each month. The average temperature change for each month was added to the historical temperature time-series values for the sub-basin for the associated months. This portion of the procedure resulted in a set of adjusted precipitation and temperature time series for all sub-basins for input to the hydrologic models. Figure 2.34 depicts an example of the grid cells corresponding to an individual sub-basin in the hydrologic model.

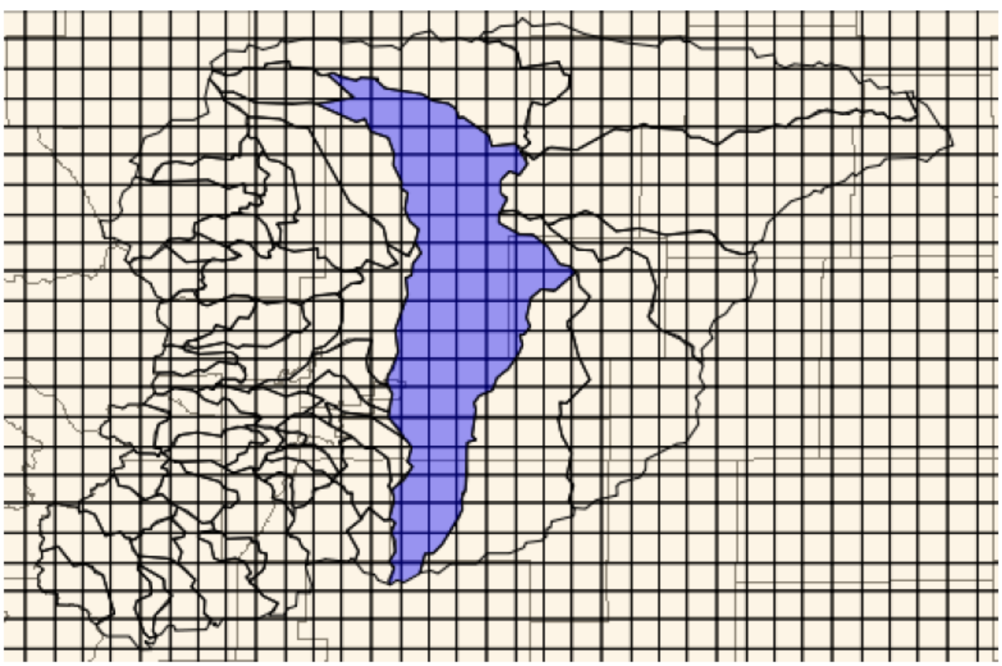


Figure 2.34 1/8th degree grid cell coverage in the South Platte sub-basins

(All grid cells with area inside the selected sub-basin are area weighted to produce a unique monthly pattern of precipitation and temperature changes for that sub-basin.)

The next step in the procedure was to modify the monthly PET parameters in the individual sub-basin hydrologic models as described previously. This procedure was identical to the procedure used for the simple sensitivity analysis, except that the temperature values used to adjust the Penman-Monteith outputs were those derived from the GCM and varied by month. Using the adjusted sub-basin model parameters and the adjusted input time series, the hydrologic simulation model was executed to compute the hydrologic response throughout the system.

The entire procedure was repeated for each of the 10 GCM projections to produce results for comparison and evaluation.

The WEAP model

The procedures followed in the WEAP model were similar to those conducted in the Sacramento model with the following differences. For each of the banded catchments, a single climate-forcing data point was selected from the 1/8th degree Maurer gridded dataset. For consistency, the same data point used for the historical climate data was then used to identify the change signal for the climate-change scenarios. The weekly, historical precipitation time-series values for each banded sub-catchment were multiplied by the monthly precipitation factors at that data point for the associated months. The average temperature change for each month was added to the weekly, historical temperature time series values for the associated months. This resulted in a set of adjusted precipitation and temperature time series for all banded sub-catchments for the WEAP hydrologic model.

Compilation of Results

A spreadsheet was prepared as a repository and display tool for the data generated by the models. The spreadsheet includes the following data, calculations, and figures:

1. Monthly time series of computed undepleted flow for each gauge location (including missing periods);
2. Filled monthly time series of undepleted flow, in which simulated flow from the Sacramento model was used to fill gaps in the undepleted flow record in item 1, above);
3. Monthly time series of simulated undepleted flow (the baseline simulation) for the Sacramento and WEAP models;
4. Monthly time series of climate adjusted undepleted flows for the four simple sensitivity simulations, the five 2040 simulations, and the five 2070 simulations for the Sacramento and WEAP models;
5. A summary sheet showing annual percent change in runoff volume between the baseline and climate change runoff simulation for each climate change scenario and gauge location;
6. A summary sheet showing annual calibration statistics for each model and gauge location;
7. A sheet permitting the selection of a single gauge for detailed analysis, with climate-change impact charts for the selected gauge, including: annual volume comparison for each climate scenario and hydrologic model; a summary annual volume organized according to year type (wet, normal, and dry); average monthly volume comparison graphs; a simulated monthly runoff plot; box and whisker plots of annual volume for the simple sensitivity runs showing max, min, mean, and standard deviation; a shift in runoff timing plot; a historical annual volume plot; and supporting tables for each plot;
8. A calibration statistics sheet for the selected gauge, including monthly summaries of historical and simulated undepleted flow, standard deviation, RMSE, NSE, and monthly

bias, and calibration graphics showing mean monthly values for historical undepleted flow and simulated undepleted flow from the Sacramento and WEAP models;

9. A climate-adjusted time-series sheet with adjustments computed by applying a time series of the ratio of undepleted-to-baseline simulated flow for each month in the historical record; and
10. A climate-adjusted time-series sheet with adjustments computed by applying average monthly ratios of baseline-to-simulated climate-adjusted flow to the historical undepleted flow time series; this sheet also includes a variety of graphics depicting the monthly percent changes.

The results spreadsheet is included with the electronic distribution of the report and as an attachment in the published version of the report. Results of both the simple streamflow sensitivity analysis and the GCM-based streamflow sensitivity analysis are presented and discussed in the *Results and Discussion* section of the report, below.

CHAPTER 3
RESULTS AND DISCUSSION

The results of the simple sensitivity analysis and the GCM-based sensitivity analysis are presented below. General results are presented first, followed by a discussion of specific findings. The results highlight the six selected gauge locations that have been noted in previous sections of the report to limit the volume of material presented. These locations are the Blue River below Dillon, the Colorado River near Cameo, the South Platte River above Spinney Mountain Reservoir, the South Platte River at South Platte, the Cache la Poudre River at Mouth of Canyon, and the Arkansas River at Salida. Tables showing the percent change in annual streamflow volume are presented in Appendix B. To remove bias inherent in the hydrologic model simulations, all results presented here are adjusted by the ratio of undepleted flow to baseline simulated flow for the respective hydrologic models.

SIMPLE SENSITIVITY RESULTS (STAGE 1)

Figure 3.1 through Figure 3.3 present for each model the average annual undepleted streamflow at six locations for each of the sensitivity simulations in addition to the historical undepleted volume. Note that the scale of the y-axis is unique for each station to emphasize the relative differences between scenarios. In summary, the temperature or precipitation changes for these scenarios were applied uniformly across all basins at each time step and included:

- A temperature increase of 1.8 ºF (1 ºC),
- A temperature increase of 7.2 ºF (4 ºC),
- A precipitation increase of 7.5%, and
- A precipitation decrease of 3%.

The Sacramento and WEAP models show similar responses to temperature increases. Both models show roughly similar changes in runoff volume under a modest 3% reduction in precipitation, while the Sacramento model simulated greater runoff volume than the WEAP model under the increased precipitation scenario.

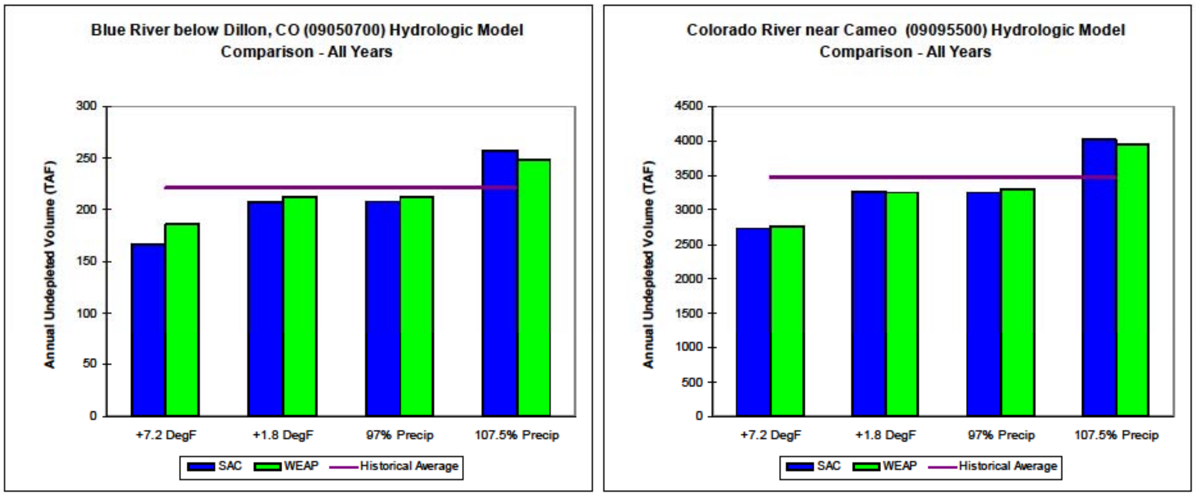


Figure 3.1 Sensitivity of average annual volume to precipitation and temperature change - Blue below Dillon, Colorado near Cameo

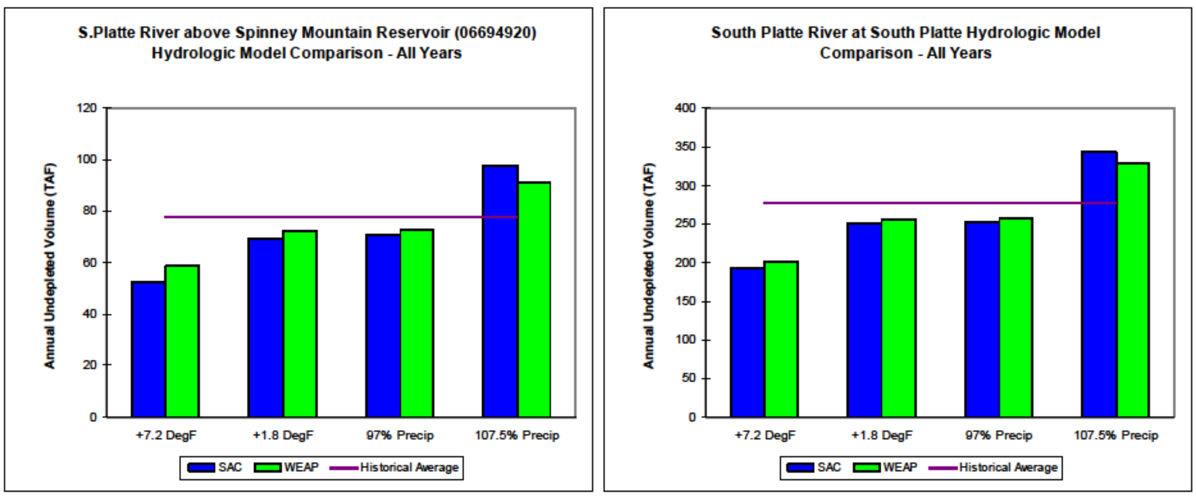


Figure 3.2 Sensitivity of average annual volume to precipitation and temperature change – South Platte above Spinney, South Platte at South Platte

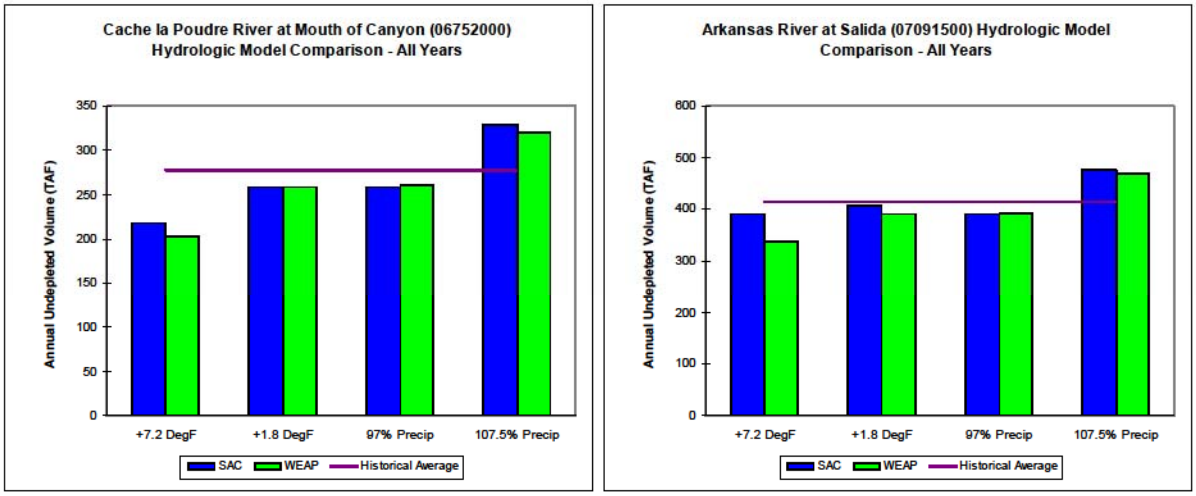


Figure 3.3 Sensitivity of average annual volume to precipitation and temperature change - Cache la Poudre at Mouth of Canyon, Arkansas at Salida

Figure 3.4 presents the average monthly streamflow volume results for each of the sensitivity simulations and the simulated baselines from each hydrologic model. The simulated baselines are computed for the historical period 1950 through 2005. For the 7.2°F scenario, both models simulate fairly dramatic shifts in the timing of runoff, with the peak shifting a month earlier. One notable difference between the Sacramento and WEAP simulations for the 7.2°F scenario is in the month of April, where WEAP simulates a much greater runoff volume when compared with the Sacramento model. In the WEAP model, the substantial warming leads to earlier runoff, but the ET is still energy limited due to the relatively short days and limited solar insolation in the early spring. In the Sacramento model the increase in PET is combined with an increase in soil moisture due to earlier snowmelt, resulting in an increase in the simulated AET in the early spring and less runoff in April. Although both of these factors are active in each model, the model formulations appear to result in a different emphasis being applied.

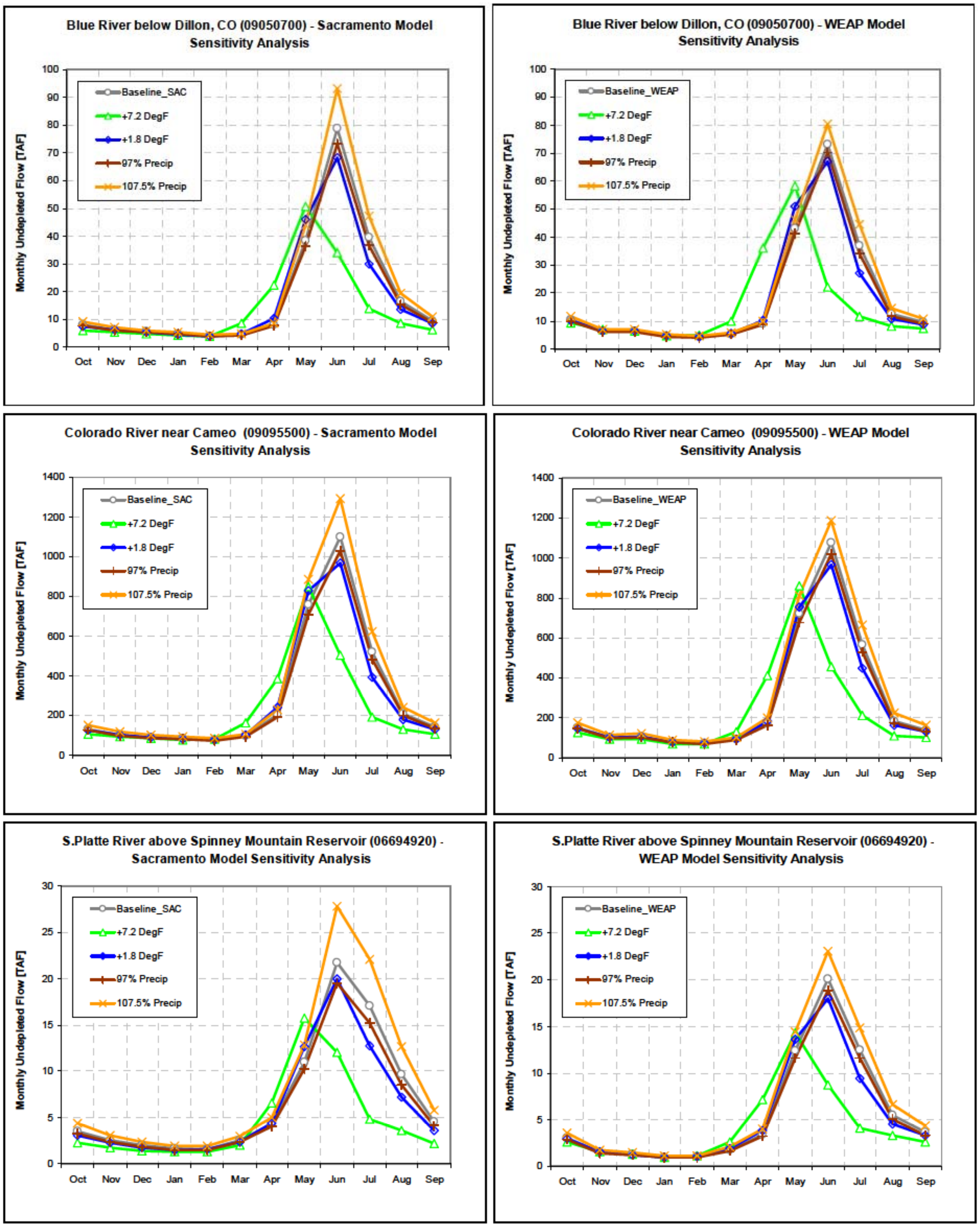


Figure 3.4 Sensitivity of monthly volume to precipitation and temperature change (continued)

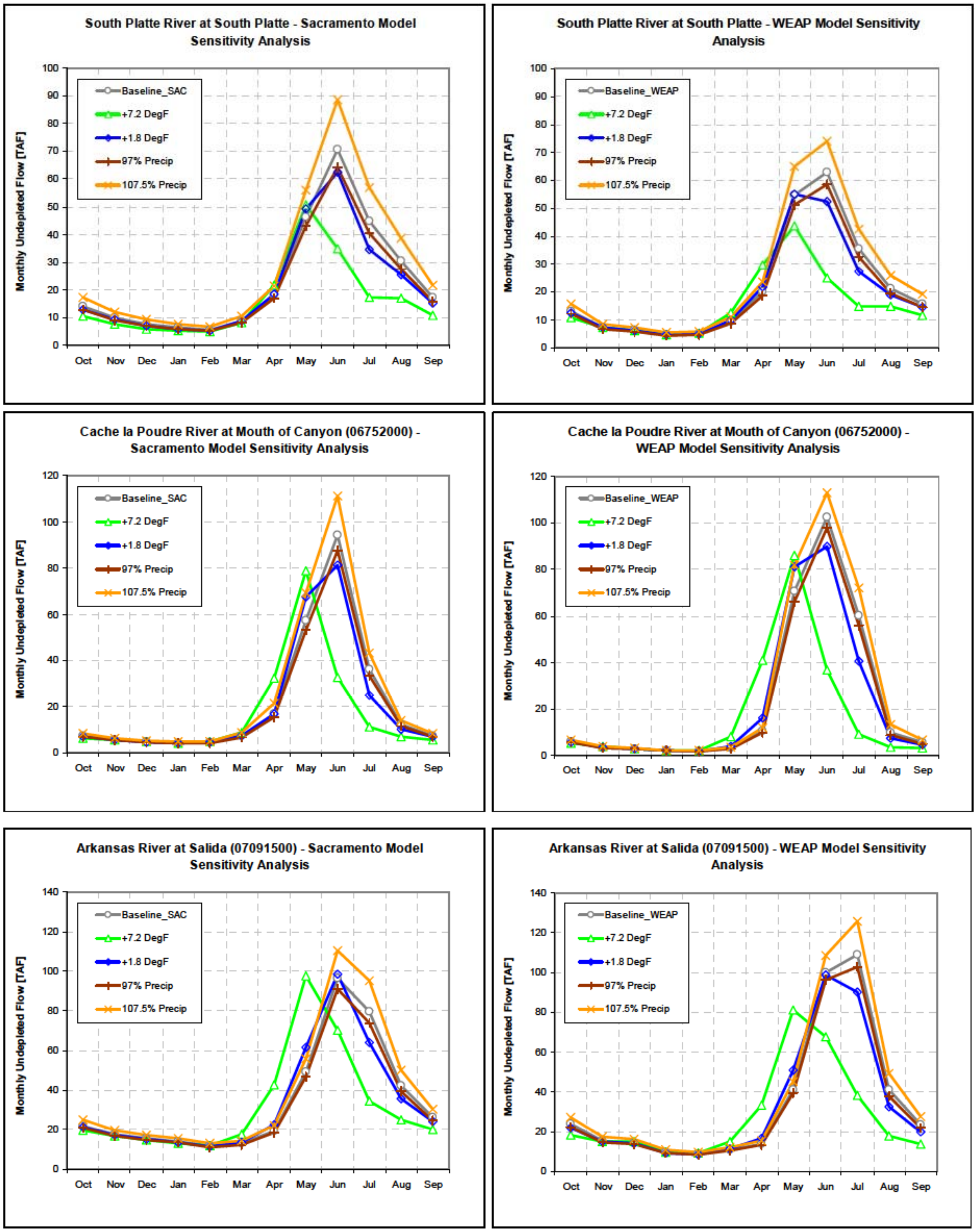


Figure 3.4 (continued)

Figure 3.5 shows the change in timing of runoff for the selected uniform temperature and precipitation change scenarios. The change in timing is computed here as the number of days earlier that the center of mass of runoff occurs between the baseline and climate adjusted simulations. The 7.2° F scenario leads to earlier runoff on the order of 15 to 25 days. The WEAP model tends to accentuate the shift toward earlier runoff in this case, as melt water tends to runoff instead of evapotranspire, as noted previously. The method used to calculate the change in timing is discussed under Runoff Timing in the *GCM-Based Streamflow Sensitivity* section, below.

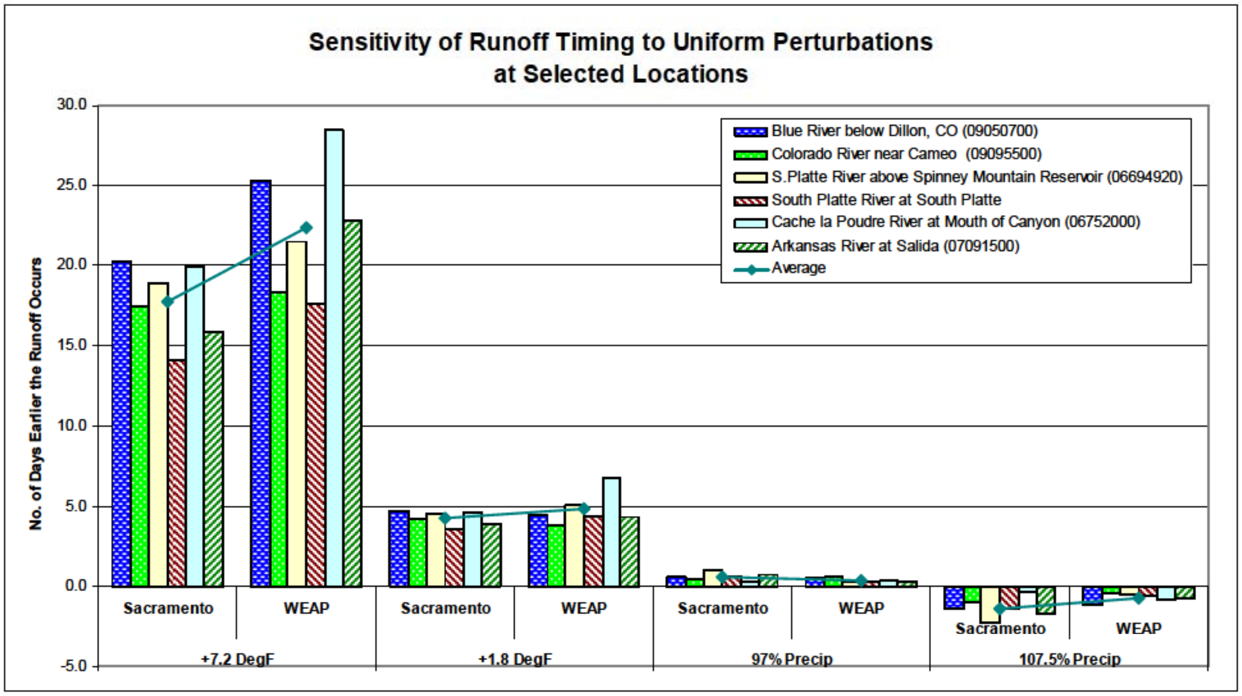


Figure 3.5 Sensitivity of Runoff Timing to Uniform Temperature and Precipitation Perturbations

Several observations from the simple sensitivity runs include:

- The simulated responses of the models are consistent with expectations regarding the direction and magnitude of runoff changes in response to temperature increases and precipitation increases and decreases, e.g. temperature increases lead to earlier runoff and decreased total streamflow volume.
- The changes resulting from temperature increase include both a reduction in total annual volume (seen in the annual volume plots as well) and a shift in timing of the runoff peak.
- The simulated change in annual volume to a temperature increase was greatest for the South Platte, and smallest for the Arkansas for both models.
- The sensitivity of annual volume to precipitation change appears to be nearly uniform among all basins, although it might be slightly higher for the South Platte.
- The reduction in total runoff volume from the 1.8°F increase in temperature was roughly similar to the reduction in runoff from a 3% reduction in precipitation for both models.
- The Sacramento model tended to produce less runoff under the 7.2°F scenario when compared with the WEAP model, except in the Arkansas Basin. For both models the

reduction in volume and shift in runoff timing is quite dramatic under the 7.2°F scenario.

- The timing of peak runoff is later when precipitation increases and earlier when precipitation decreases, but these shifts are minor.

These results provide an initial indication of the expected trends in simulated annual runoff volume and timing as a result of changes in precipitation and temperature inputs.

GCM-BASED STREAMFLOW SENSITIVITY RESULTS (STAGE 2)

The ten GCM-Based climate scenarios were used to modify the historical temperature and precipitation forcing data used by each hydrologic model. Streamflow generation is sensitive to both the temporal and spatial pattern of temperature and precipitation change, and the GCM-based scenarios explicitly represent these patterns. Table 3.1 summarizes these scenarios and includes the spatially averaged seasonal and annual average temperature and precipitation change for each of the future time periods, compared to the 1950-1999 baseline. Bold values are the average seasonal changes across months, and non-bold values are the high and low monthly value range. The seasons are defined as: Winter (December – February), spring (March – May), summer (June – August), and fall (September – November). All models show monthly, seasonal, and annual warming, though both the magnitude and timing of that warming vary. These variations are likely a result of the internal workings of the climate models and emission scenarios. Seasonal precipitation change varies across projections and future time horizons. The projections consistently depict wetter winters, with the exception of a slight decrease in the *2070 Hot & Wet* scenario.

Table 3.1 Seasonal temperature differences and precipitation percent changes

Average Seasonal Change – 2040

	Temperature Increase (°F)				
	Warm & Wet	**Hot & Wet**	**Median**	**Warm & Dry**	**Hot & Dry**
Winter	**1.4** (1-2)	**2.6** (2-3)	**2.9** (2-3)	**1.9** (1-3)	**4.0** (4-5)
Spring	**0.8** (0-1)	**4.0** (3-5)	**2.5** (1-4)	**2.1** (1-2)	**5.2** (5-6)
Summer	**2.1** (2-3)	**6.3** (6-7)	**4.5** (4-5)	**3.7** (3-4)	**6.0** (5-7)
Fall	**2.3** (1-3)	**4.1** (3-6)	**3.7** (2-5)	**3.1** (3-4)	**5.0** (4-6)
Annual	**1.6**	**4.2**	**3.4**	**2.7**	**5.0**
	Precipitation Change (%)				
	Warm & Wet	**Hot & Wet**	**Median**	**Warm & Dry**	**Hot & Dry**
Winter	**11.2** (-9 - +33)	**7.3** (+3 - +12)	**19.9** (+13 - +25)	**15.9** (+14 - +20)	**3.1** (-1 - +6)
Spring	**10.0** (+6 - +17)	**4.3** (-6 - +17)	**-6.2** (-17 - +2)	**-7.2** (-14 - +2)	**-6.4** (-30 - +22)
Summer	**10.7** (-10 - +21)	**3.3** (-1 - +9)	**-8.2** (-17 - +2)	**-13.2** (-21 - -4)	**-18.8** (-32 - -12)
Fall	**14.1** (+1 - +23)	**0.4** (-10 - +6)	**8.5** (-9 - +31)	**-8.8** (-15 - +2)	**-10.9** (-18 - +1)
Annual	**11.4**	**3.8**	**2.6**	**-3.7**	**-8.5**

(continued)

Table 3.1(Continued)

Average Seasonal Change – 2070

	Temperature Increase (°F)				
	Warm & Wet	**Hot & Wet**	**Median**	**Warm & Dry**	**Hot & Dry**
Winter	**3.5** (3-4)	**5.2** (4-7)	**4.6** (3-6)	**4.3** (3-5)	**5.6** (4-6)
Spring	**3.8** (3-4)	**6.5** (6-7)	**4.5** (3-6)	**4.1** (3-4)	**5.9** (5-7)
Summer	**4.2** (4-5)	**7.5** (7-8)	**5.6** (5-6)	**5.3** (5-6)	**11.4** (11-12)
Fall	**4.2** (2-5)	**6.2** (4-8)	**5.6** (4-7)	**5.1** (4-6)	**9.3** (8-12)
Annual	**3.9**	**6.4**	**5.1**	**4.7**	**8.1**
	Precipitation Change (%)				
	Warm & Wet	**Hot & Wet**	**Median**	**Warm & Dry**	**Hot & Dry**
Winter	**12.0** (-4 - +12)	**-3.2** (-8 - +3)	**20.6** (+9 - +28)	**15.7** (0 - +26)	**13.8** (+9 - +17)
Spring	**1.8** (-5 - +16)	**1.4** (-10 - +9)	**-8.7** (-22 - +3)	**-4.2** (-16 - +14)	**-2.7** (-16 - +15)
Summer	**24.5** (+9 - +37)	**20.8** (+12 - +31)	**-2.6** (-4 - -1)	**4.6** (0 - +9)	**-25.2** (-48 - -8)
Fall	**7.8** (+4 - +13)	**0.0** (-19 - +15)	**-4.3** (-5 - -3)	**-16.0** (-29 - -6)	**-9.5** (-11 - +5)
Annual	**10.8**	**4.9**	**0.4**	**-0.1**	**-5.9**

*Values in parentheses represent the range of changes encountered in the monthly data.

The average annual undepleted streamflow volume was computed for each climate change scenario and for both hydrologic models, with the results presented in Figure 3.6 through Figure 3.11 at the six selected locations. A horizontal line depicts the historical average annual undepleted streamflow volume. Note that the scale of the y-axis is unique for each station.

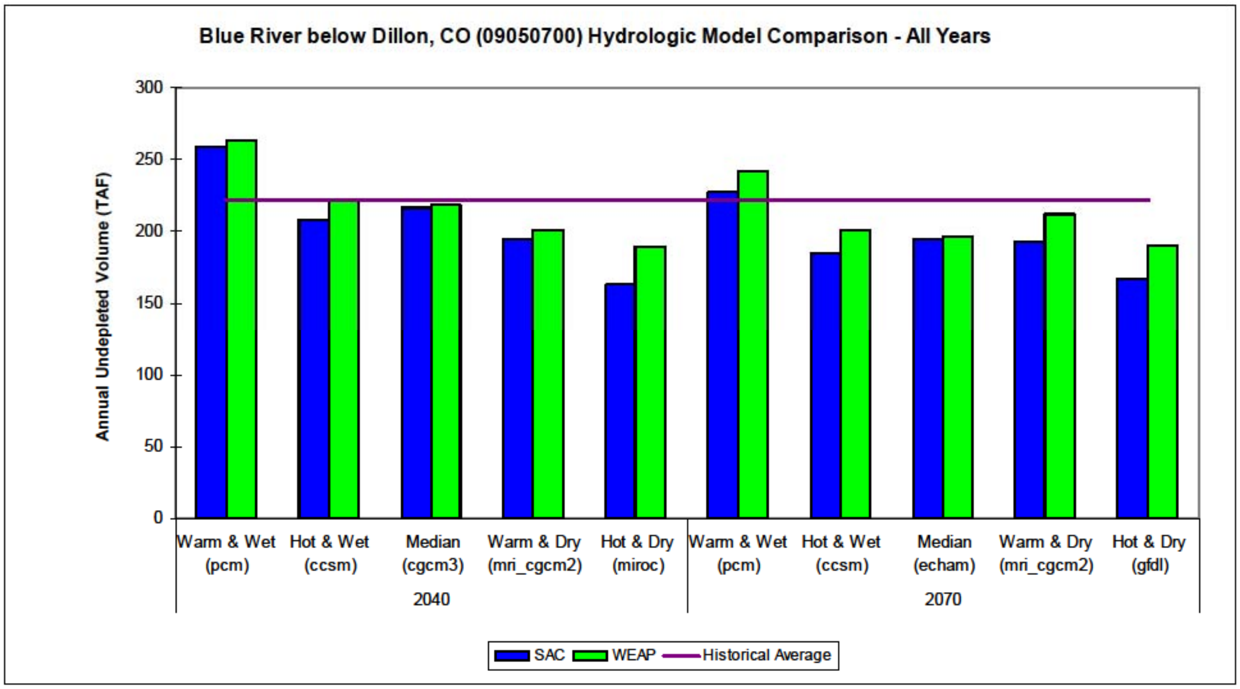


Figure 3.6 Average annual volume change for all climate change simulations – Dillon

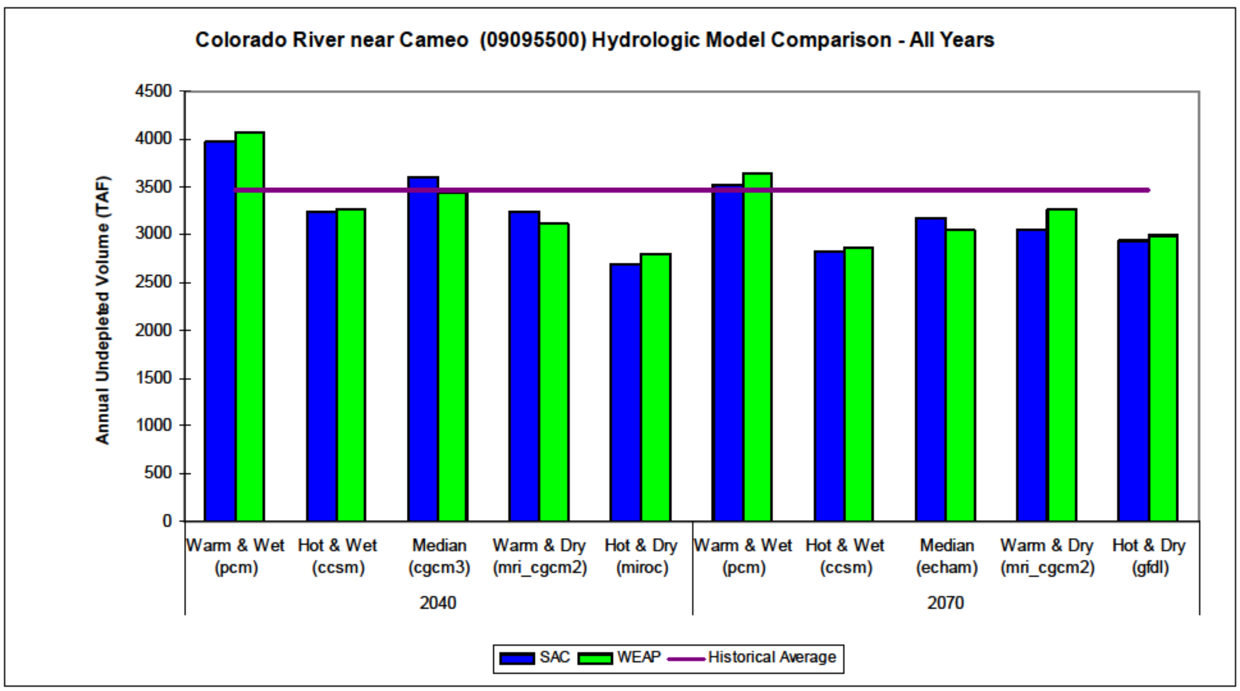


Figure 3.7 Average annual volume change for all climate change simulations - Cameo

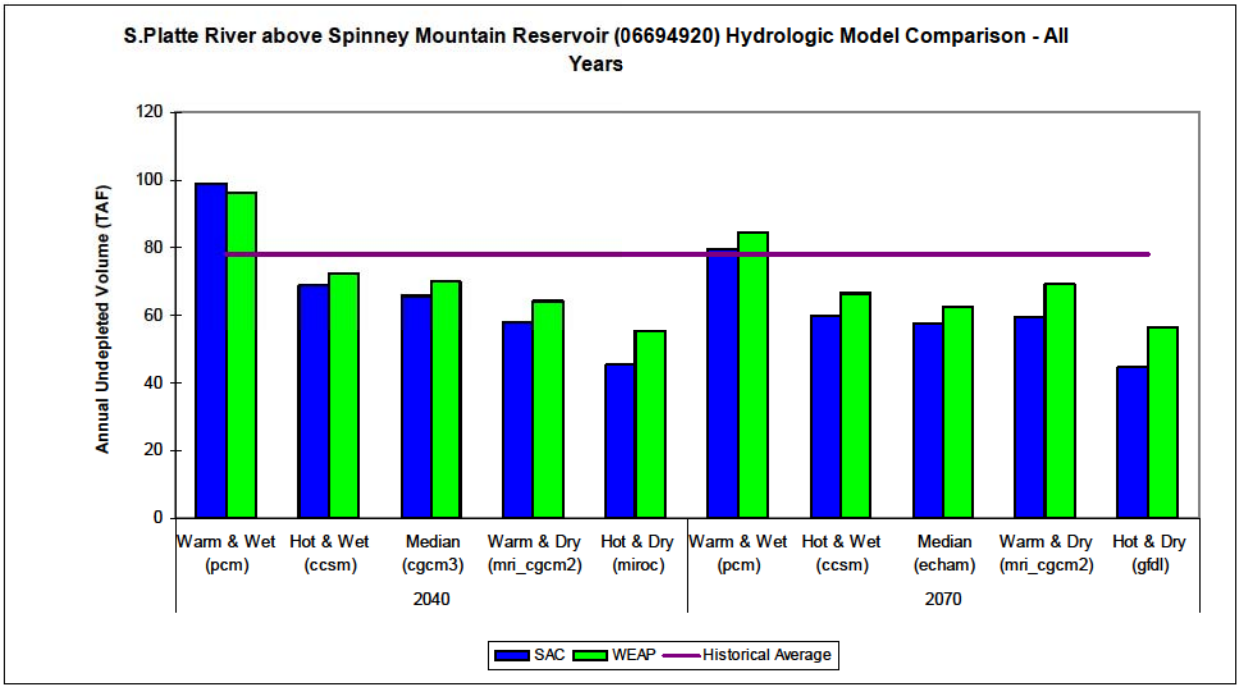


Figure 3.8 Average annual volume change for all climate change simulations - Above Spinney.

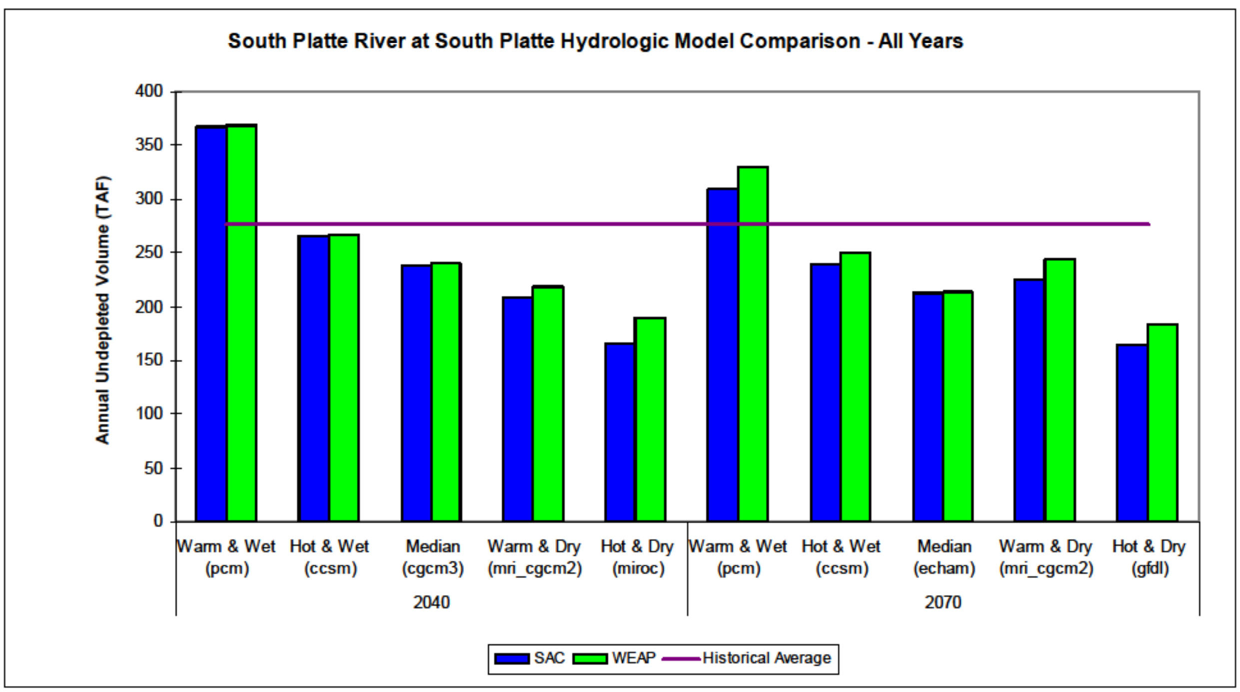


Figure 3.9 Average annual volume change for all climate change simulations - South Platte

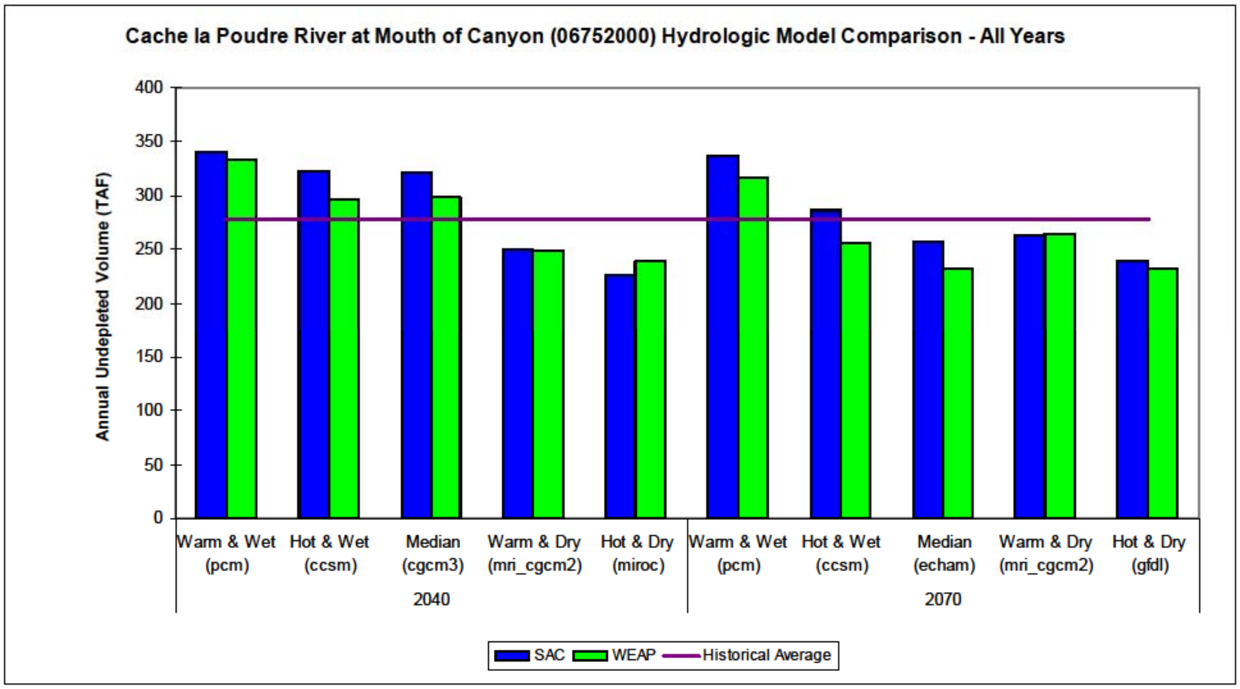


Figure 3.10 Average annual volume change for all climate change simulations - Cache la Poudre

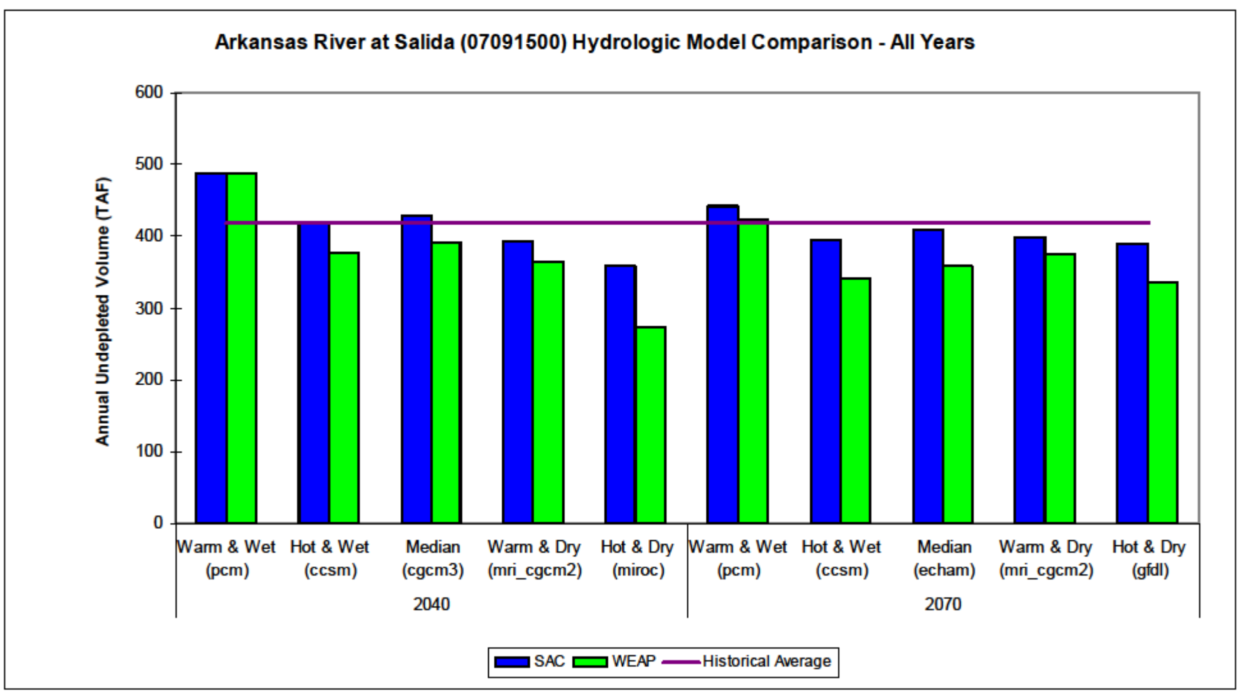


Figure 3.11 Average annual volume change for all climate change simulations – Salida

The figures show that only one of the ten scenarios consistently results in an increase in total streamflow volume across all the watersheds and for both models (e.g. *2040 Warm & Wet*). The *2040 and 2070 Hot & Dry and Warm & Dry* scenarios all show declines in total annual volume, but at many locations the decline is greater for 2040 than for 2070, as discussed further on page 86. The *2040 Median* and the *2040 Hot & Wet* scenarios suggest a more complex, spatial climate-change pattern. The *2040 Median* scenario shows little to no change in simulated runoff for the Colorado and Arkansas Basins, decreased runoff in the South Platte Basins, and increased runoff in the Poudre Basin. The *2040 Hot & Wet* scenario yields declines in simulated annual runoff from all basins except the Poudre. Figure 3.12 and Figure 3.13 depict the spatial pattern of precipitation change on an annual basis for the *2040 Median* and the *2040 Hot & Wet* scenarios. Within the study area the *2040 Median* shows a strong southeast-northwest, dry to wet gradient, while the *2040 Hot & Wet* scenario shows an opposite precipitation gradient (e.g. a drier southwest and wetter northeast).

The wetter scenarios suggest a modest increase in total precipitation, with corresponding increases in simulated runoff in many cases. For example, all of the *Warm & Wet* scenarios show increased runoff, while there is an overall decline in runoff under the *2040 Hot & Wet* scenario, as the increased evapotranspiration from warming dominates the modest precipitation increase, except in the Poudre Basin (Figure 3.10). Increased winter precipitation is the most optimistic finding for water providers, as snowpack is the primary mechanism of water storage across the Colorado Rockies, with providers relying on it as the primary water source to maintain reservoir levels and to aid in late summer flows. Perhaps most notable among the scenarios is that both the *2040 and 2070 Hot & Dry* scenarios are wetter in the winter, with overall drying attributable to less precipitation in the spring, summer, and fall seasons.

The *2070 Hot & Wet* and the *2070 Hot & Dry* revealed interesting results in terms of both spatial and temporal variability of precipitation. The "wet" characteristic of the *2070 Hot & Wet* scenario is primarily due to *increased* summertime precipitation, while the "dry" characteristic of the *2070 Hot & Dry* scenario is largely attributable to a *decrease* in summer precipitation (see Figure 2.5). The Colorado at Cameo location (Figure 3.7) shows that the total annual runoff volume in the *2070 Hot & Wet* scenario is actually less than the *2070 Hot & Dry* scenario, largely an outcome of timing and spatial distribution of precipitation change, as winter precipitation is greater in the later scenario, particularly over the western portion of the basin (see Figure 2.5, Figure 3.14 and Figure 3.15). The *2070 Hot & Wet* and *2070 Hot & Dry* scenarios exhibit strong spatial pattern of precipitation change, although opposite in direction. The *2070 Hot & Wet* scenario reveals wet to the east and drying to the west, while the *2070 Hot & Dry* scenario shows a strong east-west gradient, with substantially more drying in the east, with some increases in annual precipitation, most notably over the Colorado Basin.

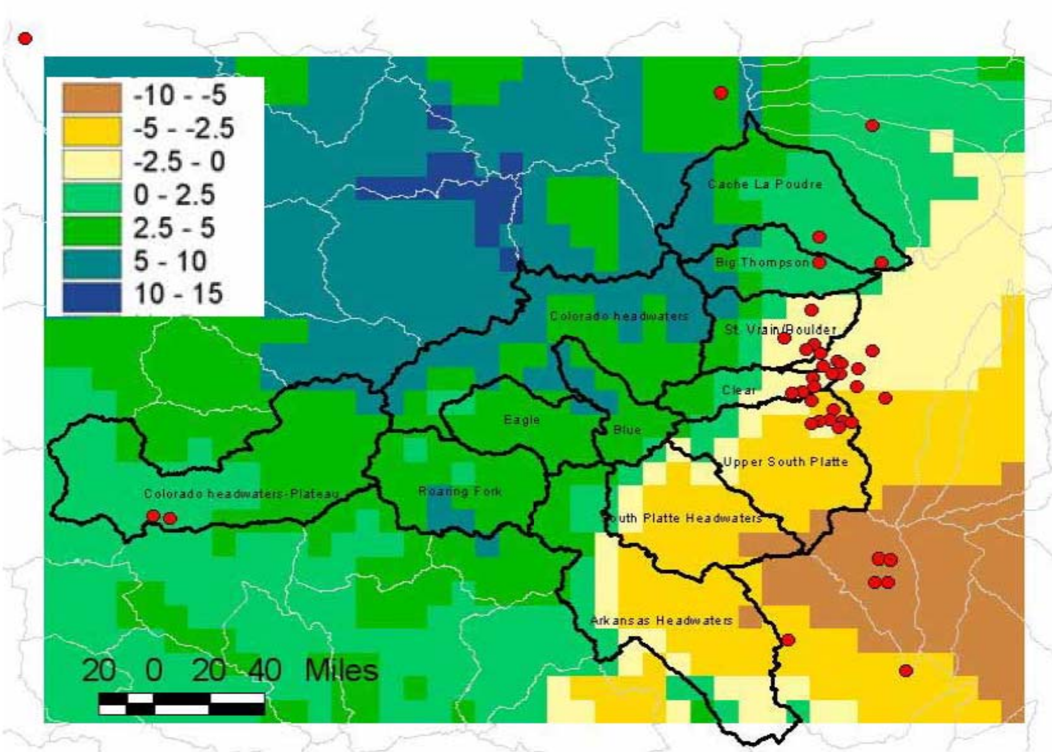


Figure 3.12 Percent change in total annual average precipitation between the historical period (1950 to 2000) and the 2040 period (2025 to 2054) for the *2040 Median* scenario (cgcm3_1.2 B1)

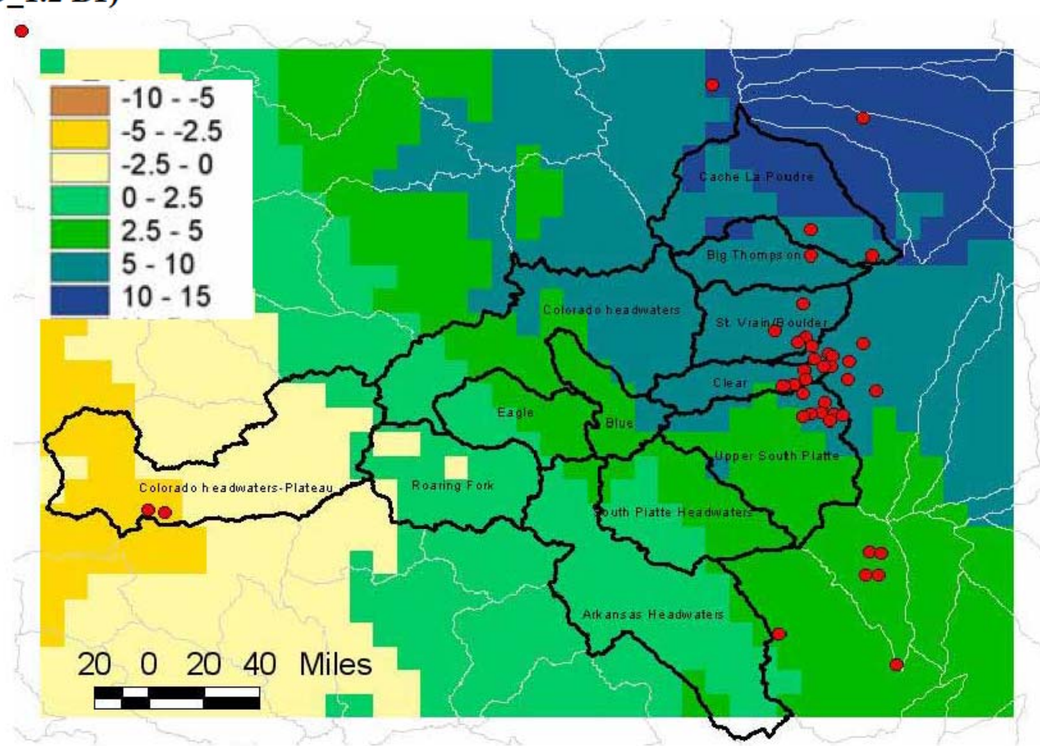


Figure 3.13 Percent change in total annual average precipitation between the historical period (1950 to 2000) and the 2040 period (2025 to 2054) for the *2040 Hot &Wet* scenario (ccsm3_0.2.sresa1b)

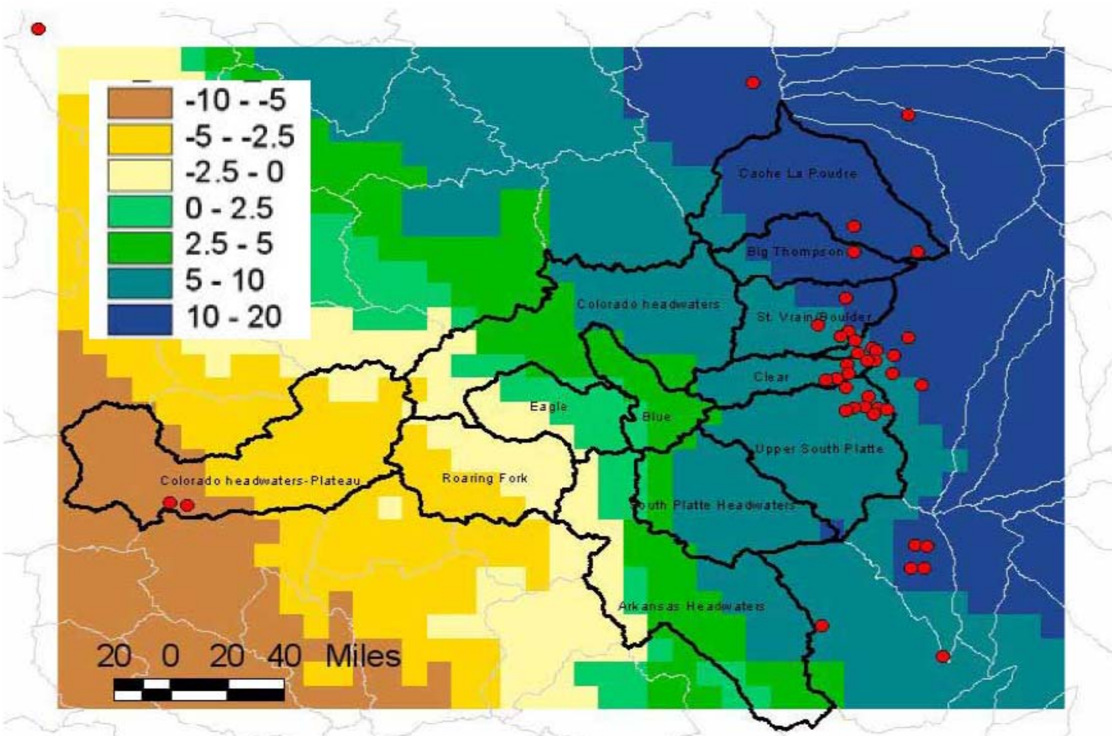


Figure 3.14 Percent change in total annual average precipitation between the historical period (1950 to 2000) and the 2070 period (2055 to 2084) for the 2070 Hot &Wet scenario

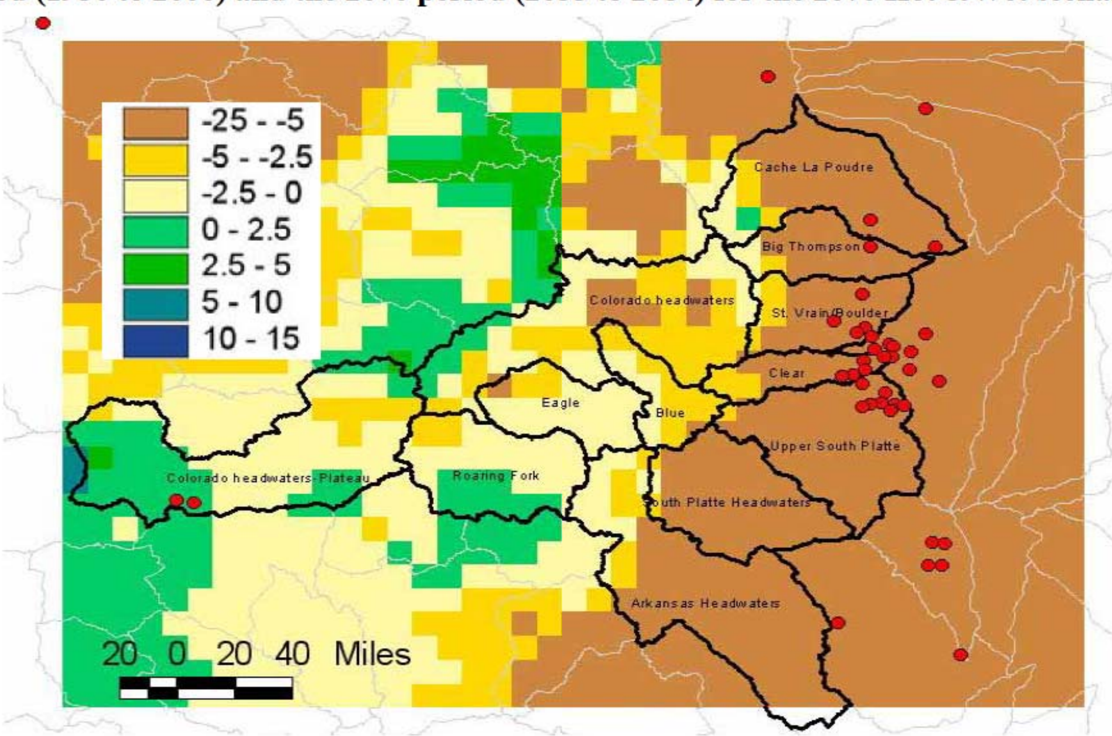


Figure 3.15 Percent change in total annual average precipitation between the historical period (1950 to 2000) and the 2070 period (2055 to 2084) for the *2070 Hot & Dry* scenario

AVERAGE MONTHLY SIMULATED STREAMFLOW

In addition to annual volume, average monthly simulated streamflow volumes were computed for each climate change scenario and for both hydrologic models. These results are summarized for the six representative locations for 2040 scenarios in Figure 3.16 and the 2070 scenarios in Figure 3.17. The gray line is the average simulated baseline for each model using the unadjusted, historical climate sequence. Note that the scale of the y-axis is unique for each station.

There are some general observations regarding the sensitivity of simulated streamflow under the climate change scenarios for both the Sacramento and WEAP models. While both are continuous, lumped parameter models, the Sacramento and WEAP models differ in several of their process formulations (e.g. the soil moisture and snowmelt algorithms as examples). This fact gives rise to fundamental differences in their characterization of streamflow response to climate change. The Sacramento model tends to produce greater evaporative losses in mid-winter and late spring under warming when compared with the WEAP model. Likewise, the WEAP model tends to yield greater springtime flows under warmer conditions. Combined, these differences tend to make WEAP a less sensitive model to temperature perturbations than the Sacramento model using the PET response procedure formulated for this study.

The WEAP model tends to be less sensitive to warming in terms of streamflow reduction, with the most notable difference between the models in the month of April. It appears that warmer spring conditions tend to mobilize surface runoff more in the WEAP model than in the Sacramento model, and while simulated potential ET is higher in the future relative to the historical climate, the increase is low relative to the summer months simply due to the smaller insolation in April. In addition, relatively low soil moisture conditions heading into April tend to favor surface and sub-surface runoff instead of ET, thus actual simulated ET remains relatively low and the melt water tends to runoff. In the Sacramento Model, losses in the late and early spring tend to increase as a result of the increased potential for ET associated with higher temperatures. The increased potential corresponds with increases in available soil moisture due to earlier snowmelt and the fact that the Sacramento model first simulates the filling of tension water zones prior to simulating snowmelt runoff, allowing more of the increased potential ET to be realized. The Sacramento Model also tends to estimate higher ET loss in mid-winter than does the WEAP model because it simulates some loss from forest-covered areas even when the ground is snow covered.

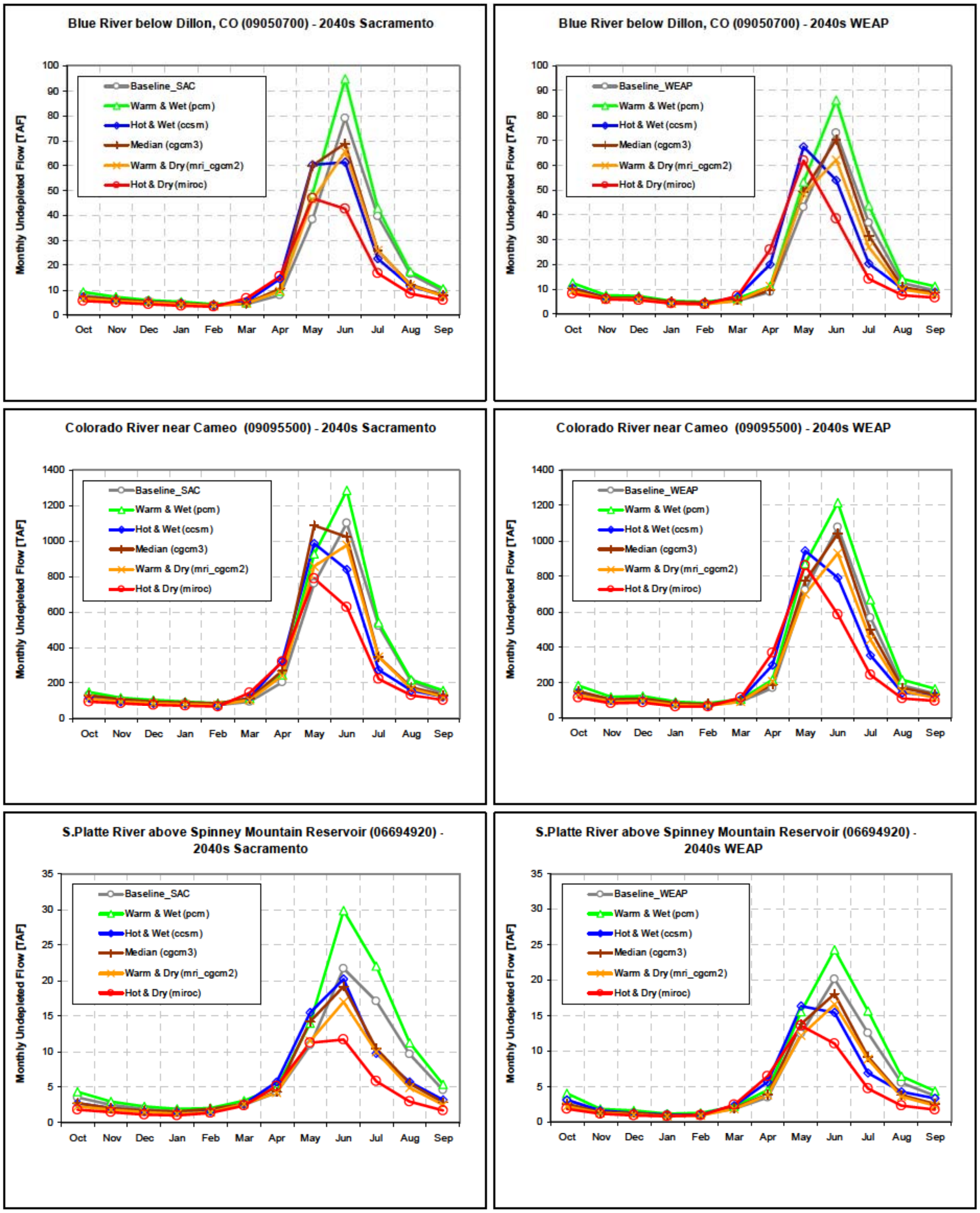


Figure 3.16 Simulated average monthly streamflow volume for the 2040 scenarios (continued)

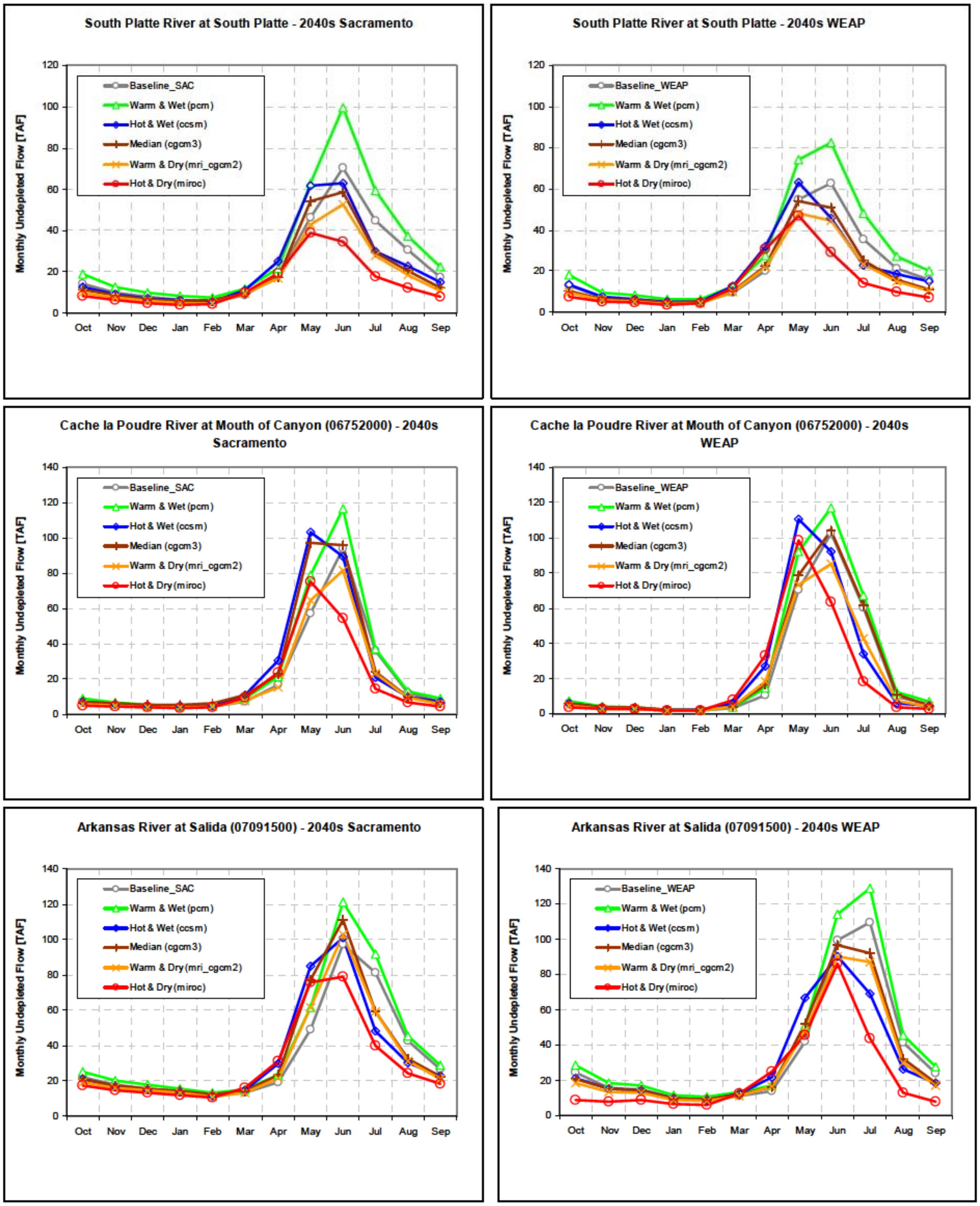


Figure 3.16 (continued)

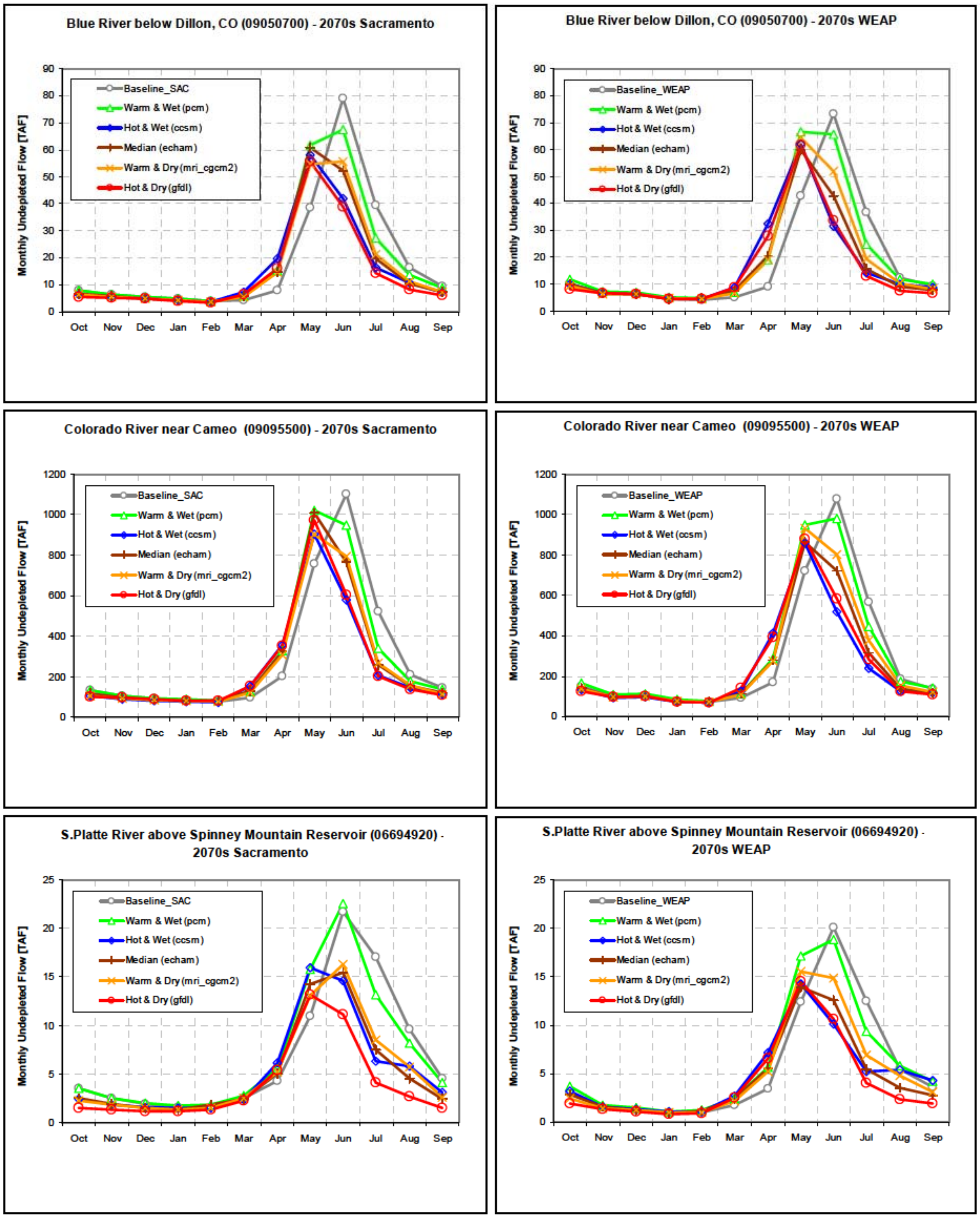


Figure 3.17 Simulated average monthly streamflow volume for the 2070 scenarios (continued)

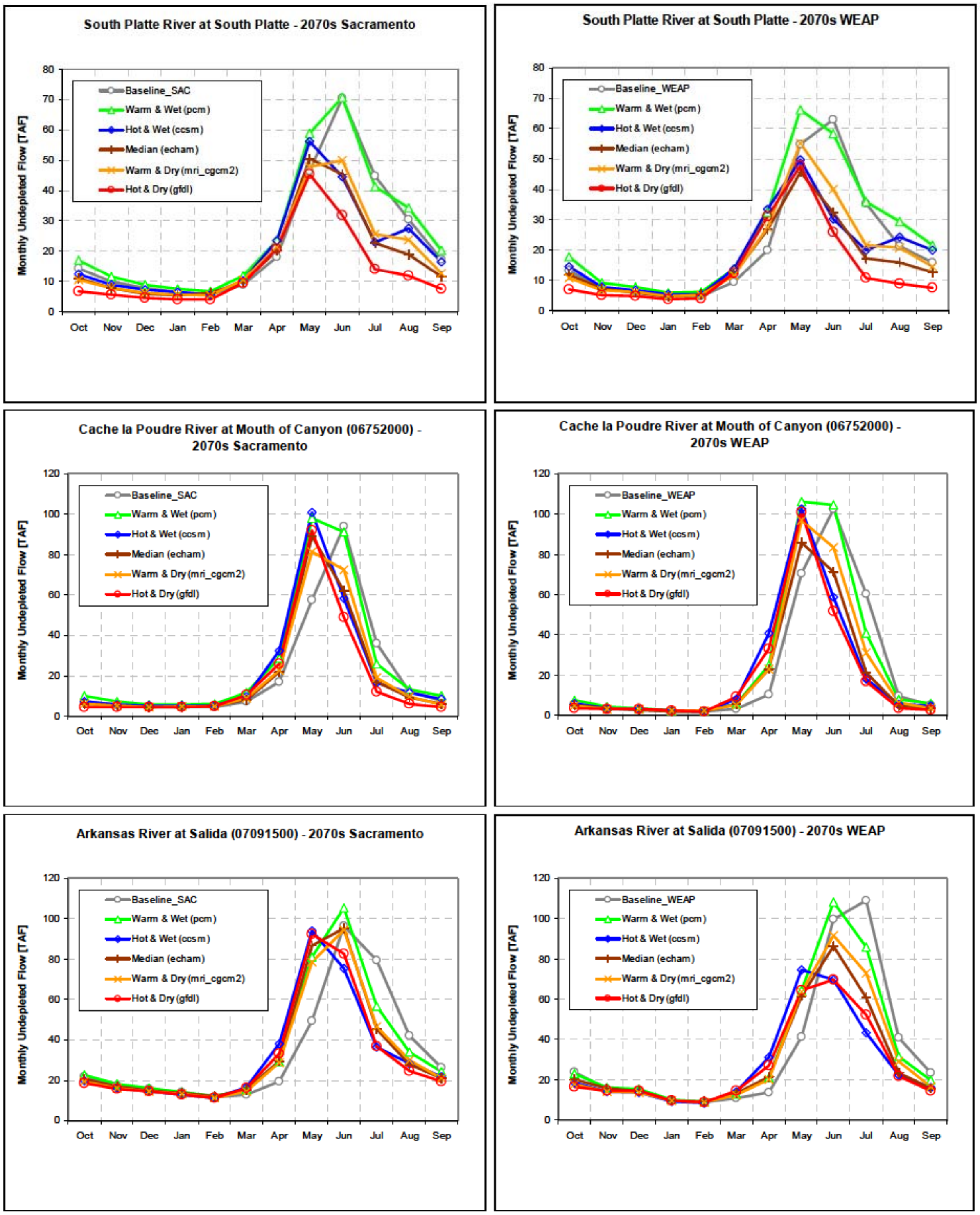


Figure 3.17 (continued)

RUNOFF TIMING

Runoff timing is important when considering the availability of water during times of peak demand as well as in making structural and operational plans for managing storage. Changes in timing can also impact the value of water rights in relation to available storage and demand.

It is expected that the results of this study, including projected changes in runoff quantity and timing, will be used to drive water allocation and planning models, allowing the impact of the range of GCM projections and associated hydrologic model results simulated in this study to be included in the planning process. Runoff timing was calculated for each modeled scenario using a center-of-mass technique. This technique computes the day of the year that represents the temporal center of mass of annual runoff, with equal runoff volume before and after the computed date. Shape differences in the hydrograph influence the center of mass, showing the effects of:

- Earlier snowmelt due to increased temperatures in the selected GCMs,
- Increase in ET based on reduced snow cover, and
- Differences in response to individual precipitation events.

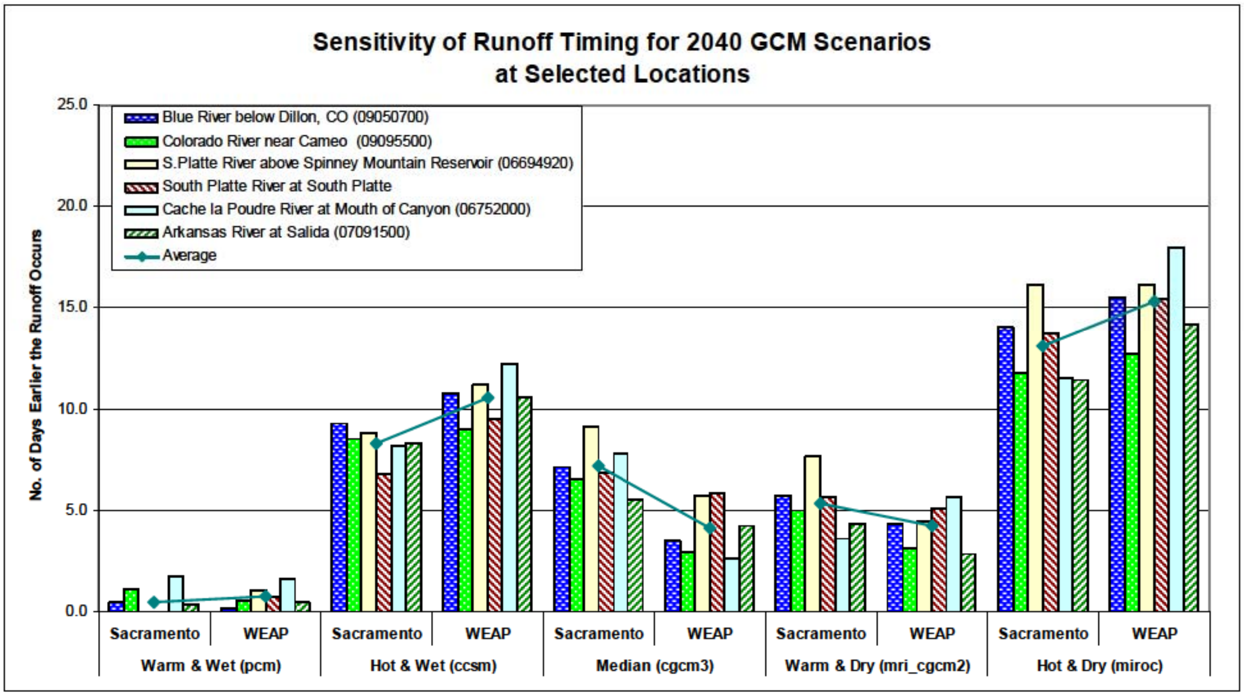
For all the studied alternatives, the selected GCMs consistently indicate an increase in temperature, although they differ in the seasonal distribution of that temperature increase. Table shows the range of simulated average annual changes to runoff timing at selected points for each model for each future time period. With one exception, which is associated with the *2040 Warm & Wet* Sacramento model simulation on the South Platte, both the WEAP and Sacramento models simulate earlier runoff.

Table 3.2 Change in Runoff Timing for two future periods, showing the range and variability of timing changes by location and model. Change is reported in number of days, with positive numbers indicating earlier runoff.

2040 Location	Sacramento Model		WEAP Model	
	Maximum	Minimum	Maximum	Minimum
Blue River below Dillon	14.0	0.5	15.5	0.2
Colorado River near Cameo	11.8	1.1	12.7	0.5
South Platte River above Spinney Mountain Reservoir	16.1	-0.8	16.1	1.1
South Platte River at South Platte	13.7	-0.1	15.4	0.8
Cache la Poudre River at Mouth of Canyon	11.5	1.7	18.0	1.6
Arkansas River at Salida	11.4	0.4	14.1	0.5

2070 Location	Sacramento Model		WEAP Model	
	Maximum	Minimum	Maximum	Minimum
Blue River below Dillon	16.2	7.9	19.3	8.6
Colorado River near Cameo	14.6	7.6	15.6	6.3
South Platte River above Spinney Mountain Reservoir	18.4	6.1	18.2	7.5
South Platte River at South Platte	13.5	4.4	17.8	4.1
Cache la Poudre River at Mouth of Canyon	14.2	8.0	21.0	10.5
Arkansas River at Salida	12.4	7.0	18.0	7.2

Figure 3.18 presents the simulated change in runoff timing for selected locations for both hydrologic models and both future periods. The average value for the six basins is indicated for each hydrologic model, with a line drawn between them to highlight the comparison between models. The simulated runoff timing between the two models and among basins is similar, while differences between GCM projections are more prominent. Differences between the two future time periods suggest a uniform shift toward earlier runoff that reflects the trend toward warming in the later period. Consistent with the results of the simple sensitivity assessment, temperature changes appear to dominate the impact on timing, while the impact of precipitation is not apparent (i.e. “hot” models project the largest change in timing and “warm” models project the smallest changes).



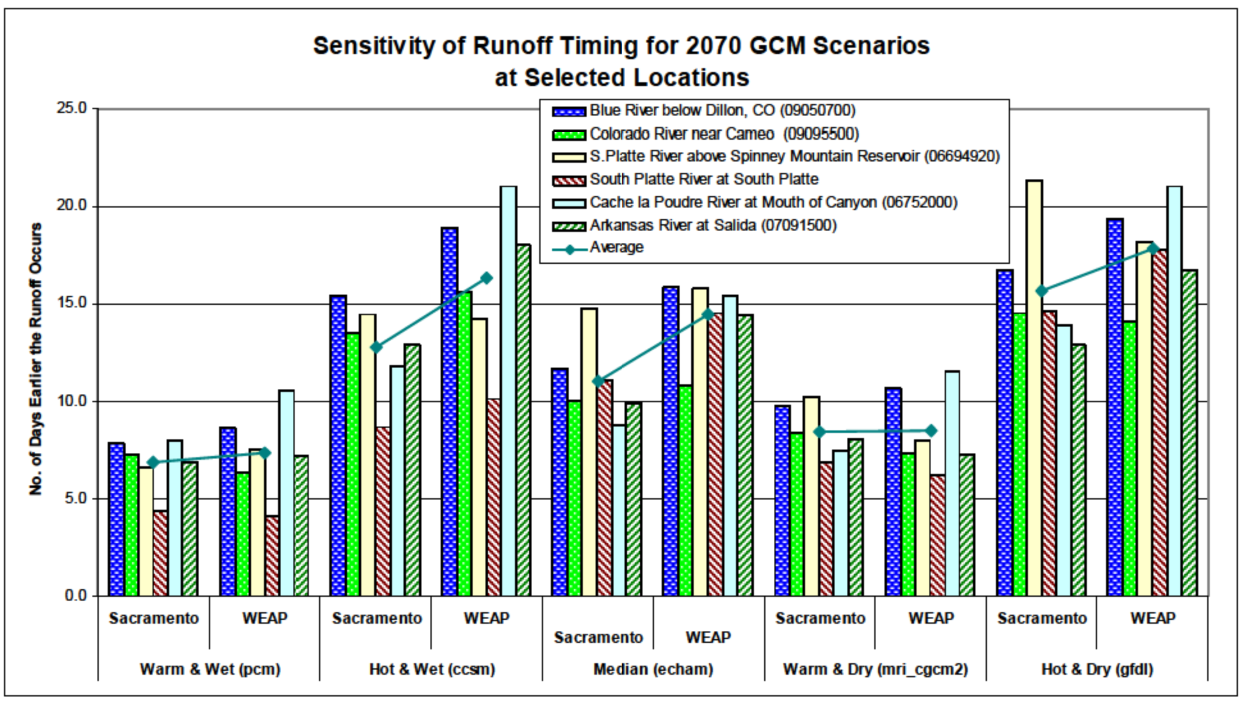


Figure 3.18 Shift in Simulated Runoff Timing – Selected Locations

Figure 3.19 presents scatter plots comparing the change in runoff timing between the WEAP and Sacramento models for six selected locations and for both 2040 and 2070 time periods. These figures show that, generally, for scenarios in which the shift in runoff timing is small, the Sacramento model simulates a larger shift than the WEAP model, and when the number of days earlier is large, the reverse is true, with the WEAP model simulating larger differences than the Sacramento model. This pattern is consistent for all study points, although individual responses to particular GCMs cause variations in the response of each model. A more subtle pattern identifiable in these plots is the greater variation between the two models for high-elevation watersheds (Dillon and Spinney) than for larger, lower elevation watersheds (Cameo and South Platte).

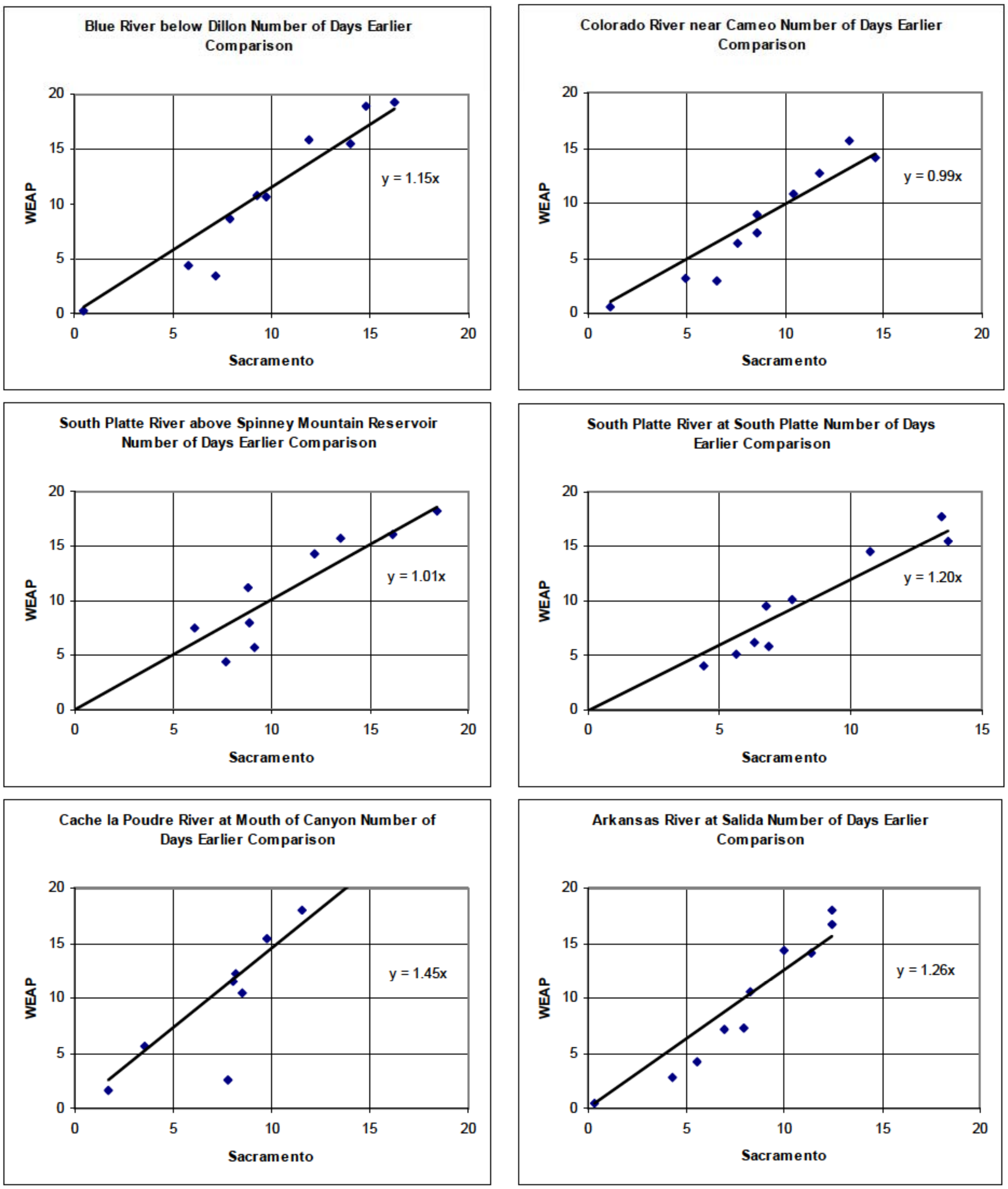


Figure 3.19 Runoff Timing Change Scatter Plot

COMPARISON OF 2040 AND 2070 PERIODS

Climate Model Response

A fundamental trend exhibited in all of the climate model projections is toward increased warming from the 2040 period to the 2070 period. This trend was clear from the outset of this study when the decision was made to assess the impact on streamflow for both time periods. Moving from 2040 to 2070, there was no obvious trend toward either more or less precipitation. Both time periods showed a wide range of precipitation changes among the GCM projections. The temperature and precipitation changes from the baseline period to 2040 and 2070 are illustrated in Figure 3.20. The temperature comparison is indicated in absolute change, in degrees F, while precipitation is indicated as a percent change. The temperature change almost doubles in moving from the 2040 to the 2070 period. The precipitation increases in three of the five projections, and does so in both future periods.

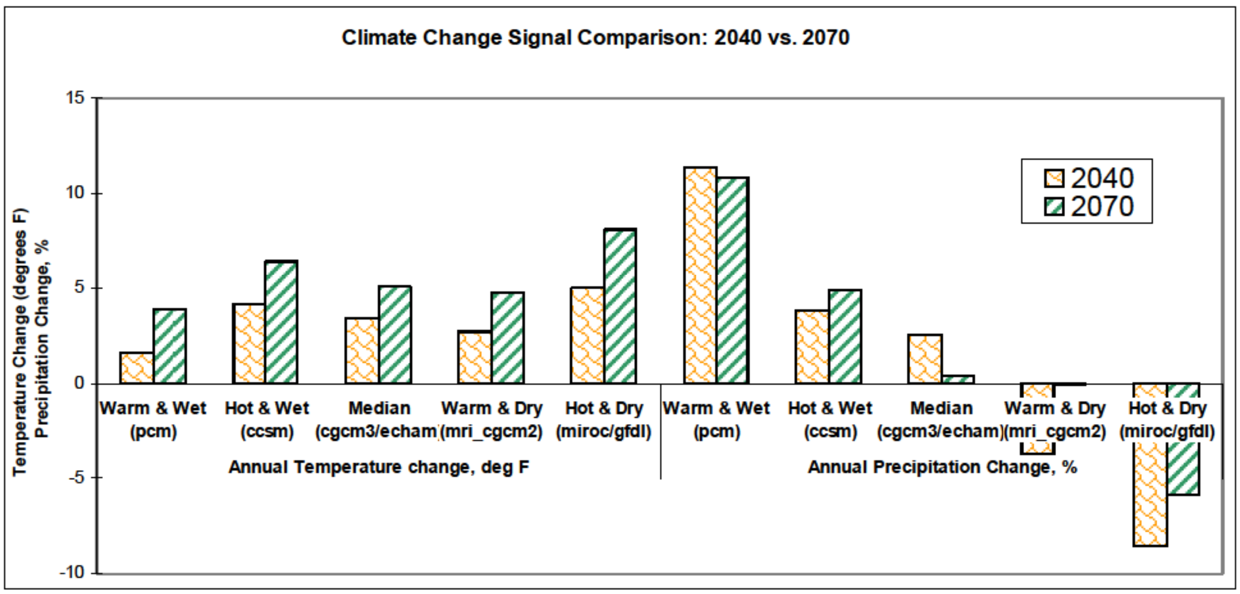


Figure 3.20 Comparison of Temperature and Precipitation Change for 2040 and 2070 Periods

Average annual changes are indicators of hydrologic response, but the seasonal distribution of the change may also have an important impact. Figure 3.21 and Figure 3.22 show the seasonal temperature and precipitation changes exhibited by the selected climate models, allowing a comparison of the 2040 and 2070 periods. The increased warming between the periods is again evident, but it is notable that the 2070 hot & dry scenario is significantly hotter than the 2040 scenario in the summer and fall, while not much different in the winter and spring. The precipitation pattern changes significantly from the 2040 to the 2070 period, with four of the five models showing increased summertime precipitation between periods and in relation to the surrounding seasons. In contrast, the hot & dry scenario shows a further reduction in summer precipitation, while winter precipitation increases quite dramatically.

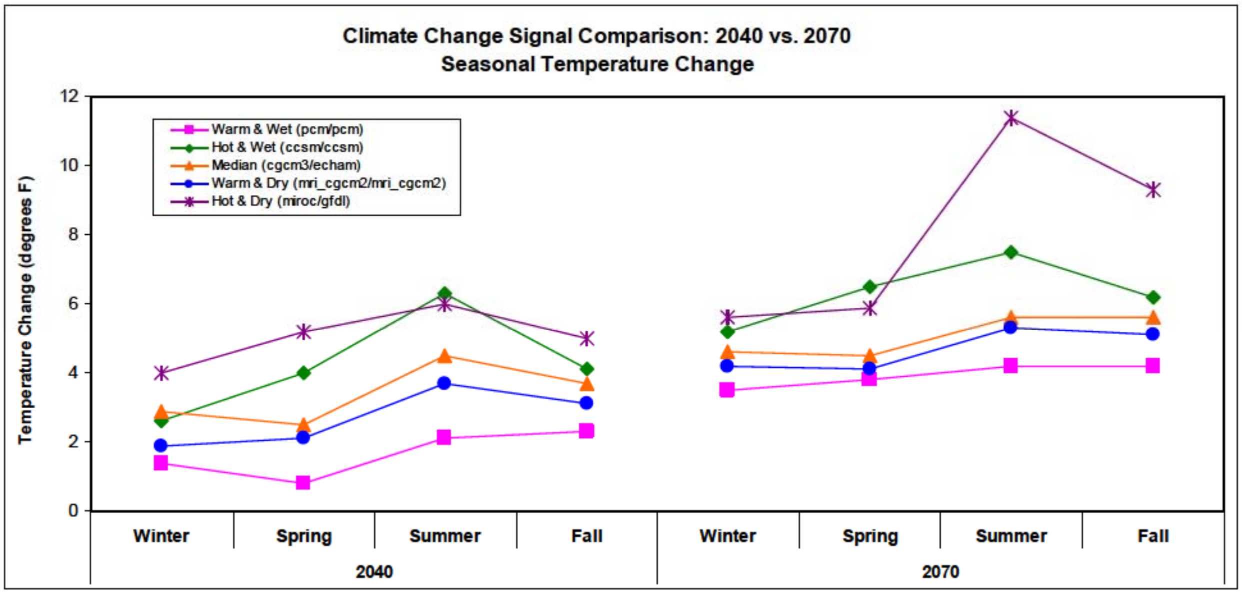


Figure 3.21 Comparison of Seasonal Temperature Change for 2040 and 2070 periods

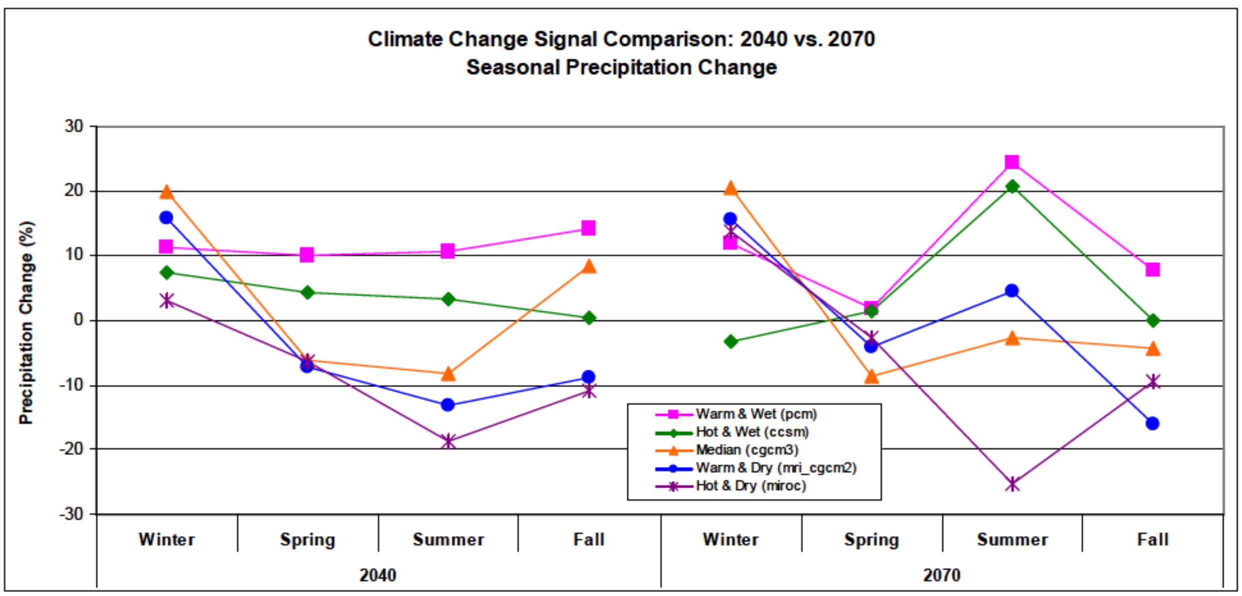


Figure 3.22 Comparison of Seasonal Precipitation Change for 2040 and 2070 periods

Hydrologic Response

The study team expected that increased warming in the 2070 period would generally lead to decreased runoff volume in the hydrologic response when compared with the 2040 period due to increases in ET. This trend was only observed in three of the five scenarios. Figure 3.23 shows the ratio of annual flow volumes between the baseline and climate adjusted flows at six selected gauges in this study, comparing the 2040 and 2070 periods. The average ratio of the six gauges is shown with a line indicating the trend from the 2040 to the 2070 period.

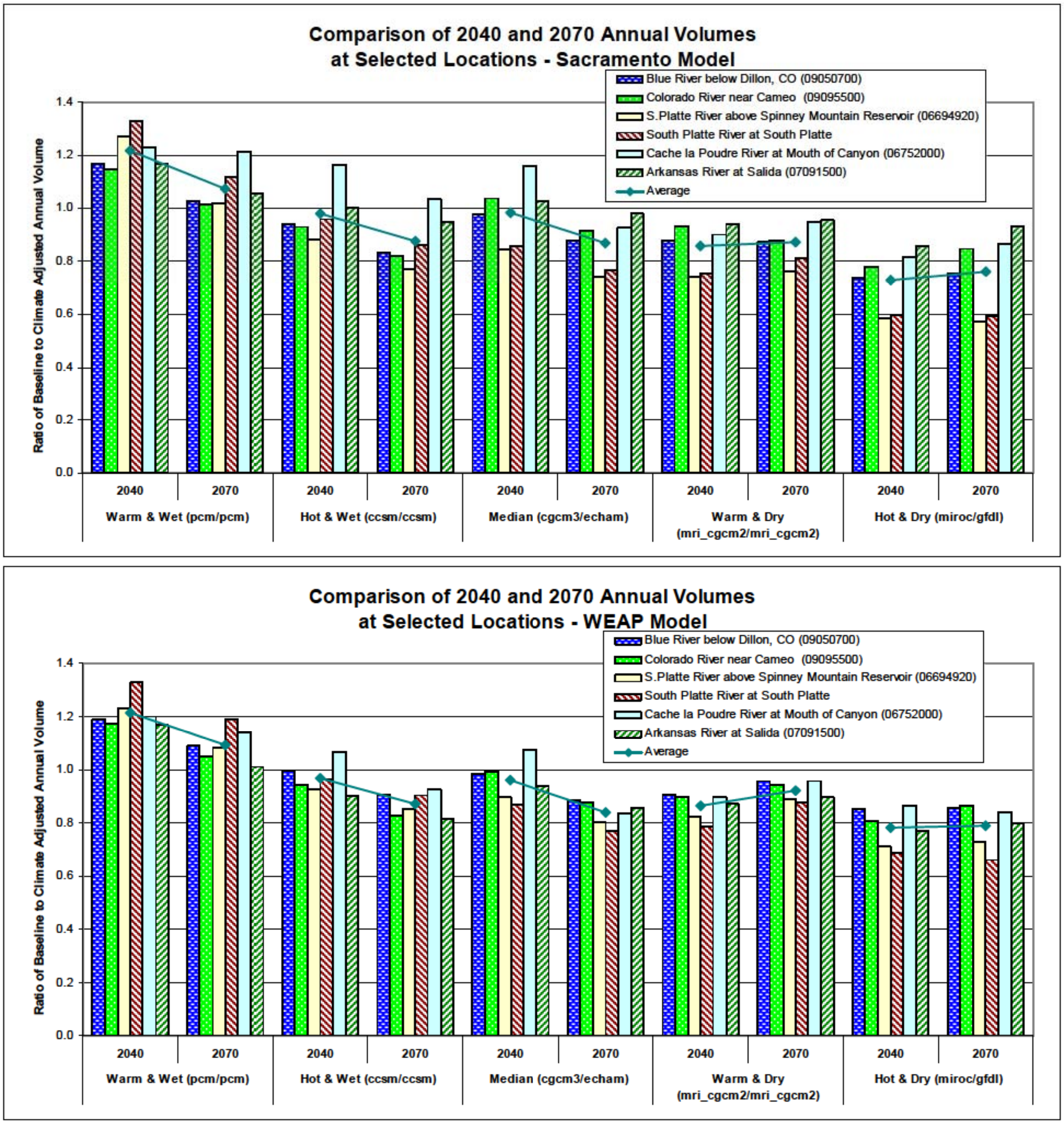
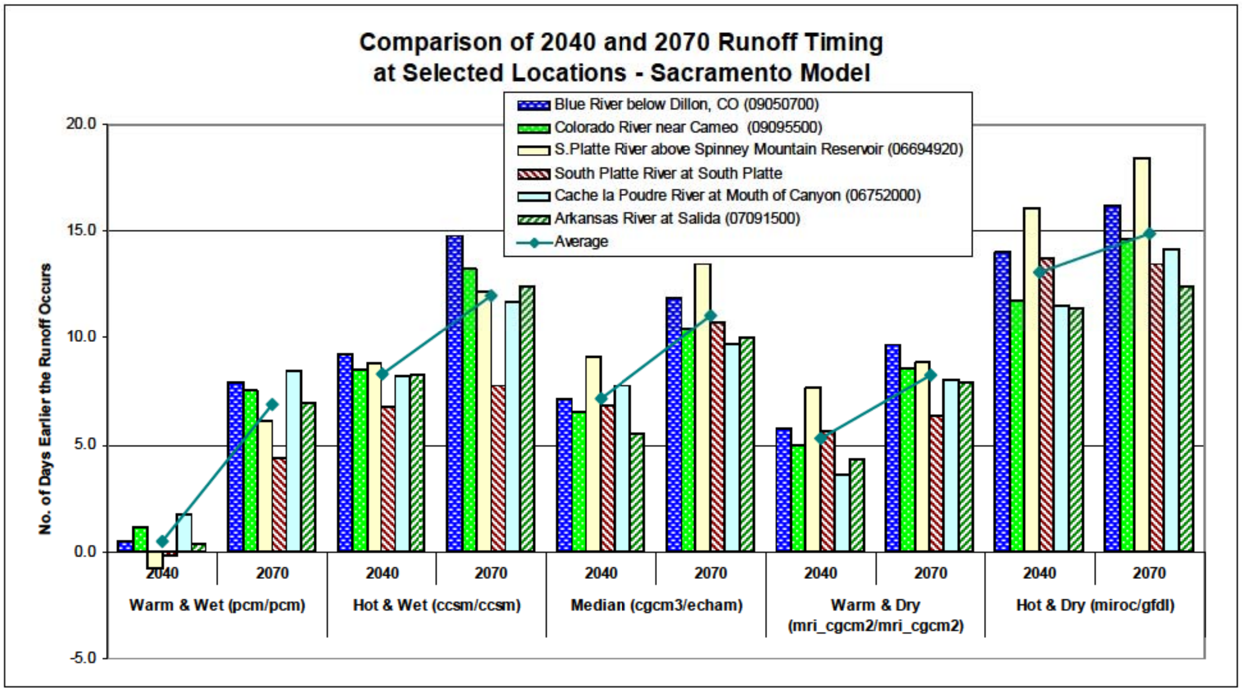


Figure 3.23 Comparison of Annual Flow Volumes at Selected Locations for 2040 and 2070 Periods

The two "dry" scenarios show an increase in annual volume from 2040 to 2070 for both the Sacramento and WEAP models. A possible explanation is that the dry models both show increased precipitation from the 2040 to the 2070 period, which may offset the temperature increase. It is also important to note that the seasonality of temperature and precipitation changes can have impacts that either exacerbate or mitigate the anticipated tendency. For example, in the 2070 hot & dry scenario the summer shows a very hot & dry condition, while the winter is relatively wet and the spring is not especially hot. It appears that this combination allows development of strong runoff in the spring and early summer with relatively moderate ET losses, while the high ET demand in the late summer encounters very little available water on which to act, effectively negating the impact of the increased temperature.

The study team anticipated increased warming from 2040 to 2070 would lead to noticeable increases in the number of days earlier that runoff would occur. Figure 3.24 shows the change in runoff timing between the baseline and climate adjusted flows at six selected gauges in this study, comparing the 2040 and 2070 periods. The average change in the number of days earlier that runoff occurs for the six locations in the graph is shown with a line indicating the trend from the 2040 to the 2070 period.



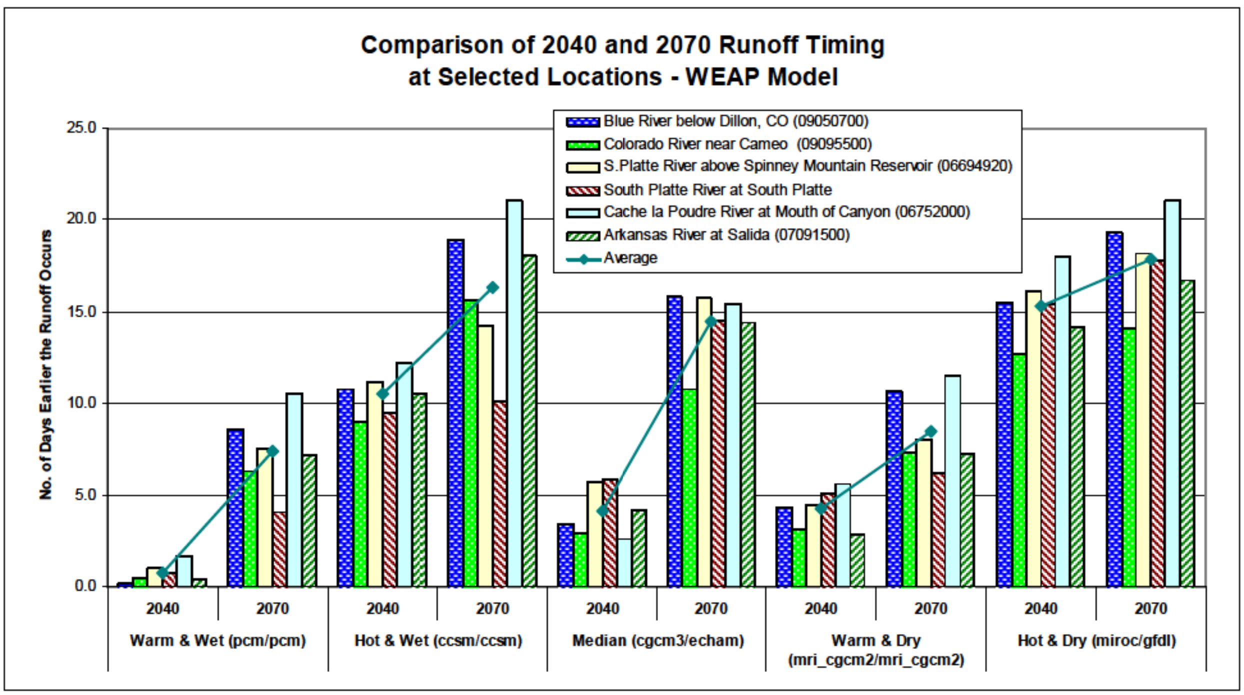


Figure 3.24 Comparison of Runoff Timing at Selected Locations for 2040 and 2070 Periods

Both the Sacramento and WEAP models show increases in the number of days earlier that runoff occurs. It is interesting to note that in the Warm & Wet scenario, both hydrologic models show an average increase from less than a day to nearly seven days earlier that runoff occurs from the 2040 to the 2070 period. This is probably due to the fact that in the 2040 period the effect of increased temperature in advancing the onset of runoff is offset by the increase in precipitation, which extends the duration of runoff, while in the 2070 period the temperature increases further while the precipitation increase remains unchanged from the 2040 level.

ELEVATION-BASED EVALUATION

Study participants were interested in the potential correlation that basin elevation might have on climate change impacts. Percentage changes in annual streamflow volume were reviewed for several gauge locations at different elevations in the Colorado and the South Platte basins to evaluate possible correlations. The Colorado River locations included Dillon, Green Mountain, Dotsero, and Cameo. For the South Platte River, Spinney, South Platte at South Platte, and Henderson were evaluated. Table 3.3 reports the mean basin elevation above each selected gauge location.

Table 3.3 Mean basin elevation above selected gauges

Station Location	Elevation (ft)
Blue River below **Dillon**, CO (09050700)	10935
Blue River below **Green Mountain** Reservoir (09057500)	10513
Colorado River near **Dotsero** (09070500)	9288
Colorado River near **Cameo** (09095500)	8782
S.Platte River above **Spinney** Mountain Reservoir (06694920)	9978
South Platte River at **South Platte**	9382
South Platte River at **Henderson** (06720500)	8322

To compare impacts for basins of different sizes and different baseline annual streamflow volumes, the average annual runoff volume for each climate scenario simulation was computed as a percent of the baseline annual volume. Figure 3.25 shows a comparison of hydrologic response to the Stage 1 simple sensitivity simulations for sub-basins in the Colorado and South Platte Rivers, organized to show sub-basins in order of decreasing elevation. Figure 3.26 shows results for the 2040 GCM-based climate simulations, and Figure 3.27 shows results for the 2070 GCM-based simulations.

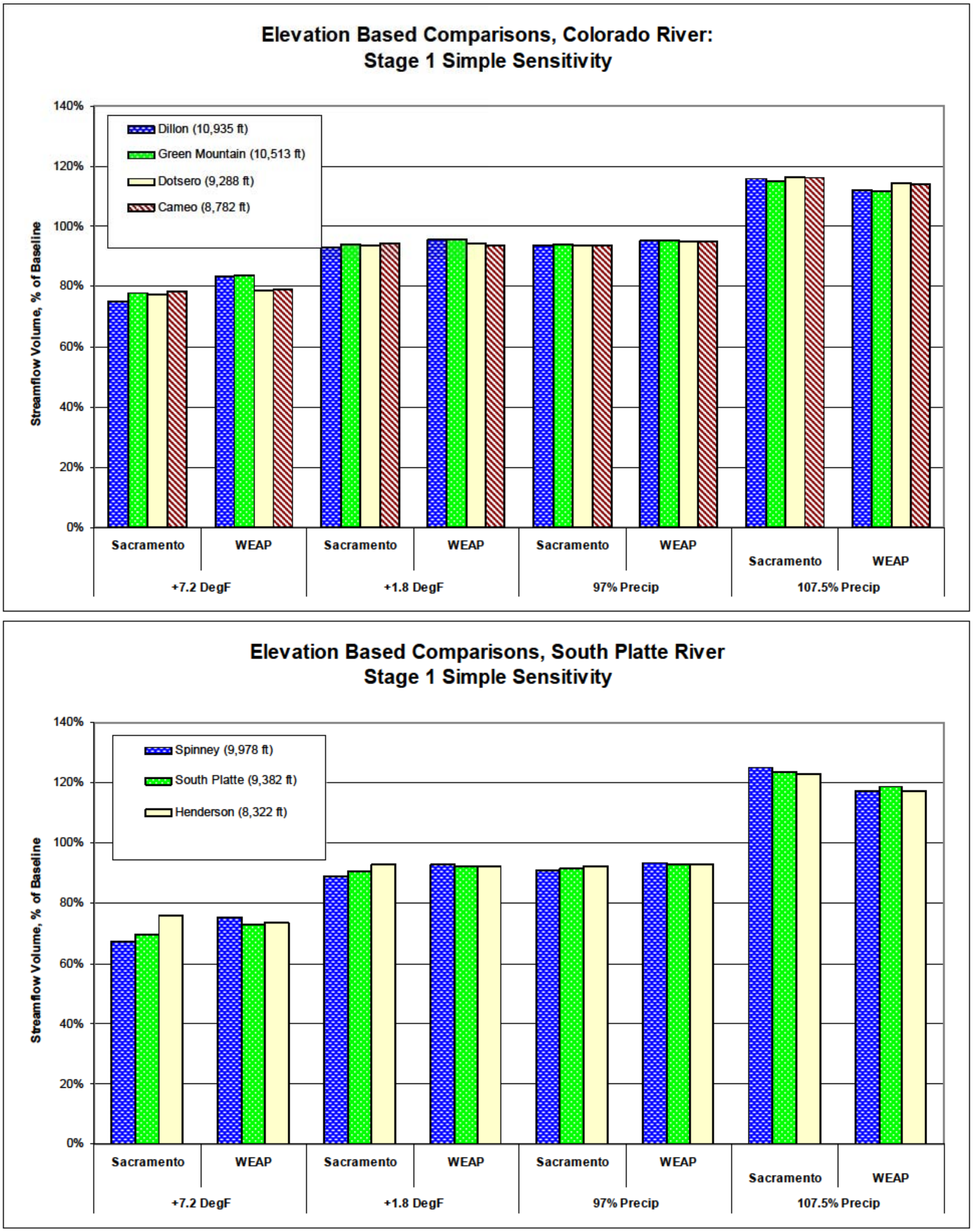
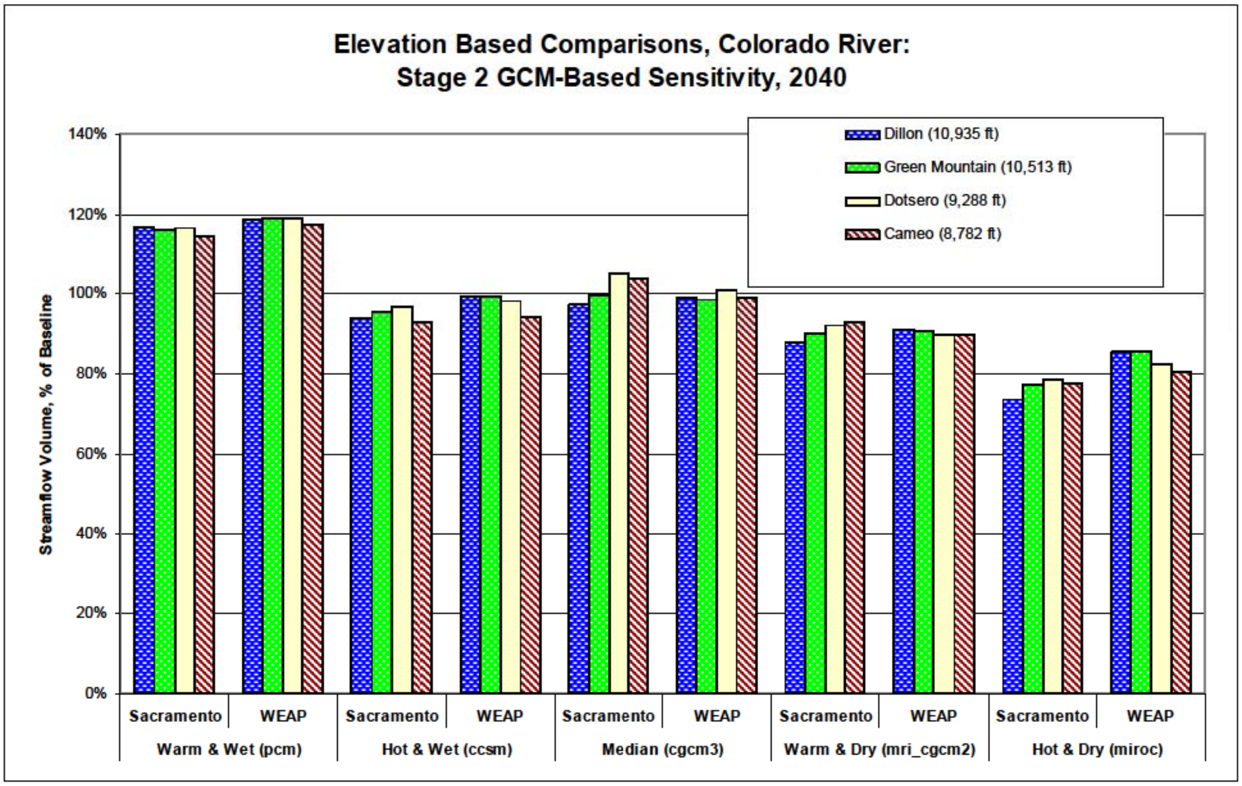


Figure 3.25 Elevation-Based Comparisons of Hydrologic Response: Stage 1 Simple Sensitivity Results for the (a) Colorado River and (b) South Platte River



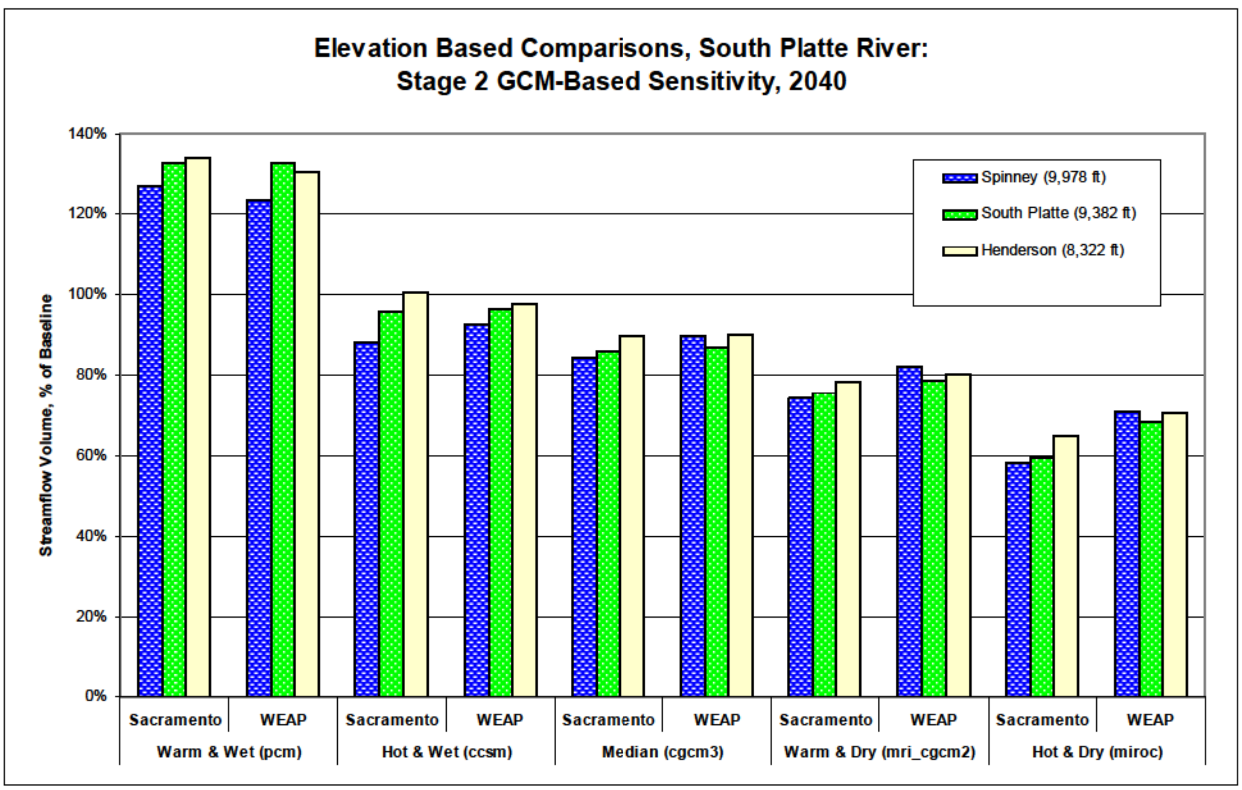
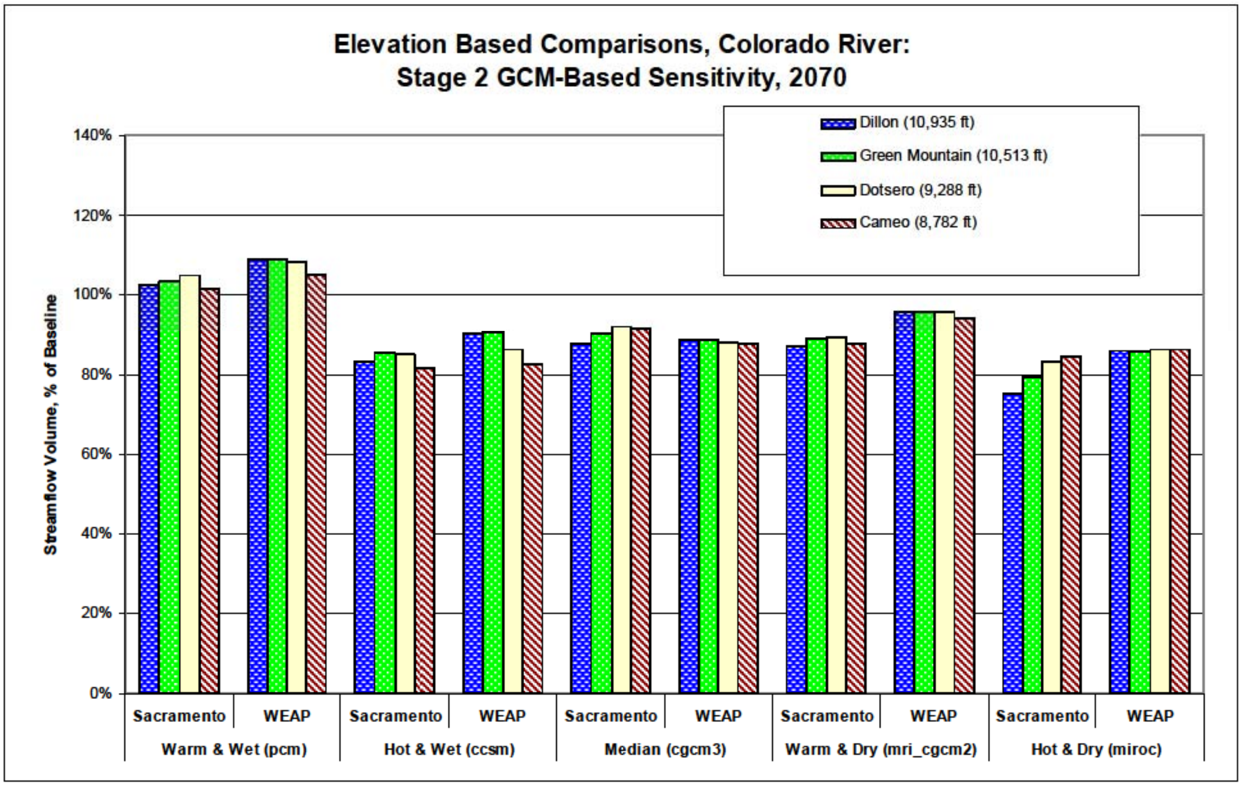


Figure 3.26 Elevation-Based Comparisons of Hydrologic Response: Stage 2 GCM-Based Sensitivity Results for 2040 for the (a) Colorado River and (b) South Platte River



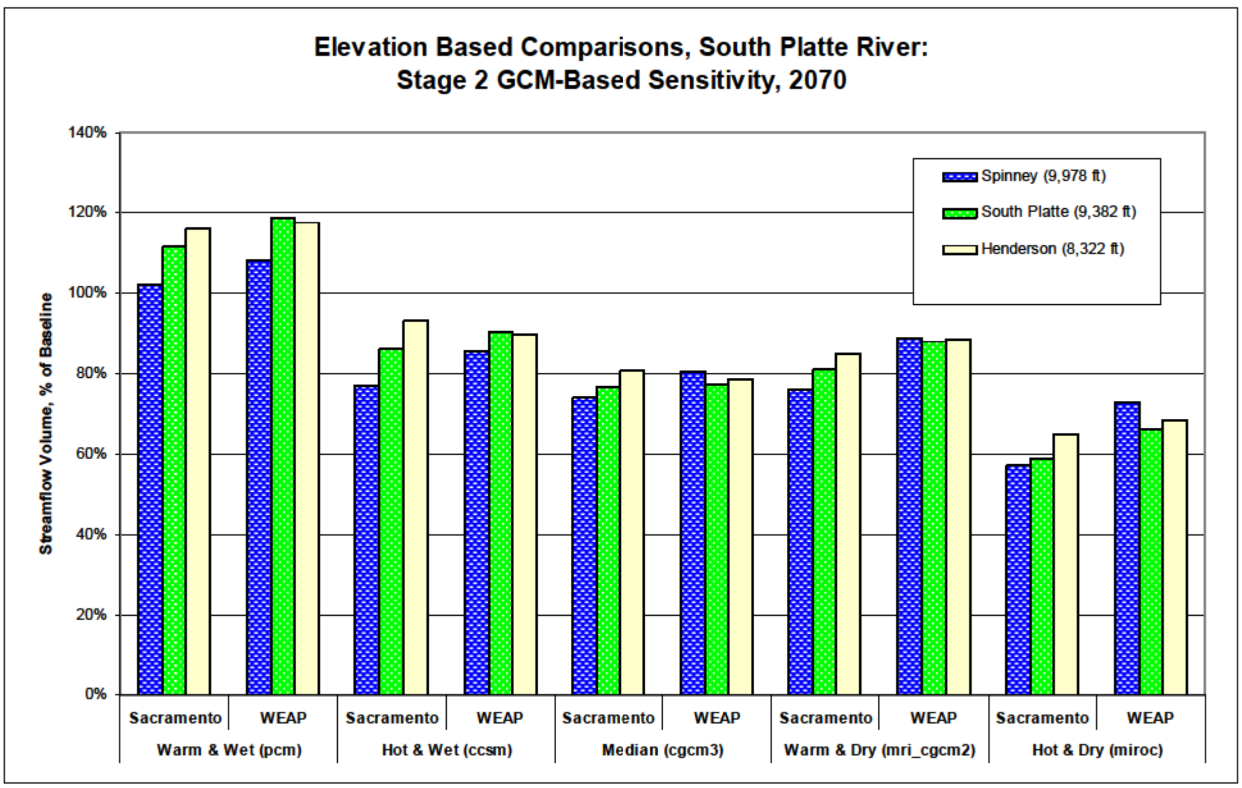


Figure 3.27 Elevation Based Comparisons of Hydrologic Response: Stage 2 GCM-Based Sensitivity Results for 2070 for the (a) Colorado River and (b) South Platte River

Several observations drawn from the figures above are listed below. :

- The WEAP model results show no discernable tendency with respect to differences in elevation.
- The Sacramento model results indicate increased sensitivity (i.e. larger reductions in streamflow) to large temperature increases at higher elevations than at lower elevations.
- The Sacramento model results indicate a weak tendency for increased sensitivity to precipitation changes at higher elevations, but only in the South Plate.
- A tendency for increased sensitivity to temperature change at higher elevations is observed in the Sacramento model results. This tendency is stronger in the South Platte than in the Colorado, and stronger in the 2070 simulations than in the 2040 simulations.

The fact that the WEAP model does not exhibit elevation-based differences in climate change impacts suggests that there are no strong elevation-based differences in the precipitation and temperature change signals computed from the GCM output (and the tendency demonstrated in the Sacramento model is based on its model formulation, and not change signals computed from the GCM output). Although this investigation used statistically downscaled data, which provided temperature and precipitation information at a resolution consistent with the scale of the hydrologic models, these data are derived from GCMs with much coarser resolution. Therefore, sub-basins in the hydrologic models that have important elevation differences might lie under just one or two grid cells in the original GCM, so that elevation-based differences in the GCM output may not be discernable.

CHAPTER 4
CONCLUSIONS

The foregoing chapters describe how this study met its primary objective of analyzing the sensitivity of streamflow to climate change for three watersheds, and developing streamflow sequences that represent the effects of climate change on the baseline streamflow. The specific study aims outlined at the end of the *Introduction – Approach* section were met by performing four tasks:

1. Selection of climate model projections - A procedure was identified and applied for selecting multiple climate model projections for use in hydrologic simulations. Ten climate scenarios were selected and associated with specific GCM projections. Characteristics of the projections were analyzed and presented. A downscaled dataset of GCM output was used in the selection and analysis procedure.
2. Historical undepleted streamflow development - A consistent sequence of historical undepleted flows for the period 1950-2005 for 18 key gauge locations were developed for use in hydrologic model calibration and also as a set of baseline flows for comparing against climate adjusted streamflow simulations.
3. Hydrologic model development - Two hydrologic models were configured and calibrated for use in computing the hydrologic response to temperature and precipitation climate changes. This included establishing climate forcing datasets of historical temperature and precipitation for input to each hydrologic model and evaluating differences in hydrologic model accuracy.
4. Assessment of streamflow sensitivity to climate change – A procedure for evaluating hydrologic response to variations in climate using uniform adjustments to temperature and precipitation was developed and tested. It was then extended to simulate the hydrologic response to possible climate change using the ten climate scenarios and associated GCM projections identified in Task 1.

The results include the documentation and evaluation of:

- Change in annual runoff volume,
- Change in the timing of runoff,
- Spatial variability associated with these changes,
- The impact as a function of basin elevation, and
- The differences between the two hydrologic models in representing the response to climate change.

The procedures used in this study and outlined in this report can be repeated for subsequent use in the region or in other parts of the country to increase understanding about climate impacts on water supplies.

FINDINGS

The pool of 112 GCMs from which 10 scenarios were selected for hydrologic simulation showed a broad range in projected future temperature and precipitation for the North-Central region of Colorado. Though all projections showed warming, the average annual temperature changes ranged from just over 1° to nearly 6° Fahrenheit for the 2040 time period and from about

2° to nearly 10° Fahrenheit for the 2040 time period. Meanwhile, average annual percent change in precipitation ranged from -15% to +17% for the 2040 time period and from -18% to +28% for the 2070 time period (See Table 2) .

Likewise, there are significant variations in hydrologic responses simulated from the selected GCM projections. For example, average annual change in streamflow volume for the South Platte below Cheesman ranges from +32% (2040 Warm & Wet scenario) to -42% (2070 Hot & Dry scenario). Analysis of the change in timing for the scenarios considered indicates that the center of mass of annual runoff arrives 1 to 14 days earlier in the 2040 simulations and 7 to 17 days earlier in the 2070 simulations.

This variability results from the differing average annual perturbations in temperature and precipitation, from the difference in the monthly distribution of those perturbations in each projection, and from differences in the spatial distribution of the changes. Those differences cannot be attributed entirely to the particular GCM model formulation, as ensembles of the same model can produce very different results. This implies that some of the variability is associated with the current state of climate science and climate modeling (Barsugli et al. 2009), even when averaged over periods of 30 years. Thus, one of the most important findings of this study is that each climate projection considered has a unique impact on runoff volume, and to grasp the broad picture of future possible changes in streamflow, the range of impacts from multiple scenarios needs to be considered, as opposed to looking for a central tendency or averages of simulation results. This application of a scenario approach also helps to inform climate impact assessment and response for individual water managers and utilities by emphasizing variability, while noting that no single projection is the most likely (for more information on scenarios and scenario planning see "The Art of the Long View," by Peter Schwartz [1991]). Within this context, the following are key observations drawn from this study.

- GCM model output encompasses a broad range of projected changes to future temperature and precipitation.
- There is substantial variability in projected future streamflow based on the range of climate model projections used for streamflow simulation.
- Although the results indicate both increases and decreases in annual streamflow volume, depending on the projection used, more of the selected climate projections resulted in decreases than increases.
- Where decreased annual streamflow volume is indicated for a given projection, it is a result of the computed increase in ET due to increased temperatures, coupled with either a decrease in precipitation or else a small increase in precipitation insufficient to offset the increased temperature effect.
- Where increased annual streamflow volume is indicated for a given projection, it is a result of increased precipitation sufficient to offset the increased temperature effect for that projection.
- The average annual characteristics of climate models over a large area (e.g. average annual precipitation and temperature change) are not the only predictors of streamflow response to a given projection. The spatial and temporal distribution of those changes across multiple sub-basins and over the twelve-month period has considerable influence on hydrologic model results.
- The GCM outputs include important patterns of spatial variability that differ between projections and produce distinct hydrologic responses among sub-basins. For

example, a GCM projection showing, on an average, an increase in precipitation over the study area is likely to have some areas of significant precipitation increase coupled with areas of modest decrease, with corresponding variation in the hydrologic response of the sub-basins in those two areas.

- GCM temperature and precipitation perturbations are not uniform over the course of the year but vary by month, and differ between projections. The temporal distribution of these changes is important because an increase in temperature can have a different impact in the late summer, when soil moisture is limited, versus early spring when the melting snowpack results in increased availability of surface water and soil moisture. Likewise, precipitation changes appear to have more impact under saturated soil conditions in the spring than under dry conditions in the summer and fall months.
- The hydrologic models responded similarly to fixed perturbations of climate inputs applied in the simple sensitivity assessment.
- While differences exist between the two hydrologic models in simulating specific river basins or in response to specific GCM projections, the models are in agreement about the general tendency for each projection and within each river basin.
- Although *potential* ET might be greater due to warming, it does not necessarily mean that *actual* ET will increase accordingly, as reduced precipitation may lead to limited soil moisture or as earlier runoff may lead to reduced late summer soil moisture (these factors are explicitly addressed in the methodology of this study).
- Simulated runoff timing is determined by complex factors that differ between models, but notwithstanding those differences, the results show relatively close agreement between models in projecting changes in runoff timing.
- At the scale of the river basins evaluated in this study, there does not appear to be a consistent tendency among GCMs regarding elevation-based differences in climate change patterns. Similarly, there are no clear tendencies regarding elevation-based differences in simulated hydrologic response that are evident from the results of both hydrologic models for multiple river basins.
- While increased temperatures are shown to reduce simulated average annual streamflow, the reductions are not uniform across the study area, with the driest basins, such as those in the South Platte, experiencing the greatest percent reduction in streamflow due to warmer conditions, while the wetter basins, including the upper areas of the Colorado, show a smaller percent reduction.

STRENGTHS AND LIMITATIONS IN APPLYING THE STUDY APPROACH

One of the strengths of the overall approach employed in this study is that it allowed the spatially and temporally variable climate change signal to be incorporated into the hydrologic simulation while preserving the spatial and temporal structure and variability of the historical climate. By selecting specific GCM projections to represent the climate change signal on an average monthly basis instead of using average annual temperature and precipitation adjustments, the results of this study highlight the variability that can result from particular combinations of monthly distributions of temperature and precipitation change. Another benefit of the approach is that it produces output time series representing possible future scenarios under climate change that can be applied to existing simulation tools used by water managers and utilities for comparison with simulations based on historical time series that do not consider climate change. The approach could also be expanded without much difficulty to include all of the available 112 GCM projections (as well as projections that might be developed in the future) for a more complete analysis.

The following are limitations in the application of the study approach that became apparent over the course of the investigation:

- In selecting a specific GCM projection to represent a particular region of the climate change space, the peculiarities of that projection add to the variability in the results and do not permit an evaluation of trend associated with that space. One way to overcome this deficiency without losing the benefit noted above would be to simply use all of the GCM projections as input to a hydrologic model and then evaluate the hydrologic outputs from all 112 projections to identify trends.
- The study approach does not provide any insight into the potential for increased or decreased intensities of rainfall outside of the average monthly change, or for variation in the diurnal distribution of temperature increases, or any other characteristic of the GCMs that may indicate fundamental changes in climatic characteristics beyond the average monthly change in temperature and precipitation. This was not a serious limitation for the purposes of this study, but might be important in areas where changes in peak flows are of greater interest. Any efforts to overcome this particular limitation would have to overcome the lack of GCM output available in a format that would support more detailed analysis and would have to be justified with confidence that the climate models are in fact capable of representing those changes in a meaningful way.
- While the response of evapotranspiration (ET) to temperature change is a key element in determining changes in runoff volume, there are additional variables beyond temperature that influence ET that were not part of the downscaled GCM outputs and could not be incorporated into the study approach.
- The study approach targets evaluations for specific future points in time, without representing the gradual change in climate and associated runoff that may occur over time. This permits managers to plan for a specific future point in time, but does not facilitate evaluating the impact of climate change on vulnerability of water supplies during the period leading up to a future system design or state.

LESSONS LEARNED

Two primary considerations in assessing future water availability for Front Range water providers are average annual volume and the timing of runoff. Because the water supply for these agencies is primarily stored in the snowpack, permanent changes in the timing and volume of this important resource would have major impacts on water availability and would force changes in water management strategies. The change in annual runoff volume and timing of runoff, together with the potential range of these changes, are the outputs of the study that are of greatest interest to the participants and their constituents. These two outputs are tied to a few fundamental processes represented in the two hydrologic models. These include, among others, snow accumulation and melt processes, the phase in which precipitation occurs (rain or snow), movement and storage of water through soil layers, and ET from the surface and subsurface soil. The most important inputs that govern these processes are temperature and precipitation.

GCM output includes projections of future temperature and precipitation that can be used in conjunction with hydrologic models to estimate changes in volume and timing of runoff. Output from currently available models projects temperature and precipitation changes within a wide range. The variety in GCM output results in a wide range of estimates of change in runoff volume and timing.

Runoff timing is most sensitive to temperature, due to its effect on the form of precipitation (rain or snow) and on snowmelt. Precipitation changes alone have a minor influence on runoff timing. Even changes in the timing of precipitation have little impact on runoff timing because of the dominance of snowmelt in the annual runoff cycle and the controlling impact of temperature on snowmelt. Because all of the climate scenarios indicate increased temperature, nearly all of the scenarios simulated indicate earlier runoff, with the effect being more pronounced in the 2070 period. While the range of projections regarding the number of days earlier that runoff will occur is broad, the tendency to earlier runoff is uniform.

Simulated runoff volume is sensitive to both precipitation and temperature change. The sensitivity to temperature change is because of the influence of temperature on ET in the hydrologic model formulations. Because all of the climate scenarios indicate increased temperature, all of the climate-adjusted runoff simulations are impacted by an increase in ET and a corresponding reduction in volume. Many of the climate projections show a slight increase in precipitation, which partially or wholly offsets the reduction in runoff caused by increased ET. Those projections that show reduction in precipitation accentuate the reduced runoff volume that results from increased temperature. The occurrence of both increases and decreases in precipitation accentuate the spread of volume changes simulated from the selected climate scenarios.

Based on these observations, study participants may wish to prepare for the impacts of climate change on water availability, with the following considerations:

- Expect runoff to occur earlier.
- Consider contingency plans for both increases and decreases in average annual runoff.
- Monitor evolving indicators of climate change at both global and regional scales to identify trends and evaluate the relative merits of existing and future climate models..
- Broaden the scope of selected climate models to use in hydrologic simulation to more fully explore the range and distribution of possible outcomes.
- Be prepared to incorporate updated climate model outputs in planning processes based on forthcoming advances in climate science.
- Encourage advances in climate science that will facilitate accurate hydrologic assessment.

Climate change adaptation is about preparing for change and variability in the future. This study provides important information to water utilities and managers to aid in identifying the hydrologic response to possible climate change. The following expands on the ideas noted above for application of the results of the study and recommendations for future investigation and research.

CHAPTER 5
APPLICATION AND RECOMMENDATIONS

APPLICATIONS FOR WATER PROVIDERS

The results of this study can be applied at multiple levels, from the perspective of the specific study participants that use the outputs directly, to readers who may be interested in climate change impacts in Colorado, to others who may be interested in applying the methodology of this study to other regions. One of the important outputs of this study is a set of climate-adjusted streamflow sequences representing the impact of selected future climate projections on undepleted streamflow volume for 18 gauge locations. Regional water providers in Colorado can use these climate-adjusted streamflow sequences in conjunction with water system models to estimate the impacts of climate change for future water supply planning purposes. Water providers can use this information in their planning to identify robust strategies for water management decisions that respond to variability and uncertainty in annual water supplies.

The methodology of GCM selection, development of adjusted historical climate sequences, and hydrologic simulation that was developed in this study can be applied widely to assess climate impacts on water supplies both for additional projections in the basins studied or for other locations where there is access to downscaled GCM datasets. Although applying this methodology does not require a thorough understanding of climate science, users of the methodology should be informed about the capabilities and limitations of climate science and models. An important application note is that because of the uncertainty and variability in all of the characteristics of climate models that ultimately impact the timing and volume of runoff, it may be valuable and important to simulate water systems operations using multiple climate projections to reveal potential vulnerabilities specific to the hydrologic response to each projection.

Finally, it is important for the water utility community to communicate its needs regarding developments in climate science and required outputs from the models to the climate research community so that subsequent efforts might emerge as helpful in modeling hydrologic impacts of climate change.

RECOMMENDATIONS FOR ADDITIONAL INVESTIGATION AND RESEARCH

The findings and lessons learned from this study indicate opportunities to improve understanding of the issues surrounding hydrologic response to climate change. To provide better information for planning, additional investigation efforts should seek to better understand the factors that contribute to climate variability while refining aspects of the procedure that can help to reduce uncertainty. The brief available historic record reflects basic inter-annual variability and some, but not all of the long-term variability in the natural climate system. Climate models attempt to represent variations that may result from increased emissions. Both are important for understanding potential impacts on water supplies in the future. Uncertainty results from lack of knowledge or understanding, either on the part of the science community or within the formulations of climate and hydrologic models. Some uncertainty can be reduced, for example through improved models, but some cannot, including the uncertainty associated with the chaotic component of climate and weather systems. The following specific suggestions for additional investigation and research respond to the foregoing suggestions.

1. Climate Model Investigation and development – Output from climate models formed the basis for the evaluation of changes in runoff volume and timing in this study. Several suggestions for research and development relate to climate modeling.
   - It has been noted that precipitation is both a hydrologic model input to which runoff volume is highly sensitive, as well as a widely varying climate model output, including projections of both increase and decrease. This is an important source of uncertainty in the runoff simulation results. In the short term, it would be helpful to develop a better understanding of the nature of precipitation projections in climate-change modeling, including the degree of confidence that might be lent to them, and potential differences between models in accurately simulating precipitation trends.
   - Investigate and apply possible methods to extract information from the climate models about changes in inter-annual and daily climate characteristics. For example, droughts and floods will be impacted by changing durations of high temperatures or low precipitation, or by increases or decreases in precipitation intensity. No information of this nature can be inferred from the models using the data and methods of this study. An investigation of this nature should be accompanied or preceded by an investigation of the expected skill of climate models in predicting changes in these climate characteristics as a function of the climate model inputs.
2. Additional Scenarios – This study considered just five scenarios from a dataset of 112 possible projections for analysis for each of two future periods. Using the methods and procedures developed for this study, a subsequent analysis based on a simulation of *all* of the available GCM projections would be instructive in better understanding the distribution of variability among the streamflow responses to the GCMs.
3. Demand – In using the results of this study in water system models, methods and procedures could be formulated and applied to simulate the impact to corresponding climate change scenarios on demand.
4. Planning strategies – Many of the participating water agencies formulate their planning problems within the context of the historical hydrology, as their models rely on these data, and not on the explicit use of climate variables like precipitation, temperature, etc. The approach used in this study allows direct comparisons of volume and even direct simulation of water system models using climate-adjusted runoff volumes. It may be instructive, however, to identify new strategies for planning that would facilitate the direct use of climate-change time series, so that system models can be more forward looking, indicating the development of climate change impacts over time.
5. Evapotranspiration – A major factor in projecting reduced average annual streamflow volumes in this study is the simulation of increased ET resulting from warmer temperatures. ET is computed in both hydrologic models as a function of soil-water availability and PET. PET is computed for each basin with temperature as the only climate variable in the Penman Monteith equation, yet there are other variables in the PET formulation that could change under future warming, including solar radiation, wind speed, and relative humidity. Currently there are no simple ways to extract information about these variables from climate models for use in hydrologic simulation, nor is it clear to what degree climate models can accurately represent changes in these variables under the influence of climate change. The following suggestions may assist in improving

estimates of ET in response to climate change and in improving confidence in those estimates:

- Work with climate model experts to identify elements of climate models that correspond with variables that impact ET, evaluate climate-model skill in predicting these variables, and determine feasibility of extracting the information from climate models and including them in the hydrologic modeling procedure.
- Incorporate a daily ET computation component into the SAC model and evaluate the correlation between temperature and ET surrogates (runoff). A heuristic adjustment factor could also be included as a calibration parameter to either amplify or dampen the sensitivity of potential ET to temperature change, which was computed using the Penman-Monteith formulation. This approach could help assess the effectiveness of the models in historical dry and wet periods (or warm and cool periods) to increase confidence that the effect of climate changed inputs can be properly represented in the outputs.

Many of the participants in this study began with limited experience and knowledge in climate science and climate modeling, or of how climate model outputs might be applied to hydrologic models, to gain insight into changes in runoff volume and timing under the influence of climate change. Participation in this study has both broadened and deepened the understanding of the participants, and the study methodologies are developed sufficiently such that many of the suggestions for additional investigation and research noted above should now be more accessible to the participants.

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ABBREVIATIONS

AET	actual evapotranspiration
AOP	annual operating plans
ARBFC	Arkansas-Red Basin River Forecast Center
CBRFC	Colorado Basin River Forecast Center
CDSS	Colorado Decision Support System
CMIP3	Coupled Model Intercomparison Project phase 3
° C	degrees Celsius
CWCB	Colorado Water Conservation Board
DSS	decision support system
ET	evapotranspiration
° F	degrees Fahrenheit
GCM	general circulation models
IPCC	Intergovernmental Panel on Climate Change
MAP	Mean Areal Participation
MAT	Mean Areal Temperature
MBRFC	Missouri Basin River Forecast Center
NCAR	National Center for Atmospheric Research
NSE	Nash Sutcliffe Efficiency
NWS	National Weather Service
NWSRFS	National Weather Service River Forecast System
PCM	Parallel Climate Model
PCMDI	Program for Climate Model Diagnosis and Intercomparison
PET	Potential Evapotranspiration
RMSE	root mean square error
SAC-SMA	Sacramento Soil Moisture Accounting model
SRES	Special Report on Emissions Scenarios
WEAP	Water Evaluation and Planning
WGCM	Working Group on Coupled Modeling
WCRP	World Climate Research Programme
WWA	Western Water Assessment

APPENDIX A: CALIBRATION STATISTICS

SACRAMENTO MODEL CALIBRATION STATISTICS

Sacramento	Overall	Wet Years							Normal Years							Dry Years						
Watershed	Nash Sutcliffe Efficiency	Historical Annual Mean (TAF)	Baseline Annual Mean (TAF)	Annual Bias	Nash Sutcliffe Efficiency	Historical Monthly Mean (TAF)	Standard Deviation (TAF)	RMSE (TAF)	Historical Annual Mean (TAF)	Baseline Annual Mean (TAF)	Annual Bias	Nash Sutcliffe Efficiency	Historical Monthly Mean (TAF)	Standard Deviation (TAF)	RMSE (TAF)	Historical Annual Mean (TAF)	Baseline Annual Mean (TAF)	Annual Bias	Nash Sutcliffe Efficiency	Historical Monthly Mean (TAF)	Standard Deviation (TAF)	RMSE (TAF)
Colorado River																						
Fraser River at Granby (09034000)	0.940	218	214	-2%	0.960	18	24	5	147	155	5%	0.920	12	16	4	94	96	1%	0.865	8	9	3
Williams Fork near Leal (09035700)	0.915	103	99	-4%	0.934	9	12	3	74	72	-3%	0.891	6	9	3	52	51	-1%	0.917	4	5	2
Blue River below Green Mountain Reservoir (09057500)	0.950	522	540	3%	0.944	44	54	13	375	372	-1%	0.953	31	38	8	265	265	0%	0.935	22	22	6
Blue River below Dillon, CO (09050700)	0.945	306	314	3%	0.945	25	33	8	217	218	0%	0.945	18	22	5	148	144	-3%	0.921	12	13	4
Colorado River near Granby, CO (09019500)	0.936	365	392	8%	0.940	30	45	11	267	265	-1%	0.928	22	33	9	185	174	-5%	0.940	15	21	5
Colorado River near Dotsero (09070500)	0.944	2,773	2,867	3%	0.955	231	289	61	1,973	1,977	0%	0.932	164	198	52	1,346	1,365	1%	0.915	112	120	35
Colorado River near Cameo (09095500)	0.955	4,839	4,994	3%	0.964	403	485	93	3,362	3,396	1%	0.943	280	325	77	2,310	2,350	2%	0.935	193	189	48
Homestake Creek at Gold Park (09064000)	0.937	60	61	1%	0.932	5	8	2	42	42	-1%	0.941	4	6	1	29	30	5%	0.930	2	4	1
Roaring Fork River near Aspen (09073400)	0.946	146	149	2%	0.934	12	18	5	105	106	0%	0.957	9	13	3	78	78	-1%	0.943	7	9	2
South Platte																						
S.Platte River above Spinney Mountain Reservoir (06694920)	0.762	122	126	3%	0.760	10	12	6	74	76	3%	0.731	6	7	3	42	51	22%	0.577	3	4	2
South Platte River below Cheesman Reservoir	0.798	258	243	-6%	0.798	21	24	11	138	138	0%	0.759	11	11	5	76	96	26%	0.453	6	6	5
South Platte River at South Platte	0.844	464	425	-8%	0.874	39	42	15	249	259	4%	0.725	21	18	10	146	180	24%	0.580	12	11	7
South Platte River at Henderson (06720500)	0.850	877	794	-9%	0.856	73	75	29	461	480	4%	0.759	38	31	15	261	331	27%	0.538	22	17	11
South Platte Tributaries																						
Cache la Poudre River at Mouth of Canyon (06752000)	0.901	406	369	-9%	0.906	34	52	16	270	249	-8%	0.892	22	32	10	165	168	2%	0.854	14	18	7
St. Vrain Creek at Canyon Mouth near Lyons	0.903	164	159	-3%	0.892	14	18	6	113	113	1%	0.919	9	12	3	72	75	5%	0.841	6	8	3
Big Thompson River at Mouth of Canyon near Drake (06738000)	0.907	176	165	-6%	0.921	15	20	5	119	123	3%	0.896	10	12	4	80	81	1%	0.813	7	8	3
Boulder Creek at Orodell	0.887	96	91	-5%	0.912	8	10	3	71	72	1%	0.886	6	8	3	48	49	4%	0.733	4	5	2
Arkansas River																						
Arkansas River at Salida (07091500)	0.818	577	547	-5%	0.838	48	55	22	402	386	-4%	0.808	33	32	14	292	321	10%	0.595	24	20	13

WEAP MODEL CALIBRATION STATISTICS

WEAP	Overall	Wet Years							Normal Years							Dry Years						
Watershed	Nash Sutcliffe Efficiency	Historical Annual Mean	Baseline Annual Mean	Annual Bias	Nash Sutcliffe Efficiency	Historical Monthly Mean	Standard Deviation	RMSE	Historical Annual Mean	Baseline Annual Mean	Annual Bias	Nash Sutcliffe Efficiency	Historical Monthly Mean	Standard Deviation	RMSE	Historical Annual Mean	Baseline Annual Mean	Annual Bias	Nash Sutcliffe Efficiency	Historical Monthly Mean	Standard Deviation	RMSE
Colorado River		(TAF)	(TAF)			(TAF)	(TAF)	(TAF)	(TAF)	(TAF)			(TAF)	(TAF)	(TAF)	(TAF)	(TAF)			(TAF)	(TAF)	(TAF)
Fraser River at Granby (09034000)	0.690	218	191	-13%	0.760	18	25	12	147	157	6%	0.602	12	16	10	94	102	8%	0.480	8	10	6
Williams Fork near Leal (09035700)	0.746	103	85	-17%	0.791	9	13	6	74	76	3%	0.766	6	9	4	52	58	11%	0.303	4	6	4
Blue River below Green Mountain Reservoir (09057500)	0.781	522	476	-9%	0.802	44	55	24	375	351	-6%	0.765	31	38	18	265	255	-4%	0.631	22	24	13
Blue River below Dillon, CO (09050700)	0.777	306	299	-2%	0.801	25	34	15	217	216	0%	0.755	18	22	11	148	155	5%	0.635	12	14	8
Colorado River near Granby, CO (09019500)	0.714	365	328	-10%	0.834	30	46	18	267	252	-6%	0.615	22	33	21	185	164	-11%	0.586	15	22	14
Colorado River near Dotsero (09070500)	0.790	2,773	2,903	5%	0.797	231	296	130	1,973	2,058	4%	0.778	164	198	93	1,346	1,357	1%	0.715	112	132	64
Colorado River near Cameo (09095500)	0.793	4,839	4,784	-1%	0.817	403	498	207	3,362	3,384	1%	0.779	280	325	153	2,310	2,291	-1%	0.592	193	212	120
Homestake Creek at Gold Park (09064000)	0.738	60	56	-6%	0.756	5	8	4	42	39	-8%	0.730	4	6	3	29	26	-8%	0.641	2	4	2
Roaring Fork River near Aspen (09073400)	0.630	146	132	-9%	0.734	12	18	9	105	118	12%	0.506	9	13	9	78	81	4%	0.621	7	9	5
South Platte																						
S.Platte River above Spinney Mountain Reservoir (06694920)	0.669	122	98	-20%	0.634	10	13	7	74	62	-16%	0.648	6	7	4	42	47	14%	0.607	3	5	2
South Platte River below Cheesman Reservoir	0.736	258	219	-15%	0.712	21	26	13	138	136	-1%	0.684	11	11	6	76	99	29%	0.630	6	9	4
South Platte River at South Platte	0.731	464	382	-18%	0.689	39	44	23	249	241	-3%	0.694	21	19	10	146	162	11%	0.690	12	15	6
South Platte River at Henderson (06720500)	0.711	877	720	-18%	0.680	73	81	43	461	456	-1%	0.597	38	31	19	261	309	18%	0.607	22	27	11
South Platte Tributaries																						
Cache la Poudre River at Mouth of Canyon (06752000)	0.612	406	371	-9%	0.628	34	53	31	270	275	2%	0.638	22	32	19	165	192	17%	0.074	14	20	17
St. Vrain Creek at Canyon Mouth near Lyons	0.677	164	145	-12%	0.699	14	19	10	113	103	-9%	0.622	9	12	7	72	80	11%	0.638	6	8	5
Big Thompson River at Mouth of Canyon near Drake (06738000)	0.594	176	173	-1%	0.582	15	20	13	119	114	-4%	0.563	10	12	8	80	79	-2%	0.600	7	8	5
Boulder Creek at Orodell	0.758	96	87	-9%	0.771	8	11	5	71	68	-4%	0.763	6	8	4	48	50	6%	0.582	4	5	3
Arkansas River																						
Arkansas River at Salida (07091500)	0.721	577	528	-8%	0.756	48	56	27	402	406	1%	0.664	33	32	18	292	320	10%	0.530	24	23	14

APPENDIX B: ANNUAL PERCENT CHANGE IN STREAMFLOW VOLUME

SACRAMENTO MODEL ANNUAL PERCENTAGE CHANGES BY SCENARIO

Sacramento	Simple Assessment				2040					2070				
Watershed	Percent Change from Model Baseline				Percent Change from Model Baseline					Percent Change from Model Baseline				
Colorado River	+7.2 DegF	+1.8 DegF	97% Precip	107.5% Precip	Warm & Wet (pcm)	Hot & Wet (ccsm)	Median (cgcm3)	Warm & Dry (mri_cgcm2)	Hot & Dry (miroc)	Warm & Wet (pcm)	Hot & Wet (ccsm)	Median (echam)	Warm & Dry (mri_cgcm2)	Hot & Dry (gfdl)
Fraser River at Granby (09034000)	-24%	-6%	-6%	17%	19%	1%	5%	-9%	-22%	8%	-12%	-8%	-9%	-19%
Williams Fork near Leal (09035700)	-20%	-5%	-6%	15%	16%	-2%	1%	-10%	-22%	6%	-11%	-8%	-9%	-20%
Blue River below Green Mountain Reservoir (09057500)	-22%	-6%	-6%	15%	16%	-5%	0%	-10%	-23%	3%	-15%	-10%	-11%	-21%
Blue River below Dillon, CO (09050700)	-25%	-7%	-6%	16%	17%	-6%	-2%	-12%	-26%	3%	-17%	-12%	-13%	-25%
Colorado River near Granby, CO (09019500)	-24%	-7%	-6%	16%	16%	2%	7%	-9%	-21%	11%	-9%	-8%	-8%	-19%
Colorado River near Dotsero (09070500)	-23%	-6%	-6%	16%	16%	-3%	5%	-8%	-21%	5%	-15%	-8%	-11%	-17%
Colorado River near Cameo (09095500)	-21%	-6%	-6%	16%	15%	-7%	4%	-7%	-22%	1%	-18%	-8%	-12%	-15%
Homestake Creek at Gold Park (09064000)	-13%	-4%	-5%	13%	13%	-6%	1%	-6%	-18%	1%	-14%	-6%	-10%	-14%
Roaring Fork River near Aspen (09073400)	-19%	-6%	-6%	13%	9%	-13%	-4%	-10%	-24%	-6%	-22%	-12%	-15%	-18%
South Platte														
S.Platte River above Spinney Mountain Reservoir (06694920)	-33%	-11%	-9%	25%	27%	-12%	-16%	-26%	-42%	2%	-23%	-26%	-24%	-43%
South Platte River below Cheesman Reservoir	-32%	-10%	-9%	25%	32%	-8%	-15%	-25%	-42%	8%	-18%	-25%	-21%	-42%
South Platte River at South Platte	-30%	-9%	-9%	24%	33%	-4%	-14%	-24%	-40%	12%	-14%	-23%	-19%	-41%
South Platte River at Henderson (06720500)	-25%	-7%	-8%	22%	34%	0%	-10%	-22%	-36%	16%	-8%	-20%	-16%	-36%
South Platte Tributaries														
Cache la Poudre River at Mouth of Canyon (06752000)	-22%	-7%	-7%	19%	23%	16%	16%	-10%	-18%	21%	3%	-7%	-5%	-14%
St. Vrain Creek at Canyon Mouth near Lyons	-16%	-5%	-6%	16%	20%	7%	4%	-11%	-20%	16%	0%	-8%	-6%	-19%
Big Thompson River at Mouth of Canyon near Drake (06738000)	-21%	-6%	-6%	17%	21%	9%	7%	-10%	-20%	17%	-1%	-9%	-7%	-17%
Boulder Creek at Orodell	-18%	-5%	-6%	15%	18%	3%	-1%	-12%	-20%	12%	-4%	-10%	-8%	-22%
Arkansas River														
Arkansas River at Salida (07091500)	-6%	-3%	-7%	14%	16%	-1%	2%	-7%	-15%	5%	-6%	-3%	-6%	-8%

WEAP MODEL ANNUAL PERCENTAGE CHANGES BY SCENARIO

WEAP	Simple Assessment						2040					2070		
Watershed	Percent Change from Model Baseline					Percent Change from Model Baseline					Percent Change from Model Baseline			
Colorado River	+7.2 DegF	+1.8 DegF	97% Precip	107.5% Precip	Warm & Wet (pcm)	Hot & Wet (ccsm)	Median (cgcm3)	Warm & Dry (mri_cgcm2)	Hot & Dry (miroc)	Warm & Wet (pcm)	Hot & Wet (ccsm)	Median (echam)	Warm & Dry (mri_cgcm2)	Hot & Dry (gfdl)
Fraser River at Granby (09034000)	-23%	-6%	-5%	14%	21%	2%	0%	-11%	-17%	12%	-10%	-15%	-6%	-19%
Williams Fork near Leal (09035700)	-8%	-2%	-4%	9%	15%	4%	3%	-5%	-9%	11%	-1%	-4%	1%	-8%
Blue River below Green Mountain Reservoir (09057500)	-17%	-4%	-5%	12%	19%	-1%	-1%	-9%	-15%	9%	-10%	-11%	-4%	-14%
Blue River below Dillon, CO (09050700)	-16%	-4%	-5%	12%	19%	0%	-1%	-9%	-15%	9%	-9%	-11%	-4%	-14%
Colorado River near Granby, CO (09019500)	-22%	5%	-8%	8%	13%	2%	9%	-6%	-10%	10%	-8%	-14%	-5%	-15%
Colorado River near Dotsero (09070500)	-21%	-6%	-5%	14%	19%	-2%	1%	-10%	-18%	8%	-14%	-12%	-4%	-14%
Colorado River near Cameo (09095500)	-21%	-6%	-5%	14%	17%	-6%	-1%	-10%	-19%	5%	-17%	-12%	-6%	-14%
Homestake Creek at Gold Park (09064000)	-21%	-5%	-5%	14%	18%	-10%	-4%	-11%	-23%	2%	-20%	-15%	-9%	-17%
Roaring Fork River near Aspen (09073400)	-10%	0%	-1%	14%	17%	-4%	2%	-3%	-13%	5%	-12%	-6%	-2%	-7%
South Platte														
S.Platte River above Spinney Mountain Reservoir (06694920)	-25%	-7%	-6%	17%	23%	-7%	-10%	-18%	-29%	8%	-14%	-20%	-11%	-27%
South Platte River below Cheesman Reservoir	-27%	-8%	-7%	19%	31%	-5%	-14%	-21%	-33%	17%	-11%	-22%	-12%	-34%
South Platte River at South Platte	-27%	-8%	-7%	19%	33%	-3%	-13%	-21%	-32%	19%	-10%	-23%	-12%	-34%
South Platte River at Henderson (06720500)	-28%	-10%	-9%	16%	29%	-5%	-12%	-22%	-31%	15%	-12%	-24%	-13%	-34%
South Platte Tributaries														
Cache la Poudre River at Mouth of Canyon (06752000)	-27%	-7%	-6%	15%	20%	7%	7%	-10%	-14%	14%	-8%	-17%	-4%	-16%
St. Vrain Creek at Canyon Mouth near Lyons	-21%	-5%	-5%	12%	20%	5%	2%	-11%	-17%	16%	-4%	-14%	-4%	-20%
Big Thompson River at Mouth of Canyon near Drake (06738000)	-16%	-7%	-7%	18%	25%	7%	8%	-12%	-18%	19%	-7%	-16%	-5%	-20%
Boulder Creek at Orodell	-19%	-4%	-5%	12%	19%	4%	0%	-10%	-14%	14%	-3%	-12%	-4%	-16%
Arkansas River														
Arkansas River at Salida (07091500)	-19%	-6%	-6%	12%	16%	-10%	-7%	-14%	-23%	1%	-19%	-15%	-11%	-21%

The following organizations contributed financially to this Tailored Collaboration project:

- Denver Water
- Colorado Springs Utilities
- Boulder Department of Public Works
- City of Aurora Utilities
- Fort Collins Utilities
- Northern Colorado Water Conservancy District

Joint Front Range Climate Change Vulnerability Study

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ISBN 978-1-60573-168-1
9 781605 731681
4205
1P-2C-4205-02/12-FP

SAVE THE COLORADO SAVE THE POUDRE WATEKEEPER ALLIANCE
WILDEARTH GUARDIANS LIVING RIVERS THE ENVIRONMENTAL GROUP

June 18, 2015

TO: Rena Brand and Kiel Downing, U.S. Army Corps of Engineers

Re: **Moffat Collection System Project: Climate Change and Greenhouse Gas Impact Analysis**

Dear Ms. Brand and Mr. Downing,

Climate change presents a critical challenge to Colorado, the Southwest United States, and our planet. The organizations signed below are deeply concerned about the current and coming effects of climate change, and are committed to finding solutions to environmental problems that do not create new environmental problems or worsen existing problems. At a minimum, environmental decision-making must be fully informed by comprehensive analysis of potential climate impacts so that agency action can be designed to avoid, minimize, and mitigate impacts.

This letter is submitted to inform and assist the Corp's analysis as it formulates the Record of Decision for the Moffat Collection System Project. The Corps has committed that it will accept "meaningful and substantive comments on the analysis until the agency makes a decision on the project…"[1]

The National Environmental Policy Act requires that the U.S. Army Corps of Engineers analyze all environmental impacts associated with the proposed Moffat Collection System Project ("Moffat"). Because Moffat requires permitting under the Clean Water Act, the Corps' assessment of the project must address the EPA's 404(b)(1) guidelines (see 40 C.F.R. § 230), and the Corp's "public interest" factors (see 33 C.F.R. §§ 320 et seq.) including:

- Rejecting a permit if there is a practical alternative that would cause less adverse impact
- Ensuring that permitting the project does not cause significant degradation to waters of the U.S., including jurisdictional Waters of the U.S. such as riffle-pool complexes and "jurisdictional wetlands"
- Mitigating any impacts

Commensurate with increasing scientific recognition of the nature and scale of the threat, law and policy are evolving with regard to the level of climate change analysis needed in federal environmental reviews. The Counsel of Environmental Quality (CEA) recently issued new "draft

[1] http://www.dailycamera.com/boulder-county-news/ci_25989891/epa-see-plans-gross-reservoir-expansion-threat-water

guidance" (Dec. 2014) about climate change emissions from projects evaluated under NEPA. According to the CEQ's summary of the new Draft Guidance:

> This guidance explains that agencies should consider both the potential effects of a proposed action on climate change, as indicated by its estimated greenhouse gas emissions, and the implications of climate change for the environmental effects of a proposed action. The guidance also emphasizes that agency analyses should be commensurate with projected greenhouse gas emissions and climate impacts, and should employ appropriate quantitative or qualitative analytical methods to ensure useful information is available to inform the public and the decision-making process in distinguishing between alternatives and mitigations. It recommends that agencies consider 25,000 metric tons of carbon dioxide equivalent emissions on an annual basis as a reference point below which a quantitative analysis of greenhouse gas is not recommended unless it is easily accomplished based on available tools and data.[2]

The Guidance concludes:

> This guidance document informs Federal agencies on how to apply fundamental NEPA principles to the analysis of climate change through assessing GHG [greenhouse gas] emissions and the effects of climate change for Federal actions subject to NEPA. It identifies opportunities for using information developed during the NEPA review process to take into account appropriate adaptation opportunities. Applying this guidance will promote an appropriate and measured consideration of GHG emissions and the effects of climate change in the NEPA process through a clearer set of expectations and a more transparent process, thereby informing decisionmakers and the public and resulting in better decisions.
>
> This guidance also addresses questions raised by other interested parties.73 Agencies are encouraged to apply this guidance to all new agency actions moving forward and, to the extent practicable, to build its concepts into currently on-going reviews.[3]

Case law decisions by the judiciary are keeping pace with Executive branch actions and the emerging scientific consensus regarding climate change threats. In June 2014, the United States District Court for the District of Colorado issued a decision involving proposed coal mining operations on Colorado's West Slope holding that federal agencies' NEPA analysis process must estimate GHG emissions associated with combustion of coal.[4] High Country Conservation Advocates v. U.S. Forest Service (D. Colo. 2014).[5] The Court found that the USFS Coal Mining EIS

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[2] https://www.whitehouse.gov/administration/eop/ceq/initiatives/nepa/ghg-guidance (emphasis added)

[3] https://www.whitehouse.gov/sites/default/files/docs/nepa_revised_draft_ghg_guidance_searchable.pdf at 30-31 (emphasis added)

[4] http://www.scribd.com/doc/231657158/US-District-Court-order-on-West-Elk-coal-mine-expansion-in-Sunset-Roadless-area-Colorado at

[5] http://www.coloradoindependent.com/148011/judge-blocks-colorado-coal-mine-plan-orders-feds-to-evaluate-climate-impacts

violated NEPA by not considering an expert report submitted by Plaintiffs regarding GHG emissions forecasts. Id. at 31. The decision directed that the federal "defendants are immediately enjoined from proceeding with the Exploration Plan in any manner that involves any construction, bulldozing or other on-the-ground, above-ground or below-ground disturbing activity in the subject area." Id. at 36.

Responding to the federal agency's claim that no accepted methods were available to calculate the social cost of carbon emissions, the court found "a tool is and was available: the social cost of carbon protocol. Interagency Working Group on Social Cost of Carbon, Technical Support Document (Feb. 2010) [. . .] The protocol—which is designed to quantify a project's contribution to costs associated with global climate change." Id. at 17. This tool should be utilized by the Corps in its analysis of the Moffat project.

In a decision dated May 8, 2015, the same federal court held that NEPA's hard look standard requires that agencies analyze the "increase in greenhouse gas emissions" among other air quality impacts of proposed projects. Wildearth Guardians v. U.S. Office of Surface Mining, Reclamation and Enforcement (D. Colo. 2015).[6] The court's holding applies to both direct and indirect impacts from the project. "Indirect effects are effects that "are caused by the action and are later in time or farther removed in distance [than direct impacts], but are still reasonably foreseeable." 40 C.F.R. § 1508.8(b)." Id. at 26. Applied to the proposed Moffat project, this indicates that the Corp's analysis should encompass the climate impacts of any new development, such as residential subdivisions and related traffic patterns that are expected to be permitted and built as a result of a decision approving the proposed additional Moffat diversions.

Consistent with NEPA and the law and policy summarized above, we evaluated the potential greenhouse gas emissions that would be produced by the Moffat Collection System Project to consider whether the project, as proposed in the FEIS, would contribute to climate change. At least three significant sources will contribute to climate change emissions from the proposed Moffat project: 1) the construction of the project, 2) harmful impacts to the hydrology of over 600 acres of wetlands and riparian areas due to watershed depletions in the tributaries from which Moffat collects water, from the Fraser River, and from the Upper Colorado River, and 3) emissions of methane, nitrous oxide and carbon dioxide from the fluctuating water levels and operations of an expanded Gross Reservoir. The Corps project team should determine what additional sources warrant inclusion in the climate analysis for direct, indirect, and cumulative impacts.

In terms of (1) above, we have calculated that the total climate change emissions produced during the construction of the project – also called "embodied" emissions – would be at least 782,000 metric tons CO_2-equivalents. These emissions from construction alone would be equal to or greater than the emissions from more than 164,000 automobiles on the road for one year, or, the burning of more than 840 million pounds of coal.

[6] http://www.wildearthguardians.org/site/DocServer/OSM_Colorado_Ruling_5_08_15.pdf?docID=16002

In terms of (2) above, harmful impacts to the hydrology of over 600 acres of wetlands and riparian areas, we have calculated that the total climate change emissions for Moffat would likely be more than 38,000 metric tons CO_2-equivalent. <u>These emissions would be equivalent to the emissions from 8,000 automobiles on the road for one year.</u>

In terms of (3) above, the scientific literature has not yet reached consensus on quantifying methane and carbon dioxide emissions from reservoirs in Western semi-arid environments. However, the existing literature clearly documents emissions in this category, establishing that the emissions from Gross Reservoir are likely to be at least several thousand metric tons of CO_2-equivalent each year. As this science progresses over the coming months, we will offer additional input to you.

The Corps of Engineers must analyze these emissions so that the project complies with the National Environmental Policy Act and other federal laws and regulations, and consider the analysis in the Record of Decision for Moffat.

These estimated results would be significant greenhouse gas emissions at a time when we should be doing everything we can to reduce greenhouse gas emissions in every aspect of our lives. Importantly, our initial estimate of GHG emissions from Moffat -- at least 780,000 metric tons -- is over <u>30 times greater</u> than what the draft guidance indicates is a minimum threshold for analysis and mitigation.

Our calculations are based on the following methodology:

1. Embodied emissions from construction of the project – including fuel burned on site, concrete manufacturing and use, rock fill, an estimated 23,600 truck trips, and excavation in the construction of the project – would total more than 782,000 metric tons CO_2-equivalent[7] [8], which is more than 43 metric tons CO_2-equivalent per acre-foot of water proposed to be yielded from the project. We calculated these emissions by matching the projected materials and excavation amounts in the financial cost estimates for the project with the embodied emissions calculated in the Inventory of Carbon and Energy (ICE) database.

2. The project's proposed action would affect more than ~600 acres of riparian-associated wetlands and riparian areas in the Fraser River, Upper Colorado River, and tributaries from which the Moffat project will collect water. Carbon in soils and wetland vegetation are a major sink for ecosystem carbon, and reduced wetland hydrology would have significant impacts upon those wetlands, the loss of which would likely result in a major source of emissions to the atmosphere of at least 38,000 metric tons CO_2-equivalent per year. We evaluated the Natural Resource

[7] Technical Memorandum, Northern Integrated Supply Project, Glade Complex, Facilities Update and Cost Estimate
[8] ICE database (http://www.circularecology.com/ice-database.html#.U1Z4B_ldVgg)

Conservation Service (NRCS) SSURGO soils database for wetlands soils in the affected region[9], and the U.S. Forest Service FIA database for riparian vegetation in the affected area[10], and then modeled the soils under drained and undrained conditions using the CENTURY model[11] [12] and estimated the shifting of vegetation from wetlands and riparian forests to non-riparian shrublands.

3. Reservoirs in the American West are significant sources of greenhouse gases, and the reservoir expansion for the project, if built, is likely to emit thousands of metric tons CO_2-equivalent per year[13] [14]. While we are unaware of a current model to predict the greenhouse gas emissions from temperate reservoirs, available research indicates that no temperate reservoirs have been found to be a net year-round sink for carbon. Nearly all reservoirs studied to date appear to be net sources of greenhouse gas emissions, and there is no reason to indicate that an expanded Gross Reservoir would be any different. Recent measurements indicate emissions are particularly high from reservoirs that fluctuate significantly over the course of the year, as do most reservoirs in Colorado such as Gross Reservoir. Emissions of the greenhouse gas methane in particular can be extremely high from hydropower facilities such as Gross Reservoir.[15] [16]

These projections constitute significant new information that must be used and analyzed as a part of the Environmental Impact Statement (EIS) for Moffat. The Record of Decision (ROD) must be informed by the best available science, and without this analysis, the EIS would not satisfy the requirements of the National Environmental Policy Act or recent court decisions. If the Corps has not already done so, we recommend that the Corps conduct a rigorous scientific analysis of the climate impacts for this project, borrowing the methodology and conclusions presented above as appropriate. The analysis will have direct bearing on how the Corps complies with the mandate that the ROD selects the Least Environmentally Damaging Practicable Alternative.

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[9] Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/. Accessed 2/15/2014.

[10] USDA Forest Service. 2000. Forest inventory and analysis national core field guide, volume 1: Field data collection procedures for phase 2 plots, version 1.6. USDA Forest Service, Internal report. On file at USDA Forest Service, Washington Office, Forest Inventory and Analysis, Washington, D.C.

[11] Parton, W.J., D.W. Anderson, C.V. Cole, J.W.B. Stewart. 1983. Simulation of soil organic matter formation and mineralization in semiarid agroecosystems. In: Nutrient cycling in agricultural ecosystems, R.R. Lowrance, R.L. Todd, L.E. Asmussen and R.A. Leonard (eds.). The Univ. of Georgia, College of Agriculture Experiment Stations, Special Publ. No. 23. Athens, Georgia.

[12] Century Model Home Page. http://www.nrel.colostate.edu/projects/century/, viewed on 2/15/2014.

[13] Soumis, N. *et al.* 2004. Greenhouse gas emissions from reservoirs of the Western United States. Global Biogeochemical Cycles 18(3): GB3022.

[14] Deemer, B.R., J.A. Harrison, and M.T. Glavin. 2012. Water level drawdown boosts greenhouse gas production in a small eutrophic reservoir. Poster at the Ecological Society of America Annual Meeting, Portland, OR.

[15] http://ecowatch.com/2014/08/14/dams-not-clean-energy-climate-change/

[16] http://www.climatecentral.org/news/hydropower-as-major-methane-emitter-18246

Scientists across the globe increasingly recognize that climate change has civilization on the brink of a looming climate crisis should current trends continue unchecked. The earlier and more decisively action is pursued, the later and less cataclysmic impacts will occur. Effective action starts with informed environmental decision-making, the core goal of NEPA.

Thank you for the opportunity to provide input and make requests of your offices regarding the environmental impacts of the Moffat System Collection Project. Your organization and ours mandate objective, scientifically valid information to thoroughly comply with applicable law and policy, including the recent court holdings summarized above. Please acknowledge receipt of this letter.

Respectfully,

Gary Wockner
Executive Director
Save The Colorado

Mark Easter
Board Chair
Save The Poudre

Pete Nichols
National Director
Waterkeeper Alliance

Jen Pelz
Wild Rivers Program Director
Wildearth Guardians

John Weisheit
Colorado Riverkeeper
Living Rivers

Chris Garre
Board Chair
The Environmental Group

To: Federal Energy Regulatory Commission
From: Rocky Smith
Date: April 6, 2018
Subj: **COMMENTS ON VEGETATION REMOVAL AND ASSOCIATED ACTIVITIES FOR THE MOFFAT COLLECTION SYSTEM PROJECT, GROSS RESERVOIR ENLARGEMENT**

INTRODUCTION:

I have more than 35 years of experience working on forest management issues on National Forests across Colorado from a conservation perspective, including approximately 25 total years as a forest watch coordinator on the staff of Rocky Mountain Wild, Colorado Wild, and Colorado Environmental Coalition. Among past projects was being a leader in the campaign to promote alternatives to the then-proposed Two Forks Dam and Reservoir from 1985 to 1991. Two Forks was ultimately vetoed by the U.S. Environmental Protection Agency. In the years since, Denver Water has established that not only was Two Forks not needed to supply its customers or service area, but the success of conservation measures and other strategies to address supply and demand also renders the Moffat proposal to raise Gross Dam and expand Gross Reservoir unnecessary.

The comments below were prepared for Save the Colorado to assess the impacts and analysis regarding forestry issues and vegetation removal in the Supplemental Environmental Assessment released by the Federal Energy Regulatory Commission. My *curriculum vitae* is attached to this comment.

I. IMPACTS FROM TREE CLEARING TO ENLARGE GROSS RESERVOIR WOULD BE CONSIDERABLE AND HAVE NOT BEEN FULLY DISCLOSED

A. THE PROPOSED PROJECT WOULD REMOVE TREES FROM A SIZABLE AREA.

To enlarge Gross Reservoir under approved alternative 1a, many trees would have to be cut and removed. According to the Final Environmental Impact Statement (FEIS) for the Moffat Collections System Project and the Supplemental Environmental Assessment For Amendment Of Hydropower License (SEA), about 200,000 trees would have to be removed from 400 - 473 acres of land adjacent to the existing reservoir[1]. This would generate an estimated 50,000 tons of residue. SEA at 12, Gross Reservoir Tree Removal Plan for Pool Enlargement (TRP) at 5. Due to

[1] FEIS p. 5-220 states that approximately 200,000 trees on 400 acres would be cut, while 5-311 states that 473 acres of forest would be lost through clearing and inundation. The Supplemental EA at 12 states that vegetation would be removed from approximately 465 acres.

limited access, temporary roads would have to be constructed, and existing roads would have to be improved. FEIS at 2-50, 5-397.

The “new inundation area” would extend to 7406 feet elevation (FEIS at 5-220, SEA at 12), from which “[a]ll trees and wood would be removed”. FEIS at 5-281. Vegetation would be cleared from all areas around the reservoir up to 7410 feet. Ibid. In any case, the removal and disposal of vegetation from a sizable area around the existing reservoir would cause considerable impact, as is discussed below.

Tree removal is desired because it would” minimize problems with floating debris, decaying vegetation, and potential water quality concerns”. SEA at 12. See also id. at 50 and 51-52. Vegetation removal from the inundation area is also required by a project mitigation measure to “to minimize water quality impacts from organic matter”. SEA at 18.

B. THE COMMERCIAL VALUE OF THE TREES IN THE PROJECT AREA IS LIMITED OR NON-EXISTENT.

The SEA hints that some material could be sold, as it “could…be turned into marketable products, such as saw-timber and firewood.” SEA at 12. However, the material is expected to have “little if any commercial value” TRP at 4. Indeed, most of the trees, which are generally 4-14 inches in diameter and only 20-50 feet tall (TRP at 2), are not likely to be desirable for any kind of building material, such as dimension lumber.

Pages 14-15 of the TRP discuss in more detail the possibility of selling some of the material cut from around the reservoir, and conclude that the “most likely outlet for the small sized material coming from this project may be firewood sales or giveaway”.

However, it is unlikely that very much firewood could be sold. Air quality laws and regulations in effect for the region prohibit burning firewood on many days. See further discussion on burning below.

C. DISPOSAL METHODS ALL HAVE LIMITATIONS AND WOULD CAUSE CONSIDERABLE IMPACT.

SEA at 12 lists three methods for treating the estimated 50,000 tons of residue that would be produced: ground-based systems with hand felling and skidding with rubber tires, or cable yarding; helicopter yarding; and use of a hydro-axe feller/buncher. Ground-based systems would be used where road access exists or temporary roads could be constructed, while copter yarding and the hydro-axe would be used in areas “with poor access, small trees, steep slopes, and abundant rock”. Ibid.

Ground-based systems would involve soil disturbance by skidders or use of other heavy equipment. Impacts are discussed in more detail in subsection D below.

Copter yarding and the hydro-axe could be used for areas where road access is not feasible. Copter use would have impacts, such as noise and the “wind” created by the rotors. This would have adverse impacts on some wildlife species and also on nearby residents. These impacts do not appear to have been addressed in the FEIS or the SEA. Material yarded by helicopter would still have to be transported and disposed off-site.

Use of the hydro-axe would mean a piece of heavy equipment would make repeated trips across areas to be cleared, i. e., areas with very erosive soils. This would probably cause at least as much erosion as for comparable clearing accessed by building and using roads.

The hydro-axe creates baseball to soccer ball-sized chunks of wood which, contrary to what is stated at TRP p. 7, will not decay readily. The chunks created below the expected new inundation area would have to be moved out of this area to avoid have floating debris and decay of organic material in the reservoir. This material would then rest on dry soil in a relatively dry environment. They would not be able to decay except maybe over a very long time period (many decades).

Use of cable systems could reduce ground disturbance somewhat, with cable yarding replacing some skid trails. But it is highly unlikely that cable yarding is feasible for clearing vegetation around the reservoir. Use of such systems requires a well-trained and experienced operator. Few cable systems have been used in Colorado, and none that we know of in recent history on the Front Range, because it takes a high volume of at least moderately valued material to allow an operator to recoup his investment in the expensive equipment. As discussed above, the trees in the project area have very limited, if any, commercial value.

Some of the material produced could be burned. However, burning more than minor amount of wood residue would likely violate air quality regulations and cause problems for residents, both local and downwind. The TRP observes that “burning large quantities of forest residue, in close proximity to residential areas, is problematic in the extreme”. Id. at 5. “A traditional pile and burn approach to disposing this material is no longer viable due to air quality concerns and regulations.” TRP at 11.

Air curtain destructors could be used to burn the material, which would produce less air pollutants than standard burning of piles. But ash would be produced, and have to be hauled offsite. See TRP at 11. This means that motor vehicle access and use would be needed, generating the some of the same impacts that would occur with other disposal methods, as is discussed in more detail below.

Whatever disposal methods are used, a considerable amount of the material produced from clearing to enlarge the reservoir would have to be hauled offsite.

D. ANY GROUND DISTURBANCE WOULD CAUSE CONSIDERABLE SOIL EROSION

Soils in the area tend to be very erosive and prone to landslides. FEIS at 3-229. See also FEIS Table F-1, which lists the soils in the Gross Reservoir Area and shows most of them having moderate to severe water erosion hazard, as well as other limitations, including "potential landslide activity". Removing vegetative cover from these areas will make them highly susceptible to erosion. FEIS at 3-229; see also id. at 5-213. The area also has a high density of rock, both large and small. TRP at 4. Some areas where soil is already disturbed would be further disturbed to enlarge the reservoir. FEIS Table 5.7-1, p. 5-220. And finally, additional soil would be disturbed because "[a] portion of the cleared area would also be used for borrow material". Id. at 5-220.

The entire area surrounding the existing reservoir is quite steep. See Trails Illustrated Map 100, Boulder-Golden, and TRP Map A. The latter shows that most of the area to be logged is on slopes of 40 percent or greater. Forty percent is considered the steepest slope on which conventional ground-based logging systems can be safely operated.

The steepness will limit the opportunities for road building, as construction and use of such roads would cause erosion. Ground disturbance from logging would be considerable, especially since whole trees (i.e., with limbs and tops attached) are expected to be skidded (TRP at 6). It will also limit the use of equipment like skidders because some slopes would be too steep for their safe operation. Road construction, tree felling and skidding could cause sediment to begin to fill the reservoir, resulting in a loss of storage capacity.

Erosion could be considerable, given the highly erosive soils in the area:

> Disturbance of soil and litter would result in accelerated erosion, which would need to be controlled with erosion and timber harvest Best Management Practices (BMPs).

FEIS at 5-212.

FEIS p. 5-212 states that “stumps and roots would remain in place”. However, to minimize water quality impacts from “decomposition of organic matter” (SEA at 50), stumps from trees cut would probably also have to be removed. Otherwise, stumps would slowly decay and may eventually come out of the ground under water to create floating debris, which would cause problems for reservoir operations. Stumps could also be a hazard to boaters using an enlarged reservoir.

Stump removal would require considerable digging, bulldozing, or even blasting, followed by use of heavy equipment to cut and grind the stumps and remove the chips, or to haul out whole stumps. Any method of separating stumps from the ground, treating them on site and/or removing them from the area would require additional use of motor vehicles and would disturb the highly erosive soils.

E. TREE CLEARING AND DISPOSAL WOULD ADVERSELY AFFECT AIR QUALITY

The impacts of removal and disposal of trees cut for reservoir enlargement have not been included in the analysis of air quality impacts in the FEIS and SEA. FEIS p. 5-408 states that, beyond the impacts from construction (mainly from the use of heavy equipment and workers commuting), there would be additional impacts to air quality from tree removal and disposal. However, these impacts are not specified.

The issue of how much tree removal and disposal would affect air quality is important because emissions from implementation of the project, even without the additional impacts from tree removal, would exceed the de minimis thresholds for carbon dioxide (CO) and nitrogen oxides. FEIS at 5-407, -408. The Denver metro area is a non-attainment area for ozone and a maintenance area for CO and PM_{10}. Id. at 3-507. Any action that would exceed the de minimis standard for any pollutant for which an area is in non-attainment or maintenance status automatically triggers a Conformity Determination to ensure that the action would comply with the Clean Air Act. See FEIS at 3-508. Thus an accurate and full accounting of all possible emissions is essential.

Impacts from removal and disposal of tree debris would add to the other project emissions, since considerable additional vehicle trips would be needed, as discussed above, to complete this portion of the project. This would include workers commuting to the site to perform the work, as well as vehicle trips for processing and/or hauling out debris. Vehicle use, especially heavy equipment used for processing and hauling wood residues, would add CO to the air.

If the slash was chipped, an estimated 2174 truck trips would be needed to remove it from the site. TRP at 13. If whole trees were hauled offsite, there would be many more truck trips (ibid.).

If all of the residue was burned in an air curtain destructor, 1000 to 2000 tons of ash would be produced, most or all of which would have to be hauled out. Id. at 12. The TRP does not estimate how many truck trips would be required to remove this ash, but calculating from Table 4 on p, 13, it appears that 100 trips would be needed.

Burning would obviously add pollutants like PM_{10} to the air in the area and downwind. While use of an air curtain destructor may reduce the air quality impacts of burning, it still may require a permit from the Department of Health and Environment, Air Pollution Control Division. See FEIS at 5-408.

F. SOME IMPACTS FROM TREE CLEARING AND ASSOCIATED ACTIVITIES MAY NOT HAVE BEEN DISCLOSED

It is unclear if the all of impacts described above have been fully considered in the FEIS and SEA. There is no specific discussion of amounts of erosion expected from tree clearing and on-site treatment and hauling off-site (see FEIS at 2-512), nor any analysis of how well any mitigation measures, best management practices, or other measures would reduce the impacts.

The analysis of impacts to soils from tree clearing states that "[m]oderate impacts on soils include erosion resulting from disturbance and compaction during harvest. " However, the FEIS was prepared prior to some of the details of the project being known. For example the TRP, though prepared in July 2008 and supplemented in October of that year, was apparently not considered, nor were the plans addressing soil erosion, which are further discussed below.

> With any dam raise alternative, Denver Water will implement environmental protection, mitigation, and enhancement measures at Gross Reservoir, including an erosion and sediment control plan for social trails and roads.

FEIS at 5-217. Various plans are mentioned which will be implemented and reduce impacts to soils. The Erosion Control and Reclamation Plan is mentioned at SEA at 45, 61, and 87, among other places. A plan for Reclamation and Revegetation Seed Mixes and Mulch Materials is mentioned at SEA 87. Also mentioned is an Erosion and Sediment Control Plan, to be done by FERC's San Francisco Regional Office prior to the commencement of any ground disturbing activity. SEA at 88.

The conclusion in the SEA is that with implementation of all of these plans, effects on soils and geology won't exceed those disclosed in the FEIS. SEA at 45. However, we do not find the plans cited above in any of the project documents. Until these plans are finalized, the full impacts of reservoir enlargement cannot be known. We also do not find a description of the purported best management practices or mitigation measures that would be applied to reduce impacts, nor a discussion of how effective these measures would be in reducing impacts. With highly erosive soils and activities proposed that would disturb those soils over a large area surrounding the reservoir, the conclusion that impacts would only be moderate may not be justified.

As stated above, impacts from use of helicopters on wildlife, nearby residents, and recreational visitors have not been disclosed.

Part of the area from which trees would be removed is in the Winiger Ridge Project Area and/or the Forsythe II Project Area.[2] Both projects would include areas outside the dam enlargement cutting area, and would remove a number of trees, some by clearcutting, others by partial cutting. There could be cumulative impacts from tree removal in these areas, such as loss or degradation of wildlife habitat for species needed forested habitat. These cumulative impacts have not been disclosed in the FEIS or SEA.[3]

Given the non-attainment and maintenance status for certain air pollutants in the Denver metro area, and the fact that two pollutants would exceed the de minimis thresholds, it is very important that all the possible sources of air pollution from the enlargement of Gross Reservoir, including from tree removal and disposal, be fully disclosed.

II. THE IMPACTS TO HIGHWAY 72 HAVE NOT BEEN FULLY ASSESSED

Hauling would use County Road 77S to the Coal Creek Canyon Road, Colo Highway 72[4], or various county and national forest roads to access Highway 72 near Pinecliffe. See map at: https://grossreservoir.org/wp-content/uploads/2016/09/MapProposedGrossResHaulRoute.pdf. See also the Supplement to the TRP (October, 2008) at 7.

Aside from hauling out tree residue, 6,552 truck trips would be needed to haul in cement and fly ash for construction of the expanded dam. These loads would likely be carried by heavy trucks, which would have to use Highway 72 and County Road 77S to get to and from the construction site. To remove tree residue form the site, many additional truck trips would be needed, which is discussed in detail above.

Highway 72, which currently sees relatively little traffic, may not be able to handle the huge increase in heavy truck traffic without the need for significant maintenance and repair. We do not see any analysis of the impacts to Highway 72, or the possible need to maintain or upgrade the highway prior to the project or repair it after the project is complete. In fact, we do not find any

[2] At least part of the Winiger Ridge Project has been implemented, while implementation of Forsythe II is likely to begin this year.
[3] There is only a brief mention of these two projects - see FEIS at 4-413, -414.
[4] Hauling could not use Flagstaff Road, CR 77, through Boulder, as "logging truck access is prohibited" on this road. FEIS at 5-397.

information on the current levels of traffic on highway 72 and other routes that might be used for the project. Thus, while the FEIS provides estimates of the amount of vehicle trips that would be generated by the project, there is no way for interested public to compare that to current levels of traffic.

To minimize impacts to traffic and public safety, the SEA (p. 76) relies on a draft 2005 Traffic Control Plan prepared by Denver Water. As with some other documents cited in the SEA, we do not find this Plan in any of the project documents. Traffic has likely increased in and around the project area since 2005 due to population growth. The analysis also cites “a finalized Traffic Management Plan, Erosion Control and Reclamation Plan, Road Maintenance Plan, and Tree Removal Plan”. SEA at 78. Except for a 2008 (non-final) version of the TRP, these documents are not available either.

III. THE PROPOSED MITIGATION FOR LOSS OF FORESTED HABITAT WOULD NOT FULLY COMPENSATE FOR THE LOSS OF FORESTED HABITATS

To compensate for the loss of current national forest land that is mostly or entirely forested, the Forest Service would purchase the purported 539-acre Toll property from Denver Water. This would serve “as mitigation for resource values that would be lost on Denver Water and Forest Service lands due to inundation and construction-related ground disturbance”. SEA at 22.

However, the description of this property in the Off-License Agreement (OLA) is as follows: “parcel 11, SW ¼ section 1, Township 2 South, Range 44 West… (160 acres)”. OLA at 12, section 7.1.

This property is only 160 acres, not 539 acres. This would not likely fully compensate for the loss of 280 acres of national forest land to clearing for reservoir inundation. See SEA at 30 and further discussion below. And even the 160-acre purchase is far from assured because it “is contingent upon appropriations for purchase of the property being available”. OLA at 13. The fact that this provision (land purchase to compensate habitat loss) is in the OLA, not part of the FERC license for the project, will make it harder to enforce.

Full compensation for the forested habitat to be lost is necessary because the inundation of land around the reservoir would violate the Arapaho-Roosevelt Forest Plan (Forest Plan), which applies to all the national forest land in the project area and surrounding area, as described below.

The reservoir enlargement would cause the loss of a small amount of old growth and a larger amount of developing old growth, both in the ponderosa pine/Douglas-fir type. FEIS at 5-287. Old growth is valuable because it provides high quality habitat for cavity-nesting species like pygmy nuthatch (*Sitta pygmaea*) and flammulated owl (*Otus flammeolus*), habitat that is less prevalent or non-existent in younger stands. Maintaining old growth preserves the history of climate and fire in the respective area, aiding research into what natural stands were like prior to settlement by European descendants and the frequency of fire since then. Large old trees have thick bark and are fire-resistant. See Huckaby et al, 2003.

Also, old growth, in contrast to younger stands, cannot be created by human action in a short time frame. Thus a loss of existing old growth and developing old-growth will be a long-term loss.

Old-growth in ponderosa pine and Douglas-fir stands is uncommon on the Arapaho-Roosevelt National Forest[5], as most of the stands in this timber type have been logged or otherwise subjected to human manipulation that has degraded or eliminated the stands' ecological and other values as old growth.

Forest Plan Guidelines 117, 118, and 122 state:

> Provide for the most rapid development of future Douglas-fir and ponderosa pine old growth conditions and increase amounts in the future.
>
> Retain all existing Douglas-fir and ponderosa pine old growth and increase amounts in the future.
>
> Allow through vegetation protection or encourage through vegetation treatments the development of future Douglas-fir and ponderosa pine old growth conditions within identified old-growth areas.

Forest Plan at 32.

One old growth stand that would be removed to allow construction of an enlarged reservoir is described in the FEIS:

> The ponderosa pine community located on the southern peninsula of the western lakeshore is <u>an especially good example of a historic ponderosa forest</u>.

Id. at 3-240; emphasis added. Clearly, the Forest Plan provisions quoted above were designed to protect stands such as this one.

[5] A 1992 survey found that only one percent of all the old growth on the Arapaho-Roosevelt National Forest was in ponderosa pine/Douglas-fir. The survey results further stated that …"the least old growth exists at the lowest elevations with the most roads". See Lowry, 1992. Ponderosa pine/Doulas-fir is at the lowest elevations of the Arapaho-Roosevelt National Forest in areas that are mostly well-roaded.

The project area lies within the Thorodin Geographic Area (GA). Under Goals and Desired Condition for this GA, direction states: “[e]mphasize old-growth recruitment and retention.” Forest Plan at 107.

Clearing for the reservoir would cause the loss of effective habitat.[6] FEIS at 5-299. Forest Plan Goal 95 states: “[r]etain the integrity of effective habitat areas”. Forest Plan at 30. Under management area 3.5, which the project area is in, standard[7] 2 states: “Maintain or increase habitat effectiveness, except where new access is required by law”. Forest Plan at 359.

The project would cause loss of interior forests. FEIS at 5-288. Interior forests are defined as follows:

> Areas of relatively dense (40 percent [or] more crown closure) and large trees (mature or old growth) that are buffered (at least 300 feet) from temperature, light and humidity differences of sizable openings, and also from human disturbance or regularly used roads and trails (11 or more people or vehicle trips per week).

Forest Plan at G-26. Plan Goal 39 states:

> Maintain, and restore where necessary, habitats of sufficient area and appropriate spatial pattern, to minimize the adverse effects of human-caused fragmentation.

Forest Plan at 17.

Enlarging the reservoir would cause the permanent loss of hundreds of acres of elk winter concentration areas, including severe winter range, and migration corridor. FEIS at 5-282, 283. This would violate the Forest Plan’s Guideline 103, which states:

> Maintain the function of key or unique habitats such as…winter ranges,…,migration corridors, animal concentration areas….

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[6] “Habitat effectiveness” is defined in the Plan as follows:

> The degree to which habitat is free of human disturbance and available for wildlife to use. Effective habitat is mostly undisturbed land area which buffered (at least 300 feet in essentially al situations) from regular motorized and non-motorized use of roads and trails (11 or more people or vehicle trips per week).

Plan at G-24.

[7] Standards are measures that must be followed: “Standards are mandatory and deviation from them is not permissible without an amendment to the Forest Plan”. Forest Plan at 11.

Forest Plan at 30.

Clearly, the proposed reservoir enlargement would not conform to the Forest Plan due to the loss of certain habitats, as described above. It is not clear if the proposed Forest Service acquisition of the Toll property would actually offset the habitat loss from the project.

> The parcels in the Toll Property are surrounded by the Roosevelt National Forest and contain diverse vegetation types, including forest, grassland, wetland, fens, wet meadows, pond, stream, and riparian habitat. The Toll Property includes valuable wildlife habitat, including elk and mule deer summer range and migration corridors, as well as habitat or potential habitat for a number of other species, including Forest Service sensitive species.

SEA at 61. The area does not likely have winter range, as it is too high in elevation and thus too cold with too much persistent snow cover for use by deer and elk during winter[8]. It is not clear if it provides interior forest habitat, effective habitat, or old growth, which are some other habitat types that would be lost with expanded reservoir clearing and inundation.

FERC, Denver Water, and the U. S. Forest Service must: clarify how many acres the Forest Service will be able to purchase from Denver Water, how likely the money will be available for this purchase, and how the purchase and any other mitigation measures would compensate for the loss of forested habitats and winter range from inundation at the expanded reservoir.

REFERENCES

Huckaby, Laurie Stroh, Merrill R. Kaufmann, Paula J. Fornwalt, Jason M. Stoker, and Chuck Dennis, 2003. Identification and Ecology of Old Ponderosa Pine Trees in the Colorado Front Range. USDA Forest Service Rocky Mountain Research Station, General Technical Report RMRS-GTR-110, September 2003.

Lowry, Dennis G., 1992. An Old-Growth Forest Inventory Procedure for the Arapaho and Roosevelt National Forests, Colorado. IN: Old-Growth Forests In the Southwest and Rocky Mountain Regions: Proceedings of a Workshop. USDA Forest Service Rocky Mountain Forest and Range Experiment Station (now Rocky Mountain Research Station), General Technical Report RM-213, June, 1992.

[8] According to Trails Illustrated Map 103, the elevation of the parcel is likely between 9,000 and 10,200 feet on a north-facing slope.

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SKILLS AND KNOWLEDGE

Through 35-plus years of experience in working on issues related to the national forests of Colorado, I have developed expertise on many issues related to management of our national forests. This include knowledge of various laws, including: National Forest Management Act, National Environmental Policy Act, Endangered Species Act, as well as regulations for application of these laws and others. I am very familiar with the national forests of Colorado, having traveled extensively and visited many areas where projects are proposed. I have reviewed many projects and plans proposed for Colorado's national forests.

RECENT WORK EXPERIENCE

<u>Private Contractor</u>

Time: July 2012 to present

Duties: I work as a consultant for non-profit environmental and recreation organizations, and private interests, on issues relating to national forest management, including: laws (proposed and passed); regulations (draft and final); management plans (draft and final); and individual projects. The latter include: timber sales, vegetation management projects, wildlife habitat projects, recreation management, oil and gas leasing, coal leasing, ski area expansion, and others. For one client, I regularly review lists of possible projects for one Bureau of Land Management field office in Colorado.

The above work involves: determining which projects, plans, etc. might be of interest to one or more clients; researching items possibly of interest; reporting about the issues with a particular project or plan; writing comments; and preparing administrative objections, as appropriate.

Most recently, I coordinated the response of the Colorado environmental community to the proposed revised plan for the Rio Grande National Forest in southern Colorado by writing, assembling, and compiling comments that were sent to the Forest Service. I continue to consult with local groups regarding the proposed expansion of Eldora Ski Area. The result has been an agreement by the Ski Area not to expand toward Middle Boulder Creek.

At times, I review some projects for national forests outside of Colorado, primarily in California.

Colorado Wild and Rocky Mountain Wild[9]

Time: January 2000 to June 2012

Duties:

--Directed the Forest Watch Program, under which I monitored projects, activities, programs, plans, policies, and regulations proposed and approved by the U. S. Forest Service and its parent agency, the U. S. Department of Agriculture.

--I wrote detailed comments on a variety of proposals by the U. S. Forest Service, including: timber sales, fuels reduction projects, ski area expansion proposals, and proposed regulations. The latter included the Colorado Roadless Rule and various versions of the agency's planning rule, which governs all activities that occur on national forest lands.

--I helped prepare comments on proposals for leasing of public lands parcels for oil and gas. I became familiar with the rules, regulations, and policies governing oil and gas leasing and development on federal public lands.

--I worked on fighting proposed coal mine extensions under roadless areas in western Colorado. I became familiar with laws, regulations, and policies governing the leasing of national forest lands for coal mining.

--I regularly reviewed proposed regulations and policies and proposed and enacted laws, and developed summaries and fact sheets about the content for interested parties.

--I appealed and objected to various projects, using the agency's administrative review processes.

--I helped lawyers prepare litigation for a few of the cases I and/or others had worked on.

--I wrote media advisories and did interviews with various reporters in print and electronic media.

[9] Colorado Wild and the Center For Native Ecosystems merged to become Rocky Mountain Wild as of June, 2011. My work did not change as a result of the merger.

--I frequently wrote and distributed alerts to various interests on proposed activities, encouraging people to attend meetings and hearings, and to write letters to agency officials and others.

--I developed a high level of expertise in national forest management and forest ecology that is relied upon by many people and organizations in Colorado and nationally. I consulted with environmental and outdoor recreation organizations regularly, both locally and nationally.

<u>Private contractor</u>

Time: May 1998 to December 1999

Duties: I worked for various private clients who needed assistance dealing with various aspects of national forest management. I helped clients understand the public involvement, environmental analysis, and administrative review processes, and helped them make their input most effective.

Employer: <u>Colorado Environmental Coalition</u>

Time: September 1985 to April 1998

Duties:

--My duties were similar to those for Colorado Wild/Rocky Mountain Wild.

--I was one of the leaders in the campaign to promote alternatives to the then-proposed Two Forks Dam and Reservoir from 1985 to 1991. This long campaign was successful, in that Two Forks will not be constructed.

-- I reviewed grazing lease renewal proposals and allotment management plans after passage of the Rescissions Act in 1995.

--I led the development of citizens' management alternatives for three national forests as they revised their land and resource management plans under the National Forest Management Act.

EDUCATION

BA, Communication and Public Address, University of Wisconsin, Madison, 1972.

SAVE THE COLORADO WATEKEEPER ALLIANCE COLORADO RIVER CONNECTED

WILDEARTH GUARDIANS LIVING RIVERS THE ENVIRONMENTAL GROUP

Date: August 27, 2015

To: U.S. Army Corps of Engineers
From: Save The Colorado, The Environmental Group, Waterkeeper Alliance, Wildearth Guardians, Living Rivers, Colorado River Connected

Re: FEIS for Moffat Collection System Project failed to analyze impact of diversions on the Colorado River Compact, climate change, looming "shortages," and increasing the likelihood of a "Compact Call"

The National Environmental Policy Act requires that the Army Corps of Engineers (Corps) take a "hard look" at all direct, indirect, and cumulative impacts associated with the proposed alternative in the Moffat Collection System Project (Moffat)[1]. The proposed alternative for Moffat would take an average of 18,000 acre feet of new water out of tributaries of the Colorado River at the very top of the Continental Divide in Colorado. The other three action alternatives in the Moffat FEIS also would divert nearly as much water from the tributaries of the Colorado River.

Although the FEIS purports to analyze the environmental impacts on the tributaries at and near the diversion point, the FEIS completely fails to analyze the impacts on the water supply system for the entire Colorado River, including on the likelihood of the new proposed Moffat diversions adding to the potential for a "Compact Call" on the Colorado River.

The "Colorado River Compact" is federal law that allocates water in the Colorado River system, approved by Congress on August 19, 1921 (42 Statutes at Large, page 171), and ratified and legislated by the Acts of the Legislatures of participating member States. The Compact provides that the Upper Basin states (Colorado, Wyoming, Utah, New Mexico) shall get 7.5 million acre feet (maf) (Compact Article III(d)) and the Lower Basin states (Nevada, Arizona, California) shall get 7.5 maf.[2] Additional federal treaties have determined that the United States shall deliver 1.5 maf to Mexico annually. Thus 16.5 maf of water are allocated each year. Further, the Colorado River Compact requires that the lower basin has "senior rights" such that the Upper Basin states must deliver at least 7.5 maf to the Lower Basin states over any 10-year period, or 7.5 maf/year on average. Therefore, on average, 9.0 maf/year must be delivered by the upper basin to the lower basin and Mexico each year. In the Upper Basin, the State of Colorado shall get 51.75% of the upper basin's allotment as long as the requirement of the lower basin is met.

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1 http://planning.usace.army.mil/toolbox/processes.cfm?Id=231&Option=National%20Environmental%20Policy%20Act

2 http://www.usbr.gov/lc/region/g1000/lawofrvr.html

Due to long-term drought and a likelihood that climate change is already occurring in the Colorado River basin, over the past 16 years (1999-2014), the average flow in the Colorado River has equaled approximately 12.5 maf, well under the 16.5 maf allotted to all parties resulting in a large "cumulative streamflow deficit" across the system[34]. Despite the shortage, the delivery of water to the Lower Basin has still occurred because the Upper Basin stores water in the Colorado River Storage Project reservoirs – Navajo Reservoir, Blue Mesa Reservoir, Flaming Gorge Reservoir, and Lake Powell. Through "equalization" programs established as part of the 2007 interim guidelines, Upper Basin water can also stored in Lake Mead. However, the dramatic decline in river flows has also caused a corresponding decline in in reservoir levels in the two biggest reservoirs, Lakes Powell and Mead, and as of this writing the total combined storage in the reservoirs is at its lowest point in history since the reservoirs began to fill in the 1960s[5].

Parties involved in Colorado River management agree that an official "shortage" is likely to be declared in 2017[6] which would cut water deliveries to Arizona and Nevada. Such a shortage just missed being declared in 2015 due to "miracle rains" in the Upper Basin and the state of Colorado[7].

Climate change models developed and utilized by the U.S. Bureau of Reclamation[8], NASA[9], multiple university research centers[10], and U.S. EPA[11] predict that the Colorado River basin will likely be greatly impacted by future droughts as climate change intensifies. In its recent "Colorado River Basin Study," the U.S. Bureau of Reclamation predicted that temperature would increase across the basin[12], less precipitation and more "drying"[13] would occur across the basin, and total flow in the Colorado River would decrease to 13.7 maf over the period of 2011 - 2060 due to climate change[14]. 13.7 maf is significantly lower than the total 16.5 maf that is allotted, representing a 17% reduction in flows from the quantity the Colorado River Compact anticipates and allocates.

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[3] See figure B-14 on page B 24: http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Technical%20Report%20B%20-%20Water%20Supply%20Assessment/TR-B_Water_Supply_Assessment_FINAL.pdf

[4] See figure B-18 on page B 27: http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Technical%20Report%20B%20-%20Water%20Supply%20Assessment/TR-B_Water_Supply_Assessment_FINAL.pdf

[5] http://www.inkstain.net/fleck/2015/07/coases-reservoirs-how-transaction-costs-are-emptying-lake-mead/

[6] http://kjzz.org/content/145015/colorado-river-shortage-looms-arizona-water-managers-look-elsewhere

[7] http://www.gjsentinel.com/news/articles/miracle-may-8232for-colorado-8232water-levels

[8] http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Technical%20Report%20B%20-%20Water%20Supply%20Assessment/TR-B_Water_Supply_Assessment_FINAL.pdf

[9] http://climate.nasa.gov/news/2238/

[10] http://summitcountyvoice.com/2015/08/20/climate-west-may-be-in-permanent-drought-by-2060s/

[11] http://www.epa.gov/climatechange/impacts-adaptation/southwest.html

[12] See Figure B-37 on page B 53: http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Technical%20Report%20B%20-%20Water%20Supply%20Assessment/TR-B_Water_Supply_Assessment_FINAL.pdf

[13] See page B 56 and Figure B-40: http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Technical%20Report%20B%20-%20Water%20Supply%20Assessment/TR-B_Water_Supply_Assessment_FINAL.pdf

[14] See page B-65 and Figure B-45: http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Technical%20Report%20B%20-%20Water%20Supply%20Assessment/TR-B_Water_Supply_Assessment_FINAL.pdf

The Colorado River system is on the verge of having a "Compact Call," whereby the lower basin states would legally force the upper basin to deliver their full of 7.5 maf (plus 1.5 maf to Mexico) down the river. The State of Colorado has been preparing for a Compact Call for nearly a decade[15], and the State of Colorado's ongoing "Colorado Water Plan" process has put significant thought and verbiage into how a Compact Call would be addressed as the state diverts more and more water out of the Colorado River system[16],[17].

The likelihood and extent of a Compact Call absolutely would be exacerbated by new diversions out of the Colorado River and its tributaries in the upper basin. Further, each state in the upper basin is currently planning to divert more and more water out of the Colorado River system.

- Wyoming has claimed that it may be able to divert additional unallocated water out of the Colorado River system, and has stated that it intends to divert additional flows[18]. Wyoming is currently operating under a "10 new dams in 10 years"[19] policy – four of which would be on the Green River, a tributary to the Colorado River – as directed by Governor Mead. Further, Wyoming is trying to greatly expand the water diversion out of Fontenelle Reservoir[20] which is on the Green River, a tributary to the Colorado River.

- Utah has similarly asserted that it may be able to divert additional unallocated water because it alleges that it is not currently diverting its full allotment of Colorado River water. State officials have stated they want a new "dam on every river in the state,"[21] and are actively planning for the Lake Powell Pipeline[22] that would divert a very large amount of new water out of the Colorado River.

- It is unclear how much, if any, of Colorado's allotment of Colorado River water currently remains not diverted. Some people contend that Colorado may not be currently diverting the state's "full" allotment of Colorado River water, and cite that belief to justify the fact that the state is planning for multiple new, largely transbasin diversions of water out of the Colorado River including the Moffat Project, Windy Gap Firming Project, and projects associated with the Eagle River MOU[23]. Further, the Colorado Water Plan process is laying the groundwork for a new major "trans-mountain diversion" of water out of the Colorado River, the Plan intends to "fully develop Colorado's entitlement,"[24] and the director of the Colorado Water Conservation Board has publicly stated that the state does not intend to let its water flow to California[25]. During the

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[15] See slide 10: http://water.state.co.us/DWRIPub/DWR%20Presentations/kknox_0607.pdf
[16] See Draft 2 for discussion about risk of a compact call and trans-mountain diversions: http://coloradowaterplan.com/
[17] http://aspenjournalism.org/2015/08/26/transmountain-diversion-framework-endorsed/
[18] http://www.wyomingnews.com/articles/2015/05/03/news/01top_05-03-15.txt
[19] http://www.wyofile.com/wyoming-dam-construction-plans-advance/
[20] http://www.sltrib.com/home/2696289-155/wyoming-officials-want-expanded-usable-storage
[21] http://www.standard.net/Environment/2014/09/25/Talk-of-Utah-running-out-of-water-is-scare-tactics-says-conservation-group
[22] http://www.water.utah.gov/lakepowellpipeline/generalinformation/default.asp
[23] http://www.aspentimes.com/news/17406963-113/garco-water-meeting-seeks-to-protect-w-slope
[24] http://www.savethecolorado.org/blog/is-the-colorado-water-plan-ethically-bankrupt/
[25] http://www.sltrib.com/home/1928692-155/story.html

> Colorado Water Plan process, the CEO/Manager of Denver Water (which is the applicant of the Moffat Project) has very aggressively stated that his agency and the state intends to develop even more water out of the Colorado River through trans-mountain diversions[26].

Each new diversion of water out of the Colorado River system increases the likelihood of a Compact Call. Supplemental NEPA analysis for the Moffat Project must assess the potential for additional diversion and storage facilities from each of the states considered above, in addition to the reasonably foreseeable future diversions in Colorado already partially addressed by the FEIS. The Moffat Collection System Project's 18,000 acre feet would exacerbate the stress on the Colorado River water supply system, cause less flow to the lower basin, and increase the likelihood of a Compact Call. The environmental impact of a Compact Call has not at all been analyzed in the FEIS for Moffat. Because a compact call has never historically occurred, it is unclear from what parts of the upper basin the water would be forced to be sent to the lower basin.

Denver Water acknowledged the possibility of a Compact Call and the potential for significant impacts in an August 6, 2014 press release summarizing voluntary efforts to mitigate impacts of such an eventuality:

> In a first-of-its-kind partnership, agricultural and environmental organizations, West Slope water districts and Denver Water have come together to explore measures that could help benefit the Colorado River and avoid reaching critically low water levels in Lake Powell. Should levels in this important reservoir continue to decline due to the prolonged drought in the basin, it could result in a Compact Call, putting water supplies to much of Colorado and the upper basin states at risk.
>
> "Complying with the Colorado River Compact is a shared responsibility across all water-use sectors and among all the upper basin states" said James Eklund, director of the Colorado Water Conservation Board. "We must control our destiny. The worst case is a Compact Call or a situation where the federal government determines how we will manage critical flows. We simply must work together to protect the future of this state, all our economies and critical industries to avoid a future compact call."[27]

Further yet, Denver Water has directly stated that a Compact Call would have devastating impacts on its water supply. In this August 2015 *Wall Street Journal*[28] article and in this August 2014 *Las Vegas Sun*[29] article, Denver Water Director James Lochhead stated:

> "The biggest concern in Colorado and the upper basin states is the potential for what we call a "Compact Call," which is when we can't meet our water obligation to the lower basins. If we get to that situation on the river, it's not just a Las Vegas problem or an upper basin problem. If the river's to that point, then potentially <u>we lose half of Denver's water supply</u>."(underline added)

[26] http://www.savethecolorado.org/blog/will-denver-and-the-front-range-drain-the-colorado-river-and-the-west-slope/
[27] http://www.denverwater.org/AboutUs/PressRoom/B8EFE199-960D-766C-5D107097DDD3A65F/
[28] http://www.wsj.com/articles/water-fight-stirs-up-old-rivalries-in-colorado-1440439441
[29] http://lasvegassun.com/news/2014/aug/28/theres-drought-vegas-challenge-denver-water-biz/

Thus, the project proponent is well aware of the looming likelihood of a Compact Call. Denver Water seems to be relying on untested voluntary cooperation to lessen the impacts. The Moffat FEIS must take a "hard look" at the entire Colorado River system and the potential for the proposed Moffat Project to exacerbate current shortages and ecological challenges, possibly contributing to a Compact Call sooner rather than later and reducing the ability to cushion the impacts of such a call to impacted entities on Colorado's West Slope and across the Upper Basin.

Importantly, Colorado is but one of five Upper Basin states, and one of eight Compact states/countries. Notwithstanding the well-intentioned interest in various parties to work together in Colorado according to non-binding principles, Colorado does not now and never will control her own destiny so long as the Compact is the Law of the River conferring various rights and obligations to all eight member states and Mexico.

One Colorado River expert opines that "Colorado may already be at or above full development of its Colorado River supplies at certain periods."[30] Among the "sobering thoughts" advanced by Eric Kuhn, General Manager of the Colorado River Conservation District, is:

> Can you imagine the impacts to Colorado if a Compact Call curtailed projects such as the C-BT, Dillon Reservoir, Fry-Ark, Moffat Tunnel Collection System, Homestake, Twin Lakes, Wolford, Dallas Creek, Dolores and Central Utah Project, San Juan-Chama, etc., and they could not legally divert a drop of water?![31]

NEPA requires not only imagining such a scenario, but analyzing it. Kuhn states two equally sobering concerns demanding analysis in the Moffat FEIS:

> • The model results Reclamation has provided the Basin States uses the 1906-1995 period. Is this period representative of the long term hydrology? This period looks very wet.
>
> • Are hydrologic and climatic conditions changing faster than our ability to recognize these changes and develop near modeling and planning tools?[32]

Kuhn's sobering bottom line includes the possibility that: "If flow at Lee Ferry (undepleted) for the next 10-30 yrs. averages about 13 maf/year – could be big trouble."[33] Recall from text above, in the last 15 years, flow has equaled approximately 12.5 maf/year, and U.S. Bureau of Reclamation predicts that climate change will reduce flows to 13.7 maf/year over the period of 2011 – 2060.

The FEIS for Moffat must analyze the likelihood that the current proposed action and all alternatives under consideration in the Moffat FEIS could hasten a Compact Call, contribute to significant direct, indirect, and cumulative impacts both within and outside the State of Colorado, potentially affecting all eight member states/countries in both the Upper and Lower Basins.

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[30] http://www.fs.fed.us/rmrs/docs/climate-change/western-watersheds-workshop/certainty-uncertain.pdf at 18.
[31] Id. at 19.
[32] Id. at 22.
[33] Id. at 25.

Accordingly, before issuing a final Record of Decision, the Corps must prepare a Supplemental EIS analyzing the critical environmental impacts of unprecedented water shortages in the Colorado River system, and the environmental and socio-economic impacts of a Compact Call on applicable rivers, streams, states, and impacted populations. This analysis must encompass the entire Colorado River system and tributaries.

While Moffat proponent Denver Water has asserted that the Project would increase security for its own system, it is incumbent on the Corps to analyze 1) the possibility that completing the project would actually diminish water security for - not just Denver Water - but all users in the Upper Basin; and 2) the potentially significant socio-economic impacts that could unfold in such a scenario.

Failure to analyze these impacts violates NEPA should the final decision adopt any of the current action alternatives. The only way to proceed without preparing an SEIS would be to select an alternative that avoids any additional diversions from the West Slope to Gross Reservoir and Dam, and rejects the proposal to expand Gross Reservoir by raising the dam.

We send these comments to you for insertion into the public record for Moffat under the direction you have previously given the public that you will accept "meaningful and substantive comments on the analysis until the agency makes a decision on the project…"[34]

The groups signed below stand ready and willing to meet with the Corps and Denver Water officials to discuss this crucial and glaring omission in the current NEPA documents prepared in conjunction with the Moffat project.

Please acknowledge receipt of this letter. Thank you,

Gary Wockner
Executive Director
Save The Colorado

Pete Nichols
National Director
Waterkeeper Alliance

Jen Pelz
Wild Rivers Program Director
Wildearth Guardians

John Weisheit
Colorado Riverkeeper
Living Rivers

[34] http://www.dailycamera.com/boulder-county-news/ci_25989891/epa-see-plans-gross-reservoir-expansion-threat-water

Chris Garre
Board Chair
The Environmental Group

Lesley Adams
Coordinator
Colorado River Connected

The Environmental Group (TEG) • Save the Colorado • Save the Poudre

June 9, 2014
Submitted via electronic mail and delivered in-person by Chris Garre, President of TEG
To: Rena Brand, Moffat EIS Project Manager
U.S. Army Corps of Engineers, Omaha District
Denver Regulatory Office
9307 South Wadsworth Boulevard
Littleton, CO 80128

Re: Moffat Collection System Project – Final Environmental Impact Statement

Dear Ms. Brand:

The Environment Group, Save the Colorado, and Save the Poudre (collectively, the Conservation Organizations) respectfully submit the following comments on the Final Environmental Impact Statement (FEIS) for the Moffat Collection System Project. Despite our disappointment in not receiving the extension to review the 11,000 page document, we have provided thorough and rigorous comment on the false claims, faulty review, and inadequate analyses in the Moffat Project FEIS.

By permitting another large-scale water diversion project such as this, the US Army Corps of Engineers only furthers the destructive practices that threaten our nation's rivers and future water supply. Water development is listed by the National Wildlife Federation as one of the main drivers of habitat loss in the U.S. Climate Change will alter the availability of water in the future and the time is now to change the conversation about water management in Colorado.This document examines the fatal flaws of the FEIS and brings your attention to the harm to the communities we represent and to the wildlife that rely on these vital and shared water resources. We examine the flaws in the Moffat Project and provide more practicable alternatives with less adverse effects.

Please see the table of contents for an outline of our main arguments. Attached you will find Appendix A: "Addendums" that contain additional information pertaining to the content of this document. You will find in Appendix B-F: References, in CD form that will be hand delivered to the Corps on June 9th, 2014. Appendix B-F contains the references cited in the text as well as additional sources. We appreciate your time and consideration of our response to the FEIS concerning a project that holds local and regional consequences for both human and wildlife communities on both sides of the Continental Divide.

Sincerely,
Chris Garre, TEG   Gary Wockner, Save The Colorado   Mark Easter, Save The Poudre

Contributing authors: Lisa Buchanan, Judy Green, Chris Garre, Emily Troisi, Susan Bates, Kai Eldredge, John Lodenkamper, Geoff Elliott, Heather Lazurus, Joni Teter

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SUMMARY OF COMMENTS:

Post-Moffat trans-basin diversions out of the Fraser, Williams Fork, Blue, and Colorado River basins have left depleted river systems in these headwater basins; between 60 and 80 percent in the Fraser River, and on the Colorado River below Windy Gap and near Kremmling. Severe depletions under existing diversions already stress aquatic ecosystems in these basins to a point **near or at failure.** The proposed Moffat Project would divert the majority of remaining water at their diversion structures to operate an expanded Gross Reservoir that increases the current storage capacity of 41,811 AF by almost 3 times. Concerns with the FEIS are numerous.

The purpose and need of project is stated inconsistently, narrowly, and inaccurately in the FEIS;

- The project purpose of attaining an additional annual firm yield of 18,000 AFY for Denver's north water supply system is **confused with contingency reserves** that are used only under drought conditions
- The project does little to balance Denver's north and south water supply systems, another stated goal of the project, as additional diversions, the difference between existing measured and the proposed project diversions, through the Roberts Tunnel entering the south system are **more than twice that for the Moffat Tunnel entering the north system.**
- The PN screening criteria that additional diversions come from the Moffat Collection System and add to Denver's northern water system are so narrow that every final alternative must include an expanded Gross Reservoir.
- **Water diverted through the Roberts Tunnel and from the South Platte as part of the project cannot be used in the north system and therefore**, contradicts the PN screening criteria.
- Use of unrestricted demand particularly during drought periods when water restrictions would very likely be in place, **inflates demand requirements and water shortfall estimates**. Thus **the No Action scenario as presented in the FEIS is worst case**, inflated, and **cannot be substantiated**.
- Water supply demand projections have a high degree of uncertainty because of uncertainties inherent in economic, hydrologic, and demographic predictions; different prediction methods often yield widely different results, so **use of a range of demand projections instead of an average is more appropriate.**
- The **arbitrary shortfall of 18,000 AFY** was fabricated to support a reservoir that would "fit the site."

Impacts of the Project are minimized and obfuscated due to use of the "Full Use" baseline, use of average annual statistics **instead of irrigation season and median statistics, and omission of impacts caused by past historical and hidden modeled diversions trans-basin diversion**.

- The FEIS discusses several potential baselines based on historical hydrologic data, Current Conditions PACSM model results, and Full Use of Existing PACSM model results. The Full Use baseline was ultimately used to assess the impacts of the Proposed Moffat Project so that project impacts were limited to what the EIS claims is the "minimal" and "negligible" incremental change between Full Use and Proposed Project

Model results. In fact, an independent firm yield analysis of the expanded Gross Reservoir with additional water diversions shows that all additional diversions, those embedded in the current conditions model scenario (7,300 AFY) plus both the Full Use (2,713 AFY) and Proposed Project (10,280 AFY) diversions, are required to meet the firm yield goal of the Moffat Project. **Based on this analysis, the appropriate baseline by which to assess impacts on the Upper Colorado basins caused by the Moffat Project is the Post-Moffat historical record.**

- **Impacts to stream flows caused by additional project diversions are under-estimated** or under-represented in the EIS due to use of annual rather than irrigation season data and *average rather than median statistics* to describe flow depletion and the baseline flow conditions. Because averages of stream flow data at all USGS gage locations in the Fraser River and downstream on the Colorado River are skewed high, the average inaccurately inflates the amount of water that remains in streams in the Upper Colorado basins both historically and in post-project PACSM model results.

- The predicted impact of additional diversions on stream flows in the Fraser and Upper Colorado basins that utilizes the historical median baseline is substantially greater than project impacts noted in the EIS; **with some flow reductions greater than 100 percent**.

- Cumulative impacts in the EIS are limited to impacts caused by additional diversions between the Current Condition and the Proposed Project. **By ignoring pre-existing impacts to the upper Colorado basins caused by historical diversions, past cumulative impacts are not included in the project.** Also, the EIS ignores impacts of substantial additional diversions that are embedded in the Current Condition model scenario.

<u>Alternatives Summary</u>

The purpose of NEPA and CWA laws concerning Environmental Impact Analyses is to:

- explore and objectively evaluate all reasonable alternatives,
- provide a clear basis of choice among the options
- select the Least Environmentally Damaging Practicable Alternative (LEDPA) to avoid impacts instead of mitigating them and to avoid destruction of an area of water of the US.

The screening process in the FEIS is flawed and raises numerous concerns about the expansion of Gross Reservoir or the Moffat Project. Flaws include use of:

- an extremely narrow definition of purpose and need,
- erroneous and inconsistent low cost estimate for the preferred alternative,
- ill defined screening criteria,
- out of date project costs.

The flawed screening process in the FEIS based on narrowly defined project purpose and need, **biases its outcome to five final alternatives that are essentially the same; all include expansion of Gross Reservoir to some degree and all utilize additional trans-basin diversions from the Upper Colorado drainages**. The EIS process thus did not produce a clear basis of choice of alternatives.

The Corps may not be impartial to the outcome of the FEIS analysis. Gross Reservoir expansion was an alternative evaluated in the Two Forks Dam project EIS. At that time the Corps advocated for the Gross Reservoir expansion alternative. If the Corps does advocate for the expanded dam they would likely approve the narrow definition of purpose and need to assure that expansion of Gross Reservoir survives the screening process potentially ignoring regulatory guidance under Section 404 of the CWA and in the federal register that the "corps will not be a project opponent or advocate, but will provide an objective evaluation."

The flawed screening process eliminated several alternatives based solely on cost, biased by the extremely low cost of the proposed alternative; expansion of Gross Reservoir. This low cost could not be substantiated and was inconsistent with other cost estimates for the same or similar project noted under the FERC permit application. Based on other supporting evidence, the costs in the FEIS appear to be inaccurate, resulting in a seriously flawed screening process in which the LEDPA may have been screened unnecessarily. **Also, costs embedded in the Colorado River Cooperative Agreement have not been included in the proposed alternative further biasing the cost comparisons in the FEIS**. Alternatives 2a1, 2b, 3a1, 3b, 5a, 5b, 6a, 10c, 13b and 14, screened in the cost comparison should be analyzed for both environmental impacts and practicability before a Section 404 decision is made.

Other alternatives screened unnecessarily using PN3 criteria, the requirement for a near-term timeframe, that meet the CWA 404 guidelines and could be considered the LEDPA are the institutional/water management alternatives 304, 305, 306, and 501; the near-term time frame was not defined. The ET1 criteria, requiring use of proven technology, inappropriately screened Alternative 402, direct potable reuse.

The proposed project was not evaluated using the LP2 screening criteria. Since the proposed project as stated, does not meet the firm yield requirement of the LP2 screening criteria, it should have been screened early in the EIS process.

The Moffat Project is classified as "non water-dependent." This classification requires additional evaluation of special aquatic sites such as wetlands and selection of the least environmentally damaging project (LEDPA). The Corps has the burden of determining and documenting that the selected alternative is the LEDPA. Though the preferred alternative does affect special aquatic sites (SAS) in Gross Reservoir and on the Western Slope, the FEIS fails to prove that there is no other alternative with less impact on the SAS. In fact, all of the alternatives including the preferred alternative affect special aquatic sites; every alternative that does not was rejected. Because a viable alternative not involving a SAS was not among the alternative choices, the project cannot be permitted. **It cannot be claimed that the Moffat Project is the LEDPA because it does impact an SAS, has more adverse effects that other alternatives, and is costly**.

Because the Corps will violate EPA's 404(b)(1) Guidelines and its own mandate if it issues a Section 404 permit for the Moffat Project, the Corps should deny the permit.

Potential courses of action include:

- re-evaluation of alternatives that were unnecessarily screened
- since expansion of Gross Reservoir does little to alleviate the imbalance in north and south systems, connection of the two systems should be a priority to bring raw water directly to the Moffat Treatment Plan or upstream of the plant to provide raw water to customers.
- The view of many reviewers of the DEIS was that the most commonsense and obvious LEDPA was not proposed—water conservation, deemed highly feasible as described in Addendum I.
- Wastewater treatment is becoming more efficient and less costly, and the development of satellite wastewater treatment systems and gray-water systems is moving ahead. Denver Water should propose an alternative that fits with the times and is forward-looking. Because there is time, the Corps and Denver Water should go back to the drawing board and find creative and non-destructive ways to meet future supply and demand needs.

<u>Mitigation Summary:</u>

The Mitigation and Enhancement Coordination Plan (MECP), drafted by Denver Water and Grand County in February 2014, does not adequately address impacts to the Upper Colorado basins.

- Basin impacts attributed to the proposed project are minimized and obfuscated in the FEIS; thus mitigations noted in the MECP Section 1 are minimal and do not reflect the substantial basin impacts that will occur if a high percentage of the remaining flows are withdrawn from the mainstem and tributaries of the Upper Colorado basins.

- The MECP does not follow federal regulations and guidance on mitigation plans; therefore there are significant omissions in the current plan.

- The majority of work associated with mitigation efforts would be done on a voluntary basis (Section 2 of the MECP), and does not assure that mitigation will be effective.

- Decisions on mitigation efforts in the Fraser Basin are limited to a few entities in the MECP and should allow input from all interested parties.

- Classification of old versus new water diverted from the Fraser and Williams Fork basins is confusing and potentially provides a loophole by which Denver Water would not be obligated to implement any of the mitigation plan.

- The plan will require substantial editing to reflect true basin impacts and to adhere to the structure of a comprehensive mitigation plan as outlined by the EPA.

As water supply becomes increasingly over drawn on all Colorado Rivers and, in this case, in the Upper Colorado basins, administering water rights while protecting valuable aquatic resources and upper basin communities is of utmost importance for the state. Trans-basin diversions have already put stream systems and Western Slope communities at risk of failure. A different approach that does not support draining Western Slope basins dry is absolutely necessary. **Section 2 of the MECP, may be a start toward this approach, however, it should not be voluntary and should not depend on acceptance of a project that will dry up two important upper Colorado basins.** Because water use on the Eastern Slope pushes the upper western slope basins toward perpetual drought conditions, it is high time that all state water users take responsibility for impacts of historical and potential future trans-basin diversions. All state water users need to pay into a fund, as a fee tied to their water use. Funds should be administered by a state agency to monitor the health of basins from which water is diverted in accordance with monitoring methods outlined in the EPA regulations and guidance documents and other state or federal agencies. This fund would also be utilized to offset costs incurred by the upper basin communities caused by low stream flows; a direct effect of trans-basin withdrawals from the upper basins. Such a system should be included in the State Water Plan and should take effect immediately, **prior to any further diversions from upper Colorado Basins**. Assessments on the health of river systems should be utilized as a management tool for water supply providers and to provide an upper limit to the amount of water that can be diverted each year from the Upper Colorado watersheds.

"Other Comments":

U.S. District Court, Consent Decree, Civil Action No. 77-W-306, Denver v. Andrus, 1979, otherwise known as the "Foothills Agreement" mandates the creation and approval of a system-wide EIS (SEIS) prior to construction of any supply projects by Denver Water.

BACKGROUND

Depletion of Stream Flows in the Fraser River and Upper Colorado Basins

Stream flow gages maintained and monitored by the USGS are located throughout the Fraser and Williams Fork Basins (Figure 1) and on the Upper Colorado River. Figure 1 also shows Denver Water's diversion system: including diversion aqueducts and trans-basin tunnels in the upper Fraser and Williams Fork basins. A majority of native flows upstream of the diversion aqueducts are captured and diverted to the eastern slope through the Moffat Tunnel thus basin stream flows are already depleted. **This depletion was evaluated using USGS data from pre-Moffat and post-Moffat time periods** (i.e. before and after Denver Water started diverting water through the Moffat and Gumlick Tunnels) when these data were available.

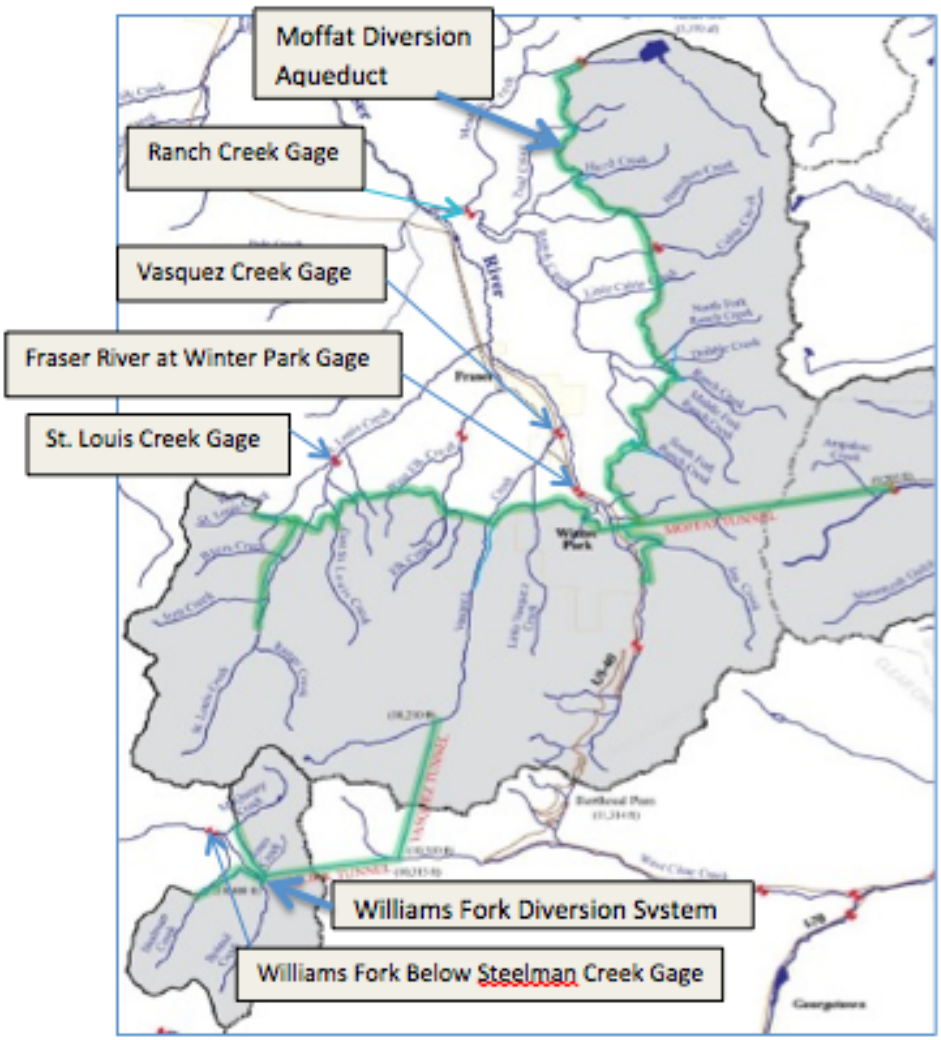
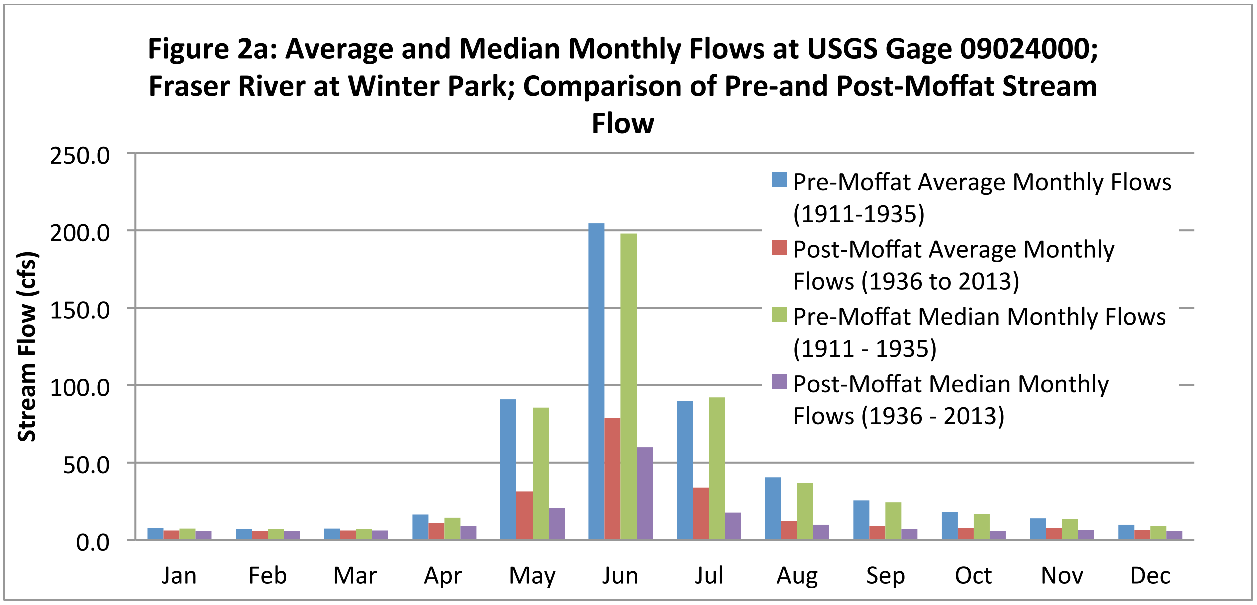
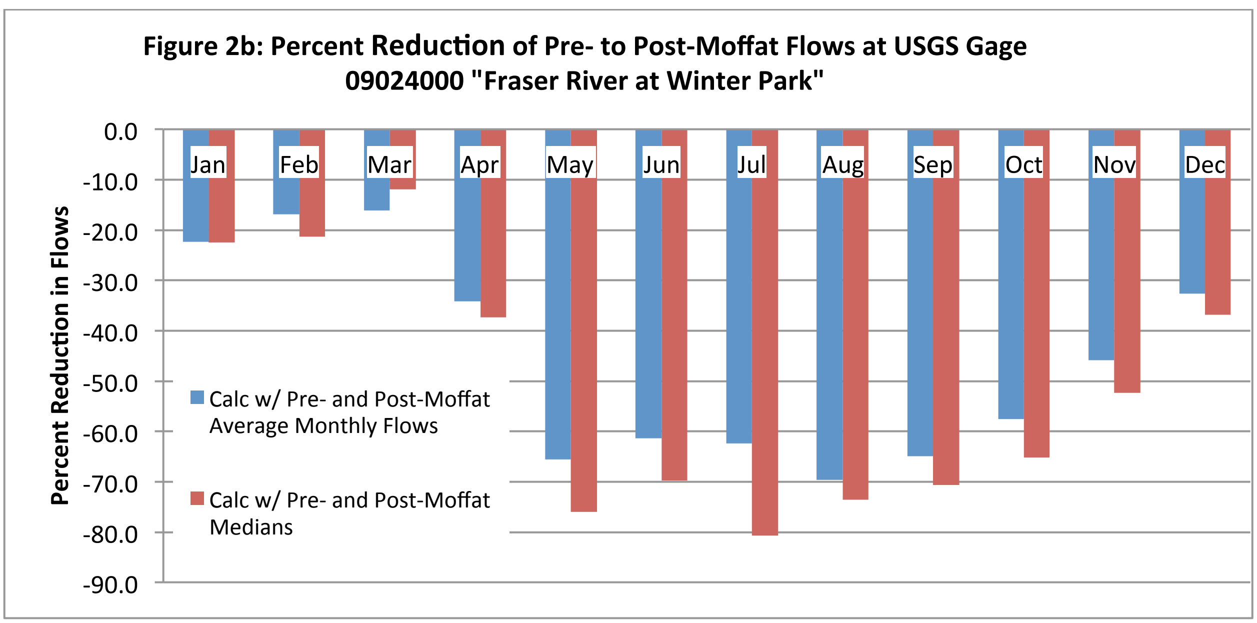


Figure 1: Denver Water's Diversion System and USGS Gage Locations in the Fraser and Williams Fork River Basins.
Source: Figure 1-1 FEIS

Fraser River Main Stem

Stream flow data at the USGS gage (09024000) "Fraser River at Winter Park" located downstream of the west portal of the Moffat Tunnel (Figure 1) were used to evaluate depletion of native flows in the Fraser River main stem caused by DW Moffat diversions. Flows were recorded at this USGS gage between 1911 and the present. Years 1911 to 1935 represent pre-Moffat conditions which were compared to the post-Moffat flows recorded from 1936 to 2013. Average and median monthly pre- and post- flows are shown in Figure 2a. Percent reduction in monthly average and median pre- to post-time periods is presented in Figure 2b.

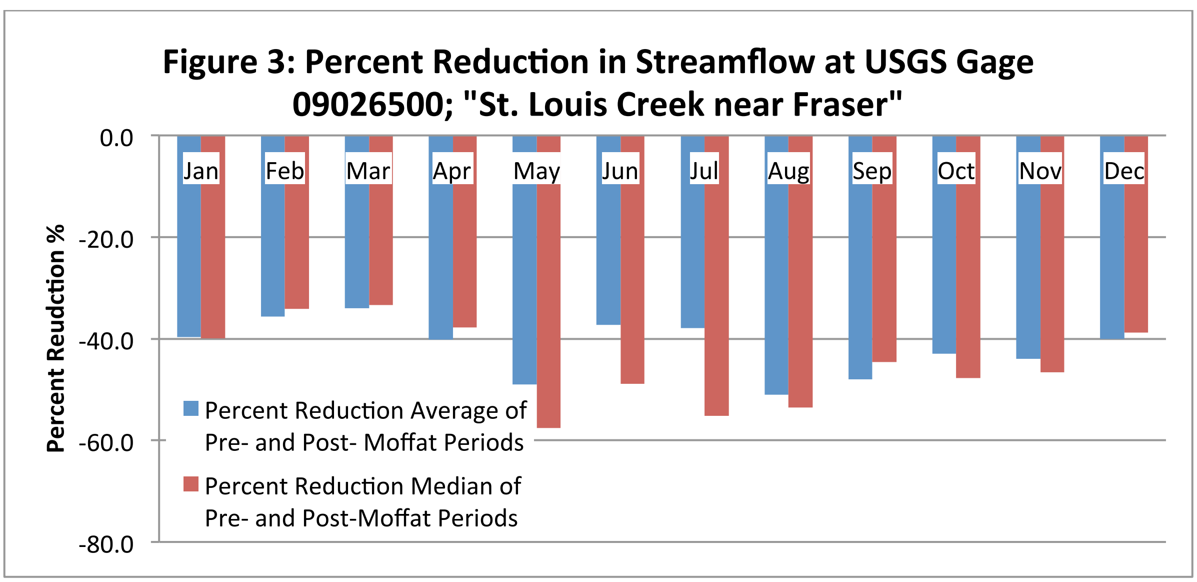




Stream flow in the Fraser River at Winter Park is substantially depleted under current operating conditions and Gross Reservoir storage at 41,811 AF. Average stream flows have been reduced by between 60 and 70 percent in May through September. Median monthly stream flows, lower than average monthly flows, are reduced by 70 to 80 percent from pre- to post-Moffat diversion periods in May through September (See comment In Section I.B.1. “use of median vs. average”). This means that, half the time flows during the irrigation season at this gage could be depleted by greater than 70 to 80 percent. EIS discussions of flow depletion are based on annual averages (59.4 %) that under represent the extent of depletion during the irrigation season. Pre- to post-Moffat depletion estimates based on annual medians are higher at 64 percent.

Tributary Depletion

Major tributaries to the Fraser River from which Denver diverts water to the Moffat Tunnel include Vasquez Creek, St. Louis Creek, and Ranch Creek. On all but St. Louis Creek, the period of record at tributary USGS gages does not start prior to Denver Water’s diversions. Diversion infra-structure was completed on St. Louis Creek in 1956 (waterdata.usgs.gov) while USGS stream flow data at USGS gage 09026500; St. Louis Creek near Fraser, runs from 1935 to the present. Average and median flow depletion from pre-Moffat (1935 to 1955) and Post-Moffat (1956 to 2013) periods are shown in Figure 3. Stream flows on St. Louis Creek are, on average, reduced by 30 to 40 percent in winter months, December through April, and between 35 and 50 percent from May through November. Median percent reduction of pre- to post-Moffat flows are higher, sometimes greater than 50 percent during the irrigation season. Note that two streams, Deadhorse Creek and Spruce Creek, enter St. Louis Creek between Denver Water’s diversion points and the USGS gage. These side streams, originating at Bottle Peak, elevation 11,584 feet, likely contribute significant flow to St. Louis Creek during the snowmelt months of May and June.



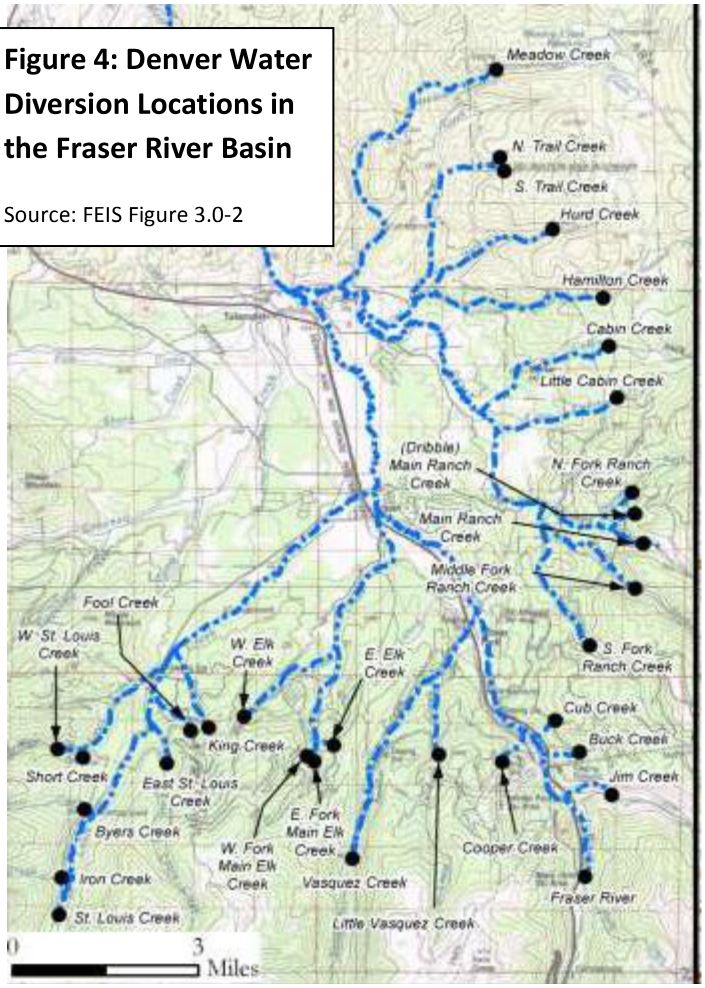


Figure 4: Denver Water Diversion Locations in the Fraser River Basin

Source: FEIS Figure 3.0-2

Denver diverts from every contributing side stream on Ranch and Vasquez Creeks (See Figure 4). Denver diverts "*100 percent of the water from streams that do not have minimum bypass flow requirements.*" These streams "*are fully diverted and dried up early in runoff season similar to dry years. Once Denver Water anticipates filling Gross and Ralston reservoirs and water demand is being met, Denver Water will begin to reduce diversions*" and allow water to flow past their diversion structures in the Fraser Valley until *"Gross Reservoir begins to be drawn down, typically in mid-summer, when Denver Water will again divert the maximum amount available to keep Gross Reservoir as full as possible." (FEIS p. 3-36).* In addition, bypass flows, measured at USGS gages located downstream of the diversion structures, are often made up of inflows entering the streams between diversion gates and the USGS gages. These downstream flows originate from elevations of less than 9,500 feet on Ranch and Vasquez Creeks. Due to both the ubiquitous distribution of diversion gates and diversion operations, tributaries to the Fraser River, particularly Ranch and Vasquez Creeks are and have been severely depleted during the diversion/irrigation season. Unfortunately, USGS gage data do not start prior to Denver Water's diversion period on these tributaries.

Colorado Mainstem Depletion

Stream flows at the USGS gage at Hot Sulphur Springs show severe depletions of flows at this location due to trans-mountain diversions through both the Alva B Adams Tunnel from the Three Lakes Reservoir system and through Moffat Tunnel in the Fraser Valley. The following Figure 4 shows an average annual reduction of 77 percent of native pre-diversion flows consistent with Table 3.1-14 of the FEIS which states that an estimated 33.6 percent of annual native flows remain in the Colorado River at Hot Sulphur Springs. Figure 6 better shows the step-wise impact of compounding diversions on the median daily hydrograph at Hot Sulphur Springs (compared to Figure 3.1-3 of the FEIS). Trans-mountain diversions from both upstream basins, the Fraser and Upper Colorado, and out of priority exchanges with water in the Williams Fork Reservoir have created a "hole in the river" and perpetual drought conditions at Hot Sulphur Springs.

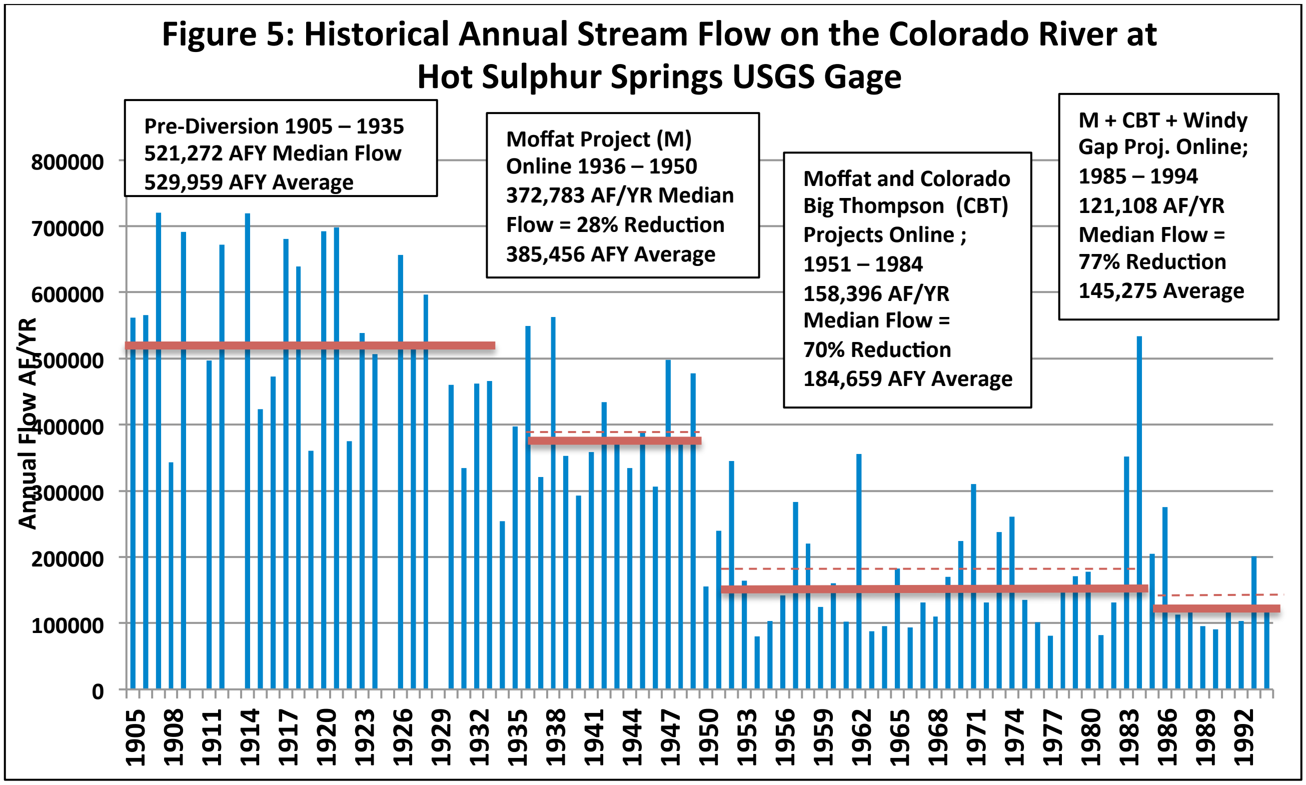


Figure 5: Historical Annual Stream Flow on the Colorado River at Hot Sulphur Springs USGS Gage
Pre-Diversion 1905 – 1935
521,272 AFY Median Flow
529,959 AFY Average
Moffat Project (M)
Online 1936 – 1950
372,783 AF/YR Median
Flow = 28% Reduction
385,456 AFY Average
Moffat and Colorado
Big Thompson (CBT)
Projects Online ;
1951 – 1984
158,396 AF/YR
Median Flow =
70% Reduction
184,659 AFY Average
M + CBT + Windy
Gap Proj. Online;
1985 – 1994
121,108 AF/YR
Median Flow =
77% Reduction
145,275 Average
Annual Flow AF/YR
800000
700000
600000
500000
400000
300000
200000
100000
0
1905
1908
1911
1914
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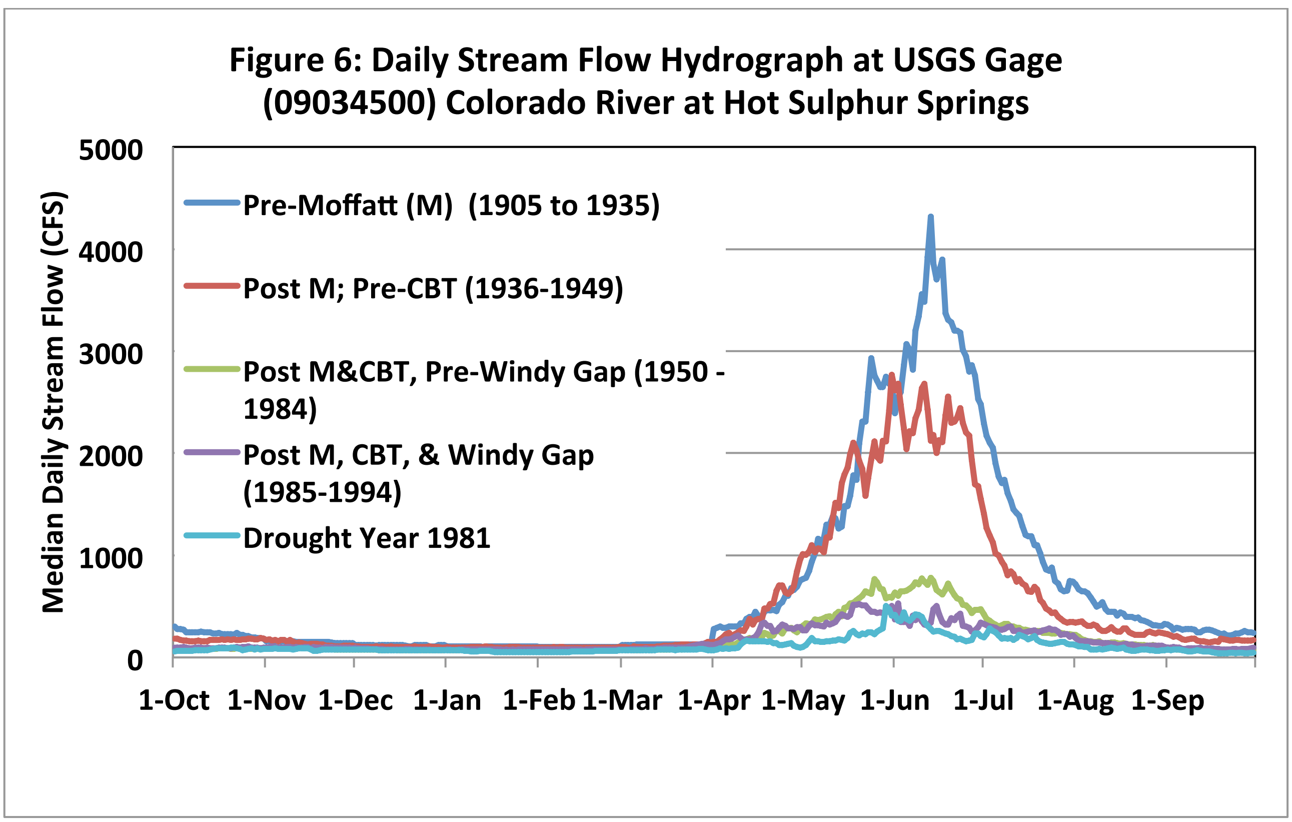


Figure 6: Daily Stream Flow Hydrograph at USGS Gage (09034500) Colorado River at Hot Sulphur Springs
Pre-Moffatt (M) (1905 to 1935)
Post M; Pre-CBT (1936-1949)
Post M&CBT, Pre-Windy Gap (1950 - 1984)
Post M, CBT, & Windy Gap (1985-1994)
Drought Year 1981
Median Daily Stream Flow (CFS)
5000
4000
3000
2000
1000
0
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep

Data also are available at the Colorado near Kremmling gage to evaluate the impact of trans-mountain diversions on the Colorado River. Pre-diversion annual flow data from 1905 to 1918 average 1,337,878 AF/YR (median of 1,259,776 AF/YR) while post-diversion annual flow data after the Windy Gap project went on line in 1985 averages 706,894 AF/YR (median of 642,009 AF/YR). River flow reductions at the Kremmling gage reflect a vast array of upstream diversions and reservoir operations. As a result the Colorado River flows at Kremmling have historically been depleted by approximately 49 percent (47.2 percent using averages) annually. Irrigation season flows in May, June, and July, show the true impact of diversions during these months with 67.6, 81.7, and 66.4 percent reduction in flows (using median of monthly flows) between pre- and post-diversion time periods (61.1, 73, and 56.1 percent if using average flows).

DISCUSSION

I. The Analysis in the Moffat FEIS Violates NEPA.

The National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321-4370h, is the "centerpiece of environmental regulation in the United States." *New Mexico ex rel. Richardson v. Bureau of Land Mgmt.*, 565 F.3d 683, 703 (10th Cir. 2009). Congress enacted NEPA, in part, to "promote efforts which will prevent or eliminate damage to the environment." 42 U.S.C. § 4321. This purpose is accomplished primarily through the preparation of an EIS (or environmental assessment (EA)) that forces federal agencies "to pause before committing resources to a project and consider the likely environmental impacts of the preferred course of action as well as reasonable alternatives." *New Mexico*, 565 F.3d at 703. By requiring agencies to analyze the environmental impacts of a proposed action in an EIS, "NEPA facilitates informed decision-making by agencies and allows the political process to check those decisions." *Id.* The NEPA process guarantees that an agency prepares a "coherent and comprehensive up-front environmental analysis to ensure informed decision making to the end that 'the agency will not act on incomplete information, only to regret its decision after it is too late to correct.'" *Blue Mountains Biodiversity Project v. Blackwood*, 161 F.3d 1208, 1216 (9th Cir. 1998) (quoting *Marsh v. Or. Natural Res. Council*, 490 U.S. 360, 371 (1989)).

The Moffat FEIS violates NEPA because it fails to analyze reasonable alternatives to the Moffat project and does not take a hard look at the project's environmental impacts. The Conservation Organizations urge the Corps to correct these flaws in the FEIS before issuing a Record of Decision (ROD) approving the proposed action.

A. The FEIS failed to analyze a reasonable range of alternatives to the proposed Moffat project.

The "heart" of an EIS is its analysis of alternatives to the proposed action. 40 C.F.R. § 1502.14. Agencies must "rigorously explore and objectively evaluate all reasonable alternatives" to the proposed action. *Id.* § 1502.14(a). The purpose of this alternatives analysis is to allow the agency and the public to "compare the environmental impacts of all available courses of action." *New Mexico*, 565 F.3d at 703. The alternatives analysis must "sharply defin[e] the issues and provid[e] a clear basis for choice among options by the decision-maker and the public." 40 C.F.R. § 1502.14. The Moffat FEIS's alternatives analysis is fatally flawed because it only analyzed a narrow range of alternatives to the proposed Moffat project. Instead, the FEIS should have fully analyzed reasonable alternatives.

As Boulder County addresses in their comments; "Based upon the experience of other metropolitan communities in the arid southwest, we believe that the potential for water conservation and efficiency in Denver Water's existing system have been understated and the Denver Water's price structure is too low, sending a weak conservation price signal" (Domenico et al, 2014). We agree with this sentiment and have further discussion located in <u>Section II.A of this document for analysis on alternatives that additionally pertain to the 404(1)(b) alternatives analysis.</u>

1. The FEIS's purpose and need statement is unreasonably narrow and foreclosed reasonable alternatives to meet future water demand.

NEPA requires agencies to evaluate all feasible and non-speculative alternatives to the proposed action that would achieve the proposed project's overarching objective. *Utahns for Better Transp. v. U.S. Dep't of Interior*, 305 F.3d 1152, 1166 (10th Cir. 2002); *Davis v. Mineta*, 302 F.3d 1104, 1119–20 (10th Cir. 2002). Consequently, an EIS's purpose and need statement is critically important in determining what alternatives must be analyzed. Agencies cannot define the purpose and need of a project "so narrowly as to preclude a reasonable consideration of alternatives." *Wyoming v. U.S. Dep't of Agric.*, 661 F.3d 1209, 1244 (10th Cir. 2011) (quoting *Citizens' Comm. to Save Our Canyons v. U.S. Forest Serv.*, 297 F.3d 1012, 1030 (10th Cir. 2002)); *see also Nat'l Parks & Conservation Ass'n v. Bureau of Land Mgmt.*, 606 F.3d 1058, 1072 (9th Cir. 2009) (agency cannot "craft a purpose and need statement so narrowly drawn as to foreordain approval of the [proposed project]"); *Simmons v. U.S. Army Corps of Eng'rs*, 120 F.3d 664, 666 (7th Cir. 1997) ("If the agency constricts the definition of the project's purpose and thereby excludes what truly are reasonable alternatives, the EIS cannot fulfill its role."). For example, if a proposed project's objective is to provide additional road capacity across a river, a purpose and need statement that limits alternatives to a bridge at a specific location would be unreasonably narrow. *Davis*, 302 F.3d at 1119–20. Similarly, if the overall purpose of a proposed water supply project is to satisfy a "thirst for water," a purpose and need statement that requires constructing a single new reservoir is unreasonably narrow. *Simmons*, 120 F.3d at 667, 669–70.

<u>**Inconsistencies in Stated Purpose of the Project**</u>

The stated purpose of expanding Gross Reservoir ***is to provide a firm yield of 18,000 AFY from the Moffat Collection System to Gross Reservoir, the Moffat WTP, and upstream water rights holders*** to help satisfy a future demand of 363,000 AFY on Denver Water's water supply system and balance northern and southern water supply operations.

Inconsistency in Purpose, Drought Contingency versus Firm Yield

Statements made in the FEIS contradict this declared purpose of the project, by implying that the storage in the expanded Gross Reservoir would be used only for drought contingencies, so that the actual purpose of the project is unclear. Two such statements are:

1. Page 4-61 of the FEIS, the statement; "in general, the majority of "new" water diverted to Gross Reservoir would be kept in storage until a dry year or sequence of below average years occurs."
2. In Chapter 1 of the FEIS it states; "to meet future demands Denver water would rely on the north and south systems. In drought or emergency Denver Water would rely on additional water of 18,000 AFY stored in Gross Reservoir."

If contingency storage is all that is required versus a firm yield of 18,000 AFY, **a different alternative should be evaluated for contingency storage that can be filled between drought periods**. Alternatively, agricultural rights on the eastern slope could be leased in drought years to cover Denver's water supply needs during these critical periods.

Inconsistency in Purpose, Water Sources for Expanded Gross Reservoir and Moffat Water Treatment Plant:

- Response number 738-92 for the DEIS federal comments states: "*The 18,000 AFY of new firm yield under the Proposed Action comes from increased diversions through the Gumlick Tunnel, Moffat Tunnel, and Roberts Tunnel as well additional South Boulder Creek and South Platte River diversion*." Yet the stated purpose of the project is to provide the Moffat water treatment plant and upstream water rights holders with **18,000 AFY of new raw water.** How will the additional diversions through the Roberts Tunnel and South Platte diversions supply additional water to the Moffat WTP? Alternatives connecting the raw water supplies in these two basins were not included in the final proposed alternative. **Please explain this inconsistency.**

- In the same comment response **the responder confused the average increase in diversions with firm yield** – which incorporates storage in the system. They listed diversions from the Gumlick Tunnel (1900 AFY), Fraser River Basin (8,400 AFY), the Blue River Basin (4,800 AFY), the South Platte River Basin (2,400 AFY in direct diversions and exchanges to Conduit 20), and South Boulder Creek (1,200 AFY) for a total average diversion of 18,700 AFY. **Average diversion amounts are not the same as average firm yield of a surface water reservoir supply system**. **Please clarify the purpose of the proposed expansion of Gross Reservoir.**

- Not only are inconsistencies noted in DEIS comment responses but also in FEIS Table H-7.1 where 4,836 AF/Y on average will be diverted through the Roberts tunnel from the Blue River Basin to the South Platte Basin to supply water for the expanded Gross Reservoir on South Boulder Creek. This represents 32 percent of the average 15,120 AF/Y trans-basin diversions (Moffat supplying 10,285 AF/Y) of the proposed project that will not be available for water supply operations in the north supply system and the

Moffat Water Treatment Plant. The explicit purpose of the proposed project is to supply additional water to Denver's northern system. **Please explain this inconsistency.**

Inconsistency in Purpose: Balancing North and South Water Supply Systems:

The FEIS consistently states that one of the most important needs of the project is to further balance the north and south water supply systems. Table 1 summarizes additional trans-basin diversions inherent in the PACSM modeling. Diversions noted under modeled current conditions equal the discrepancy between modeled annual average diversions and the measured annual diversions averaged from 1984 to 2013. Measured diversion flows were obtained from the Colorado Decision Support System database. Substantially more water is obtained from trans-mountain diversions through the Roberts Tunnel in both the "Current Condition" and "Full Use" model scenarios. Of the total diversions, 31 percent of future modeled diversions will come from the Moffat Collection system to the northern water supply system and 69 percent will come from the Blue River to the southern system. This is in addition to the current imbalance noted in Section 1.3.1.6 of the FEIS; of Denver's total water supply, 80 percent is supplied through the southern system, which also contains 90 percent of the available storage. It appears that this imbalance in water supply and storage will still be present even with an expanded Gross Reservoir and additional diversions from the Moffat Collection System. A direct more permanent connection between the north and south water supply systems seems advisable under these circumstances. **Please explain, given that the system imbalance will remain even with the proposed project, why alternatives that provide a more permanent connection between the north and south water supply systems were screened from detailed evaluation**.

Table 1: Trans-Basin Diversion Summary

	Moffat Tunnel Annual Average Diversions (AF/YR)[1]	Roberts Tunnel Annual Average Diversions (AF/YR)[2]	Total Trans-Basin Annual Average Diversions (AF/YR)
Modeled Current Condition Embedded Diversions	7,267 (35%)	13,449 (65%)	20,716
Modeled Full Use	2,713 (9%)	27,263 (91%)	29,976
Modeled Proposed Project	10,284 (68%)	4,836 (32%)	15,120
Total Diversions	20,264 (31%)	45,548 (69%)	65,812

[1] Measured average annual diversions through the Moffat Tunnel based on cdss data.
[2] Measured average annual diversions through the Roberts Tunnel noted in Joint Rebuttal Document **(Grand County, ND)** comments on the DEIS

Definition of Firm Yield Comment:

The stated purpose of the proposed Moffat-Gross project (FEIS, page 1-4) is "***to develop 18,000 AFY of new, firm yield to the Moffat Treatment Plant (MTP) and raw water customers upstream of the MTP***…." Section 1.4.2 of the FEIS defines firm yield as: "***the maximum average annual demand that can be met by Denver Water's system without shortages through the study period***." Based on the above statements, it is assumed that the expanded Gross

Reservoir will supply 18,000 AFY to Denver Water's system throughout the period of record (the 1947 to 1991 was chosen to be the hydrologic study period upon which to base water supply decisions in the EIS).

The New Jersey Department of Environmental Protection (NJDEP) guidance document (NJDEP, 2011) provides guidance to state water providers on how to calculate the "safe" or firm yield of surface water supply reservoir systems. Their definition of "safe yield" is "*that maintainable yield of water from a surface or ground water source or sources which is available continuously during projected future conditions, including a repetition of the most severe drought of record, without creating undesirable effects…*" The intent the proposed project thus seems consistent with NJDEP guidance and per the stated purpose of the project (page 1-4, FEIS) that the 18,000 AFY of firm yield would come from the Moffat Collection System rather than the Denver Water Supply system as a whole.

The NJDEP guidance was written to "*ensure that all people of the state have a sufficient water supply and within each basin there are enough water supplies to ensure present and future needs.*" Safe yield is estimated on an annual basis since repeating surface water supply and end-user demand patterns also vary on this scale. Because critical period durations and timing during the annual water cycle are different for different water supply systems, "*expressing safe yield estimates as average rates over the critical drawdown periods would result in numeric values with inconsistent temporal bases*." Therefore, to maintain consistency, safe yield estimates for each water supply system are reported as a "*single average annual rate*" (NJDEP, 2011). Again, the stated intent of the project seems consistent with the NJDEP guidance.

However, per the FEIS and inconsistent with the NJDEP guidance, the firm yield requirement for the project was determined based on one critical period, 1953 to 1957. This time period may not represent the most critical years of the 1947 to 1991 study period (see Critical Drought Period comment below). Evaluation of the firm yield of the reservoir water supply system over the entire 45 year test period, as suggested in the NJDEP guidance, would provide a more realistic estimate of the feasibility of the project to consistently supply the required firm yield of 18,000 AFY.

The LP2 screening criterion, noted in the following LP2 comment and in Chapter 2 of the FEIS, allows **for less than 18,000 AFY in some years but only at a frequency of less than 25 percent of the time.** This is inconsistent with NJ guidance, which states that the firm yield should be supplied consistently over the study period. Please provide information on the frequency with which 18,000 AFY yield is achieved from the Moffat Collection/Gross Reservoir expansion project throughout the selected period of record and if it is met in a sufficient number of years to exceed the EIS screening criteria. Also, when the 18,000 AFY was not met, could the higher post 2022 water demands be satisfied and what if any contingency plans were included to adjust for short years.

<u>Critical Drought Period Comment</u>:

Page 1-25 of the FEIS: The need for 72,000 AF of additional storage in Gross Reservoir was determined in the EIS using the PACSM model to simulate conditions leading up to and during the critical drought period of 1953 to 1957. According to the EIS, four years of additional storage is required to provide 18,000 AFY in each of the four critical drought years. This analysis is a "best case" test since the expanded Gross Reservoir was very likely full in 1952 in the PACSM simulations; one of the five wettest years on the western slope between 1947 to 1991, the model period of record. This sequence of water years was not repeated in the 1970s which had low to average year flows on the western slope in the early 1970s. As a result, no additional storage or firm yield was available from the expanded Gross Reservoir between 1976 and 1978 (Addendum IV "Firm Yield Analysis"). The 1970s, as well as the 1950s, should be evaluated as a critical low flow period by which to test the feasibility of attaining the required 18,000 AFY firm yield from the Moffat Gross project. Note also that there are actually five years from 1953 to 1957.

Screening Criteria LP2 Comment:
The following comments pertain to the LP1 and LP2 screening criteria for the FEIS.

LP1 "*To advance, alternatives must consist of a manageable level of additional storage and conveyance components. Providing a firm yield of 18,000 AF/yr will likely require approximately 72,000 AF/YR of new surface water storage based on a storage to firm yield ratio of 4:1. A minimum storage volume for any one component is needed to reduce the number of possible storage elements to a manageable and practical combination. A minimum storage of 15,000 AF per site could require as many as five new surface storage sites…..*

LP2 "*To advance, a water supply must be physically available and legally obtainable from a sustainable source in sufficient amounts and with sufficient frequency to satisfy the need for additional firm yield in a practical manner. Firm yields are considered insufficient to be practically developed if they supply less than approximately 20 % of the additional firm yield required. Yields are considered insufficient to practically provide additional firm yield if there is less than 15,000 AF available with a frequency of less than 1 year out of 4. These limits are intended to provide flexibility in formulating alternatives, yet prevent the incorporation of extraordinary levels of complexity in the implementation and operation of an alternative.*"

1. LP1 also limits the size of storage impoundments to 15,000 AF, one fifth or twenty percent of the stated total storage of 72,000 AF required by the project, to aid in managing future water operations. This is understood. However, LP2 should be rewritten to reflect a firm yield of one fourth of 15,000 AF or 3,750 AF for each increment of 15,000 AF of storage. Therefore, if the entire 72,000 AF of storage is to be implemented at one location, the LP2 criteria should be applied to the entire firm yield of 18,000 AF/YR.
2. The sufficiency statement for LP2 is not stated correctly. (In this case, given Gross Reservoir will be expanded by 72,000 AF, this comment refers to a firm yield of 18,000 AF/YR instead of 3,750 AF). LP2 should read*; "Yields are considered insufficient to practically provide additional firm yield if there is less than 18,000 AF available with a frequency of* ***[more]*** *than 1 in 4 years."* Stated as is, it is insufficient if the targeted firm yield is NOT met in less than 1 year out of four (say 1 in 5 years or more). In fact, it should be insufficient if the firm yield is NOT met [more] than one in four years or greater than 25 percent of the time.

The Proposed Project Does Not Meet its Firm Yield Requirement

A water supply system not only needs to provide the firm yield during a critical drought period but also "*continuously during projected future conditions.*." (see comment on NJDEP firm or "safe" yield guidance above). The FEIS needs to discuss what firm yield the expanded Gross Reservoir provides over the entire simulation period of 1947 to 1991; how many years was 18,000 AFY of firm yield provided by the enlarged system and whether or not the actual firm yield meets the LP2 screening criteria for water supply alternatives noted in Chapter 2 of the FEIS and in a previous comment here.

Because actual firm yield for the project was not discussed in the DEIS and now the FEIS, and because stream flows in the Fraser Basin are already severely depleted, an independent estimate of the firm yield of the expanded reservoir combined with the remaining water supply in the Fraser and Williams Fork basins was undertaken (Buchanan, 2014); the summary section of that report is presented below. Please see **Addendum IV: Firm Yield Analysis for more information**.

"*Results of this analysis indicate that the stated 18,000 AFY firm yield requirement for the proposed project, expansion of Gross Reservoir to almost three times its current volume, cannot be met under both of the flow situations above representing both the "current" and "full use" EIS baseline model scenarios. Results of this analysis are as follows. The average of all calculated annual excess basin flows closely match the FEIS average additional diversions between the "current" and "proposed" model scenarios of the PACSM water supply model . In fact the average calculated excess basin flow is greater than average modeled diversions by approximately 2,600 AFY and so represents a "best case" estimate of the ability of the proposed project to meet the firm yield requirement of 18,000 AFY.*

- *Current conditions EIS baseline: Including storage in the expanded portion of Gross Reservoir and all estimated basin excess flows, the reservoir would fill in only 3 years out of 44; the 72000 AF of extra storage would be depleted or zero in 12 years; the required yield of 18,000 AF/YR would be met in 32 years (72.7%) and not met in 12 years (27.2%). The LP2 screening criteria established in the EIS is not met.*
- *In fact, it would require 4,000 AFY more than all the calculated excess basin flows of 15,557 AFY to achieve the 18,000 AFY firm yield required by the proposed project at the frequency required by the LP2 EIS criteria.*
- *"Full Use" EIS Baseline: Under the "full use" baseline, a portion of the excess basin flows would be diverted through the Moffat Tunnel and the existing Gross Reservoir to the Moffat Water Treatment Plant without requiring expansion of the reservoir. Under this baseline, that preferred in the EIS as the proposed project, the expanded reservoir would fill in only 1 year out of 44; the 72000 AF of extra storage would be depleted or zero in 20 years; the required yield of 18,000 AF/YR would be met in 24 years (54.5%) and not met in 20 years (45.5%) of this 44 year period of record. The percentage of years where the firm yield of 18,000 AF/YR was NOT met substantially exceeds the EIS alternative screening criteria of greater than one in four years or 25 percent.*
- *Incremental additional diversions from the Fraser and Williams Fork basins are included in the "current condition", "full use", and "proposed project" model scenarios. Of*

these, the impacts of only the last, the "proposed project" diversions, on basin stream flow are considered to be project impacts in the EIS. In fact all of the modeled additional diversions, equal to approximately twice that of the "proposed project" diversions, are required to achieve the stated project firm yield of 18,000 AFY at a sufficient frequency.

- *Basin impacts attributed to the "project" should reflect all additional diversions included in the "current", "full use", and "proposed project" model scenarios and are likely twice what is stated in the EIS.*
- *Guidance published by the New Jersey Department of Environmental Protection (NJDEP, 2011) define firm or "safe" yield as a continuous quantity of water that can be provided even through a historical critical drought period. Even with 4,000 AFY of additional excess basin flows, storage and firm yield in the expanded Gross Reservoir were zero from 1976 through 1978 due to average or below average years leading up to these three years. This is in contrast to the selected 1950s critical drought years (1953 to 1957) of the PACSM modeling where the expanded Gross Reservoir filled in wet year 1952 just ahead of the drought period. The mid-1970s should also be included as a critical drought period against which to evaluate the feasibility of the project to achieve the additional firm yield of 18,000 AFY.*"

This independent analysis evaluated two main questions:

1. What amount of excess water remains and is available for additional diversions in the Fraser and Williams Fork basins above that already diverted to operate the existing (41,800 AF) Gross Reservoir, and
2. Does the expanded Gross Reservoir (113,800 AF) and various levels of additional diversions noted in the EIS provide the stated project firm yield of 18,000 AFY?

Results of the evaluation indicate that all of the additional EIS diversions:

- the extra diversions embedded in the current conditions PACSM model scenario of 7,300 AFY,
- the additional 2,713 AFY diversions for full use, and
- the additional 10,284 AFY diversions noted as "project" diversions
- or a total 20,297 AFY

are required to achieve a firm yield of 18,000 AFY at the required frequency noted in the EIS LP2 screening criteria. In fact, the "project" firm yield which utilizes the expanded reservoir and the stated "project" diversions (10,280 AFY) fall far short of this required frequency. Therefore, either:

1. The project as presented in the EIS should have been screened from further consideration, and/or
2. Since at least twice the volume of stated project diversions are required to meet the project screening goal, full impacts of the project should reflect twice the volume of additional "project" diversions and not be limited to impacts noted in the EIS between the modeled "Full Use" and "Proposed Project" Scenarios.

Unknowns for the Fraser and Williams Fork basins are:

1. What are the "natural" inflows between Denver's diversion structures and the USGS gages and what is the variability in these inflows between dry, average, and wet years.
2. Related to number 1 above, how much excess water is available at Denver Water's diversions structures that would be available to fill and operate the expanded Gross Reservoir?

Stream flow data need to be collected to address these unknowns, particularly in the irrigation months of May, June, and July.

Arbitrary Sizing Determination for the Preferred Alternative

The preferred alternative was sized based on the topography of the area surrounding Gross Reservoir. Project alternatives should be sized based on the requirements of the stated purpose and need, not on "what the site would produce". David Little, Director of Planning for Denver Water, clearly stated the arbitrary nature of Denver Water's sizing determination for the preferred alternative in a Radio Interview on April 30th, 2014:

Interviewer: "How much of the Gross Reservoir project do you think depends upon the assumption of growth in the metro area?"
David Little: "Well we sized the project based on what the site would produce. The growth in the metropolitan area will far outstrip the water supply that's going to be provided by Gross reservoir." … "But that assumes that the past is good indication of the future. You start throwing in the equation of global climate change and with our conservation program in this project we could be in a situation that we're just staying even with what we have right now for our customers, even though our customer base is growing at a phenomenal rate. "

Full recording of the 1-hour radio interview/panel is attached in **Appendix C**, as is an audio excerpt of the preceding text.

The speculative Nature of Predictions:

The FEIS begins with the statement of purpose and secondary needs, supported by supply and demand data and projections. The speculative nature of predictions of all types, and particularly water supply and demand predictions is illustrated in the following:

- The memorandum prepared by Harvey Economics (HE) states: "The drawback to these models is the requirement for voluminous and accurate data necessary to conduct meaningful regression analysis." And, "In truth, there is little opportunity for testing the accuracy of demographic and economic forecasts. Such forecasts are inherently very uncertain." (Appendix A, Memorandum Jan. 2004, Review of Denver Water's IRP, p. 4). Further, "The information provided by Denver Water was represented and accepted without audit of the original data sources." (Appendix A, Memorandum Jan. 2004, Review of Denver Water's IRP, p. 4)

- "The CRWAS [Colorado River Water Availability Study] provides twelve different water supply scenarios based on historical hydrology paleohydrology, and the ten climate change projections. The broad range of projected conditions poses a daunting challenge to planning. There is no single way to move forward with planning for water supply under profound uncertainty . . ." (CWCB, 2010a).

- "Colorado will need between 600,000 and 1 million acre-feet/year of additional M&I water by 2050." (CWCB, 2004; p.3).

- "2050 water demands are projected to range from approximately 1.75 million AFY to nearly 2.1 million AFY." (CWCB, 2010a)

We begin with the speculative nature of predictions to put into perspective our concerns with the "data" presented in the FEIS. Furthermore, the accepted scientific procedure in data analysis and forecasting is the use of confidence intervals to indicate the range in which the particular datum lies as a measure of the uncertainty of the measurement (Billings and Jones, 2008; p. 304.). There are no confidence intervals in the FEIS; the FEIS uses averages i.e. average annual demand, and specific numbers such as the 18,000 AF shortfall. This is highly unscientific and omits valuable information.

Test of Project Purpose and Need

The Corps is responsible for determining the purpose and need of the projects that it permits. The stated purpose of the Moffat Project is as follows: "*The purpose of the Moffat Collection System Project is to develop 18,000 acre-feet per year of new, firm yield to the Moffat Treatment Plant and raw water customers upstream of the Moffat Treatment Plant pursuant to the Board of Water Commissioners' commitment to its customers.*" (FEIS, Executive Summary, ES-6). The purpose is three-fold: (1) secure 18,000 AF new firm yield; (2) deliver this new supply to the Moffat Treatment Plant (MTP); (3) deliver this new supply to raw water customers upstream of the treatment plant. The Corps agrees with Denver Water that the project would also address three interrelated needs that could be met by increased water delivery to MTP: increased reliability in delivery to customers during drought, greater flexibility during an emergency and reduction in vulnerability due to the fact that 80 percent of water supply comes from the south system and an enlarged reservoir in the north system would change the balance. Because the statement of purpose and need quantifies the needed additional supply, 18,000 AF, and makes it essential in solving all stated needs, the first step in **addressing the validity of the entire project** is to determine the validity of this aspect of the purpose (screening criterion PN1).

1. Supply and Demand Projections:

Use of Unrestricted Demand Inflates Demand Requirements During Drought :

Objections were raised concerning the use of "unrestricted demand" in demand projections in the DEIS because unrestricted demand is not the case during a drought—and drought protection is a primary reason for the expansion of Gross Reservoir. The explanation given in the response to this concern is "Drought response is temporary in nature and inherently uncertain, driven by immediate conditions. Modeling water supply and firm yield assumes a perfectly operating system of a long period of time." (FEIS Appendix N, Response #910-329, Part D, page 80.). At response #1531-8 re: complexities of calculating supply shortfall, “In short, the conventional approach cannot account for all these uncertainties. Consequently, for analysis purposes, **this approach uses the simplifying assumption that customer demands would not be restricted during a drought** (emphasis added) and sets aside a Strategic Water Reserve as a way to compensate for issues not specifically accounted for in the approach.”

This simplified demand model approach is perilously unscientific and leads to false calculations and false conclusions, such as the need to use the Strategic Water Reserve when the need does not exist. It is precisely during a drought, when stage 2 (or 3) restrictions are in place, that demand must be determined to assess adequacy of supply. Can supply meet demand during a drought? The answer cannot be ascertained by comparing supply during a drought to “unrestricted demand” under normal conditions. While useful when correctly estimated, unrestricted demand projections cannot predict water demand during a drought.

This comparison falsely over-estimates demand and thereby underestimates supply. Inexplicably, “unconstrained demand” is used blatantly in No Action Alternative projections related to water quality during drought when “system-wide storage...would be drawn down to a minimum of approximately 68,400 AF by the end of the critical period. These figures are based on **not imposing mandatory restrictions** during a drought (emphasis added)” (FEIS, Chapter 5, p. 119). The discussion continues, “Based on trying to meet an unconstrained demand, however, Denver Water’s raw water customers would be short by approximately 9,600 AF and treated water demands would be short by approximately 600 AF during the critical period.” This is false. Predicting supply during a drought **while assuming unrestricted demand is fallacious.** Denver Water would restrict water usage during severe drought; these shortages under the No Action scenario are worst case, inflated and unsubstantiated. The No Action Alternative discussion **fails CEO Guidance, 46 Fed. Reg. 18026, 18027 (March 23, 1981)** “Where a choice of ‘no action’ by the agency would result in predictable actions by others, this consequence of the ‘no action’ alternative should be included in the analysis.” It can be predicted that during a drought and stage 2 restrictions, Denver Water customers would take action, as they have done so remarkably in the past.

Erroneous and Misleading Calculation of Demand

As seen in Table 2 (Table 1-1 of the FEIS), the shortfall of 18,000 AF in 2032 is a derived figure based on five estimations, none of which are certain and should be shown with confidence intervals; one factor, non-potable reuse is known (and stated erroneously for 2010, Table 1-1). **Total system supply** is erroneously calculated for 2010, and remains constant at 345,000 AF from 2020 when the non-potable treatment plant is fully functioning to 2050, a **30-year span with no change in supply**. This is clearly inaccurate—as if time and technology stood still—and wrong because the additional supply, 18,000 AF, from the Moffat Project is **not included** in total system supply. Two categories of savings that are subtracted from the model-generated ”unrestricted demand” in 2032 of 432,700 AF— “additional conservation” (16,000 AF) and “system refinements/cooperative actions (12,500 AF)—are **identical over the 40 year span** from 2010-2050. This too is undoubtedly inaccurate. **The shortfall is derived from these estimations**. Because demand numbers stated in the EIS cannot be verified and appear to be erroneous there is no way to know what the shortfall in 2032 might be, or if there will be a shortfall.

The estimations from which the shortfall is derived, particularly additional conservation and system supply and system refinements/cooperative actions are not static as shown in Table 2 (FEIS Table 1-1). Using the identical figure across time for variables that may change non-linearly over time and are extremely important in calculating supply and demand, is unscientific and misleading. It is noteworthy that in two locations on its website Denver Water reports that it "produces/sells" nearly 250,000 AF annually, substantially lower than the demand noted in Table 2 of 285,000 AFY under current conditions, further questioning the unrestricted demand figures in Table 2. Predictions from the 2002 IRP are outdated. In April 2007 Denver Water submitted to the Colorado Water Conservation Board its 10-year conservation plan, "Tap-Smart: The Conservation Master Plan" (Denver Water, 2007). One goal of this extensive conservation plan is to reduce single-family residential use an additional 31,499 AFY beyond post-drought use by 2016. The plan includes similar savings in commercial and industrial customers, including multifamily residences. These goals are on target. The inaccuracies in Table 2 indicate that the Corps did not study the supply and demand data and accepted, apparently without question, the supposed shortfall upon which the expansion of Gross Reservoir is predicated.

Table 2. FEIS Table 1-1

Category	2002 IRP	2010	2032	2050
Demand				
Unrestricted Demand (see Box 1 re modeling errors)	314,000 (1)	330,000	432,700	499,700
Less:				
Historic Conservation Savings 1980 to 2000	(29,000)	(29,000)	(29,000)	(29,000)
Natural Replacement Savings	N/A	(11,800)	(27,700)	(39,000)
Plus:				
1999 Arvada Contract	N/A	N/A	3,000	3,000
Total System Demand	**285,000**	**289,200 (2)**	**379,000**	**434,700**
Supply				
System Supply	315,000	315,000	315,000	315,000 (3)
Plus: underestimated (see text and Appendix A)				
System Refinements/Cooperative Actions	N/A	12,500	12,500	12,500
Non-Potable Reuse	N/A	17,500 (4)	17,500	17,500
Total System Supply (Nearest 1,000) - underestimated	**315,000**	**345,000**	**345,000**	**345,000**
Surplus/(Shortfall)	**30,000**	**55,800**	**(34,000)**	**(89,700)**
Plans to Meet Shortfall				
Additional Conservation - underestimated	N/A	16,000	16,000	16,000
New Water Supply – likely to be underestimated	N/A	N/A	18,000	(73,700

Figures in red are uncertain or inaccurate. (1) 312,500 AF in DEIS; (2) 238,528 AF actual demand (total treated and raw water deliveries (2010 Comprehensive Annual Fiscal Report, III-67; excluding nonconsumptive demand such as evaporation and leaks); (3) 18,000 AF not included; (4) the plant will not produce 17,500 AF until buildout. (5) Note discussion above re Denver Water's conservation plan, "Tap-Smart."
NOTE: the demand model predicts an increase of 2,000 AF/Y 2002-2010, and an increase of 4,668 AF/Y, 2010-2032 more than doubling the annual increase. **This model-driven increase exceeds population increase in this time period, and is highly unlikely.**

Arbitrary Project Purpose and Need: Shortfall of 18,000 AFY Fabricated to "Fit the Site"

Denver Water has storage and refill rights to 131,078 AF in Gross Reservoir. It is notable that the proposed increase in the reservoir, 72,000 AF (based on the projected shortfall of 18,000 AF and the 4:1 ratio), is approximately current storage in Gross Reservoir of 41, 811 AF plus 72,000 AF. This fact, and the questionable figures seen in Table 2 from which the shortfall is derived raise the possibility that the shortfall was "designed" to necessitate the additional 72,000 AF so that Denver Water could use its full right to Western Slope water, a reasonable assumption.

Table 2 shows that the need for 18,000 AF firm yield is derived by subtracting "additional conservation" savings of 16,000 AF in 2032 from the derived "shortfall" of 34,000 AF in 2032. The FEIS provides no evidence that 16,000 AF is accurate. This appears to be a case of working the numbers to create the desired outcome. Any shortfall less than 18,000 AF would not generate the needed 72,000 AF. Further evidence comes from Dave Little, Director of Planning for Denver Water. In April, 2014 radio station KGNU hosted a panel discussion on the Moffat Project. Responding to a question concerning population growth in the metro area and the expansion of Gross Reservoir, Mr. Little said, "We sized the project based upon what the site would produce" (Sudler, 2014). This truthful statement suggests that the projected shortfall of 18,000 AF was fabricated to "fit the site."

Arbitrary Purpose and Need: Shortfall Inflated and Potential for Additional Conservation and Water Supply Under–estimated. Both the shortfall of 34,000 AF in 2032 and conservation savings of 16,000 AF are speculative and questionable, even with the 2010 update because:

- The demand model updated data are either estimates or variable i.e. population growth, average income, consumer price index, (and the update used the same growth rate as the 2002 model, (Appendix A-4 Summary of 2002 Demand Model Update);
- the "additional conservation" of 16,000 AF is likely to be substantially underestimated for 2032, particularly when the use of treated water on landscape is significantly reduced (see Addendum I).
- under "system refinements/cooperative actions" line on Table 2 shows a total of 12,500 AF/yr, 2010-2050, (omitting the 440 AF Consolidated Mutual project and perhaps the WISE program although this is not clear). Thus, additional planned water supply projects already in Denver's portfolio, such as agriculture transfers and increased use of reusable return flows that could be as much as 38,000 AFY (Denver Water, 2012) are not included in the future water supply estimates in Table 2.
- the addition of a single wastewater treatment plant for recycled non-potable water or a direct or indirect potable water treatment plant would eliminate the shortfall but the **projections for 2032 and 2050 include neither**. It is inevitable that Denver Water will invest in one or both of these water-saving technologies as part of its long-term strategy.

Denver Water is also developing the Downstream Reservoir Program, a system of nine storage quarries with a capacity of 32,500 AF for storing return flows, to be completed by 2020 and included in the FEIS as "system refinement" with firm yield of only 5,000 AF. In the Colorado River Cooperative Agreement (Denver Water, 2012a), Denver Water pledges to develop "an additional 10,000 acre-feet on an average annual basis through reuse, including use of reusable sources of water for augmentation and/or conservation measures not described in Articles IIA and IIB completed by the end of calendar year 2030" (*Id* p. 9). Neither of the systems above are included in Table 2. Finally, there is no estimation of potential new supply through such practices as the use of gray water for landscape irrigation. Only "natural replacement" of aging fixtures is shown to change over time, with a savings of 39,000 AF by 2050.

Inaccuracies in the demand model:

The updated demand model projections contain errors that skew the outcomes. For example, the input variable "3-yr Average Conservation $" is significantly underestimated at $1,149,949 and remains unchanged over a 50-year span, 2000-2050 (FEIS, Appendix A-4, Attachment 2). Denver Water's conservation budget for Operation and Maintenance in 2013 was **$6,078,600**, for 2012 it was **$4.2 million, and in 2011 conservation spending was higher than 2013 or 2012,** as shown in Figure 7 below. The weight of this variable in the demand model is sufficient to change the outcome, in this case over-estimating demand. In addition, 6 of the 13 variables used in the model were calculated at the 2002 rate of change although no rationale is given. Also, in comparing demand projections based on 2002 data and 2010 data the historic conservation of 29,000 AF is ADDED to the total demand figures rather than subtracted (FEIS Chapter 2, Appendix A-4).

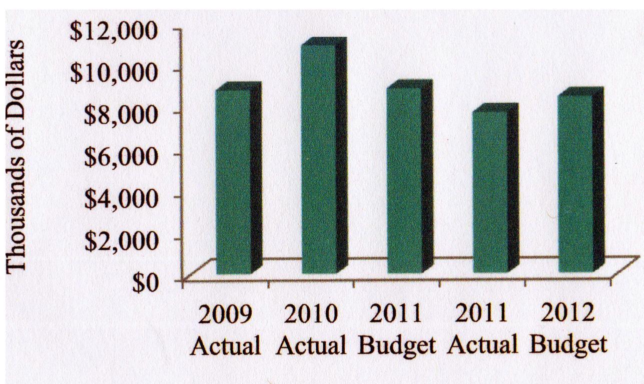


Figure 7. Conservation O&M expenditures, 2013 Revised Budget

Failure to validate

Harvey Economics (HE) was contracted by Denver Water to determine the validity of it purpose and need projections for use in the EIS. In fact, HE used the identical models, the identical data, crunched the numbers and came up with the identical figures as Denver Water (FEIS, Appendix A, page 8, Exhibit 4). This is a test of calculation reliability, if anything, and is not a test of validity. Yet HE concluded that the models and the data, and extrapolations, are reasonable and appropriate and could be used the EIS.

Considering the possibilities for increasing supply while reducing demand, it is reasonable to state that supply will not equal demand in 2022 and that the predicted shortfall if 18,000 AF in 2032 will not occur. It can be stated therefore that the dire No Action Alternative scenarios are suspect—even given the fact that "no action" is an oxymoron in the context of water supply and demand.

The Corps could argue that including potential supply mechanisms is speculative, and to some extent it is but it is equally speculative to omit them while making projections to the year 2050, or even seven years from now when demand is predicted to exceed supply. Failure to look beyond the *status quo* is unscientific and misleading. More importantly, when the purpose and need of a project as massive and as destructive as the Moffat Project are based on questionable projections that cannot be verified, then the entire exercise of reviewing an environmental impact statement is meaningless. The intent of the NEPA regulations is to avoid this problem: information in an EIS "must be of high quality. Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA." 40 CFR §1500.1(b).

Arbitrary Purpose and Need : Demand Projections Skewed and Unsupportable

The following excerpt from Denver Water's integrated water resource plan of 2002 highlights the uncertainty of predictions—focusing on the crossing of the supply and demand lines—predicted in the DEIS for 2016 and in the FEIS for 2022:

> **"**With respect to the long term, the Board determined that since its near-term strategy pushes the crossing of the supply and demand lines so far out in the future—that is, beyond the year 2035, there is little reason for it to identify today what actions it believes a future board should take 35 years hence. The IRP process identifies a promising list of future projects ranging from added conservation to significant potential for future potable water recycling to continued opportunities for conjunctive use to a long list of possible surface storage additions (whether enlarged facilities or new ones) which future boards will have decades to consider." (Denver Water, 2002: p. 70).

In conclusion: the supply and demand calculations used in the FEIS and summarized in Table 2 are speculative at best, replete with errors, and underestimate supply while over-estimating demand, particularly demand during drought conditions. The validity of the resulting "shortfall" of 18,000 AF/Y in 2030 is highly questionable and therefore cannot be used in the purpose and need statement for this project nor for determining additional storage in Gross Reservoir.

New Supply to Moffat Treatment Plant

This element of the purpose statement creates the limiting criterion (PN2) that reduces the alternative analysis mandated by NEPA and CWA Section 404 (b)(1) guidelines and forces the Corps to prepare the FEIS without the broad spectrum of alternatives for public review as required. In fact this criterion is so narrow that the least environmentally damaging practicable alternative (LEDPA) was either eliminated or not proposed (see discussion of the LEDPA below).

Delivery of new supply to the MTP is the element of the project's purpose that addresses the needs stated above: increase flexibility (in case of emergency), reduce vulnerability (so that more water is available in the event that a manmade or natural disaster impedes the operation of Strontia Springs Reservoir and other south system components), and provide greater reliability during drought (to reduce the "significant level of risk" that the Moffat plant would run out of water). These concerns are described as stresses and risks that put the entire system in jeopardy.

The consequences of not increasing supply to the Moffat Treatment Plant are speculative; no quantitative analyses are provided. The speculative nature of these needs is illustrated in the No Action Alternative analysis:

> "Long-term and permanent socioeconomic impacts would result from the No Action Alternative. Increased chances of a major system failure through the treated water or raw water systems may result in a loss of trust in Denver Water . . . This could result in a change in Denver Water's management structure and responsibilities. Denver Water may also experience an increase in expenditures related to planning for and responding to system failures. Severe and more frequent mandatory watering restrictions, including surcharges, may result in a reduced quality of life and place financial burdens on customers. Though still infrequent, mandatory restriction would reduce production, employment, and other business activity in the Denver Metropolitan area." (FEIS, Executive Summary, ES-70.)
>
> However remote (emphasis added) the possibility of a major system failure represents dire consequences for Denver Water as an institution and has major social impacts for the CSA… This perception of institutional instability may lead to new management, new oversight responsibilities, and control by other levels of government (FEIS, Chapter 5, p. 569).

Risks of System Imbalance Over-stated

In other words, the dire consequences of "no action" are exaggerated—droughts and emergencies are rare—the PACSM model predicts a possible draw-down of Gross Reservoir 4 times in 45 years; **in most years the system would operate as usual.** And, "Unlike the raw water collection systems, the treated water system **is connected**. During periods of low demand, it is possible **for any** of the three treatment plants to serve most areas within the CSA. The Marston and Moffat WTPs are primarily peaking plants, with greatest use generally during high demand. The system is designed for dual feed to any area to **minimize service interruption** (emphases added) and to maintain fire protection capability" *(Id* p. 12). Each plant can supply "most areas of the CSA." **The distribution system is integrated and flexible**. Only during high demand i.e. summer, are the other plants needed, primarily for landscape watering.

"Because of this summertime spike in demand, Denver Water's storage, treatment, distribution and other facilities need to be oversized" (Denver Water, 2010).

During winter the Moffat plant is shut down. In fact, for seven months beginning in November 2013 the Foothills Plant was also shut down for maintenance and the Marston plant alone was sufficient for treated and raw water supply. These facts cast doubt on the urgency of enlarging Gross Reservoir to solve a "balance" problem, and cast doubt on the veracity of the Corps' responses to DEIS comments concerning these issues, such as: "This system imbalance leads to vulnerability (or lack of system flexibility) to respond to water collection system outages and can seriously jeopardize Denver Water's ability to meet its present-day water needs."([1] Appendix N, response #910-354, Part D, p. 20.) "Loss of operation of any portion of the South System could require more water from the Moffat Collection System to meet customer's water demands."

(Appendix N, response #910-273, Part D, p. 11). These statements contradict Denver Water and are not accurate.

The "vulnerable" claim is perhaps more reasonable, but if the operation of the Strontia Springs Reservoir fails totally during a drought or period of high demand, the increased 5 percent of total system firm yield from Gross Reservoir will not compensate for the loss.

Nor is the purported "balance" problem solved by an additional of 5 percent firm yield gained by increasing Gross Reservoir, and the data show that supply is not as imbalanced as the 80 vs 20 percent suggests. The following table shows the percent of total supply from each system:

Table 3. Percent of total supply, 31 December (Comprehensive Annual Financial Reports)

Supply system	**2013**	**2012**	**2011**	**2010**	**2009**	**2004**	**2003**	**2002 drought**	**2001**
South Platte	**36**	**44**	**33**	**50**	**50**	**47**	**37**	**40**	**43**
Moffat	**36**	**28**	**26**	**25**	**29**	**23**	**21**	**22**	**26**
Roberts	**28**	**28**	**41**	**25**	**21**	**30**	**42**	**38**	**34**

Table 4. Percent of total system storage capacity, first and last day of the year

	2005	2004	2003	2002 drought	2001
January 1	73.8	?	46	84	85
December 31	85.8	73.8	65	46	84

These data show that on average over a year, the Moffat system has stayed above 20 percent of total supply, **even during the 2002 drought and recovery**. This demonstrates that the purported need for greater "balance" in supply capacity of the south and north systems is not essential to the operation of the total system. The other important observation is that during that "severe" drought, total reservoir capacity did not drop below 46 percent of maximum. The threat of system depletion based on 2002-2003 is exaggerated.

While it is possible to imagine a unique emergency in which both south system treatment plants fail during a severe drought in the summer, "what-if" scenarios are not a sound basis for the development of a purpose and need statement. The rationales for the secondary needs are predicated on increasing demand and unavailable supply combined with severe system failure during a drought. There are **no quantitative analyses** of the likelihood of this happening and **no quantitative analysis** of the effects on actual water supply and delivery. The need for greater flexibility during drought or emergencies is exaggerated—**flexibility is built into the system**.

The drought/reliability problem is manageable on the rare occasion that it occurs and cannot justify the impacts and costs of the Moffat Project. During the 2002 drought other supply sources were available, and both raw water customers and treated water customers were served. In that extreme case affecting the entire system, not just the Moffat Treatment Plant, Denver Water solved the problem by implementing stage 2 drought restrictions limiting landscape watering to twice a week, shutting down the Moffat plant as needed to maintain minimum pool level in Gross Reservoir and delivered raw water to customers by pumping water from the Foothills and Marston plants via ditches. The problem was not lack of supply or imbalance *per se*, the problem was that **a conveyance system for getting water to the Moffat plant was not in place**.

Strategic Water Supply: Larger than Indicated

It is important to note that the FEIS refers to a 30,000 AF firm yield strategic water reserve as the backup for emergencies, and claims that the No Action alternative would necessitate tapping into it. The reserve is actually 50,000 AF firm yield, with **200,000 AF in storage**. The reserve is more than one third of total supply when all the reservoirs are full. This immense "back up" is possible because total storage and supply in the system is immense. Figure 8 illustrates this relationship.

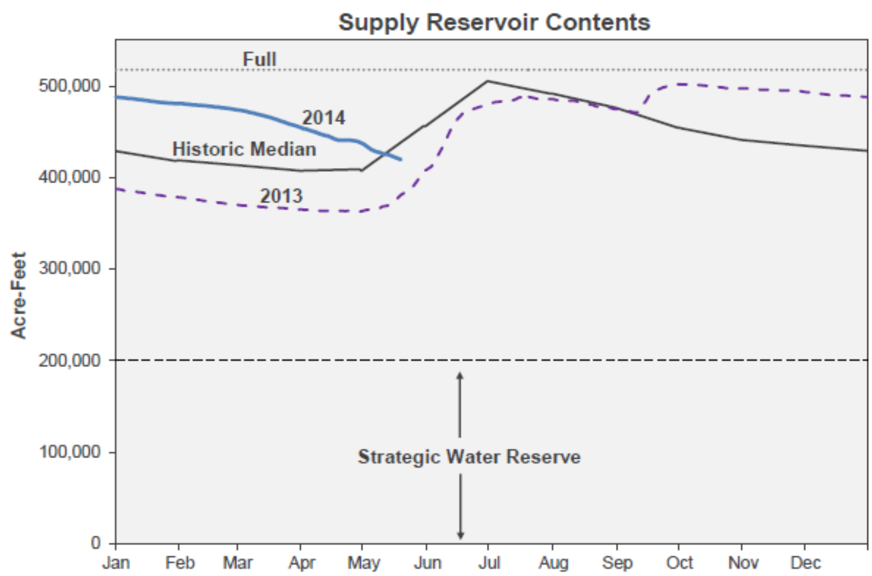


Figure 8. Denver Water, Water Watch Report, May, 19, 2014

The statement, "even in a single severe dry year, the Moffat Water Treatment Plant is at a significant level of risk of running out of water" is unclear (FEIS, Chapter 1, page 2). Again, "significant level of risk" is not quantified but such risk would likely occur only in summer when outdoor water use consumes as much as 25 percent of total treated water (Denver Water, N.D.b.). In this case, the risk can be significantly reduced through landscape watering restrictions. Data in Table 1 show that the combined supply from Gross Reservoir and Ralston Reservoir kept the treatment plant supplied during the drought, because stage 2 drought restrictions were in place.

Raw water customers upstream of the Moffat Treatment Plant.

The third element of the stated purpose for the Moffat Project concerns delivery of raw water. The main raw water customers upstream of the plant are the City of Arvada (19, 531 AF/y), City of Westminster (4,500 AF/y) and North Table Mountain and Sanitation District (6,000 AF/y), approximately 30,000 AF a year (Colorado River Cooperative Agreement, Attachment C). Raw water delivery was compromised during the 2002-2003 drought but Denver Water found a way to maintain service and when water use plummeted dramatically and stayed low compared to pre-drought use Denver Water was inspired to keep consumption low through enhanced conservation programs. Figure 9 is a modification of Denver Water's population and water use graph (Denver Water, N.D.) showing this dramatic drop and sustained reduction.

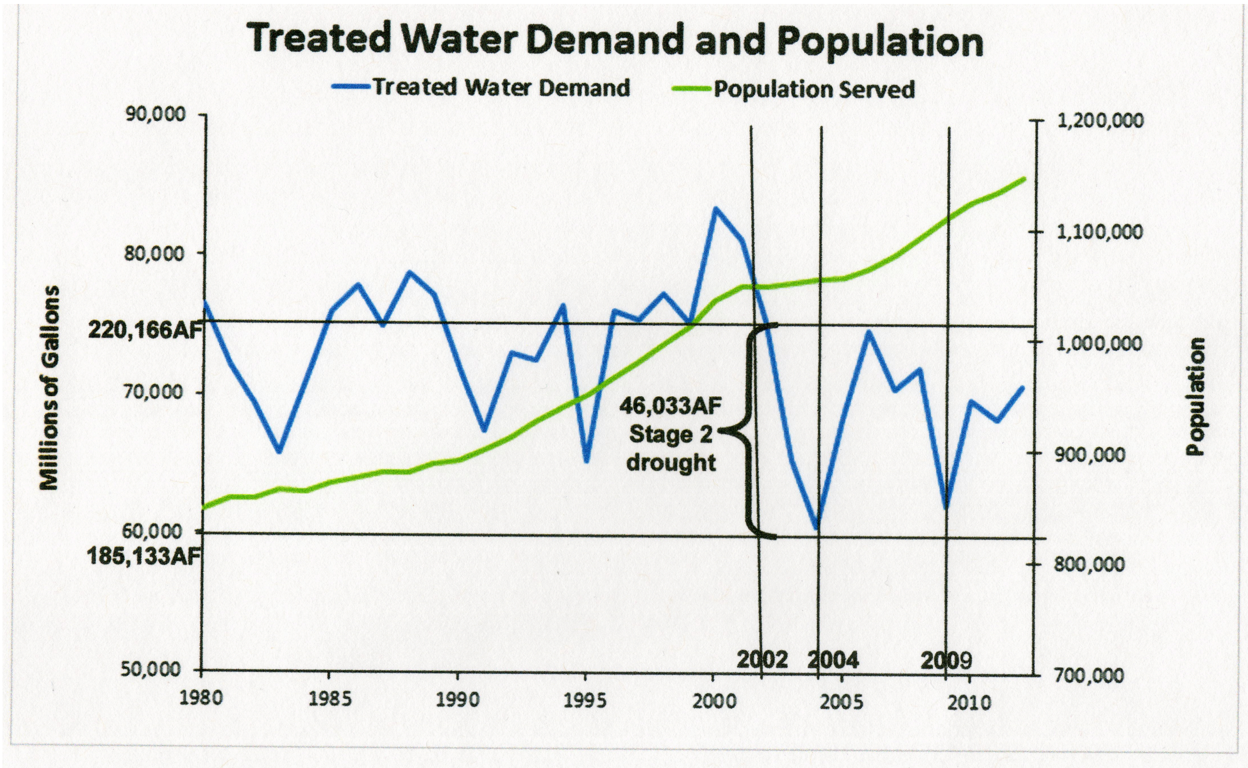


Figure 9. Modification of Denver Water's population vs use graph, showing reduction in use during drought.

These principle north system raw water customers have conservation programs and are reducing use as population grows. The City of Arvada, for example, will reduce consumption by 700 AF/y by 2018 (City & Community of Arvada, 2010, p. 10). A footnote in the FEIS concerning Arvada says, "The raw water shortages assume Arvada's demand increases by 3,000 AF per year under the No Action Alternative." (FEIS, Chapter 5, Moffat Project Effects, section 5.19.6.2 Raw Water Shortages). Apparently this is incorrect.

In addition to an effective conservation program, the City of Westminster has a reclaimed water system that will reduce potable water demand by 3,500 AF/y at build-out. Eventually reclaimed water will comprise more than 10 percent of the city's total water supply (City of Westminster, 2012). This new supply could replace raw water purchased from Denver Water.

In FEIS Chapter 5, Section 5.19.6.2 many dire consequences of the No Action Alternative are described (commercial customers would lose business, reduce production, fire workers), even though maximum shortages would occur 1 out of 45 years, and lesser shortages would mainly occur between December and March (contradicting the statement, "Residential customers would consume less water, potentially at the expense of lawns and landscaping" (p. 5-570). The predicted consequences of a rare but possible drought that these raw water customers would experience include purchasing expensive supply, enforcing "more severe" restrictions, and raising rates. These responses to drought are speculative; if they were enacted they would be temporary; if drought restrictions were in place, they might be unnecessary in the first place.

The solution to the drought-reliability problem lies in part with the raw water customers and the continuing development of conservation and efficiency programs now underway. The City of Westminster invested in a wastewater treatment facility. The City of Arvada, with the largest share of raw water from Gross Reservoir has two water treatment plants but does not treat wastewater. Arvada has dedicated over $100 million for securing water from Gross Reservoir (City and Community of Arvada, 2010; p. 17). With these funds the city could invest in a small reclaimed water system similar to Westminster's. Arvada has emergency interconnections with Westminster and with North Table Mountain and Sanitation District and it has decreed non-tributary groundwater that it is not using. This is important because Arvada has contracted with Denver Water for 3,000 AF from Gross Reservoir, contingent upon completion of the Moffat Project. Denver Water includes this amount in its demand calculations—3,000 AF of the projected 18,000 AF shortfall. Arvada and other raw water customers are reducing demand and simultaneously they are reducing the threat of unreliable water supply during a drought. This third element in Denver Water's purpose and need for the Moffat Project is increasingly less significant in spite of population growth.

Conclusion

Denver Water's treated and raw water system is flexible; vulnerability and balance issues appear to be overstated, and will not be solved by the expansion of Gross Reservoir and a relatively small increase in firm yield to the Moffat Treatment Plant. The need for an additional 18,000 AF/y by 2032 cannot be verified and appears to fail the test of scientific accuracy (40 CFR §1500.1 (b). Therefore the purpose and needs for the expansion of Gross Reservoir as stated in the FEIS are questionable. A water supply project as massive, costly and destructive as the Moffat Collection System Project cannot be justified on this basis.

2. The FEIS should fully analyze the available feasible and non-speculative alternatives to fulfill the purpose and need of this project.

Agencies must evaluate all reasonable alternatives to the proposed action that are not too remote, speculative, impractical, or ineffective. *Wyoming*, 661 F.3d at 1244. Even if an alternative would not meet the project's purpose and need if implemented alone, an agency must analyze the alternative if it could meet the proposed project's purpose and need in combination with other alternatives. *Davis*, 302 F.3d at 1121–22 ("[O]ne of the most egregious shortfalls" in an EA was the failure to analyze alternatives (such as mass transit) that together and in conjunction with one another would meet the project's overarching objective of improving traffic flow); *N. Buckhead Civic Ass'n v. Skinner*, 903 F.2d 1533, 1542 (11th Cir. 1990) (agreeing with district court statement that "a discussion of alternatives that would only partly meet the goals of the project may allow the decision maker to conclude that meeting part of the goal with less environmental impact may be worth the tradeoff with a preferred alternative that has greater environmental impact.”). Please see section II.A of this document for analysis on alternatives.

B. The FEIS fails to take a hard look at the proposed Moffat project’s environmental impacts.

An EIS must take a “hard look” at how a proposed project will impact “all aspects of the environment.” *New Mexico*, 565 F.3d at 703. To fulfill this mandate, agencies must disclose a proposed project’s ecological, aesthetic, cultural, economic, and social impacts. 40 C.F.R. § 1508.8(b). For each of these types of impacts, the agency must analyze the proposed project’s direct, indirect, and cumulative effects. *Wyoming*, 661 F.3d at 1251; 40 C.F.R. § 1508.25(c). Direct effects “are caused by the action and occur at the same time and place,” while indirect effects “are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable . . . [and] may include growth inducing effects.” 40 C.F.R. § 1508.8; *see also Utahns for Better Transp.*, 305 F.3d at 1174. Cumulative impacts are “the impact[s] on the environment which result[] from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.” 40 C.F.R. § 1508.7. The Moffat FEIS fails to take the required hard look at a number of the project’s harmful environmental impacts.

1. The “environmental baseline” in the FEIS is inflated

The FEIS discusses several potential baselines based on:

1. Historical hydrology in the Fraser, Williams Fork, and Blue River Basins,
2. Current Conditions PACSM model results, and
3. Full Use of Existing PACSM model results.

Ultimately the Full Use of Existing Model results were utilized as the baseline by which to determine the direct environmental impacts of the Proposed Moffat Project. The Full Use of Existing baseline incorporates all impacts from previous steps; historical, current conditions, and full use impacts, so that impacts from the full use to the proposed action are minimized. In fact, an independent firm yield analysis of the expanded Gross Reservoir with additional water diversions that closely match those in the FEIS (Buchanan 2014), shows that all additional diversions; those embedded in the current conditions model scenario plus both the Full Use and Proposed Project diversions, are required to meet the firm yield goal of the Moffat Project. Based on this analysis, the appropriate baseline for the Moffat Project is the Post-Moffat historical record.

1975-2004 Historical Baseline:

Historical average annual flow data for the period 1975 to 2004 were presented in Section 3 of the FEIS to illustrate historical flows in the Fraser, Williams Fork, Colorado, and Blue rivers. This period of record was chosen to “*show seasonality, peaks, and variability* [of this] *30-year period* [that] *reflects natural variability (average, wet, and dry years) and is representative of* *existing demands, facilities, and operations, and their effects on flows in Colorado's streams* (FEIS page 3-27). Section 3 of the FEIS summarizes the "past" impact of historical post-Moffat diversions as percent reduction of annual average native flows in western slope streams. As stated in later comments; use of the annual data and use of the mean both under-estimate the true impact on stream flows. Also, since flow data are not available at Denver's diversion structures, native flows at the diversion locations were calculated and, particularly for the many small un-gaged tributary streams, this calculation introduces a large degree of uncertainty into native flows as well as the amount of additional flows that are available for diversion.

<u>2006 Current Conditions PACSM Model Baseline</u>:

The PACSM model is a water allocation and accounting model used to test the firm yield of Denver Water's water supply system over a 30 year period (1947 to 1991) including a critical period of drought (1953 to 1957). Though hydrologic data from the 1947 to 1991 period are input to the model, accurate prediction of stream flows in water supply basins is not its primary purpose. The current conditions model scenario utilized "*2006 existing demands* [285,000 AFY], *facilities, agreements, operations, [water supply including water rights and distribution structures], and administration of the Colorado and South Platte River basins."* In addition, *"operations of all existing reservoirs and diversion facilities* [and demand levels] *are simulated for the entire study period, regardless of when they came on line*" (FEIS page ES-29).

"Current conditions" modeled by PACSM cannot be verified against any actual data (such as the USGS flow data in the Fraser and Williams Fork basins) as the modeled conditions do not represent actual conditions in any historical 30 year period of record. In fact, additional annual diversions through both the Moffat (7,300 AFY) and the Roberts (13,449 AFY) Tunnels (a total of 20,749 AF/Y) above that measured average 1984 to 2013 diversions reported in the Colorado Decision Support System database are embedded in the current condition model (see comment below). Impacts of these additional diversions are not acknowledged in the FEIS because the modeled current conditions scenario is used as the baseline for cumulative impacts of the proposed project. Initial conditions of the "full use" and "proposed action" model scenarios are then based on this unverifiable current condition PACSM model scenario.

<u>Full Use of Existing Baseline</u>:

The full use of existing model scenario used a projected 345,000 AFY unrestricted average annual demand that is expected to be reached by 2022 beyond which the proposed project will be required to meet unrestricted water supply demands for Denver. This model scenario "*maximizes the yield of Denver Water's existing water supplies using current facilities and infrastructure*" and does not require the Moffat Project (FEIS ES-29). Other Reasonable and Foreseeable Future Actions (RFFAs) that were included in the PACSM model under the full use model scenario are listed below.

- <u>Big Ditch in Williams Fork</u>: will no longer divert to Reeder Cr in 2013, 10,000 additional AFY available for storage in Williams Fork Reservoir allowing for additional diversions through the Gumlick and Moffat Tunnels to Gross Reservoir (FEIS pages 4-36 and 4-37).

- 10,280 Agreement: Original 5,413 AF annual releases from Williams Fork and Wolford Mountain reservoirs to meet USFWS flow recommendations for the 15-mile reach of the Colorado River in Grand Junction will be replaced with equal amounts of releases from Granby and Ruedi Reservoirs (FEIS pages 4-34 to 4-35). Frees up 5,413 AFY of storage in Williams Fork Reservoir and allows increased trans-basin diversions from the Upper Williams Fork basin. The first release from Granby Reservoir for this purpose occurred in September 2013 (personal communication, Geoff Elliot)

- Windy Gap Firming Project (WGFP): 90,000 AF Chimney Hollow Reservoir will be built west of Carter Lake on the East Slope by 2017 for 26,000 AF/yr of additional firm yield to northern Colorado. Additional Windy Gap demands, diversions, and deliveries output from the WGFP model were incorporated into PACSM at Windy Gap and Adams Tunnel nodes. Model coordination for direct and cumulative impact modeling is described on FEIS pages 4-22 through 4-26. Note the WGFP, a cumulative impact to the Moffat Project, relied on coordination of two water supply models.

- Population Growth in Grand and Summit Counties: Year round population is expected to grow from 39,000 in 2005 to about 79,000 in 2030 in Grand and Summit counties. Additional water will be needed primarily in 1. Fraser River Basin (16,168 AFY) for water suppliers Grand County Water and Sanitation District No. 1, the Town of Fraser, and Silver Creek Resort and 2. Blue River Basin (17,940 AFY) for the towns of Silverthorne, Eagles Nest, and Mesa Cortina. Additional water use included indoor, outdoor, and snowmaking build-out diversions, depletions, and return flows in Grand and Summit counties (FEIS pages 4-26 to 4-27).

- The Population Growth and Water Shortages Incorporated into the Full Use Model Scenario Comment below addresses how the population growth in the upper Colorado basins was PRIMARILY incorporated into the full use of existing model scenario, inflating the full use baseline.

Moffat-Gross Proposed Action:

Additional 18,000 AFY of new firm yield *from Moffat Collection System to* [the Expanded] *Gross Reservoir, the Moffat WTP, and upstream water rights holders"* (FEIS Chapter 1) to meet Denver's unrestricted demand of 363,000 AFY projected to occur in 2032. An additional 16,000 AFY is met by conservation measures. RFFAs identified under the Full Use Scenario are also included in the Moffat Project Scenario. "*The only difference between the Full Use of the Existing System (2022) and Full Use with Project Alternative (2032) scenarios is the inclusion of a Moffat Project alternative, which provides an additional 18,000 AF/yr of new firm yield. …The comparison of these two scenarios isolates the hydrologic effects that are attributable to a Moffat Project alternative*" (FEIS page 5-2).

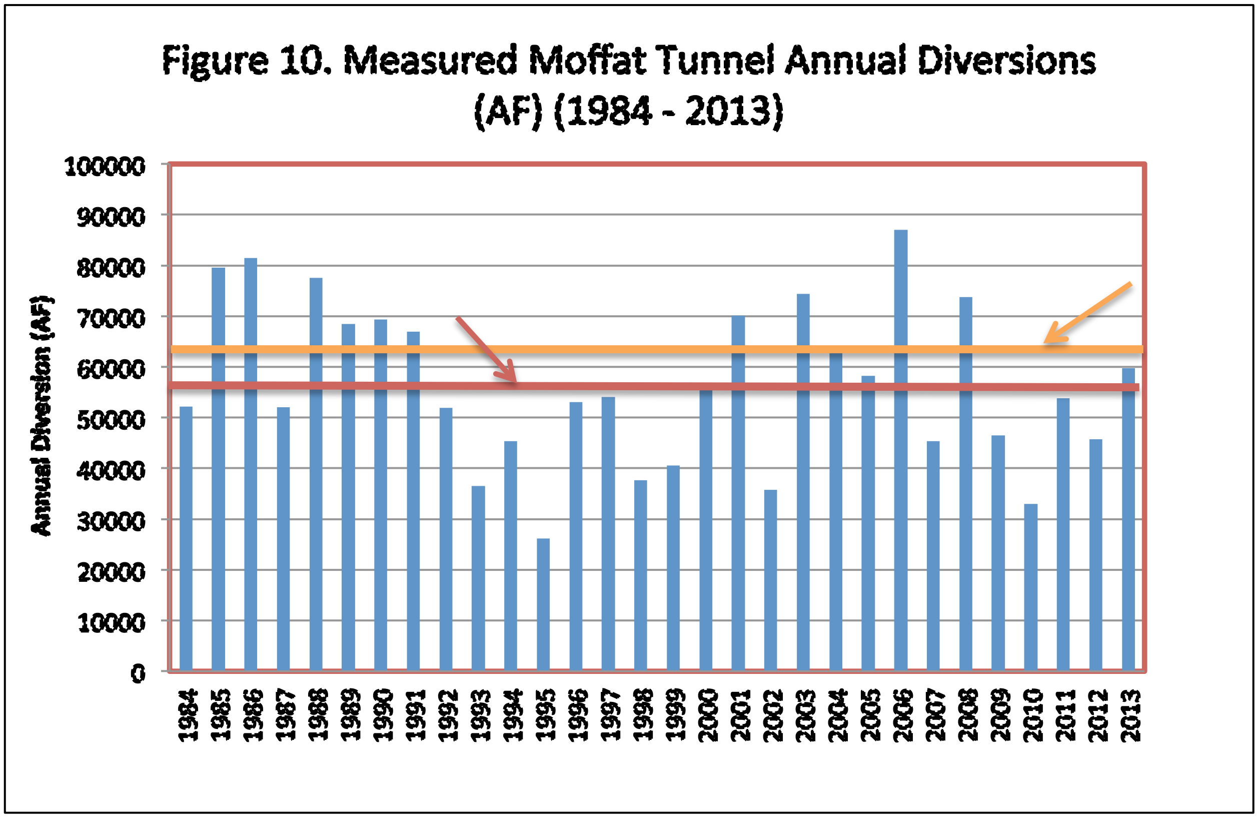
Per the EIS, the Full Use of Existing baseline including RFFAs implemented prior to 2022 and extended to 2032 was used to evaluate impacts of the proposed project; thus impacts are limited to the incremental difference between full use and the proposed project. The current condition baseline though not verifiable was used to evaluate cumulative effects of the incremental changes between current condition and proposed action model scenarios termed the “total environmental impacts” (FEIS page 5-2). Native flow average annual statistics, some from estimated flows at diversion structures, were used as the baseline for Post-Moffat historical impacts. Impacts of diversions embedded in the current conditions PACSM model though substantial were not addressed in the EIS. In fact all of the additional diversions in the three model scenarios are required to provide the 18,000 AFY additional firm yield at a frequency that meets the EIS LP2 screening criteria. Thus; the Full Use of Existing baseline is substantially inflated. Use of the Post-Moffat historical record as the baseline more accurately defines project impacts as discussed below.

Annual versus Monthly Flow Reduction Comment:

FEIS page ES-30:“For all action alternatives, additional Denver Water diversions would occur in average and wet years and would be highly concentrated during the runoff months in May, June, and July. Typically, additional diversions would be greatest in wet years following dry-year sequences.” The executive summary discusses average annual reductions in stream flow in the Fraser and Williams Fork basins due to full use of the existing system and the proposed action with RFFAs. However, as stated above additional diversions will be concentrated during the irrigation season and so the months of May, June, and July will be impacted to a much greater degree than the annual reduction in flows. Percent reduction in stream flows in the irrigation season should be discussed in the executive summary to give an accurate picture of the true impacts of both full use and the project.

Extra diversions and Flow Reductions embedded in the Current Condition PACSM Model Scenario Comment

Extra Diversions: Diversions through the Moffat and Gumlick (or Williams Fork Tunnel) Tunnels are monitored and data reported in the Colorado Decision Support System database. Average measured tunnel diversions from 1984 to 2013 are 56,532 AFY (Figure 10). Average modeled current condition Moffat Tunnel diversions reported on Table H-7.1 are 63,799 AFY; 7,267 AFY more than the measured average. Measured Gumlick Tunnel diversions average 4,954 AFY from 1984 to 2012 and compare to modeled current conditions average diversions of 8,853 AFY. Modeled diversions from the Williams Fork Basin exceed measured averages by 3,900 AFY. Therefore, of the 7,300 AFY discrepancy noted for the Moffat Tunnel diversions, 3,400 AFY on average are supplied by water from the Fraser Valley in the PACSM model.



Tunnel Diversions in 2006, used to delineate "current conditions" in the PACSM modeling, exceeded every other year in the 1985 to 2013 period of record by at least 5,600 AFY. Year 2006 did not represent a new plateau in Denver Water's water supply needs as diversions after 2006 were substantially lower, averaging 55,619 AFY and approximately 900 AF less than the 1984 to 2013 30 year average. Use of the 2006 baseline condition inflate withdrawals and reduces basin flows under the "current conditions" model scenario compared to actual measured stream and diversion flows in the Fraser and Williams Fork River Basins.

Extra Stream flow Reduction: Discrepancies between modeled current flow and historical measured flows are seen at the Fraser River at Winter Park and the Williams Fork Below Steelman USGS gages (Table 5) but not at the Vasquez Creek and St. Louis USGS gages. The total average annual flow discrepancy (8,961 AF) is greater than that seen in the Moffat Tunnel diversions (7,300 AF); potentially due to conveyance losses in the Moffat collection system and Tunnel.

Table 5: Comparison of Average Post-Moffat Measured Flows with Modeled "Current Condition" Flows				
Location	Average of USGS Post-Moffat Flows	Average Modeled "Current Condition" Flows[1]	Volume of Discrepancy Between Flows (AF)	Flow Change from Measured to Modeled Current (cfs)
Fraser River at Winter Park Gage (1936 – 2013)[2]				
Average Annual Flow (AF/YR)	13,020	8529	4,491	na
April Average Flow (cfs)	11	4	408	7
May Average Flow (cfs)	31	17	876	14
June Average Flow (cfs)	79	59	1,185	20
July Average Flow (cfs)	34	21	781	13
Total Summer months Fraser River at Winter Park			3,250[3]	na
Williams Fork Below Steelman Creek Gage (1966 – 2013)				
Average Annual Flow (AF/YR)	14,074	9,600	4,470	na
May Monthly Flow (cfs)	28	10	1,135	18
June Average Flow (cfs)	115	88	1,626	27
July Average Flow (cfs)	56	50	374	6
August Average Flow (cfs)	10	5	316	5
Total Summer Months Williams Fork Below Steelman			3,451[3]	na
Total Discrepancy at Fraser and Williams Fork Basin Gages: Measured vs Modeled				
Discrepancy Between Average Annual Flow (AF)			8,961	na
Total Summer Months Discrepancy (AF)			6,700	na

[1]Current Condition Flows from Tables H-7.1, H-1.33, and H-1.55.
[2]Averages for the post-Moffat period of record at each gage.
[3]Additional 1,209 AF discrepancy summed from August through April at Fraser River at Winter Park Gage and 971 AF summed from September through April at Williams Fork Below Steelman Gage; "na" = not analyzed.

Native Flows Comment

FEIS page 3-33:"*Native flows are defined as gaged flows or estimated flows at ungagged points plus adjustments for reservoir releases and filling, gaged inflows, trans-basin imports, and irrigation or other returns to the river*." Sections 3-36 and 3-37 discuss the percent of native flows that have historically been diverted by Denver in the Fraser basin. Stream flows are recorded at USGS gages, located up to several miles below Denver's diversion structures. Flows are not recorded above and below individual diversion structures and only at infrequent locations along its diversion system. Estimates of native flows, especially on small tributaries, likely have a large margin of error. How were native flows determined for all of the 32 tributary streams on which Denver diversion structures are present? Has Denver ever confirmed not only native stream flows at their diversion structures but also the amount of flow which enters the stream beds between the diversion structures and the downstream USGS gages? Given that basin flows are close to fully diverted, particularly in the Fraser Basin, it seems that Denver would want to fully evaluate the amount of water remaining above their diversion structures in the Fraser and Williams Fork basins. **Please discuss how native flows were determined, especially for the small tributaries on which there are diversions structures.**

Population Growth and Water Supply Shortages Incorporated in Full Use Model Scenario Comment:

FEIS page 4-26: "*The population in Grand and Summit counties is expected to more than double over the next 25 years, from a year-round population of about 39,000 in 2005 to about 79,000 in 2030*." Built out water supply shortages shown in Table 4.3.1-3 occur primarily under the Full Use of Existing Model Scenario with multiple water providers in Grand and Summit Counties experiencing water shortages. However, the proposed project incremental impacts show only one provider with additional shortages of 6 AFY. Water shortages from both population growth and increased diversions between 2005 and 2030 should be spread out over the entire period and perhaps should be greater as more water is removed from the basins due to implementation of the Moffat Project. **Please explain why the build out was assumed to take place primarily prior to 2022, the end date for the full use scenario and the beginning year for project related impacts**.

2. The FEIS does not adequately analyze the proposed Moffat project's direct impacts.

The Analysis in the FEIS does not Account for all Water Quality Impacts and Underplays the Impacts to S. Boulder Creek.

The FEIS states that "South Boulder Creek would experience **moderate to major changes** in stream temperature between Gross Reservoir and the South Boulder Creek Diversion to Ralston Reservoir. Specifically, summertime outflow temperatures from Gross Reservoir would be colder due to reservoir expansion." This is important to take into consideration for mitigation as the "cooling of water temperatures below natural levels also may influence stream ecology. Cold water released from the cooler, deeper layers of dams or weirs can inhibit native fish spawning and reduce natural rates of metabolism and organic matter breakdown" (Boulton et al, 2014).

The FEIS then goes on to state that " other water quality effects on South Boulder Creek are expected to be short term in nature and minor to negligible." (ES-38)

However as noted in their section on "Channel Morphology";

"Sediment transport capacity and supply are predicted to increase in South Boulder Creek… due to increased flows" (FEIS ES-21). Additionally;

> *"Increased flows in the North Fork South Platte River and South Boulder Creek are predicted to encourage bank instability. Bank instability issues have existed historically at these locations so significant armoring has been completed. Increased flows may result in the need for additional, localized stabilization"* (FEIS ES-22).

Effects of excess sedimentation include; "The soil particles cover spawning areas, smothering trout eggs, aquatic insects, and oxygen producing plants. Increased turbidity levels (suspended sediment) in a stream will increase water temperatures, reduce light penetration and plant growth, and affect the ability of fish to locate and capture prey by greatly reducing visibility.

Trout and other fish can die from the abrasive, gill clogging effects of suspended sediment, which interferes with their breathing." (NC State University, N.D.).

These effects are important to consider in the impacts to water quality as "sediment is the largest single non-point source pollutant and the primary factor in the deterioration of surface water quality." (NC State University, N.D.). The two sections on impacts are highly contradictory as claiming that "other water quality effects" are "minor to negligible." Note however that sediment transport capacity is likely to increase as well as increase erosion in banks.

Furthermore it has been shown that " economic consequences of excessive sediment, deposition, and transport problems in surface waters have resulted in annual costs for damages of approximately $16 billion" (USEPA, N.D.).

The Analysis in the FEIS does not Adequately Consider Socioeconomic Impacts

The Inter-organizational Committee on Guidelines Principles for Social Impact Assessment (SIA) provides a set of guidelines and principles that assist agencies and private interest in fulfilling their obligations to consider social impacts under the National Environmental Policy Act of 1969 or "NEPA" (P.L. 91-190, 42 U.S.C. 4371 et seq.) related authorities and agency mandates. The Moffat Final Environmental Impact Statement (FEIS) does not adequately consider social impacts. "Social impacts" means the consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society. The term also includes cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society. A central requirement of NEPA is that before any agency of the federal government may take "actions significantly affecting the quality of the human environment" that agency must first prepare an Environmental Impact Statement (or EIS). Preparing an EIS requires the integrated use of the social sciences. *This has not been done for the Moffat FEIS and thus constitutes noncompliance with NEPA.* Further, inadequate assessment of social impacts means that the FEIS fails to fulfill the repeated promise made in the Comment-Response Report (Appendix N of the Moffat EIS) to numerous public comments: "Prior to making decisions on the proposed Project, the Corps will evaluate and consider the Project's environmental effects, including socioeconomic effects, according to NEPA."

Intangibles – Non-economic impacts

The Moffat FEIS defines socioeconomic narrowly as "Including discussion of effects on the local economy, tourist-based, and recreational economy; effects on property values; effects on the cost of water, and effects of induced growth" (pg 1-33). The Moffat FEIS also considers archeological, historical, and paleontological sites of significance. This definition and considerations only cover economic and impacts and historical value and is far too narrow a definition. Communities on both sides of the divide are comprised of people who value their lifestyles and communities in intangible ways that extend far beyond economic impacts and the value of limited historical artifacts. Although the Moffat FEIS claims to consider cultural impacts, there is no evidence of this for either Primary Impact Areas (PIA) or Secondary Impact

Areas (SIA). The Moffat FEIS does not adequately consider non-economic social impacts, although these are repeated concerns in public comments submitted in response to the Draft Environmental Impact Statement (DEIS) and on record at the Boulder County Commissioners from written and oral comment. "*Intangible social impacts that must also be evaluated before the FEIS can be considered in compliance with the NEPA include, but are not limited to all the consequences to all communities in the PIAs and SIAs from the Moffat Collection System Project that alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society, also including cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society.*"

Social impacts around Gross Reservoir PIA

"[P]ositive, but negligible impacts" are anticipated in the Moffat FEIS for Front Range communities. This clearly does not take into account the localized impacts that residents of the Gross Reservoir PIA anticipate if the Moffat Collection System Project is approved. Residents of Boulder County in the Gross Reservoir IPA have unanimously and continuously opposed the project on many social impact grounds that include, but are not limited to, lifestyle, recreation, spiritual and cultural values, particularly related to Forsythe Falls. A report has been prepared on these significant impacts and submitted to Denver Water. We request Addendum IV "Stories of loss: A brief cultural risk assessment of the proposed Moffat Collection System Project" be officially recognized. See also "Evaluation of Notable Statements in Corps Responses (in "Public Part A" of the FEIS to Chapman 2010 Critique of DIES" (Chapman and Chapman, 2014), included here by reference but submitted separately to the Corps. Residents stand to experience significant cultural, spiritual and lifestyle impacts from the Project, while Denver Water consumers are afforded the luxury of using 50% of the utility's water supply for relatively trivial outdoor purposes.

The FEIS Underrepresents the Impacts to Wildlife, Especially Elk:

The FEIS states; "In general, Gross Reservoir would experience loss of three types of elk crucial habitats (elk severe winter range, migration corridors, and concentration areas), loss of non-crucial habitat for other big game species (i.e., mule deer, black bear, and mountain lion), and habitat fragmentation due to the inundation of South Boulder Creek and Winiger Gulch" (ES-50). Further more "Big game, including mule deer, elk, mountain lion, and black bear, would lose habitat because of permanent and temporary losses of habitat during construction and reservoir enlargement**. The Proposed Action would have the greatest impacts on big game habitats of all of the action alternatives"** (FEIS 5-282, 2014).

Winiger Ridge is listed as critical wildlife migration corridor. The Winiger Ridge area is considered a key winter range for two herds of elk totaling approximately 300 animals (PUMA, 2000: 5.2.1.2) and as the FEIS states; "Elk are present in the area during the winter, and three types of crucial seasonal habitats are present: elk migration corridor, severe winter range, and winter concentration areas…" and even though "Elk migration corridors and severe winter range are separate categories, [but] all of the construction and operation impacts would occur in both habitats" for a total of 544.4 permanent and temporary impacts to elk sever winter range and migration corridors and 321.1 acres of permanent and temporary elk winter concentration (FEIS 5-282).

Because Winiger ridge is home to over 300 elk in the wintertime, the potential for impacts due to displacement is severe, which the FEIS fails to adequately address. It states:
"*The amount of displacement is difficult to estimate, but is likely to be one-quarter to one-half mile or more, involving hundreds of acres adjacent to the construction areas on the east side of the reservoir and areas along the western shore facing the dam and quarry. Displacement is not likely to affect use of most of the Winiger Ridge area. Construction would occur year-round, including the winter when the area would normally be used as elk winter range, concentration area and severe winter range. This displacement would occur each winter during the construction period for four years.*" (FEIS 5-283, 2014)

Even though the FEIS claims no "severe impacts" to the two herds, previous studies cite the importance of proper land management for big game, which this project is not conducive to and exacerbates the problem. For example, PUMA (2000) references a study by Hallock and Reddinger in 1988-1990 (Hallock & Reddinger, 1991);

"Maintaining free-ranging herds of Rocky Mountain Elk (Cervus elaphus) is an important challenge for land planners and managers. The challenge is heightened in a landscape that is prone to potentially conflicting land uses. In the Front Range of Colorado conflicts can arise from the location of mountain residential and recreational related development. Elk may need to travel over 20 miles between summer and winter grounds. Key range, such as that needed during the winter or for calving, may be tied to specific locations that provide key elements such as food, hiding and/or thermal cover and seclusion. The use of these locations and movement between seasonal range can be adversely affected by human development and recreational use."

The FEIS fails to adequately account for impacts to the elk heard, simply stating that there will be minimal impacts, despite the potential for increased human-wildlife interactions such as;
"Loss of habitat and potential change of use patterns may force elk and deer to adjacent private lands, which could increase the Colorado Parks and Wildlife (CPW) (previously called Colorado Division of Wildlife) obligations for game damage compensation" (FEIS 5-284, 2014) and "…potential collisions with haul trucks and other vehicles along access routes including County Road (CR) 77S, and State Highways (SHs) 72, 93, and 128 due to the increase in traffic from construction. Approximately 202 construction worker vehicle trips and 44 to 74 supply delivery trips would occur per day, as described in the Transportation Analysis (Section 5.12.1)" (FEIS 5-284, 2014). Despite having previously addressed the fact that construction activities will disrupt and relocate the heard migrations, the FEIS continues; "The increase in traffic on CR 77S may result in an increase in collisions with big game and other wildlife, but are not likely to adversely affect local populations," (FEIS 5-284, 2014). This is arbitrary considering the other stated project effects such as; displacement, loss of critical habitat, changes in migration patterns, disruption to the herd due to loud construction activities, potential increase in elk relocating to private property increasing the chance for human-wildlife interactions, and finally the increased potential for road collisions with wildlife.

<u>The FEIS does not fully explain or account for construction impacts:</u>

We would like to note agreement with Boulder County's statement in their FEIS comments that there is "no description of the construction plans for the dam, how it will be constructed, what volumes of various construction materials will be used, where those materials will be sources, what transportation routes will be used, where those materials will be sources, what transportation routes will be used for what purposes, what the quarry size on site ill be or how trees will be removed and disposed of" and "Depending on the answers to these questions, the environmental impacts to Boulder County and its citizens will be very different" (Domenico et al, 2014).

Similar concerns regarding the construction are;

- Construction truck traffic levels and timing (specific details are lacking in FEIS)
- The borrow-haul study pre-dates the DEIS and there is still no further solid plans on construction impacts or need for pull-outs on 72
- There are no measures for minimizing fugitive dust (Domenico et al, 2014).

Without further information it cannot be proved that the Moffat Project is the least damaging environmental alternative and therefore the permit cannot be granted.

In addition, Boulder County's comments on development of aggregate materials and the lack of data supporting the claim that "no matter what the impacts are of developing material on site, or transporting material, the preferred alternative is the least environmentally damaging."

<u>The FEIS fails to adequately address impacts to plant communities, trees and the timber disposal methods:</u>

Although the FEIS proposed that the Proposed Action would remove more than 400 acres of trees, including more than 200,000 trees of greater than 4" in diameter (a large impact), the FEIS fails to actually explain the preferred method of disposal and the environmental impacts of these methods.

As Boulder County states "there is not a market for the Ponderosa pine and Douglas fir found in the project area" which "leaves Denver Water with limited options." Should Denver Water choose burning as a disposal method, "50,000 tons of trees contain the equivalent of 66,000 tons of sequestered carbon dioxide" (Domenico et al, 2014), which significantly increases the projects carbon footprint and further impacts an already poor assessment of climate change impacts.

<u>The FEIS makes false claims about proper disposal of pine beetle infested trees.</u>

Denver Water states; "Areas in Denver Water's supply system have been significantly affected by pine beetle infestation, so the potential for pine beetles and indirect effects of the beetle with respect to potential impacts on sediment supply and transport was evaluated in the EIS… Tree mortality from pine beetle could also create increased sediment supply from increased erosion due to a large fire fueled by the dead timber." These impacts were not evaluated.

Chapter 5, p. 221 states: "The proposed disposal methods, including use of an air curtain burner, chipping, and commercial use of merchantable logs, are all appropriate means of disposal for beetle infested trees" (FEIS 5-221). However, a summary of proper disposal methods of pine beetle infested trees on forestwellness.com states the following:

"Air curtain fireboxes are the most desirable and suitable machines to accomplish the disposal of beetle infested trees for the following main reasons: (Air Burners LLC, ND)

1. The attained high burn temperatures assure quick and total elimination of any and all beetles and larvae in or on the felled tree and collected slash.
2. The wood debris can be burned immediately upon collection, even while the freshly cut tree is still *green*. A drying-out period is not required. That gives no opportunity to any larvae population in the tree to mature into beetles that would fly away and infest healthy trees.
3. Large sections of tree trunks and brush can be loaded without excessive milling, avoiding the attraction of beetles from the release of conifer resins that may affect beetle behavior as the resins resemble beetle pheromones. (Leatherman, Dave, "2002)
4. The air curtain burner achieves 97-99% mass reduction and the resultant ash residue can almost always be applied to the land on site. This eliminates any hauling by trucks.
5. The air curtain burner provides the most cost-effective solution for the disposal of wood waste, both from the capital investment angle and the direct operating costs (see last section) and it has a useful life of 10-15 years.
6. The air curtain burner is environmentally friendly and its implementation has a limited operational "carbon footprint" in comparison with other disposal methods, as it only employs a small Diesel engine.
7. The air curtain firebox meets or exceeds US EPA regulations for air curtain incinerators.
8. The air curtain burner is batch loaded, is simple to operate without a dedicated attendant and has virtually no downtime for repairs.
9. The air curtain burner is portable, delivered fully assembled and it can be relocated on site simply by dragging it on its skids.

All alternative disposal options have serious drawbacks.
Chipping was historically considered the preferred option and it was advocated that all beetles and larvae would be 100% destroyed by the violent process within the grinding and chipping machines powered by huge engines. It was thought also that chipping would be the most environmentally friendly alternative and the most economical, as biomass co-generation plants could turn the beetle infested trees into electric power. These premises turned out to be mostly false.

Small-scale tests were carried out by Deborah McCullough, et al, of Michigan State University in 2003 to verify that all Emerald Ash Borer (EAB) beetles and larvae would be killed, if chipping resulted in chips smaller than 1 inch (25.4mm) long. (McCullough, Deborah G., et al, 2003). The typical size of this beetle is about one half inch (13.5mm) and its larvae slightly more than 1 inch (32mm) in length. (United States Department of Agriculture Forest Service, 2004) The small-scale test did not appear to represent the real-life picture. Beetles and larvae do survive the chipping process. One such report in support of this finding, also from Michigan, shows that the Emerald Ash Borer infested stands of elm trees in circles around a biomass co-generation facility to which chips from Emerald Ash Borer infested trees were hauled by trucks.

(The Detroit News" Special Report, 2004*).* This was later verified by a 2005 study conducted by David L. Roberts, et al, of Michigan State University Extension (2005). See Appendix C for references.

Another mistake often made is to refer to the Michigan State University McCullough study in order to justify that chipping trees infested with the Mountain Pine Beetle (or similar) into chips of one inch in size will suffice to kill also this beetle and its larvae. What is not considered is the fact that the mountain pine beetle is much smaller than the Emerald Ash Borer that was used in the Michigan sample. The mountain pine beetle and its larvae is typically less than 1/5 inch (5mm) long. (Colorado State University Extension, N.D.) Applying the assumptions of the McCullough study would require that trees infested with the mountain pine beetle be ground into chips smaller than about 1/10 inch (2.5mm), in order to kill the beetles and larvae effectively. Even then, it is very doubtful that all the tiny beetles and larvae would actually be hit by the cutting mechanism of the chipper or grinder. Chipping to such a small chip size would usually require more than one pass and is not practical and economical; and it is not what is actually being observed in the field today.

Also, chippers do not handle freshly cut "green" trees and brush very well, although that must be a requisite for effective beetle control. The wood waste drying time that would be required for effective chipping may give larvae ample time to mature and fly off to infest healthy trees. Another reason why the chipping and grinding of green trees would not be advisable is the fact that the chipping causes the release of large amounts of conifer resins in volatile form that attract beetles. This tends to lead to cross colonization, as the infested taken down green trees would usually be close to "leave" trees.

Another problem plaguing the chipping operators is the fact that the chips cannot be indiscriminately applied to the forest floor on site. Chips on the forest floor are unnatural and adversely affect the forest ecosystem; that is why the layer of chips that is acceptable is limited by forest scientists. As a consequence the chipped trees will have to be hauled to a landfill at considerable cost and, again, possibly causing cross contamination on the way. Usually the chips cannot be sent to biomass cogeneration plants, because either the chip specifications are not acceptable or the transport costs to a suitable facility are too high.

Finally, a chipper is actually not as environmentally friendly as often proclaimed. The emissions from the massive chipper diesel engine and the hauling trucks coupled with the (carcinogenic) wood dust released have a greater negative impact on the environment than air curtain burners. Air curtain burners use a small diesel engine that is fuel efficient and the burning of clean wood is actually a natural process that has occurred on earth for millions of years. Also, the overall cost of the chipper operation is much higher than air curtain burning, as will be demonstrated later."

Therefore, an enclosed Air Curtain Burner ("Air Curtain Firebox") is the only appropriate method for disposal of the roughly 200,000 trees that would need to be removed and disposed of in the preferred alternative.

In discussing the practicability criteria for alternatives, the Corps states, “Technical and logistical factors that should be considered include, but are not necessarily limited to: access, transportation needs, utilities, topography, and available construction techniques.” (USACE 1999). The topography of the area around Gross Reservoir is such that removal of 200,000 trees makes the process impracticable. About 50 percent of the 11.2 mile shoreline has a slope of 40 percent or greater. This is significant because a 40 percent slope necessitates complex tree removal systems. Given this topography and extent of tree removal, the preferred alternative is both environmentally destructive and impracticable and cannot be considered the LEDPA.

Lastly, impacts reach beyond tree communities. “The Proposed Action with RFFAs would result in the loss of approximately 5 acres of two globally rare foothills riparian shrubland communities, river birch/mesic forb foothills riparian shrub and thinleaf alder/mesic forb riparian shrubland. It is likely that construction and inundation of the original Gross Reservoir destroyed a larger area of these two plant communities” (FEIS, 2014; 4-414).

3. The FEIS does not adequately analyze the proposed Moffat project’s indirect impacts.

Impacts to Basin Stream Flows Due to Project Diversions are Under-Estimated

Changes in stream flows due to project diversions are under-estimated or under-represented in the EIS for several reasons:

- As discussed earlier, describing flow depletion as a percent of average annual flows under-estimates the true impacts of the diversions, which occur primarily during the irrigation season in May, June, and July. Flow depletion in these months is far greater than the annual average depletion. Annual averages also substantially under-estimate historical post-Moffat depletion of stream flow in the Fraser River at Winter Park (See Background section of comments).
- The average of hydrologic variables such as stream flow often is high because hydrologic data tend to be skewed with infrequent but regular high flows; the high values pull the average higher than 50 percent of the data. A median or 50th percentile better represents the central tendency of skewed data and is more representative of in-stream flow conditions.
- As discussed in the baseline section, additional project diversions and therefore the impact of the Moffat project on basin stream flows are hidden in incremental PACSM model steps; current condition (7,300 AFY), full use (2,713 AFY), and proposed project (10,280 AFY) model scenarios. In fact all diversions are required to deliver 18,000 AFY additional firm yield to Denver at a frequency that meets the EIS LP2 screening criteria. The historical Post-Moffat stream flows thus better represent the project baseline than the full use model scenario.

These reasons are explained below in more detail. Impacts of the Moffat Project are then re-evaluated using median historical flows as the more appropriate baseline.

Stream Flow Depletion: Direct or Indirect Impact

Reduction in basin stream flows caused by increased diversions can be considered both a direct and indirect impact. Per the EIS (page 5-2), "*a direct impact is a direct result of the Moffat Project, and occurs at the same time and in the same place as the actions associated with each alternative. Direct impacts associated with the Moffat Project would result from construction of facilities (e.g., dams, pipelines, and Advanced Water Treatment Plants [AWTPs]), and inundation by reservoirs and gravel pits). An indirect impact is a secondary or subsequent impact of the Project, and occurs later in time or at a distance from the action. The primary indirect impacts would result from Project-induced operational flow changes to the streams in the overall study area*." However, the Moffat Project will be diverting additional water from the Fraser and Williams Fork, over a long period of time, a direct long term action that each year will immediately result in decreased downstream flows. However, because stream flow reduction is defined as an indirect impact in the EIS, it is included here.

Use of Median as Better Measure of Central Tendency for Stream Flows than Averages Comment

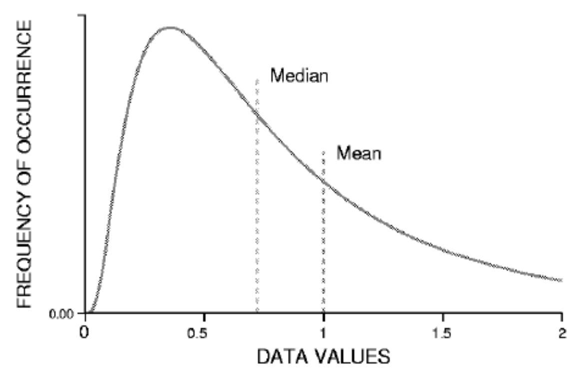


Figure 1.1 Density Function for a Lognormal Distribution

Use of the mean versus the median is an important issue when evaluating impacts of trans-mountain diversions on stream flows in the basin. If data are positively skewed, the median will be lower than the mean which is sensitive to infrequent high flows in the period of record. Use of the mean under these circumstances over-estimates the amount of water that is available in the basin; the baseline stream flow from which further diversions occur in the "current condition", "full use", and "proposed action" scenarios modeled with the PACSM model. If data are positively skewed, use of the median is more representative of the majority of stream flow data in the historical record at each USGS gage location.

Definition of Mean versus Median Issue

The USGS publication; Statistical Methods in Water Resources (Helsel and Hirsch, 2002), provides an excellent discussion of using median versus mean statistics to represent the central tendency of skewed data sets. Historical data sets of stream flow typically contain outliers that can be considerably higher than the majority of the data. For instance, high flow years that occur "infrequently but regularly" positively skew the data as shown in Figure 1-1 of the USGS report. In this case, the mean is biased high by a few of the highest data points.

"*When data are skewed the mean is not expected to equal the median, but is pulled toward the tail of the distribution. Thus for positive skewness the mean exceeds more than 50 percent of the* *data, as in figure 1.1. The standard deviation is also inflated by data in the tail. Therefore, tables of summary statistics which include only the mean and standard deviation or variance are of questionable value for water resources data, as those data often have positive skewness. The mean and standard deviation reported may not describe the majority of the data very well. Both will be inflated by outlying observations. Summary tables which include the median and other percentiles have far greater applicability to skewed data (pg. 9)."" If computing a mean appears of little value because of an outlier, the median has been shown to be a more appropriate measure of location for skewed data (pg.11)," (*Helsel and Hirsch, 2002).

Evaluation of Skewness of Stream Flow Data in Fraser and Williams Fork Basins and Downstream on the Colorado River

Histograms of stream flows were constructed to determine if data from each of the USGS gages in the Fraser and Williams Fork basins and downstream on the Colorado River are positively skewed. Histograms of monthly flow data from the post-Moffat period of record in May, June, and July, those months that will be most impacted by further diversions, are shown in Figures 11 through 17 below. Note that only post-diversions years are utilized at each gage location in order to evaluate existing stream flow conditions.

Monthly stream flows at all gages show positive skewness with the exception of June at the Williams Fork Below Steelman gage where negative skewness (a left tail toward the lower end of the distribution) is apparent. The degree to which the distributions are positively skewed can be seen in the difference between the mean and the median; the highest differences being more positively skewed with the mean exceeding the median. Substantial differences are seen in most of the months but particularly at gages on the Colorado River below Windy Gap and near Kremmling. Median June flows at the Williams Fork Below Steelman Creek gage are greater than the mean indicative of negatively skewed data for this month. Results of this analysis indicate that the median is a better measure of the central tendency of the monthly stream flow data during the irrigation season at all gages in the Fraser and Williams Fork basin and downstream on the Colorado River. This applies also to June on the Williams Fork River.

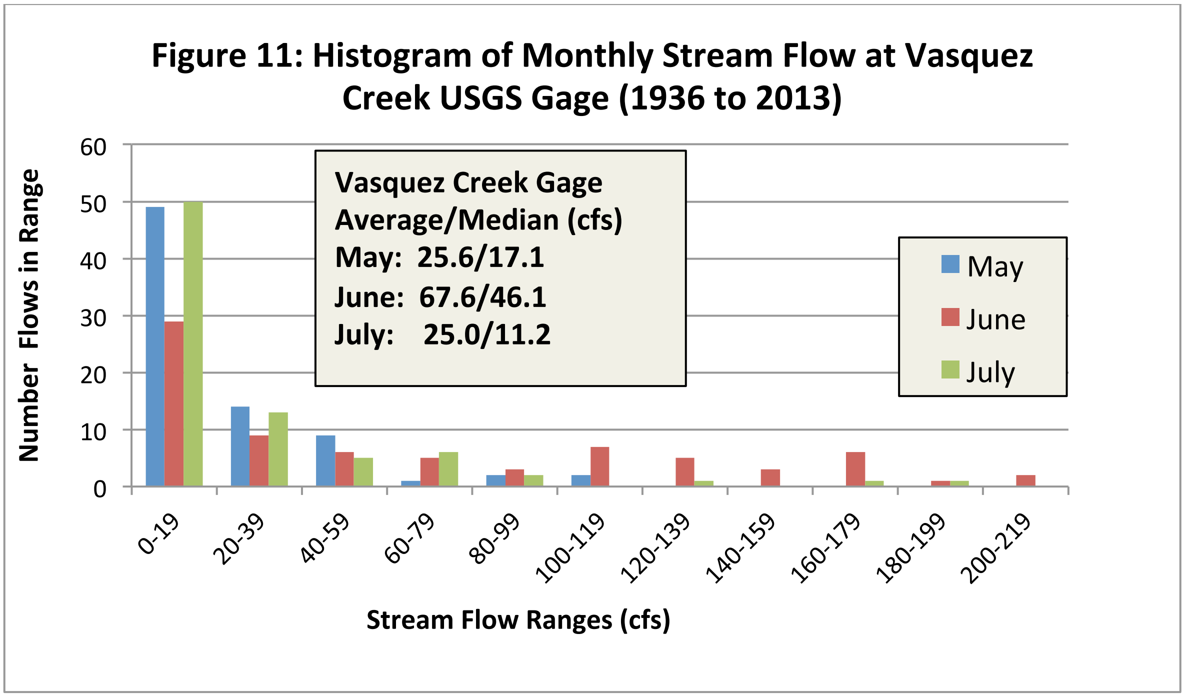


Figure 11: Histogram of Monthly Stream Flow at Vasquez Creek USGS Gage (1936 to 2013)
Vasquez Creek Gage
Average/Median (cfs)
May: 25.6/17.1
June: 67.6/46.1
July: 25.0/11.2
May
June
July
Number Flows in Range
0
10
20
30
40
50
60
0-19
20-39
40-59
60-79
80-99
100-119
120-139
140-159
160-179
180-199
200-219
Stream Flow Ranges (cfs)

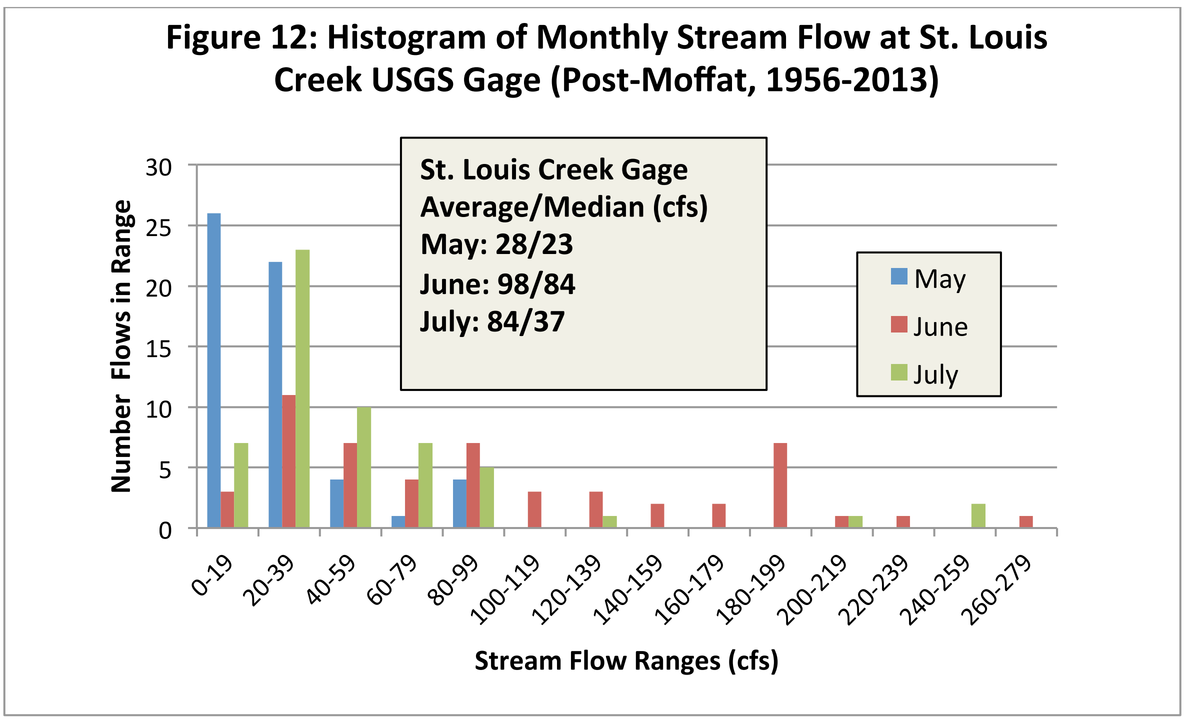


Figure 12: Histogram of Monthly Stream Flow at St. Louis Creek USGS Gage (Post-Moffat, 1956-2013)
St. Louis Creek Gage
Average/Median (cfs)
May: 28/23
June: 98/84
July: 84/37
May
June
July
Number Flows in Range
0
5
10
15
20
25
30
0-19
20-39
40-59
60-79
80-99
100-119
120-139
140-159
160-179
180-199
200-219
220-239
240-259
260-279
Stream Flow Ranges (cfs)

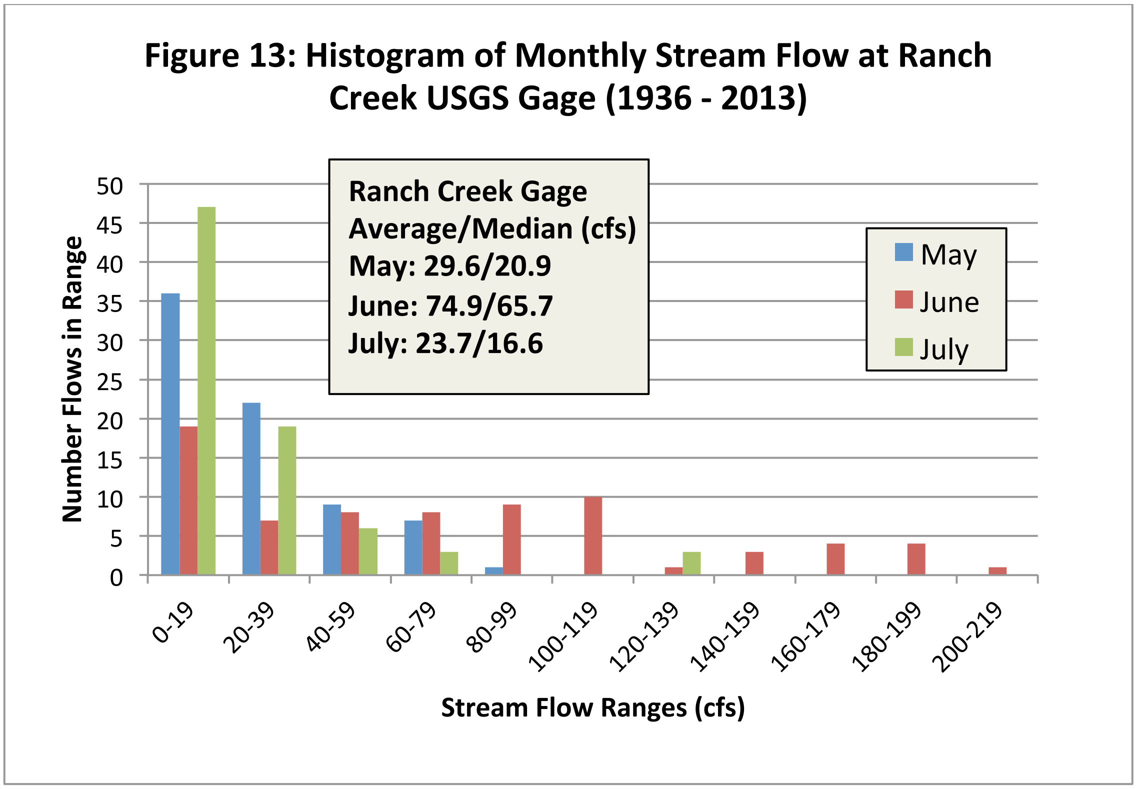


Figure 13: Histogram of Monthly Stream Flow at Ranch Creek USGS Gage (1936 - 2013)
Ranch Creek Gage
Average/Median (cfs)
May: 29.6/20.9
June: 74.9/65.7
July: 23.7/16.6
May
June
July
Number Flows in Range
Stream Flow Ranges (cfs)
0-19
20-39
40-59
60-79
80-99
100-119
120-139
140-159
160-179
180-199
200-219

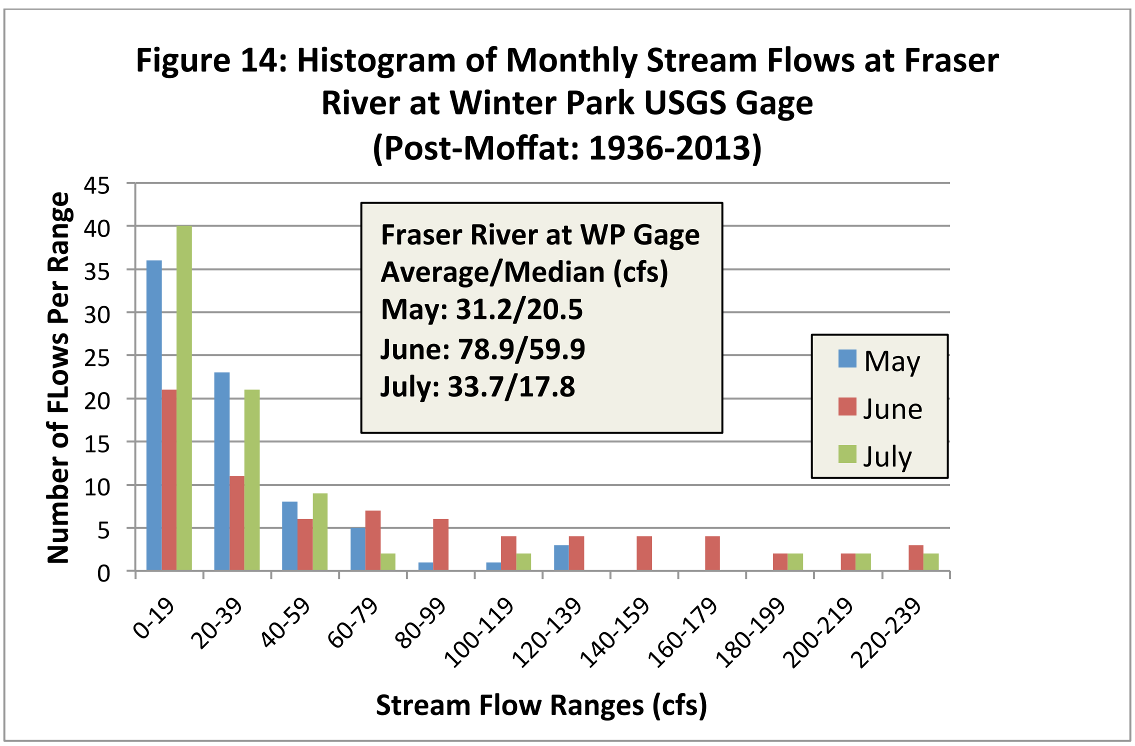


Figure 14: Histogram of Monthly Stream Flows at Fraser River at Winter Park USGS Gage (Post-Moffat: 1936-2013)
Fraser River at WP Gage
Average/Median (cfs)
May: 31.2/20.5
June: 78.9/59.9
July: 33.7/17.8
May
June
July
Number of FLows Per Range
Stream Flow Ranges (cfs)
0-19
20-39
40-59
60-79
80-99
100-119
120-139
140-159
160-179
180-199
200-219
220-239

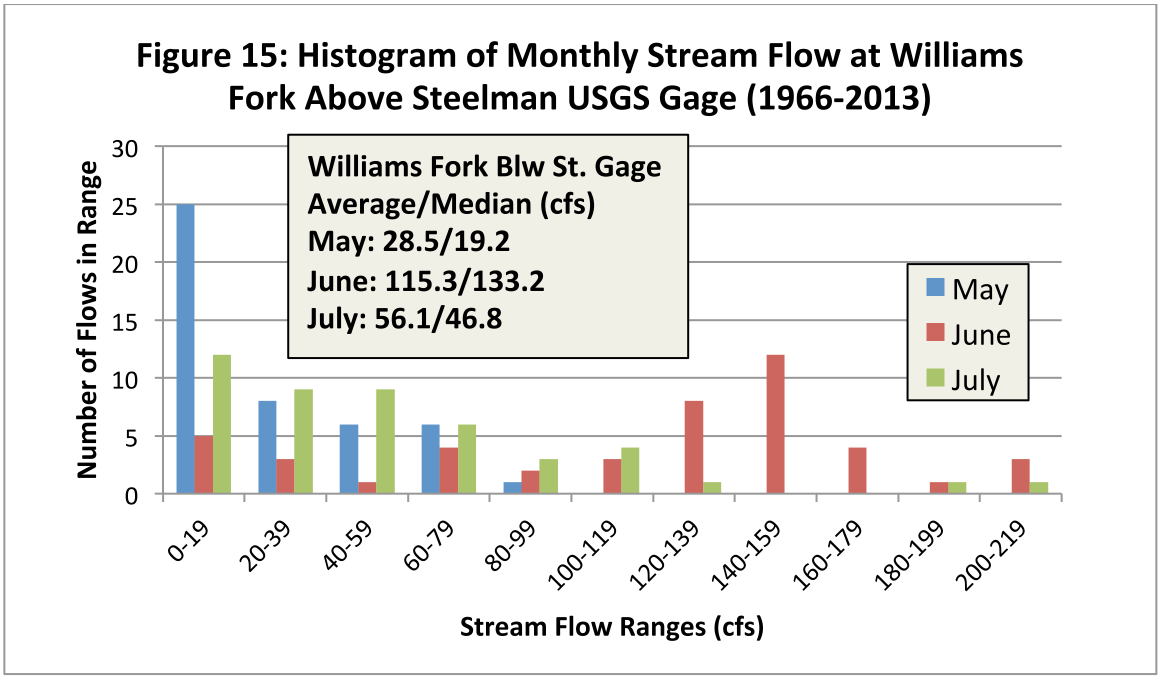


Figure 15: Histogram of Monthly Stream Flow at Williams Fork Above Steelman USGS Gage (1966-2013)
Williams Fork Blw St. Gage
Average/Median (cfs)
May: 28.5/19.2
June: 115.3/133.2
July: 56.1/46.8
May
June
July
Number of Flows in Range
30
25
20
15
10
5
0
0-19
20-39
40-59
60-79
80-99
100-119
120-139
140-159
160-179
180-199
200-219
Stream Flow Ranges (cfs)

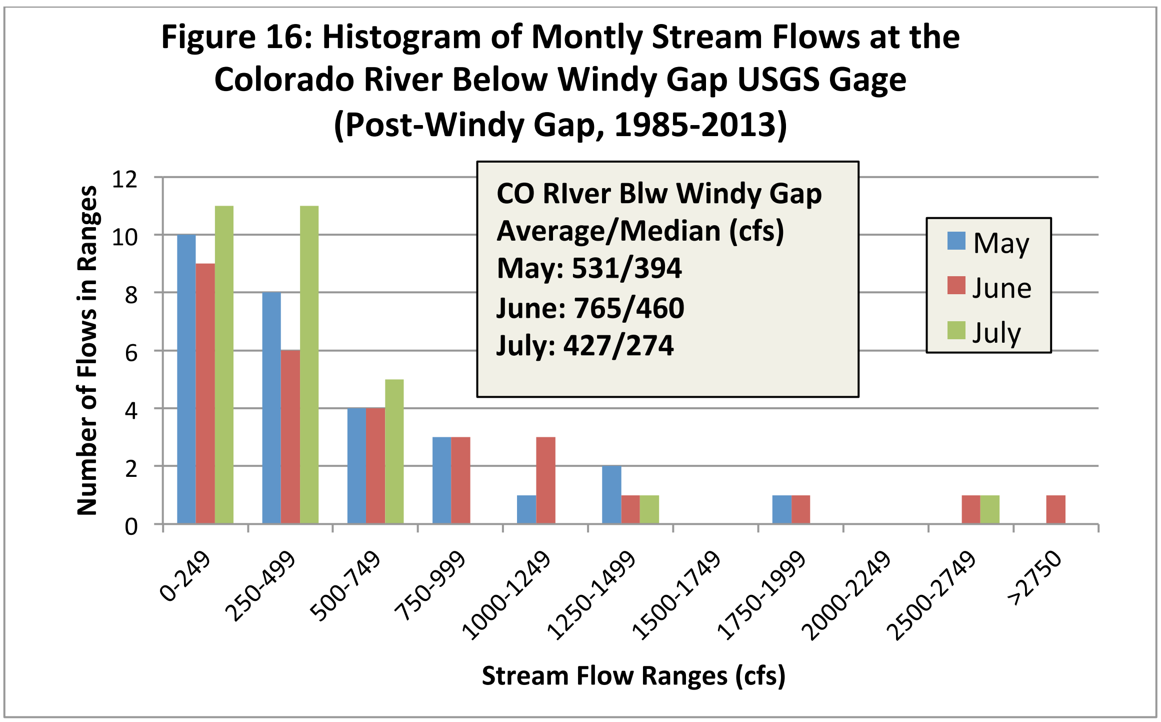
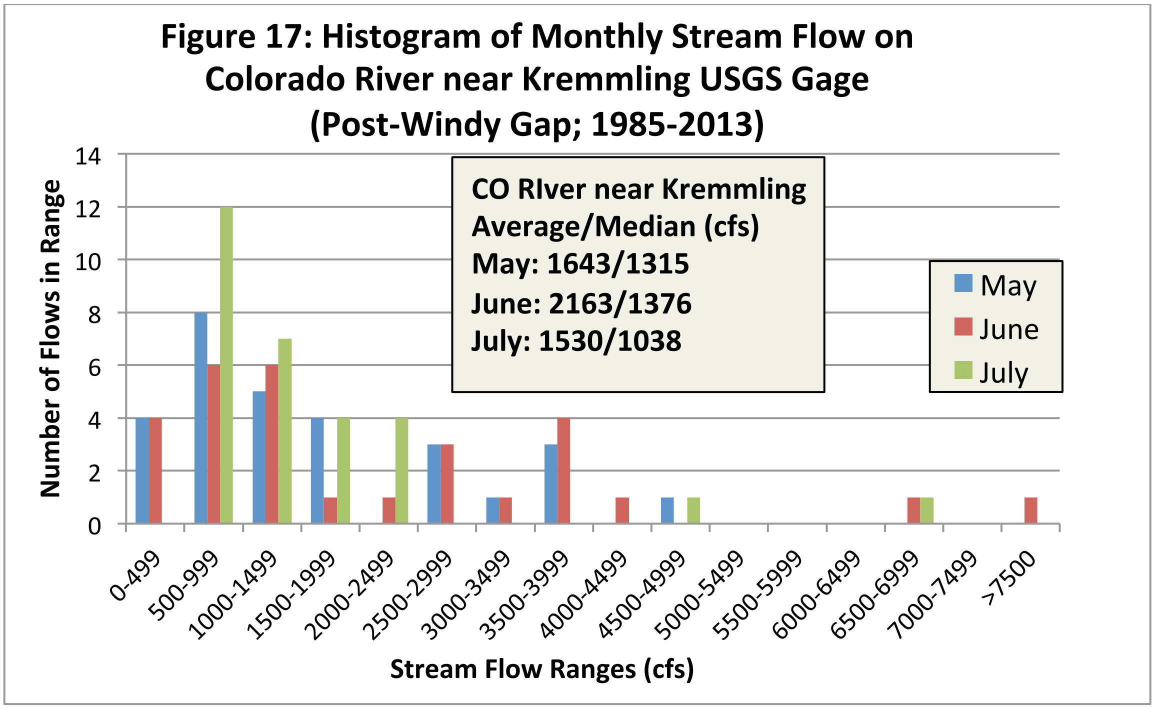
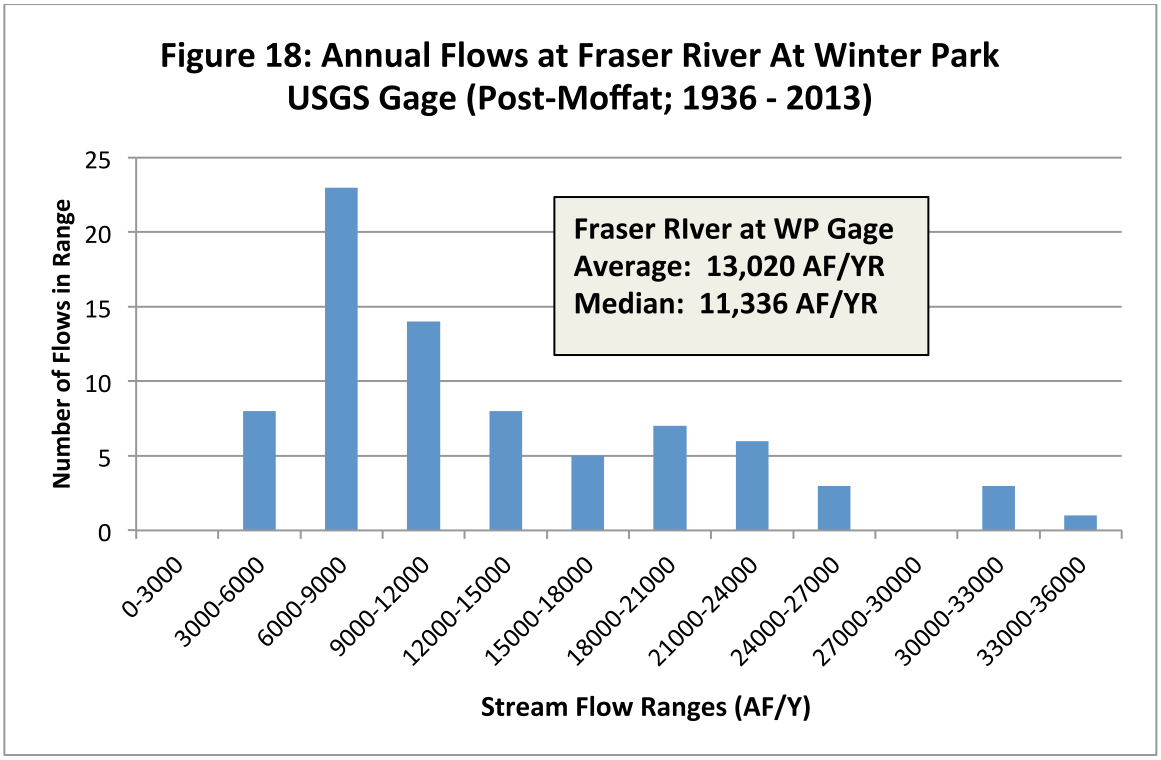


Figure 16: Histogram of Montly Stream Flows at the Colorado River Below Windy Gap USGS Gage (Post-Windy Gap, 1985-2013)
CO RIver Blw Windy Gap
Average/Median (cfs)
May: 531/394
June: 765/460
July: 427/274
May
June
July
Number of Flows in Ranges
12
10
8
6
4
2
0
0-249
250-499
500-749
750-999
1000-1249
1250-1499
1500-1749
1750-1999
2000-2249
2500-2749
>2750
Stream Flow Ranges (cfs)



A histogram (Figure 18) of annual stream flow at the Fraser River at Winter Park gage was also constructed to evaluate whether annual flow is also positively skewed. This is important when assessing the overall depletion of stream flows on the Fraser River. Annual data at this gage are positively skewed. Therefore, use of median flows in calculating the existing depletion of stream flow in the Fraser River at Winter Park is more appropriate both for months in the irrigation season, likely for all other months as well, and for total annual flows. The FEIS calculation of stream flow depletion, that uses average annual stream flows at the Fraser River at Winter Park USGS gage, thus under-estimates the actual depletion of flows in the Upper Fraser Basin. In addition, historical depletion of monthly flows is under-estimated when using averages.



Use of Median Statistics in Other Analyses

Median statistics to represent the central tendency of hydrologic data sets are used frequently in other analyses. For example, hydrologic and reservoir storage medians are output from climate models to assess future impacts of climate change on reservoir inflows, end of month reservoir storage, and surface water flows forecasting (USACE, 9/2011) as well as analysis of flood control and hydropower generation (USACE, 5/2011) at dams on the Columbia and Snake River basins. The National Resources Conservation Service reports normal snowpack as the 1981 to 2010 median of snow water equivalent at individual SNOTEL sites. Median snow pack values are utilized in water supply models that predict the timing and volume of water runoff on an annual basis (Pagano, 2009).

<u>Re-evaluation of Impacts of Moffat Project on Stream Flows in the Fraser and Williams Fork Basins</u>

Impacts of increased Denver Water diversions under the Moffat Project were re-evaluated using the median of the post-Moffat period of record as the environmental baseline. First, post-Moffat averages were compared to 1975 to 2004 average flows reported in the EIS to verify that use of a different post- Moffat time period did not affect the outcome of the evaluation. As seen in Table 6 the FEIS and USGS post-Moffat averages were similar. As discussed earlier, the post-Moffat median is typically lower than the average at all gages except Williams Fork Below Steelman gage. Significant reductions in flow between the historical average and the average current condition model scenario are seen at two gages; Fraser River at Winter Park and the Williams Fork Below Steelman gages. Therefore, the total change in flow due to the proposed action at these gages equals the difference between the average historical and the modeled proposed flows. This method was also applied to flows on the Colorado River as they would also be impacted by upstream changes. At St. Louis and Vasquez Creek gages, total change in flow equaled the difference between the modeled flows under the current condition and proposed model scenarios. Changes in flow are calculated using average numbers because both are positively skewed. These differences are then applied to the Post-Moffat median to evaluate the true impact of the proposed project on stream flow at each USGS gage: the adjusted median and the percent change from the historical median.

Table 6: Re-Evaluation of Stream Flow Depletion in Fraser and Williams Fork Basins Using Historical Post-Moffat Median Baseline and Total Proposed Changes

Stream Flow USGS Gage	FEIS average (1975-2004)[1]	USGS average / median	Modeled "Current Condition" Flows[2]	Modeled "Proposed Action" Flows[2]	Total Change in Flow Due to Proposed Action[3]	Adjusted Median and % change[4]
Fraser River at Winter Park Gage (1936 – 2013)[5]						
Pre-Moffat (1905-1935) (AFY)	na	32,079/ 31,423	na	na	na	na
Post-Moffat (1936 – 2013)(AFY)	13,360	13,020/11,336	8,529	6,053	6,967	4,369(61.5%)
Annual Flow (AFY)	13,360	13,020/11,336	8,529	6,053	6,967	4,369(61.5%)
May monthly Flow (cfs)	30	31/21	17	11	20	1 (98.5%)
June Monthly Flow (cfs)	80	79/60	59	30	49	11 (81.7%)
July Monthly Flow (cfs)	40	34/18	21	16	18	0 (99.4%)
Vasquez Creek near Winter Park Gage (1936 – 2013)						
Annual Flow (AFY)	10,247	10,513/7717	10,458	4,959	5,499	2,218(71.3%)
May Monthly Flow (cfs)	22	26/17	20	9	11	6 (64.3%)
June Monthly Flow (cfs)	65	68/46	74	41	33	13 (71.6%)
July Monthly Flow (cfs)	27	25/11	32	17	15	-4 (134%)
St. Louis Creek Near Fraser Gage (1956 – 2013)						
Annual Flow (AFY)	15,220	15,490/14,065	15,648	13,196	2,452	11,613 (17.5%)
May Monthly Flow (cfs)	30	28/23	27	22	5	18 (21.5%)
June Monthly Flow (cfs)	95	98/84	101	78	23	61 (27.4%)
July Monthly Flow (cfs)	50	54/37	54	44	10	27 (27.0%)
Ranch Creek near Tabernash Gage (1936 – 2013)[6]						
Annual Flow (AFY)	8,661	9,979/9,396	6611	4863	na	na

May Monthly Flow (cfs)	25	30/21	9.9	5.8	na	na
June Monthly Flow (cfs)	65	75/66	60.3	43.9	na	na
July Monthly Flow (cfs)	20	24/17	23.9	17.3	na	na

Table 7: Re-Evaluation of Stream Flow Depletion in Fraser and Williams Fork Basins Using Historical Post-Moffat Median Baseline and Total Proposed Changes (continued)						
Williams Fork Below Steelman Creek Gage (1966 – 2013)						
Annual Flow (AFY)	14,080	14,074/14,358	9,600	6,805	7,269	7,089(50.6%)
May Monthly Flow (cfs)	25	28/19	10	6	22	-3 (116.8%)
June Monthly Flow (cfs)	110	115/133	88	69	46	87 (34.8%)
July Monthly Flow (cfs)	55	56/47	50	30	26	21 (55.8%)
Colorado River Below Windy Gap Gage (1985 – 2013 Post-Moffat, CBT, and Windy Gap)						
Annual Flow (AFY)	164,597	186,162/ 122,899	155,653	126,767	59,395	63,504 (49.3%)
May Monthly Flow (cfs)	550	531/394	440	285	246	148 (62.5%)
June Monthly Flow (cfs)	725	765/460	684	555	210	250 (45.7%)
July Monthly Flow (cfs)	350	427/274	452	355	72	202 (26.2%)
Colorado River near Kremmling Gage (1985 – 2013, Post-Moffat, CBT, and Windy Gap)						
Pre-Moffat (1905-1918) AFY		1,337,878/ 1,259,776	na	na	na	na
Post-Moffat (1962 – 2013) AFY	725,867	717,187/ 654,716	698,958	636,349	80,838	573,878 (12.3%)
May monthly Flow (cfs)	1,750	1,643/1,315	1,333	1,171	472	843 (35.9%)
June Monthly Flow (cfs)	2,100	2,163/1,376	2,295	1,871	292	1,084(21.2%)
July Monthly Flow (cfs)	1,500	1,530/1,038	1,639	1,431	99	939 (9.5%)

[1] FEIS average utilizes data within the time period, 1975 to 2004 also from USGS gages

[2] PACSM Modeled Current Conditions; Table H-7.1 average year results (AF) and Tables H-1.33, H-1.37, H-1.42, H-1.56, H-1.58, H-1.60 (cfs results).

[3] At Fraser River at Winter Park and Williams Fork Below Steelman USGS gages where there was a substantial difference between historical post-Moffat average and current modeled flows; Difference = Historical Average minus modeled proposed flow; at St. Louis and Vasquez gages, difference = current – proposed modeled flows; at Colorado River gages difference = historical average minus modeled proposed flow similar to two Fraser River gages.

[4] Adjusted median flow = historical median flow minus difference; (difference as percent of historical median flow)

[5]USGS average and median flow utilizes data in years noted by gage name.

[6] The PACSM model did not include a node at the Ranch Creek USGS gage: Current and Proposed flows are thus the sum of modeled flow downstream of diversion structures on the North Fork/Dribble Creek, Main Ranch Creek, and South and Middle Fork Ranch Creek. These flows do not include inflows below the diversion structure and could not be compared to measured flows at the USGS Ranch Creek gage. Data taken from FEIS Tables H-1.47, H-1.48, H-1.46.

Table 8. Comparison of Percent Reduction in Stream Flows: FEIS Versus Re-Evaluation								
USGS Gage	% Reduction: Modeled Full Use to Proposed Model Scenarios				% Reduction: Impact Re-Evaluation			
	May	June	July	Annual Avg	May	June	July	Annual
FR@ Winter Pk	36	39	13	22	98.5	81.7	99.4	61.5
Vasquez Creek	29	32	23	23	64.3	71.6	134	71.3
St. Louis Creek	18	20	20	13	21.5	27.4	27	17.5
WF BLW ST.	35	21	16	20	117	34.8	55.8	50.6
COR BLW WG	3	12	5	5	62.5	45.7	26.2	49.3
COR Near Krem.	1	5	5	2	35.9	21.2	9.5	12.3

Percent reduction in stream flow caused by project related diversions noted in the EIS substantially under-estimates the true depletion in flows in the Fraser, Williams Fork, and Colorado Rivers (Table 6). At the Fraser River at Winter Park USGS gage, where historical flows are already depleted by 70 to 80 percent in the irrigation season (See background section in these comments) by existing diversions, almost the entire remaining flow in May, June, and July is slated for additional diversion across the divide. At some gages, percent reduction in flow will exceed 100 percent of flows remaining in the basins. Fifty percent of the Colorado River flows below Windy Gap and an additional 12 percent of the remaining flow in the Colorado River near Kremmling, already depleted by 50 percent, will be diverted under the cumulative effect of the Windy Gap Firming and the Moffat-Gross Projects. At the town of Hot Sulphur Springs historical flows are already depleted by 77 percent due to existing trans-mountain diversions through the Alva B. Adams and the Moffat Tunnels. Though the USGS gage at Hot Sulphur Springs was discontinued, just upstream at the USGS gage below Windy Gap, additional diversions will deplete flow remaining in the Colorado River by 26 to 63 percent in the irrigation season and by approximately 50 percent annually.

Data are presented in Figures 19 through 24 below to further illustrate the discrepancy between post-project modeled flows with adjusted historical median flows. Shown in each figure are; the post-Moffat and in the case of Windy Gap and Kremmling gages, post-Windy Gap, average and median flows, the reduced median as calculated in Table 7 above, the post-project modeled (proposed) flows, and a dry year median for comparison to all other flows. In all cases, the reduced median, the more realistic estimate of flows remaining in the streams after the proposed project comes online, was below and sometimes substantially below the modeled post-project proposed flows.

Figure 19:Comparison of Average & Median flows at USGS Gage (09024000) "Fraser River at Winter Park" with Reduced Median, Modeled Proposed and Dry Year Median Flows

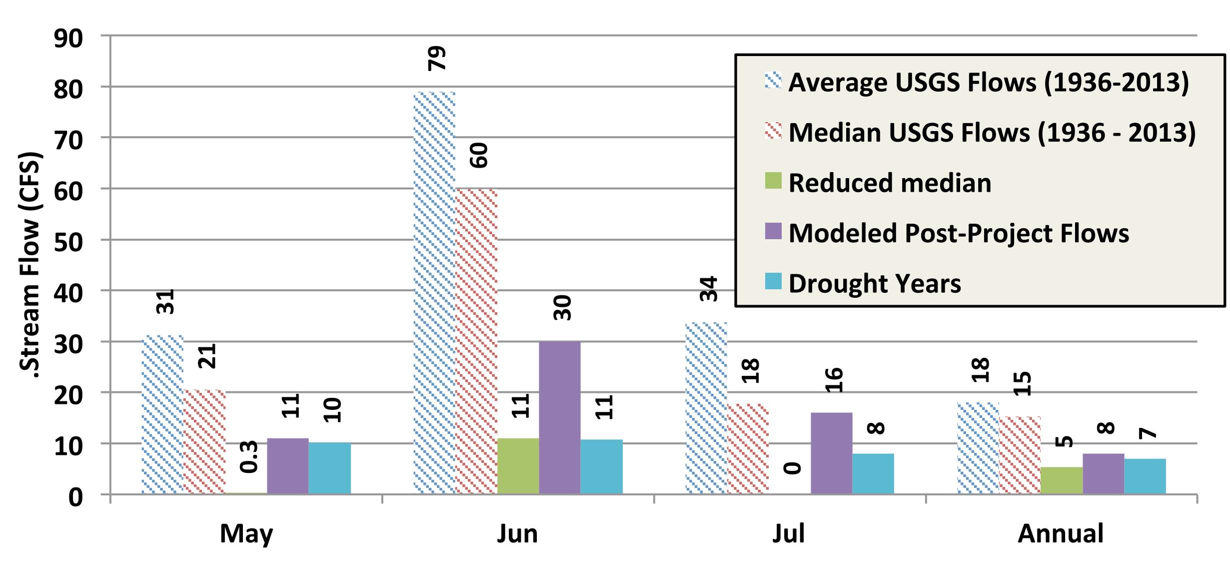


Figure 20: Comparison of Average & Median Flows @ USGS Gage 09025000 "Vasquez Creek near Winter Park" with Reduced Median, Modeled Proposed, and Dry Year Flows

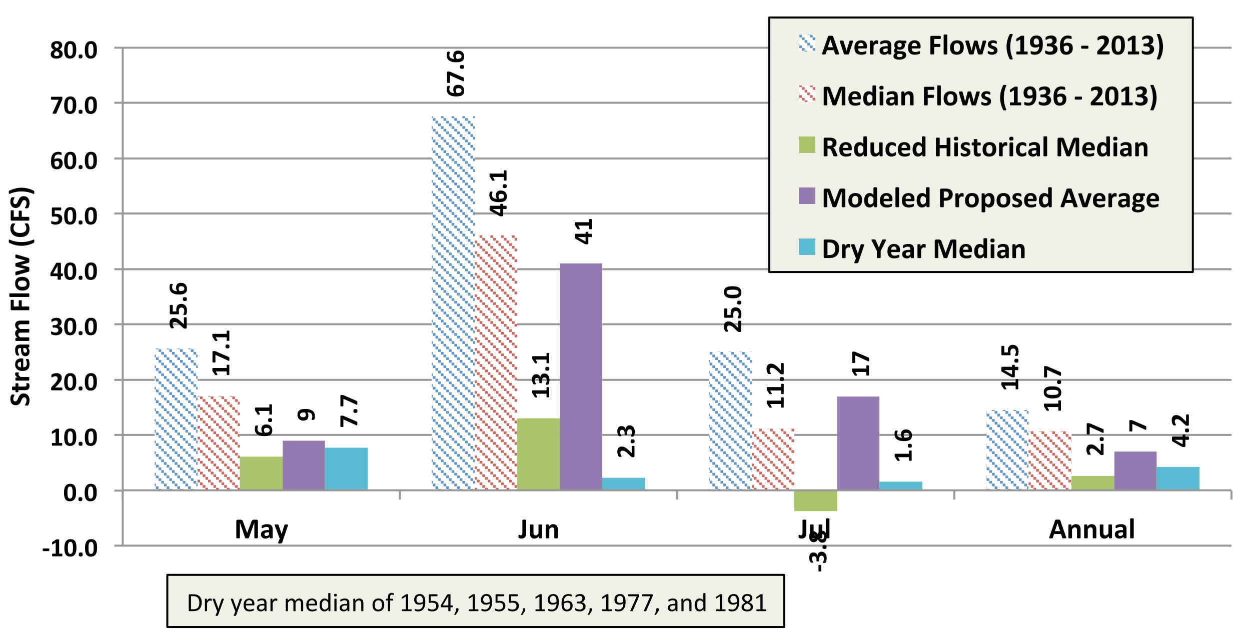


Figure 21: Comparison of Average & Median Flows @ USGS Gage 09026500 "St. Louis Creek Near Fraser" with Reduced Median, Modeled Proposed, and Dry Year Flows

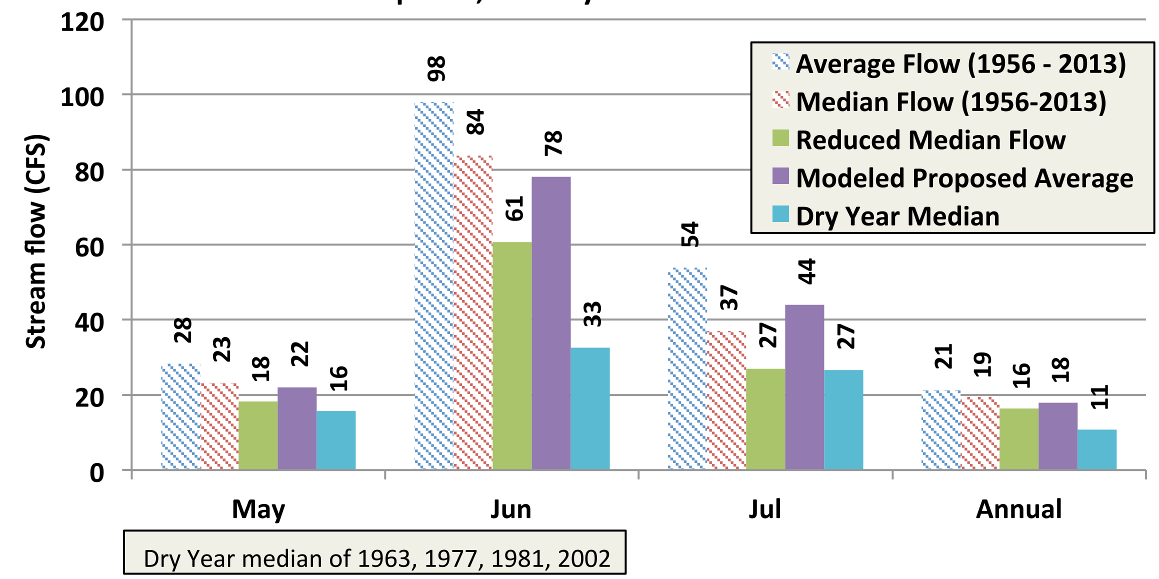
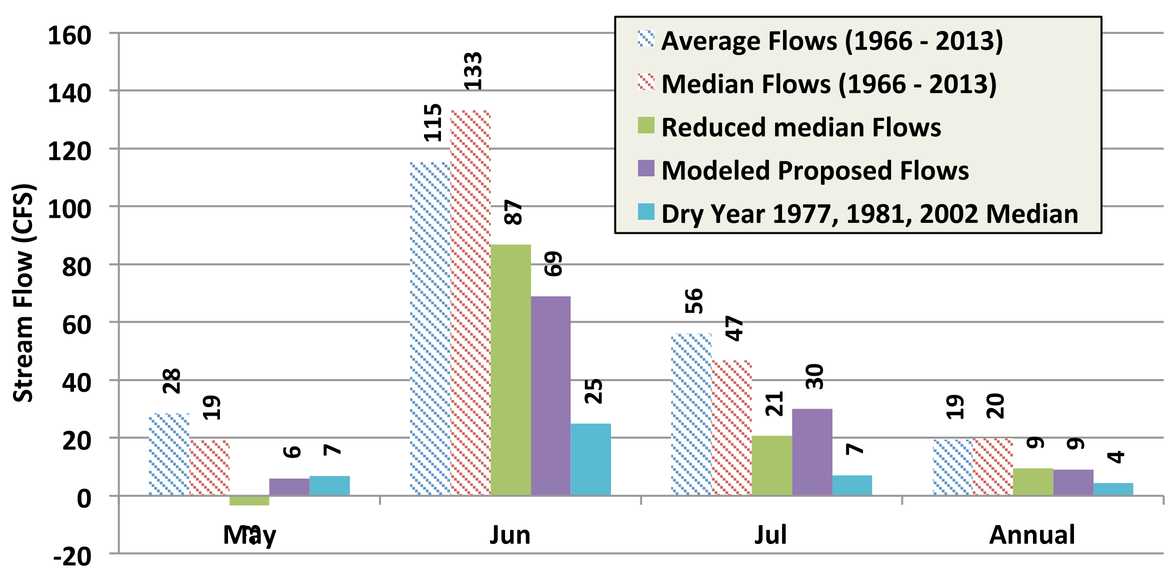
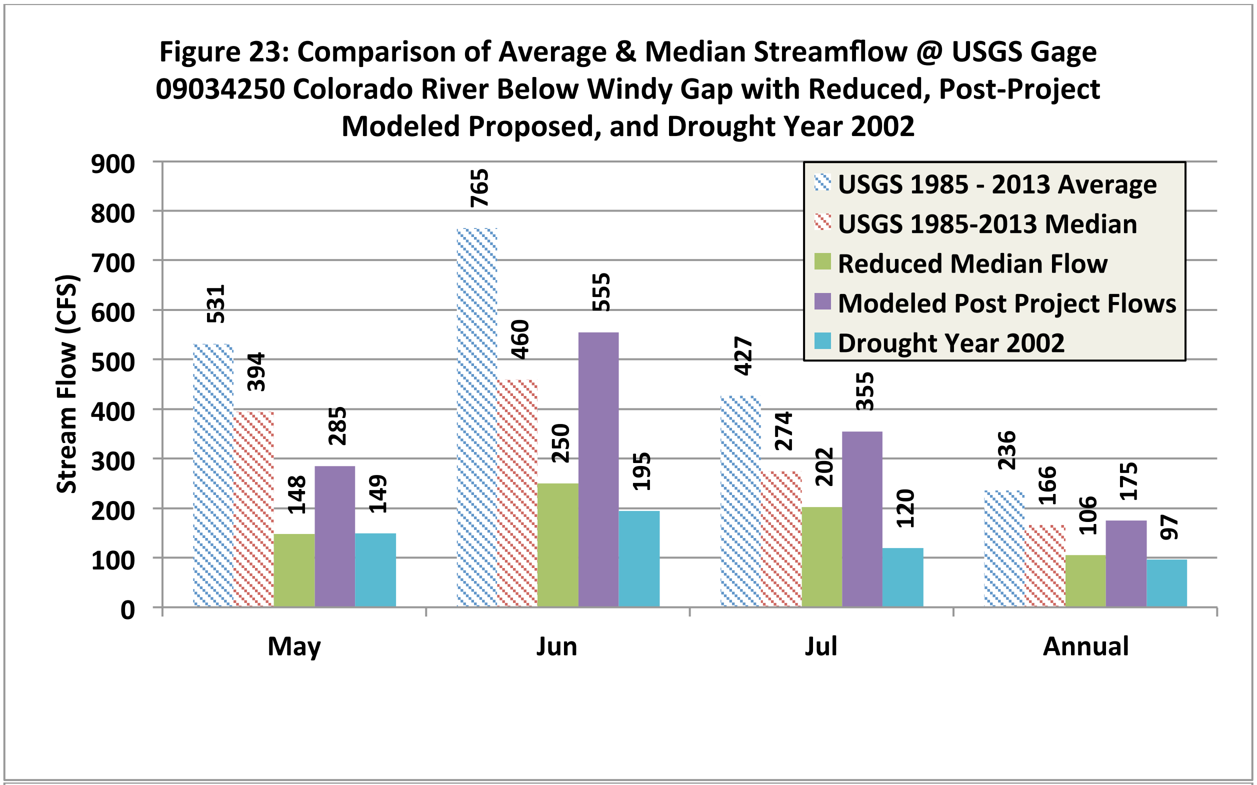
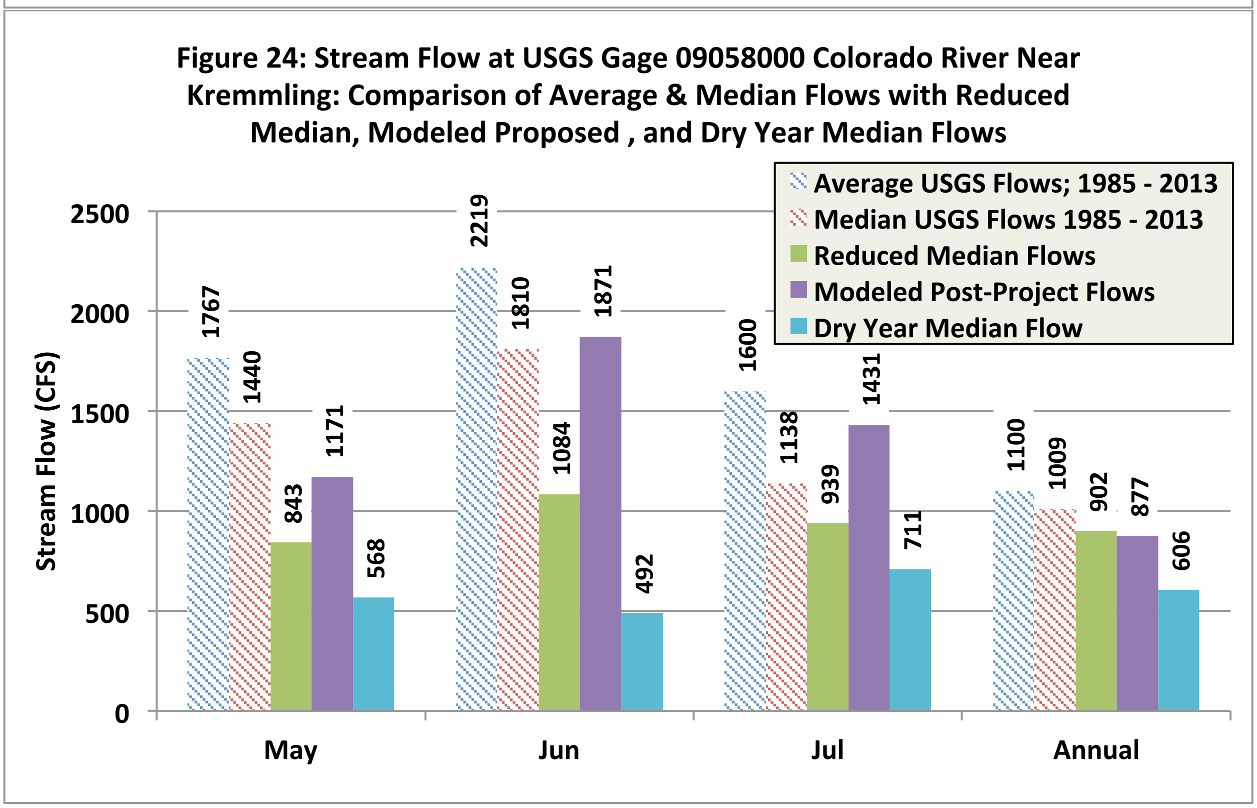


Figure 22: Comparison of Average & Median USGS Flows (09035500) at "Williams Fork Below Steelman Creek" with Reduced Median, Modeled Proposed, and Dry Year Median Flows







Use of medians instead of averages, use of monthly data in the irrigation season as well as annual data, and inclusion of the full amount of diversions that are required to meet the stated firm yield goal for the expanded Gross Reservoir more accurately depicts the impact that will be seen on the Fraser, Williams Fork, and Colorado Rivers if the Moffat-Gross (and the Windy Gap Firming project) project comes on line. By separating required diversions into small increments of historical to current condition to full use, and finally, to the proposed project and claiming that only the last increment of impacts are project related, severely under-estimates and obfuscates the true impact of the project.

The FEIS does not adequately consider geologic impacts as a result of reservoir expansion:

Gross Reservoir is in Seismic Zone 1 indicating there is little chance of significant earthquakes (FEIS). The Seismic Zones are determined by the ICBO, the International Conference of Building Officials, and uses active peak acceleration to determine the different zones (EMG, 1997). However, to better understand the earthquake risk to Gross Reservoir, the *magnitude* of earthquakes and not the active peak acceleration is important. Like active peak acceleration, magnitude takes into account the movement of the earth at the surface, and is a measurement of the total energy the earthquake releases (Swiss Seismological Service, 2013). Magnitude is a more widely and commonly used measurement of earthquakes (Swiss Seismological Service, 2013) and allows us to compare the earthquakes risks of Gross Reservoir to other dams.

Gross Reservoir is located on several faults (FEIS). Denver, like the Gross Reservoir, is also in a Seismic Zone 1 (EMG, 1997) and affected by several faults (Feth et al., 1966). Since 1960, Denver has experienced six earthquakes with a magnitude of 4.0 or greater, and numerous earthquakes of lesser magnitudes, many of these felt in surrounding counties including Boulder and Jefferson county (USGS, 2014). This suggests that a Seismic Zone 1, i.e. where Gross Reservoir is, can be an active zone with relatively large magnitudes.

In 1882, Denver experienced its largest earthquake recorded, with an estimated magnitude of 6.6 (USGS, 2014). In 1967, an earthquake of this magnitude was enough to cause cracks in the Konya Dam in Maharashtra, India (Chopra and Chakrabarti, 1973), causing many dollars in repairs. This data indicates that Gross Reservoir is at risk for the same damages that Konya Dam experienced, as suggested by the earthquake record in Denver.

In addition, earthquakes may also be caused by the increased water volume which applies stress to the faults (FEIS). While the FEIS states that the increased water due to the expansion of Gross Reservoir would not increase reservoir-induced earthquakes "at substantial levels," it also states any potential risks due to the increased water volume will be studied during the construction phase. This study should be completed and considered before the expansion starts.

Akin to Gross Reservoir, Konya Dam was considered to be in a “stable and nearly nonseismic” zone (Chopra and Chakrbarti, 1973). However, Konya Dam caused its own earthquake because of the increased water volume (USGS, 2012). In addition to damaging the dam, the earthquake killed 177 people and completely ruined 25 percent of nearby buildings (USGS, 2012). As Gross Reservoir is expanded, it, too, is at risk for causing an earthquake due to the increased water volume, potentially causing horrific damage to nearby communities in addition to damages to the dam itself.

Before the dam is expanded, studies should be conducted and evaluated regarding the potential for reservoir-induced earthquakes. As seen with the Konya Dam, despite appearing to be impossible, the Konya Dam caused a large earthquake.

Growth as an Indirect Effect:

"Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects of air and water and other natural systems, including ecosystems." 40 CFR§1508.8. A conclusion statement that growth will increase with or without the project, or that development is inevitable, is insufficient; the agency must provide an adequate discussion of growth-inducing impacts." Davis v Mineta, 301 F.3d 1104 (10th Cir. 2002). "Growth-inducing effects are expressly included in the definition of 'indirect impacts' in the regulations . . . indirect impacts need only be 'reasonably foreseeable' to require an assessment of the environmental impact." Friends of the Earth, Inc. v Corps, 109 F.Supp.2d 30, 41 (D.D.C. 2000).

The Moffat Project's discussion of the indirect effects of development along the Front Range is insufficient. The City of Arvada is developing a 1,500 acre urban "renewal" area in the northwest quadrant of the city, the Candelas Development. The area is designated for residential, commercial and industrial development. While Arvada projects 700 AF annual water savings by 2018, the city will invest $106 million for 3,000 AFY from the expanded Gross Reservoir and by 2028 will have five storage tanks totaling 3.1 million gallons to supply the Candelas Development (City of Arvada, 2010). This inconsistency between projected water savings and considerable investment in acquiring more water is about development.

The FEIS fails to adequately analyze traffic impacts:

Traffic impacts in the FEIS are based upon haul studies performed by Harvey Economics (Denver Water, 2012b), "HDR 2012," for Denver Water (FEIS p.5-396). This study builds upon an earlier one (Denver Water, 2009), "HDR 2009," but contemplated using tractor-trailers rather than 15 cu. yd. end-dump trucks. The FEIS has reverted to 15 cu. yd. trucks for a planned 4.1 year, 260 days/yr construction campaign (FEIS p. 5-395). Estimated average and peak one-way daily truck trips are shown in Table 2-19 as 22 and 37 respectively and daily worker commuter trips are shown similarly as 60 and 101.

It is stated on FEIS p. 2-115 that "In addition, flyash and cement would be hauled to Gross Reservoir and trucks associated with these materials are included with the estimate for haul trucks in Table 2-19." However, as was pointed out in DEIS responses, the truck hauls in Table 2-19 only account for the sand, not the flyash and cement. Nevertheless, through information in HDR2012, Table B-9, it is possible to arrive at a more accurate count of daily truck trips:

Material	Total Loads	One-way Miles
Sand	360,000 cu.yd./15 cu. yd.= 24,000	52.4
Cement	62,000 cu. yd./ 15 cu. yd.= 4,133	144.9
Flyash	55,000 cu. yd./ 15 cu.yd.= 3,667	346.9
Total	31,800	

So with 260 days/yr x 4.1 yrs = 1066 days, we have 31,800/1066 = 29.83 or 30 one-way trips per day, not 22. Using the same peak/average ratio, we have 37/22 = x/30 and then x = 50.

Denver Water is still vague about hauls of logs and slash, but HDR2012, Table B-8, estimates 6 loads/day in the first construction year. For a 10-hour day then, peak load is 50 + 6 = 56/10 = 5.6 trucks/hour in the initial year and average loads are 3.6 trucks/hour. This still does not include the steel pipe that will be part of the dam structure nor any miscellaneous supplies.

In HDR 2009, pp. 1-3, an analysis of the need for climbing lanes on Hwy 72 was made utilizing the American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets* (AASHTO, 2004). Traffic data were obtained from the Colorado Department of Transportation (CDOT) and showed average daily traffic (AADT) of 4900 vehicles of which 3% were heavy trucks. Using the industry standard of 10% AADT to calculate peak upgrade traffic, they showed 490/2 = 245 vehicles with 3% or 7.4 heavy trucks/hour baseline. This analysis was further refined in HDR2012 to include 3% medium trucks, an additional 7.4 peak vehicles/hour likely to operate at lower speeds than autos. However, no account was taken of recreational vehicles (RVs), which are described in AASHTO 2004, p. 233, as “self-contained motor homes, pickup campers, and towed trailers of numerous sizes.”

AASHTO says the three criteria shown below all have to be satisfied to justify climbing lanes (AASHTO, 2004: p. 244):

1. Upgrade traffic flow > 200 vehicles/hour
2. Upgrade truck flow > 20 " "
3. One of the following conditions exists:
 - 10 mph or greater speed reduction for a typical heavy truck
 - Level-of-service E or F exists on the grade
 - A reduction of 2 or more levels of service is experienced when moving from the approach segment to the grade

HDR 2009 noted that criterion 1) was met with 245 vehicles/hour and conceded that >/= 10 mph speed reduction was likely, meeting criterion 3), but said that criterion 2) was not satisfied. Using current data we have 7.4 peak trucks/hour baseline + 5.6 additional haul trucks/hour = 13 heavy trucks/hour. Adding the 7.4 medium trucks/hour would bring the total > 20, but this may not be valid under AASHTO. However. AASHTO, 2004: p. 233 does say “...where a low percentage of trucks may not warrant a truck climbing lane, sufficient recreational vehicle traffic may indicate a need for an additional lane.”

Moreover, immediately following the criteria statement above, AASHTO, 2004: p. 245 says: **"In addition, safety considerations may justify the addition of a climbing lane regardless of grade or traffic volumes."**

A proper evaluation of safety requires a complete picture of the projected impacts. In this regard, the TEG group submitted an Addendum to DEIS comments to the Corps on June 26, 2013 after thorough review of HDR2012 and testimony at a Boulder County public hearing in January 2013, where an **experienced truck driver testified**. This Addendum is included here as Addendum III: Traffic Safety. Even though it discusses some DEIS data, it mainly provides valuable detail on the specifics of the mountainous segments of Hwy 72 as well as other local roads, including Gross Dam Road, and points out the numerous and overwhelming safety concerns and includes the truck driver's testimony.

A realistic assessment of the planned project's traffic impact should acknowledge that increasing peak heavy truck traffic by 76% (5.6/7.4) and total peak vehicle traffic by 44% (101+5.6/245) does not have a "negligible impact" as is stated repeatedly in the FEIS. There are also deeply flawed assumptions in the FEIS that would make the planned schedule impossible to meet as well as exacerbate the negative impacts outlined above. HDR2012 assumes an average 40 mph haul truck speed on Hwy 72. There is an 8.5 mile segment from Hwy 93 to Gross Dam Rd., of which 6.8 miles are curving mountainous grades with posted speed limits of 25 and 35 mph in some areas. This mountainous segment has numerous blind driveways, blind curves, school bus stops and some commercial establishments. With convoys of trucks followed by long lines of cars (in both directions), there will be many occasions where the trucks will have to stop or slow to a crawl. It will then take time and distance to regain speed (see data in AASHTO, 2004: p. 235 for information on heavy truck acceleration on upgrades and downgrades).

Another flawed (implied) assumption is that the haul trucks will arrive at uniform intervals. With the disparate source locations and mileages to Hwy 72, it is quite likely that truck spacing will be minimal at times, resulting in even longer traffic backups. The extreme likelihood of truck speed reduction of > 10 mph gives rise to increasing safety concerns. AASHTO, 2004: p. 239 notes that "...the crash involvement rate increases significantly when the truck speed reduction exceeds 15 km/h (10 mph) with the involvement rate being 2.4 times greater for a 25km/h (15 mph) reduction than a 15 km/h (10 mph) reduction."

HDR 2012 shows projected costs of $4.0-5.0 million for the two climbing lanes and $22.5-25.0 million for widened shoulders to provide bike traffic safety. However, the FEIS rejects these improvements as unnecessary and too costly and shows <u>no mitigation for traffic safety</u> in Appendix M.

Another perspective on cost is the value of human lives. As the truck driver points out in his testimony on the project traffic planning, <u>there will be fatalities</u>.

Lastly, claims such as "Additional traffic associated with vegetation removal was not evaluated in the EIS because the amounts would vary depending on which disposal options would be selected" (FEIS ES-56) deny the public the option to comment on impacts.

<u>The FEIS does not adequately address impacts to special species status:</u>

Flow changes in South Boulder Creek, North Fork South Platte River, and the South Platte River would contribute to adverse effects on Platte River system threatened and endangered species including whooping crane, piping plover, least tern, pallid sturgeon, and western prairie fringed orchid. (ES-54)

As the FEIS points out; “The average annual depletion from the South Platte River Basin would be 1,607 AF. Thus, under the Proposed Action, the USFWS determined that the depletions in the South Platte River would be “likely to adversely affect” the whooping crane, least tern, pallid sturgeon, piping plover, and western prairie fringed orchid in the central and lower Platte River in Nebraska” (FEIS 5-317).

Whooping Crane Impacts:
As the National Wildlife Federation States, whooping cranes are still critically endangered and habitat loss is listed as a threat to whooping cranes. “Habitat loss—due to destruction, fragmentation or degradation of habitat—is the primary threat to the survival of wildlife in the United States. When an ecosystem has been dramatically changed by human activities—such as agriculture, oil and gas exploration, commercial development or water diversion—it may no longer be able to provide the food, water, cover, and places to raise young. Every day there are fewer places left that wildlife can call home” (NWF, 2014a).

The FEIS claims that the depletions to the South Platte River by implementing the Proposed Action are “covered by Denver Water’s continued participation and membership in the South Platte Water Related Activities Program” however does not address the mitigation plans, nor allow the public to comment if this is a reasonable solution to potential loss of habitat for endangered and threatened species such as the whooping crane and piping plover. This is a concern that is not fully addressed in the FEIS. Also it is important to note that “Dams and other water diversions [that] siphon off and disconnect waters, changing hydrology and water chemistry (when nutrients are not able to flow downstream)” are one of the main contributors to habitat loss in the United States (NWF, 2014b). This project will be yet another water development project contributing to the decline of habitat to nationally important species.

Piping plover impacts:
Similarly to the whooping crane, the piping plover is also endangered. Habitat loss is cited by the USFWS as a threat to the piping plover. Specifically they note that “Through the use of dams or other water control structures, humans are able to raise and lower the water levels of many lakes and rivers of plover inland nest sites (USFWS, 2001).

Least tern impacts:
The USFWS lists “channelization and impoundment of rivers [as having] directly eliminated nesting habitat” (Sidle & Harrison, 1990). The “Loup River from St Paul to Platte River” and the “Platte River from Lexington to Chapman and from Columbus (Highway 81 bridge) to Missouri River” are listed as “essential breeding habitat for interior least terns (USFWS, 1990). More information is needed about how diversions from this project as well as impacts from flow reductions due to climate change and other habitat losses will impact this endangered species.

Pallid sturgeon impacts:
The USFWS state water development as a reason for the current status of the pallid sturgeon; “Dams block migration, fragment the population, and alter flow rates and temperature regimes required by the species. Channelization reduces habitat diversity characterized by side channels, chutes, sloughs, and floodplains” (USFWS, 2013).

The FEIS Fails to Adequately Address Impacts to Wetlands:

Estimate of Wetland Impacts on the West Slope

The FEIS offers extensive coverage of wetland processes and conditions but ignores significant wetland impacts on the West Slope. These impacts are not only critical to watershed health and values on the West Slope, they are critical to the Corps 404 Permit for the Moffat-Gross Expansion Project.

The FEIS does acknowledge impacts to East Slope wetlands (FEIS page ES-47) but there is no tabulation of West Slope wetland impacts. Completing their independent assessment, Grand Environmental Services finds that the actual area of West Slope wetlands likely to be significantly impacted by the Moffat Gross Expansion is 312 acres. This estimate is extremely conservative and could be an order of magnitude low. That said, theFACWet assessment indicates a significant amount of the above wetland acreage will go from Functioning Impaired to Non-Functioning using the FACWet nomenclature (GES 2014).

See Section II.B. for further analysis.

4. The FEIS does not adequately analyze the proposed Moffat project's cumulative impacts.

Historical cumulative Impact Comment: Cumulative impacts are not adequately analyzed and reported in the EIS. The EIS claims that cumulative impacts to the environment in the Upper Colorado basin only include effects predicted by the PACSM model between the current conditions and full use model scenarios (Page 4-5 EIS) with additional RFFAs that will likely be completed prior to 2022 (including the large Windy Gap Firming Project which will substantially affect flows on the Colorado River particularly in combination with the Moffat Project). Ignored are the cumulative impacts of historical diversions starting in 1936 that continue to the present day. The background section of these comments shows that stream flow in the Fraser at Winter Park has been depleted by 70 to 80 percent in the irrigation season due to historical diversions. Likewise, stream flow depletion on the Colorado River in Hot Sulphur Springs, by 1994, was 77 percent of annual pre-diversion flows. Annual flow in the Colorado River near Kremmling, which reflects diversions from the Blue River, the Fraser and Williams Fork Rivers, and the Upper Colorado River basin, has been depleted 50 percent (annually) due to historical diversions from its headwaters. During months in the irrigation season, May, June and July, the Colorado River near Kremmling has been depleted by 67.6, 81.7, and 66.4 percent, respectively, due to historical diversions. The EIS does not acknowledge the true extent or impact of historical diversions on the upper tributaries to the Colorado River. By not acknowledging historical impacts, the EIS ignores the true cumulative impact of substantial additional project diversions, taken from all of the upstream tributaries to the Colorado River, on stream flow and the aquatic ecosystems in an already severely depleted river system.

Historical data for fish and benthic communities was included in Chapter 3 of the EIS and are summarized briefly here to show that under historical diversion patterns the Fraser and Colorado basins are already impacted though, as stated in the section, most stream sections are "*not yet at the tipping point.*" The tipping point is determined by comparison of basin streams with non-impacted Rocky Mountain streams (Platts and McHenry, 1988). Based on macro-invertebrate and fish surveys, some stream reaches have reached the tipping point where there are "*Few to no fish present and degraded macroinvertebrate communities*." These include but are not limited to:

- West and East St. Louis Creeks
- King Creek
- Main and East Elk Creeks
- North Fork, Main, Middle, and South Forks of Ranch Creek
- Wolverine, Cub, and Buck Creeks

Vasquez Creek is on the Colorado Section 303(d) list for aquatic life impairment. On Jim Creek, "*flow-based habitat changes are sufficient to negatively affect stream biota but not severe enough to cause population collapse*."

From page 3-416 to 3-423, the main stem of the Fraser River shows the effect of past water diversions through the Moffat Tunnel.

- The Fraser River upstream of Fraser is on the 303(d) list for aquatic life due to low MMI scores and downstream of Fraser is listed for exceedances of maximum water temperatures.
- Despite instream flow rights,…..*the Fraser River has been altered enough* [due to high percentages of native stream flow diversions] *to have crossed two flow-based thresholds…*"
- *Only a few water temperature exceedances were observed in the Fraser River from 2005 to 2009. Though these DM temperatures were stressful… with a maximum of 24.7 ^{o}C, they only ocurred twice over a four year period ….*"
- *"Although this stream has a bypass agreement, the fish population in the Fraser are not always judged to be healthy by the prescribed criteria at some sites."*
- *"Approximately 33% of the MMI scores do not attain the MMI threshold for unimpaired aquatic life use. ….In other cases, the MMI scores are well below the threshold for attainment of 42.* In particular, from Table 3.11-6 of the EIS, this MMI score was less than 42 on the Fraser mainstem from below Buck Creek to Ranch Creek.
- *"Overall the available information indicates that the Fraser River has not crossed an ecological tipping point.*"

On the Blue River downstream of Green Mountain Reservoir, *benthic invertebrate data were available since 1993 and population numbers and diversity metrics were considered excellent during the early years of the time-period. In the last six years of the period of study the number and diversity were dramatically lower. The cause…. may be related to an increase in didymo, which can form continuous mats over the substrate and is known to increase with decreasing flushing flows,"* (page 3-478 FEIS).

This picture of existing conditions in the upper basins from which a substantial amount of additional diversions are planned indicates that several stretches of river are already near or below the "tipping point." By ignoring this picture, by considering only a small portion of the additional diversions and impacts to be project related, by not acknowledging impacts of embedded diversions in the current condition model scenario, by not evaluating the true feasibility of attaining the firm yield requirement of the expanded Gross Reservoir with "project" diversions, the true impacts of these additional diversions are obfuscated and will likely be much greater than indicated in the EIS. Truly, changing the conversation to adjust to the "New Normal" around Colorado Supply needs to be embraced (Buchanan, 2014)

Embedded Diversions Cumulative Impact comment: Trans-basin diversions embedded in the current conditions PACSM model scenario are not acknowledged in the EIS. Embedded diversions equal the difference between measured and modeled diversions through both the Moffat and Roberts Tunnels. Embedded diversions (Table 8) for the Moffat Tunnel equal to 7,300 AFY on average are described in the "baseline comment section." Approximately 13,449 AFY of additional diversions are embedded in the current conditions model scenario for the Roberts Tunnel. Embedded current condition diversions represent 71 and 278 percent of proposed project diversions for the Moffat and Roberts Tunnels, respectively. Embedded diversions are not acknowledged nor are the cumulative impacts caused by these incremental diversions evaluated in the EIS. All additional diversions, when summed, amount to a 36 and 81 percent increase in the historical diversions at the Moffat and Roberts Tunnel, respectively.

Table 8: Summation of Historical and Proposed Future Moffat and Roberts Tunnel Diversions

	Moffat Tunnel (AF/Y)	Roberts Tunnel (AF/Y)	Total Diversions (AF/Y)
Historical Average	56,532 (1984 to 2013 average)[1]	56,227 (1964 – 2008 average)[2]	112,759
Embedded in Current Conditions	7,300	13,449	20,749
Additional Full Use	2,713	27,263	29,976
Additional Proposed Project	10,284	4,836	15,120
Total Diversions	76,829	101,775	178,601

[1]diversion data from cdss hydro database.
[2]From Joint Rebuttal Document to DEIS.

Misleading sections of EIS, cumulative Impacts comment: Quotes noted below come from a summary box in the executive summary section of the EIS (page ES-25) that note the cumulative adverse impact to fish and invertebrates on several sections of the Fraser, Williams Fork and Blue River basins.

- *Reductions in high flows in the upper sections of the Fraser River upstream of St. Louis Creek would have a cumulative adverse impact to fish and invertebrates.*
- *There would be a cumulative adverse impact to fish and invertebrates in most of the tributaries of the Fraser and Williams Fork rivers due to increased diversions.*
- *There would be an adverse cumulative impact in the upper section of the Blue River.*
- *Increased flows in South Boulder Creek above Gross Reservoir and the North*

Fork South Platte rivers would result in adverse cumulative impacts to fish and invertebrates.

The following quote is located just below the summary box on the same page of the EIS: "*None to minor beneficial cumulative impacts to fish, benthic invertebrates, and their habitats are anticipated to occur for most East Slope stream segments. Exceptions include minor adverse impacts to fish and invertebrates in South Boulder Creek upstream of Gross Reservoir, …. Cumulative impacts to aquatic resources in West Slope streams would be negligible, except for minor to moderate adverse impacts to fish and invertebrates in the upper Fraser River, most of the tributaries of the Fraser and Williams Fork rivers, and the Blue River downstream of Dillon Reservoir to Rock Creek*."

This is one of many examples where impacts are called out in the EIS only to be dismissed with terms like "minor" or "insignificant" or "negligible." The EIS does not prove why these impacts are in fact minor or insignificant or negligible. As discussed earlier, the total impact of the proposed project is obfuscated in several incremental steps; historical to current conditions, to full use, and to the proposed project, where only the last increment and in some cases the smallest increment are considered project related impacts. Furthermore with a failure to adequately consider and plan for climate change in this FEIS, every direct and indirect impact have potential to be more adversely impacted and thus rendering their status potentially worse off than reported in the FEIS.

II. The Corps Will Violate Clean Water Act Section 404 If It Issues a Clean Water Act Section 404 Permit For The Proposed Moffat Project.

Denver Water must obtain a Clean Water Act Section 404 permit from the Corps prior to constructing the Moffat project because the project will result in the discharge of dredged and fill materials into wetlands and other navigable waters. 33 U.S.C. § 1344; FEIS at 1-1, 1-28. The Corps has adopted regulations to implement this permitting process, known as the "public interest" factors. 33 C.F.R. § 320.4 In addition, EPA has promulgated regulations, known as the "404(b)(1) Guidelines," to eliminate unnecessary environmental impacts. 40 C.F.R. § 230. The Corps reviews all proposed section 404 permits under both the Corps' public interest factors and EPA's 404(b)(1) guidelines. 33 C.F.R. § 320.2(f).

According to EPA's 404(b)(1) Guidelines, the Corps may not issue a Section 404 permit for the proposed Moffat project if:

> (i) there is a practicable alternative which would have less adverse impact and does not have other significant adverse environmental consequences,
> (ii) the discharge will result in significant degradation,
> (iii) the discharge does not include all appropriate and practicable measures to minimize potential harm, or
> (iv) there does not exist sufficient information to make a reasonable judgment as to whether the proposed discharge will comply with the [Corps'] Guidelines for permit issuance.

Utahns for Better Transp., 305 F.3d at 1163 (summarizing the requirements of 40 C.F.R. § 230.12(a)(3)(i-iv)). Because the Corps will violate EPA's 404(b)(1) Guidelines it if issues a Section 404 permit for the Moffat project, the Corps should deny the permit.

A. Several practicable alternatives to the Moffat Project exist that would have less damaging environmental impacts.

The Corps cannot issue a Section 404 permit if there is a practicable alternative to the proposed project that has less damaging environmental impacts. 40 C.F.R. § 230.10(a). An alternative to a proposed project is "practicable" if it is "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes." *Id.* § 230.10(a)(2). The Corps has the burden of determining the least damaging practicable alternative for a project, and this burden "is heaviest for non-water dependent projects planned for a 'special aquatic site,' such as a wetlands area." *Greater Yellowstone Coal. v. Flowers*, 359 F.3d 1257, 1269 (10th Cir. 2004). "When a project is not water dependent, a presumption arises that there are practicable alternatives that do not involve special aquatic sites and have less adverse impact on the aquatic ecosystem." *Hillsdale Envtl. Loss Prevention, Inc. v. U.S. Army Corps of Eng'rs*, 702 F.3d 1156, 1165 (10th Cir. 2012) (quoting 40 C.F.R. § 230.10(a)(3) (internal quotation marks omitted)). To rebut this presumption, a project proponent must provide "detailed, clear, and convincing information" that is verified by the Corps and that "*prov[es]* that an alternative with less adverse impact is impracticable." *Greater Yellowstone*

Coal., 359 F.3d at 1269 (quoting *Utahns for Better Transp.*, 305 F.3d at 1186–87 (internal quotation marks omitted)). When the Corps prepares an EIS for a proposed project, the EIS's alternatives analysis will often provide the information on practicable alternatives for the Section 404 permit. *Utahns for Better Transp.*, 305 F.3d at 1163. However, if the EIS's alternatives analysis is insufficient to comply with EPA's 404(b)(1) Guidelines, the Corps must supplement the EIS with additional information. 40 C.F.R. § 230.10(a)(4).

404(b)(1) Alternatives Analysis

The regulatory framework. The FEIS discussion of the proposed action and alternatives, Chapter 2, begins with an overview of key federal regulations concerning the development of alternatives for meeting the purposes and needs of a proposed project. The Corps' approach is a "confluence" of the NEPA requirements for reasonable alternatives and the Corps' Clean Water Act Section 404 (b)(1) guidelines that focus on project alternatives that are the least environmentally destructive to the environmental system, and are practicable—alternatives that are "available and capable of being done, taking into account cost, existing technology and logistics in light of overall project purpose" (40 CFR 230 Subpart B).

The alternatives must satisfy the Guidelines as well as the public interest review (33 CFR 320.4[a]). Therefore, the Corps' permit actions, the range of practicable alternatives is typically a subset of reasonable alternative under NEPA. According to the Corps' NEPA guidance, the alternative analysis for actions subject to NEPA and the [404(b)(1)] Guidelines can be integrated simultaneously to ensure alternatives carried forward for analysis are practicable and that the LEDPA has not been eliminated from further consideration. The comparison of alternatives should "allow a complete and objective evaluation of the public interest and fully informed decision regarding the permit application" (33 CFR 325 Appendix B 9 [b][5]]. (FEIS, Chapter 2, p. 2).

The NEPA requirement is to "rigorously explore and objectively evaluate all reasonable alternatives (40 CFR 1502.14 (a) and to provide "a clear **basis for choice** among the options for the decision maker and the public." This is the foundation of the NEPA documents and is the basis upon which fulfillment of the Clean Water Act LEDPA (least environmentally damaging practicable alternative) requirement is demonstrated. A permit cannot be given "if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem as long as the alternative does not have other significant adverse environmental consequences." "The point is to avoid impacts instead of mitigating them if destruction of an area of water of the U.S. may be avoided, it should be avoided. (40 CFR § 230.10(a).

The burden is on the applicant to prove that the preferred alternative is the LEDPA. The burden on Denver Water then is to demonstrate that (1) the expansion of Gross Reservoir by 72,000 AF, primarily with water from the Western Slope, is the least environmentally damaging practicable alternative, (2) there is no other practicable alternative with less adverse effects, and (3) the project complies with the 404 guidelines.

Ultimately, the Corps decides if the project complies with the EPA's and its own 404(b)(1) Guidelines, set in 40 CFR §230.4 and that the LEDPA has been selected. The guidelines are binding regulations; if a project does not comply with these guidelines a 404 permit will not be granted. (33 CFR § 320.4(a)(1)). Further considerations include: Section 1500.2 of the CEO regulation states that "Federal agencies shall to the fullest extent possible . . . use the EPA process to identify and assess the reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these actions upon the quality of the **human environment**."

The springboard for both the NEPA process of creating alternatives for analysis and the CWA section 404 guidelines for determining the LEDPA begin at the beginning: the purpose and needs of the project. Because alternatives are based on a project's purpose and need, agencies cannot define the purpose and need of a project "so narrowly as to preclude a reasonable consideration of alternatives." Wyoming v U.S. Dept. of Agric., 661 F.3d 1209, 1244 (10th Cir. 2011) (quoting Citizens' Comm. to Save Our Canyons v I.S. Forest Serv., 297 F.3d 1012, 1030 (10th Cir. 2002)); see also Nat'l Parks & Conservation Ass'n v. Bureau of Land Mgnt., 606 F.3d 1058, 1072 (9th Cir. 2009) (agency cannot "craft a purpose and need statement so narrowly drawn as to foreordain approval of the [proposed project]"); Simmons v. U.S. Army Corps of Eng'rs, 120 F.3d 664, 666 (7th Cir. 1997) ("If the agency constricts the definition of the project's purpose and thereby excludes what truly are reasonable alternatives, the IES cannot fulfill its role"). For example, if a proposed project's objective is to provide additional road capacity across a river, a purpose and need statement that limits alternatives to a bridge at a specific location would be unreasonably narrow. *Davis*, 302 F.3d at 1119-20. Similarly, if the overall purpose of a proposed water supply project is to satisfy a "thirst for water," a purpose and need statement that requires constructing a single new reservoir is unreasonably narrow. *Simmons,* 120 F.3d at 667, 669-70.

Discussion:

The purpose and need statement for the Moffat Project is " . . .*to develop 18,000 acre-feet per year of new, firm yield to the Moffat Treatment Plant and raw water customers upstream of the Moffat Treatment Plant pursuant to the Board of Water Commissioners' commitment to its customers.*" The central limiting purpose is "to the Moffat Treatment Plant." Because this purpose determines the outcome of the alternatives analysis, and because the plant is supplied with water from Gross Reservoir the inevitable outcome of the alternatives analysis based on the "practicability" criterion was the selection of only alternatives that included the expansion of Gross Reservoir. There was no other outcome, and this was the outcome.

Comments to the DEIS have a common theme—that by including "firm yield to the Moffat Treatment Plant" the purpose of the Project is too narrow. A specific purpose, such as 18,000 AF or a particular location automatically eliminates analysis of viable alternatives and could eliminate the LEDPA, the primary requirement for a 404 permit. The Corps' consistent response to this objection is to point to the 303 water supply sources, infrastructure and storage components that were screened, the creation of criteria, the process of eliminating components and the eventual construction of "a variety of alternatives" as evidence that the stated purpose is not too narrow. In fact, this extensive process is evidence of nothing other than that the Corps followed NEPA requirements by creating "a broad spectrum" of components and alternatives and developing criteria based on the project purpose for eliminating them. The fact that the final five alternatives are essentially the same—all include diversions from the Western Slope—is evidence of the narrowness and constriction of the purpose, preventing "a clear **basis for choice** among the options.

The expansion of Gross Reservoir is the only or main element in these alternatives. Although there is essentially no choice, "The results of Screen 2 are a set of five alternatives to be carried forward for further analysis in the EIS. These five alternatives represent a reasonable range of practicable alternatives that encompass a variety of potential water supplies and storage sites" (FEIS, Chapter 2, p. 3). This is false. The entire "range" is expanding Gross Reservoir, expanding Gross Reservoir plus developing Leyden Gulch Reservoir, expanding Gross Reservoir plus reusable return flows stored in gravel pits, expanding Gross Reservoir plus reusable return flows stored in the Denver Basin Aquifer, expanding Gross Reservoir plus agricultural water stored in gravel pits. The lack of choice is obvious and violates the "clear choice" mandate.

Furthermore: (1) the purpose of the project must be defined so that **the applicant is not in the position to direct, or attempt to direct, or appear to direct the outcome of the Corps' evaluation**." 404 (b)(1). "Guidance should prevent District Engineers from so narrowly defining the project purpose that it unreasonably limits consideration of alternatives and thereby subverting a key provision of the guidelines." (Old Cutler Bay permit 404q Elevation 1990). (HQUSACE Review and Findings, OC bay Permit 404q Elevation, page 4.); (2) the corps will determine the purpose of the project and "will not be limited by or required to give undue deference to the proponents stated purpose– the **corps will not be a project opponent or advocate, but will provide an objective evaluation"** (USACE, 1992a: Regulatory Guidance letter 92-1 61 Fe. Reg. 30990-30992 (June 18, 1996).

Discussion:

There are several issues that bear on whether or not the Corps is influenced by Denver Water's goal to complete the construction of Gross Dam and whether or not Denver Water could appear to direct the outcome of the Corps' decision. The Corps approved the initial construction of the dam, completed in 1954, and at that time it was designed to be raised to 465 feet but was built to 340 feet. The Corps was involved again when the expansion of Gross Reservoir was an alternative to the Two Forks Dam project. The Corps was an advocate of the expansion and made the decision to select the project as an alternative to Twin Forks Dam. The current project is a resurrection of that alternative. The Corps and Denver Water have been involved in this project for many years. Naturally the Corps is an advocate of the expanded dam and reservoir and would support the purpose to achieve that goal. This is of concern because it appears that the Corps did not scrutinize the FEIS as it should have.

Evidence that the Corps is an advocate of the project lies in its failure to critically evaluate the evidence (or lack of it) for the specific need to develop 18,000 AF of firm yield based on a projected shortfall in 2032, or take a hard look at the depletion of Western Slope rivers and impacts and the possibility that the project could not succeed (see Section ii.2-ii.4 of this document).

Developing the alternatives:

Following the construction of the purpose and need statement, the next step in the NEPA/CWA process is the delineation of possible alternatives to the proposed project. This process began by generating a list of 303 water supply and infrastructure components, most of which were irrelevant to the purpose of the project. The development of viable alternatives is mandatory, but one gets the impression that this initial process and elimination was merely to fulfill the requirement for a "wide spectrum" of choices.

When the purpose of a project is narrow, the criteria for elimination of alternatives to that project are automatically narrow since the criteria are developed from the purpose. In this case, the primary screen element is PN2—must supply water to Moffat Collection System. The second limiting criterion is that the project must deliver 18,000 AF new firm yield (including 3,000 AF for the City of Arvada if the 404 permit for the project is granted). Questions concerning the validity of this criterion based on actual supply and demand were raised earlier, supported by the comment of Denver Water's director of planning Dave Little, "We sized the project based upon what the site would produce" (Sudler, 2014).

The screening criteria that are used to eliminate water supply, infrastructure components and alternatives that cannot meet the purpose of the project in the least environmentally damaging and practicable way, were completed in 2007. A relative cost index for comparing alternative costs was created. The Corps used these criteria to justify the elimination of some alternatives and consideration of others. The alternative analysis "**must be fair, balanced, and objective, and not used to provide a rationalization for the applicant's preferred result (i.e. that no other practicable alternatives exist)**. (45 Fed. Reg. 85336, 85340 (Dec. 24, 1980.) The discussion will show that this was not necessarily the case. A bias toward Denver Water's preferred alternative may be apparent. Undoubtedly the Corps is aware of third-party pressure to permit the Moffat Project. If the preferred project is not permitted the Colorado River Cooperative Agreement and the Grand County Enhancement and Mitigation Plan are cancelled, the environmental pool for the Cities of Boulder and Lafayette is cancelled, the City of Arvada's contract for 3,000 AF from Gross Reservoir is cancelled. As noted above, Arvada has already made a $33 million "down payment" on that contract.

Biased Cost Estimate Advances Gross Reservoir Expansion

After the elimination of 255 of the 303 elements, the cost screen was applied to the remaining 34 alternatives. Project cost is a key factor in determining practicability, and a critical criterion that eliminated otherwise practicable alternatives. Project cost is heavily weighted in alternative selection, and in the balance, cost can out-weigh environmental destruction, as in this case. The cost screen was based on relative costs. First, project costs were estimated, then a broader measure, the relative development cost was derived by adding 50 percent to account for additional variables. The relative cost screen was based on the least cost alternative, which was given a value of 1; the preferred action had the lowest cost. The 34 alternatives were given a value relative to the cost of the Moffat Project. For example, an alternative twice the cost of the Moffat Project was scored a 2. With a cutoff of 5, 19 alternatives were immediately eliminated. **Further analysis will show that by cost alone the LEDPA may have been eliminated.**

Cost estimate inconsistencies
As noted, Project cost is an important consideration in determining the overall practicability of a project. Of the five alternatives that survived the main screens, the preferred action—the maximum expansion of Gross Reservoir—appeared to be the least costly, thus making it more "practicable" then the others and a reason for selecting it in spite of environmental impacts.

There is however, an apparent inconsistency that raises doubt about the actual cost of the project and the reporting of cost. Table 2-25 in the DEIS, listing basic construction costs for the five alternatives is **identical to** Table 2-21 in the FEIS. These tables have the same calculations of cost for each alternative. Costs have not been updated to reflect current values. The DEIS table was simply "lifted" into the FEIS; figures are indexed to January, 2006. The inconsistency however, is more serious.

In the DEIS and FEIS total construction cost for the Moffat Project is **$139.9 million (Table 9)**. In the Moffat Collection System Project Draft FERC Hydropower License Amendment Application (October 2009), Table D-1, p. D-4, "total estimated construction cost" is **$364,144,000 (Table 10)**. In the DEIS/FEIS, annual O& M cost is $291,000; in the FERC document the average annual estimated O&M cost is $23,016,000. These tables are included for verification. While the "construction costs" might not be identical in configuration, the discrepancy between the DEIS/FEIS estimates and the FERC estimates is significant.

Table 9. Summary of estimated costs of each action alternative, Table 2-25 (DEIS) and Table 2-21 (FEIS).

Costs	Alternatives				
	1a	**1c**	**8a**	**10a**	**13a**
Total Capital Construction Costs	$139.9 million	$293.7 million	$362.0 million	$393.2 million	$426.7 million
Annual O&M Costs	$291,000	$612. million	$4.9 million	$6.0 million	$3.9 million
Present Worth of Annual O&M (for an 80-year period discounted at 3 percent)	$8.8 million	$18.5 million	$147.7 million	$181.5 million	$118.4 million
Total Present Worth Cost	**$148.7 million**	**$312.2 million**	**$509.7 million**	**$574.7 million**	**$545.1 million**

Source: Denver Water, 2006d; Harvey Economics, 2007, 2008.
Note: O&M = operation and maintenance

Table 10. Summary of Average Annual Estimated Cost, Moffat Collection System Project Draft FERC Hydropower License Amendment Application, October 2009, p. D-4.

Item	Proposed Project Cost ($ in Thousands)	Alternatives Proposed Project Cost ($ in Thousands)
Construction Cost Through 2008	$10,625	$10,625
Budgeted Construction Cost 2009	$1,235	$1,235
Incremental Construction Cost 2010 – 2016	$233,415	$225,415
Total Construction Cost Before Inflation	$245,275	$237,275
Construction Cost Inflation 2010 – 2016	$65,066	$62,836
Indirect Overhead Allocations	$16,570	$16,443
Interest During Construction	$37,233	$36,977
Total Estimated Construction Cost	$364,144	$353,531
Less: Third-Party Participation	($60,703)	($58,934)
Estimated Construction Costs Net of Third-Party Participation	$303,441	$294,598
Incremental Capital Costs Related to Hydropower and Capitalized Maintenance	$4,641	$4,535
Estimated O&M Costs	$23,016	$23,016
Less: Estimated Hydropower Revenue	($28,598)	($28,598)
Depreciation Sinking Fund	$100,139	$97,221
Net Cash Flows	$397,474	$385,606
Discount Rate	2.5%	2.5%
Net Present Value	$328,980	$319,244
Levelized Cost Over 30-Year Financing Term	$10,966	$10,641

The higher figure in the draft FERC application is corroborated by the fact that in 1999 the City of Arvada entered into an IGA with Denver Water to contract for up to 3,000 AF from the expanded Gross Reservoir through financial participation in the project and in August, 2013, an additional IGA established a payment schedule for a raw water capacity charge and a capital charge, so that Arvada's share of overall project costs, including permitting and mitigation, is 16.67 percent (Denver Board of Water Commissioners, 2013). In September 2013, Arvada put in escrow over $33 million to be transferred to Denver Water upon 404 permit approval.

The estimated cost of 3,000 AF of raw water with storage from Gross Reservoir is $106 million (City and Community of Arvada Water, 2010: p. 17). One-hundred and six million dollars is 16.67% of $635,872,825. This figure is greater than construction costs alone because permitting and mitigation costs are included in Arvada's share. Nonetheless, it appears that in the alternatives analysis for the FEIS the costs of the Moffat Project are significantly understated, perhaps by three-fold. While the Moffat Project appeared in the FEIS to be by far the least costly of the alternatives, this may not be accurate and likely skewed that cost analysis significantly.

Estimating the actual construction cost of the Moffat Project at $400 million for example, reduces the relative cost index of all the alternatives assessed in the cost screen; several drop below the cut-off value of 5. The "cost practicability" of the Moffat Project is less and the practicability of the rejected alternatives is greater. **If project cost is inaccurate in the FEIS, as it appears to be, this is a serious flaw and must be amended before the Corps proceeds with the permitting process.** Furthermore, using cost alone to eliminate alternatives without analysis violates Section 404 guidelines and NEPA guidelines because it cannot be determined that a rejected alternatives does not have less adverse effects on the aquatic ecosystem than alternatives that meet the cost criterion (40 CFR § 230.10(a); 230.12 (a)(3)(i)). As seen on Table 2-5 of the FEIS, Relative Cost of Project Alternatives (Screen 1c 2-17), at least eight alternatives would be below the index screen if the true cost of the preferred alternative had been used to formulate the index. Alternatives 2a1, 2b, 3a1, 3b, 5a, 5b, 6a, 10c, 13b and 14 should be analyzed for both environmental impacts and practicability before a Section 404 decision is made.

Because project cost is included in the assessment of practicability, total costs of the Moffat Project should be considered. Total costs include: up to $25 million to West Slope entities as per the Colorado River Cooperative Agreement and the Grand County Enhancement and Mitigation Plan, $4 million for the environmental pool (Denver Board of Water Commissioners, 2010), $1.5 million for stream rehabilitation, $750,000 to the U.S. Fish and Wildlife Service. In total, the Moffat Project would be as costly as the rejected alternatives or more so.

The high cost of alternatives that include agricultural water or reusable water to augment Gross Reservoir supply is due to the inclusion of an **advanced water treatment plant** in these alternatives. Alternatives 6 and 7 were eliminated partly because of this high cost. The plant was needed to process this water before transfer to the Moffat Treatment Plant, because when the alternatives were configured, the Moffat plant could not treat this grade of water as described in Alternative 8a "Since the existing Moffat WTP would be incapable of treating the resulting blended supply to meet drinking water standards, a new 13.6 mgd AWTP would be required to treat the South Platte River return flows prior to their introduction to the Moffat Collection System" FEIS, Chapter 2, p. 2-84). **This is no longer the case.** Recent upgrades to the Moffat plant enable it to handle agricultural and reusable water (Joe Sloan, public relations for the Moffat Project, personal communication). Therefore, **the cost and environmental impacts associated with the building and use of the advanced treatment plant in alternatives 8a, 10a, and 13a are void.** This changes the evaluation of these alternatives and opens the door for a new look at retrieving agriculture and reusable water for delivery to the Moffat Treatment Plant.

Other screening criteria PN3 and ET1

Several alternatives to the Moffat Project were eliminated because they could not meet criterion PN3, "Must produce a solution within the necessary near-term timeframe." "Necessary" near-term timeframe is undefined. Figure 1-5 (FEIS, Chapter 1 p. 1-16) shows near term as a period between 2002 and 2032. If "near-term" refers to the period between 2014 and the projected supply/demand convergence, 2022, six years beyond this convergence point in the DEIS and eight years from now, then time seems to be less of a constraint and all alternatives eliminated by PN3 should be evaluated. Like a narrow definition of purpose and need, a too-narrow criterion for eliminating viable alternatives could eliminate the LEDPA and the project would not be in compliance with Section 404 regulations.
The most important alternatives that were eliminated by PN3, and meet the CWA 404 guidelines as potential least environmentally damaging practicable alternatives are:

- 304 Renegotiate 1940 Consolidated Ditch Agreement: to allow reuse of Fraser Basin water
- 305 Treated water load shifts: conduits, pumping and treated water storage to transmit treated water from Foothills or Marston to the Moffat system
- 306 Buy back contract commitments: buy back all portions of the raw water contract to Arvada, North Table Mountain and Westminster
- 501 Convert Northwest raw water contracts to treated water contracts: Additional treatment capacity at Foothills or Marston, conduits, pumping, and treated water storage to transmit treated water to Arvada, Westminster and North Table Mountain.

These alternatives are listed as institutional/water management approaches (FEIS, Appendix B, p. 10-11). Potential storage (AF) capacity is not given. However, the raw water contracts with Arvada, Westminster and North Table Mountain total 30,000 AF/Y. Alternatives 305 and 501 would reduce the load on the Moffat Treatment Plant and Gross Reservoir by that much per year. These alternatives should be reassessed given a revised timeframe.

Alternative 402 is "Direct Potable Reuse: Water from Metro Reclamation Facility would be sent to an advanced water treatment plant, then blended into the existing distribution system." This alternative was rejected by criterion ET1: must use proven technology and management practices. **ET1 does not apply**. Proven technology and management practices are established and used around the world and have been for many years USEPA, 2004). The potential supply from either indirect or direct reuse is substantial and this alternative should not have been eliminated. Furthermore, this approach to water supply is sustainable and can be considered as the LEDPA when lack of environmental damage is balanced with cost.

Non water-dependent projects and the LEDPA

The Moffat Project is classified as non water dependent project because "The Basic Purpose of this project is water supply, and since water supply structures and their operations do not of necessity need to involve placement of dredged or fill material into waters of the U.S. the project is not water dependent (DEIS, Appendix K Section 404(b)(1) Guidelines Compliance, p. K-26). Non water dependent projects have a special requirement and burden: "When a project is not water dependent, a presumption arises that there are practicable alternatives that do not involve special aquatic sites and have less adverse impact on the aquatic ecosystem." *Hillsdale Envtl. Loss Prevention, Inc. v U.S. Army Corps of Eng'rs*, 702 F.3d 1156, 1165 (10th Cir. 2012). The Corps presumes that practicable alternatives exist where a non-water dependent project will cause a discharge in a special aquatic site (40 CFR § 230 (a) (3) 2005). To rebut this presumption, a project proponent must provide "detailed, clear, and convincing information" that is verified by the Corps proving that an alternative with less adverse impacts is impracticable. The Corps has the burden of determining the least damaging practicable alternative for a project and this burden "is heaviest for non-water dependent projects planned for a 'special aquatic site' such as a wetlands area" (*Greater Yellowstone Coal v. Flowers*, 359 F.3d 1257, 1269 (10th Cir. 2004).

Because the preferred alternative does affect special aquatic sites (SAS) in Gross Reservoir and on the Western Slope, pursuant to these regulations, Denver Water and the Corps must prove that there is no other alternative with less impact on the SAS. **The FEIS fails to do this**. All of the alternatives including the preferred alternative affect special aquatic sites; every alternative that does not was rejected. There is no explicit attempt to meet this requirement and there is no rebuttal of the presumption. The Corps might argue that the elimination of all but the five alternatives involving the expansion of Gross Reservoir proves that no LEDPA outside a sensitive aquatic site exists, but **such exclusions are not proof**.

Because a viable alternative not involving a SAS was not among the alternative choices, the project cannot be permitted. It cannot be claimed that the Moffat Project is the LEDPA because it does impact an SAS, has more adverse effects that other alternatives, and is costly.

The alternatives analysis in the Moffat EIS is fatally flawed because it only analyzed a narrow range of alternatives to the proposed project, and failed to demonstrate that the proposed project is the least environmentally destructive practicable alternative. The public is unable to "compare the environmental impacts of all available course of action." *New Mexico*, 565 F.3d at 703. According to EPA's 404(b)(1) Guidelines, the Corps may not issue a Section 404 permit for the proposed Moffat Project if:

(i) there is a practicable alternative which would have less adverse impact and does not have other significant adverse environmental consequences.
(ii) the discharge will result in significant degradation
(iii) the discharge does not include all appropriate and practicable measures to minimize potential harm, or
(iv) there does not exist sufficient information to make a reasonable judgment as to whether the proposed discharge will comply with the [Corps'] Guidelines for permit issue.

Failure to meet any one of these conditions is sufficient to enable the Corps to deny the 404 permit or to request a supplemental EIS. Elsewhere in this document (ii) and (iii) are addressed. This discussion addresses (i) and (iv). See Section 1.B of this document on direct, indirect and cumulative impacts.

Given that the preferred alternative is not the LEDPA, there are two possibilities: it was proposed and rejected; it was not proposed.

Proposed and rejected:

The discussion of eliminated alternatives above concerns alternatives that could meet the LEDPA requirements, particularly those eliminated by PN3, the time constraint. These alternatives were rejected before any determination was made regarding the practicable variables—available and capable of being done, considering cost, existing technology and logistics. This is a fatal flaw. These exclusions represent feasible and non-speculative alternatives, they are in category (i) and should have been analyzed

When a combination of alternatives could meet the purpose of the project, the combination should be considered (Davis v. Mineta, 302 F.3d at 1121-22). The combination of Gross Reservoir expansion and another method for achieving additional firm yield is not an alternative combination. There are several possibilities not discussed in the FEIS. For example Alternative 11a "Deep aquifer storage and shallow aquifer storage" passed the cost screen but was rejected although no reason is given in FEIS Appendix B. A component of this alternative would store reusable water in the Box Elder Creek Basin aquifer (52,000 AF) and convey recovered water to the Moffat Collection System. This component could be combined with gravel pit storage of agriculture water and conveyed to the Moffat Treatment Plant without first being treated since this is no longer necessary. If a rejected alternative or a combination strategy met the Section 404 regulations, and it was determined that the Moffat Project is not the LEDPA, then the projected shortfall would be 15,000 AF and within range of a combined strategy.

Not proposed:

The view of many reviewers of the DEIS was that the most commonsense and obvious LEDPA was not proposed—water conservation, in its many forms. The response to these comments by the Corps is that conservation cannot deliver new supply to the Moffat Treatment Plant or solve the "balance" problem, and therefore cannot be a viable alternative. It must be assumed however that if conservation practices were in place permanently, in all sectors including agriculture, then the expansion of Gross Reservoir would be superfluous. Addendum I: "A Commonsense Alternative to the Denver Water Moffat Collection System Project" provides an overview of the possibilities and power of conservation, clearly demonstrating that 18,000 AF "firm yield" is achievable without building a bigger dam. The document was prepared as an alternative to the Moffat Project by local organizations in the Gross Reservoir area, for distribution to conservation boards and policy-makers.

As noted in the discussion of supply and demand, Denver Water has enormous supply. The strategic water reserve alone is 200,000 AF. Most of this water is in the south system. The solution is getting water to the Moffat system when needed, not by compensating with a bigger reservoir in the north, but by building conveyance systems that bring raw water directly to the Moffat Treatment Plant, or upstream of the plant to provide raw water to customers. This alternative was not proposed.

Time and technology have not stood still while the DEIS and the FEIS were in production. Wastewater treatment is becoming more efficient and less costly, and the development of satellite wastewater treatment systems and gray-water systems is moving ahead. Denver Water should propose an alternative that fits with the times and is forward-looking. Because there is time, the Corps and Denver Water should go back to the drawing board and find creative and non-destructive ways to meet future supply and demand needs.

Conclusion

The alternatives analysis required by NEPA and Section 404(b)(1) of the Clean Water Act is flawed. Agencies and the public are given no clear choice when the non-preferred alternatives and the preferred alternative are essentially identical and none are the least environmentally damaging practicable alternative available. No proof is given that the preferred alternative is the LEDPA, or that there are no other alternatives with fewer adverse effects on aquatic systems, as is required for non water-dependent projects.

As identified in 33 CFR Sec. 320.19(a)(1), the Corps conducts a "public interest review" that seeks to balance a proposed action's favorable impacts against its detrimental impacts. In this case, a determination in favor of the proposed project would shift the balance heavily toward unsubstantiated "favorable" impacts, namely infrequent drought and emergency protection and a small increase in supply to offset a hypothetical shortage years from now.

Therefore because the Corps will violate EPA's 404(b)(1) Guidelines and its own mandate if it issues a Section 404 permit for the Moffat Project, the Corps should deny the permit.

B. The Moffat project would result in significant degradation of the aquatic ecosystem.

The Corps must deny a Section 404 permit if a project "will cause or contribute to significant degradation of the waters of the United States." 40 C.F.R. § 230.10(c). The "fundamental" principle of EPA's 404(b)(1) Guidelines is that "dredged or fill material should not be discharged into the aquatic ecosystem, unless . . . [the] discharge will not have an unacceptable adverse impact either individually or in combination with known and/or probable impacts of other activities affecting the ecosystems of concern." *Id.* § 230.1(c). A project may significantly degrade the aquatic ecosystem if the discharge, individually or collectively, causes significant adverse effects to:

> (1) human health or welfare, including municipal water supplies, fish, wildlife, and special aquatic sites;
> (2) life stages of aquatic life and other wildlife dependent on aquatic ecosystems, including the transfer, concentration, or spread of pollutants or their byproducts;
> (3) aquatic ecosystem diversity, productivity, and stability, including loss of fish and wildlife habitat; or
> (4) recreational, aesthetic, and economic values.

Id. § 230.10(c)(1)-(c)(4).

The Moffat project will result in significant degradation of the aquatic ecosystem, and thus the Corps should deny the Section 404 permit.

Grand Environmental Services (GES) prepared an independent assessment of Moffat Expansion project impacts on Jurisdictional Wetlands on the West Slope as part of FEIS comments submitted to the Corps. In that assessment, GES concludes the Corps misses significant West Slope wetland impacts that should be fully evaluated in the FEIS and fully mitigated in the proposed Denver Water 404 permit for Moffat Expansion. Grand Environmental Services focuses on the technical disagreement between the Corps vs. USEPA + USGS (USACE, 2009b; USEPA, 2009; Winter et al., 1998) where the Corps argues stream-groundwater interactions are driven by precipitation and flow from land to streams (FEIS 3.4.5). This controversy is critical to understanding Moffat Expansion wetland impacts: if the Corps is correct, there might only be negligible to minor wetland impacts on the West Slope; if the Corps is not correct, the wetland would be large enough to sway the Corps' decision-making process as well as Denver Water's cost-benefit analysis.

The GES independent wetland impacts analysis for the West Slope takes a step-by-step approach in their analysis of: Stream Depletions, Watershed Depletions, Riparian Depletions, and their final estimate of greater than 300 acres of Jurisdictional Wetlands impacted by drought conditions forced on the West Slope by past, present, and reasonably foreseeable trans-mountain diversions. Because of their conservative approach, GES believes that number could be orders of magnitude larger.

Findings on Stream Depletions

- The foundation of the Moffat-Gross FEIS is the Platte and Colorado Simulation Model (PACSM), a theoretical model that generates flow numbers supportive of Denver Water's proposal to expand trans-mountain diversions, but does not agree with readily available USGS Gage Data.
- The FEIS uses PACSM and a variety of water accounting techniques, contrary to Corps Best Practices, to overestimate flows remaining on the West Slope and underestimate impacts to the Fraser/Colorado Watershed including Jurisdictional Wetlands (Buchanan, 2014 *in* Grand Environmental Services, 2014).
- The FEIS states that present trans-mountain diversions amount to approximately 50% of native flows (FEIS page 3-36), when USGS data shows that correct proportion is 70-80% since the Moffat Collection System was built (Buchanan, 2014 *in* Grand Environmental Services, 2014). This difference is significant because after implementation of "Full Use of Existing System" + "Proposed Action," stream depletions would be at least 75 to almost 90% in the main-stem Fraser and Colorado Rivers, with at least 20 creeks depleted 100% during most, if not all year. For our study here, this study uses:
    - 70-80% depletions in the Fraser/Colorado headwaters now
    - 75-90% depletions after Moffat-Gross is implemented
- FEIS data show a steady trend toward drought in all years; that is, past, present, and reasonably foreseeable trans-mountain diversions press wet and average year flows down toward drought almost all years (FEIS Appendix H).

- The FEIS acknowledges progress toward understanding climate change, but dismisses the need to include climate change in their risk assessment even though there is now readily available guidance from U.S. Bureau of Reclamation (FEIS page ES-12).
- Ramifications of the significant depletions and trend toward drought raise concern for watershed functions, in-stream habitat including complete loss of certain communities and temperature lethal to trout (FEIS page ES-38 and 39), lack of water flows supporting local municipal water and wastewater service providers including dilution of treated wastewater into increasingly effluent dominated streams (FEIS page ES-38), normal channel adjustment mechanisms misunderstood in the FEIS (FEIS page 20), and riparian habitats including Jurisdictional Wetlands
- Additional ramifications of the misleading water flow data include a) Denver Water will not meet its stated goals with the Proposed Action (Buchanan 2014B) and b) the historic post-Moffat period should be used as baseline by which to evaluate impacts and required mitigation.

Findings on Watershed Depletions

- Trans-mountain diversions of 70-80% or more have already depleted the Upper Colorado Watershed, especially the Fraser Headwaters, significantly reducing watershed processes related to flood-flow attenuation, groundwater recharge, sediment capture, nutrient cycling including Carbon, and maintenance of groundwater levels which in turn support irrigated hay fields and riparian vegetation including wetlands.
- The FEIS ignores the Corps-required watershed approach (USACE,2002) as well as commonly understood groundwater recharge processes documented by the USGS (Winter et al., 1998). FEIS analysis misses the differences between high-gradient streams (generally gaining reaches), and moderate-gradient and low-gradient streams (losing reaches part of the year, gaining reaches other parts of the year), also the role of flooding recharge at lower elevations from snowmelt higher in the watershed (FEIS Section 3.4.5). In fact, the FEIS fails to recognize the data are more consistent with a significantly depleted watershed at risk rather than a resilient system ready to deliver more water to the East Slope.
- Trans-mountain diversions completely dewater 20 creeks and force a trend toward drought, putting at risk normal watershed processes including conjunctive flow between streams and riparian aquifers and back to streams.
- The significantly depleted watershed is losing its protective buffering characteristics, increasing the impacts of additional trans-mountain depletions. For instance, the reduced elevation of river flows combined with changes in timing of flows (FEIS page ES-41) has far-reaching ramifications on the entire watershed. In a depleted watershed, small reductions in overbank flows can have enormous impacts upon groundwater recharge which in turn significantly reduces hydro-geochemical processes including nutrient and Carbon sequestration (Johnson et al., 2011). Peak-flow reductions of a few inches drive changes in vegetation communities, especially shallow rooted grassy wetland vegetation, which can lead to significantly reduced habitat values such as wildlife habitat, bank stabilization, and food-chain support (ES-47-ES-48).

Estimating Impacts upon River Corridors including Riparian Wetlands

The FEIS concludes only negligible to minor impacts to riparian (river corridor) habitats (FEIS Page ES-47) after a total of 75-90% stream depletions and related watershed depletions. This underestimate of riparian impacts is supported by overestimate of flows now remaining in the Fraser/Colorado Headwaters, a thorough misunderstanding of watershed processes including wetland functions and values:

- Hydrologic functions including flood-flow attenuation, overbank flows, and groundwater recharge
- Hydro-geochemistry functions including nutrient cycling, and removals and sequestration of elements including Carbon
- Habitat functions including plant and animal communities, bank stabilization, stream shading, and food chain support

For more detail on Corps and interagency Best Practices misunderstood in the FEIS, see for instance Corps of Engineers Wetland Delineation Manual (Environmental Laboratory, 1987), Riparian Area Management – A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Area (Prichard, 1998), Assessing Wetland Functions (Smith et al., 1995), Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region, Version 2.0 (USACE, 2010), and Colorado Department of Transportation's Functional Assessment of Colorado Wetlands (FACWet) Method (Johnson et al., 2011).

The FEIS includes an evaluation of West Slope Wetlands according to the Corps-recommended FACWet method (FEIS 4-425 to 4-426) but incorrectly categorizes affected wetlands in the "Functioning Category" when FEIS data on page 3-36 indicates West Slope wetlands would be categorized "Functioning Impaired." GES further concludes the proposed Moffat Expansion presses West Slope wetlands toward "Non-Functioning."

C. The proposed Moffat project does not include appropriate and practicable measures to minimize potential harms.

The Corps cannot issue a Section 404 permit "unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem." 40 C.F.R. § 230.10(d). Denver Water's attempts to minimize the significant harms caused by the proposed Moffat project are insufficient and will not adequately mitigate or minimize the project's devastating effects. Consequently, the proposed project does not include the appropriate and practicable steps that will minimize the project's impacts and the Corps should deny the Section 404 permit.

It is noted here that the EPA does not approve mitigation plans as proof that the preferred alternative is the LEDPA. "Compensatory mitigation may not be used as a method to reduce environmental impacts in the evaluation of the least environmentally damaging practicable alternative for the purposes of requirements under Section 230.10(a). (USACE & EPA, 1990).

Mitigation and Enhancement Coordination Plan (MECP) Comments:

A Mitigation and Enhancement Coordination Plan (MECP) was drafted by Denver Water and Grand County in February, 2014 (Denver Water, 2014a). This mitigation plan does not adequately address impacts to the Upper Colorado basins.

- Basin impacts attributed to the proposed project are minimized and obfuscated in the FEIS; thus mitigations noted in the MECP Section 1 are minimal and do not reflect the substantial basin impacts that will occur a high percent of the remaining flows are withdrawn from the mainstem and tributaries of the Upper Colorado basins (see indirect impact section comments).
- The MECP does not follow any guidance on structuring mitigation plans (Harman et al., 2012), the majority of work associated with mitigation efforts would be done on a voluntary basis, and does not assure that mitigation will be effective.
- The plan will require substantial editing to reflect true basin impacts (impacts between the historical post-Moffat period of record and the proposed project, see baseline comment section) and to adhere to the structure of a comprehensive mitigation plan as outlined by the EPA (Harman et al., 2012).

Proposed Project Mitigation Requirements Excerpts from Chapter 5 of the FEIS:

Project impacts to the Upper Colorado Basins, including the Fraser, Williams Fork, Upper Colorado, Blue River and their tributaries are consistently minimized throughout the FEIS. Impacts are compartmentalized into increments of increased water diversion to meet steps in the projected eastern slope water demands. These increments are 1) the historical post-Moffat basin impacts under historical water diversions which have placed many tributaries and mainstem river stretches at or beyond "the [ecological] tipping point" are discussed in Chapter 3 of the FEIS, 2) not acknowledged nor discussed in the EIS, impacts caused by additional diversions embedded in the current conditions model scenario, 3) impacts due to additional diversions under the full use of the existing system model scenario, and finally, 4) impacts due to additional diversions under the proposed project. Modeled impacts to the basins in the FEIS generally are attributed to the increment between current condition and full use model scenarios, while the "project impacts," those between full use and proposed project, are often "minor", "negligible", or non-existent.

Section 1 of the Mitigation and Enhancement Coordination Plan (MECP) describes mitigation measures that will offset Project impact in Grand County identified in the FEIS. "*Denver Water believes the measures proposed in Section 1 more than offset impacts identified in the EIS*," (Denver Water, 2014a: p. 1). Several statements in Chapter 5 of the FEIS are quoted below to show what Denver Water believes are mitigation requirements for the proposed project.
Surface Water: (page 5-91 FEIS) *No mitigation is proposed for surface water hydrology*.
Flood Plains: (page 5-91 FEIS) *Due to the magnitude of impacts anticipated, mitigation and monitoring of impacts on floodplains is not recommended. There are no unavoidable direct or indirect adverse impacts identified for floodplains on the East or West slopes due to the*

implementation of any of the alternatives proposed in this EIS. No additional mitigation measures are expected to be necessary for impacts.

Water Temperature (page 5-104 FEIS):
Fraser River: *For sections 10b and 10c of the Fraser River, flow changes resulting only from the Proposed Action are not anticipated to cause increased frequency of stream temperature standard exceedances. Sections 10b and 10c would experience negligible impacts under the Proposed Action*. Ranch Creek: *For Ranch Creek, changes in flow resulting only from the Proposed Action are not expected to cause increased frequency of stream temperature standard exceedances. Negligible impacts are anticipated under the Proposed Action. Although flow is not a good predictor of water temperature for the data available for this stream reach, the number of days with low flows (days in which the modeled flow was less than 6 cfs), would not change between Full Use of the Existing System and Full Use with a Project Alternative (2032) conditions. This indicates that the Proposed Action is not anticipated to have any additional effect on stream temperature beyond the effects of Full Use of the Existing System.*

Waste Water Treatment Discharges: (page 5-106 and 107 FEIS) *Concerns of WWTP dischargers are the potential for the Proposed Action to result in more stringent discharge permits and cause costly plant upgrades resulting from stream flow changes or water quality changes in the receiving water. …. As discussed in Section 4.6.2, the projected impacts with regard to domestic WWTP permitted discharges are not attributable to the Proposed Action. As noted above, estimated acute and chronic low flows (as shown in Table 4.6.2-11) would be the same for Full Use of the Existing System as for Full Use with a Project Alternative (2032) conditions, indicating that impacts would occur before the Proposed Action would be implemented*.

Colorado River: Water Temperature (page 5-108 FEIS):
The model evaluated dry years between Full Use of the Existing System and Full Use with a Project Alternative (2032) conditions and found no days where flow changed greater than 10%. This portion of the Colorado River is listed on the 303(d) List, however, it is anticipated that impacts to water quality would occur between Current Conditions (2006) and Full Use with a Project Alternative (2032) conditions. Impacts directly associated with the Proposed Action are therefore not anticipated.

Colorado River Hot Sulphur Springs Waste Water Treatment discharges (page 5-108 FEIS):
Hot Sulphur Springs WWTP is a minor discharger and has a greater than 1:100 dilution ratio. The current permitted discharge is 0.09 million gallons per day (mgd) (0.14 cfs). Acute low flow was calculated using daily data from PACSM Node 1400, Colorado River at Hot Sulphur Springs. The lowest calculated acute low flow was 26.7 cfs, significantly more than a 1:100 dilution ratio. Therefore, impacts to the Hot Sulphur Springs WWTP discharge permit due to changes in flow between Full Use of the Existing System and Full Use with a Project Alternative (2032) are not anticipated.

Blue River (page 5-109 FEIS): *Potential exists for more stringent discharge permits for WWTPs, necessitating capital expenditures for upgrades. As shown in Section 4.6.2, the acute and chronic low flows are estimated to be the same under both Full Use of the Existing System and Full Use with a Project Alternative (2032) conditions. Thus, any changes to the Joint Sewer Authority's*

WWTP discharge permit are not anticipated to be a result of the Proposed Action, but rather a result of changes from Full Use of the Existing System. The Blue River from the outlet of Dillon Reservoir to the confluence with North Rock Creek is listed on the Monitoring and Evaluation List for Aquatic Life Use (CDPHE 2012a).

Though these quotes are not comprehensive, they typify how the EIS minimizes impacts that can be attributed to the proposed project. According to the EIS, even though the basins are already approaching the tipping point in several stretches of river, the incremental impacts of additional diversions (10,280 AF/YR of a total 76,828 AF/YR or a 13 percent increase in annual diversions concentrated in the irrigation season; 16, 36, and 30 percent increase in May, June, and July) of the proposed project will not further impact the aquatic systems in the upper Colorado as these impacts will already be seen under the full use of existing scenario.

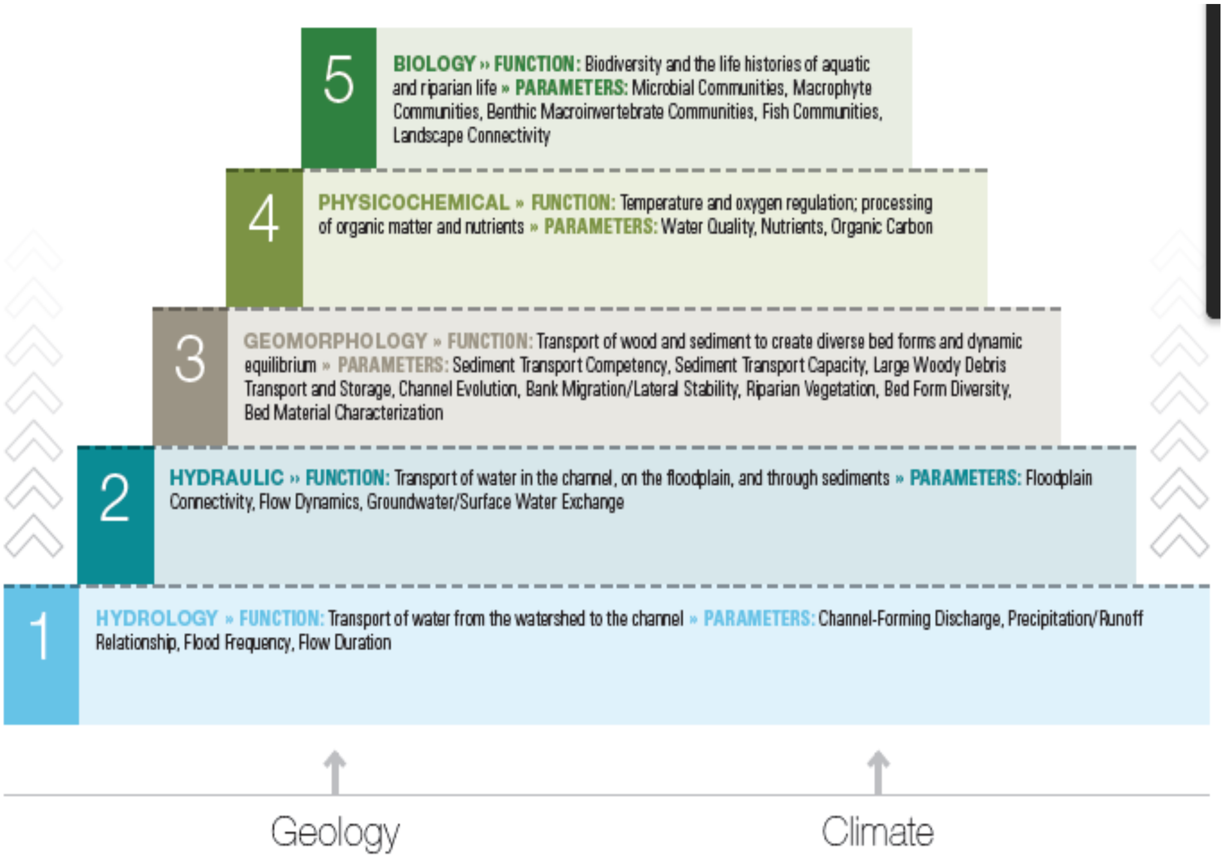
Section 1 of the MECP stipulates regulatory obligations of Denver Water to mitigate adverse impacts identified in the FEIS that can be attributed to the Proposed Project. Since most of the basin impacts are attributed to the increment between the current and full use model scenarios and the project impacts are minimized in the FEIS, Section 1 of the MECP, the portion of the mitigation plan for which Denver will be held accountable, is also minimal and does not address the overwhelming basin impacts of expanding Gross Reservoir to 3 times its current volume.

Function Based Mitigation Framework

The document, A Function-Based Framework for Stream Assessments and Restoration Projects (Harman et al., 2012), discusses a framework, the Stream Functions Pyramid, by which to assess what mitigation measures are needed and then how to evaluate the success of such mitigation measures. Denver Water's mitigation plan needs to be changed to assure that portions of the upper Colorado basin that are mitigated produce streams that function at all levels of the functional pyramid structure below; starting with the hydrologic function upon which all other levels are based. This functional assessment involves:

- Definition of goals of the project; what parameters will need to be met in the mitigated stream section.
- Determining how various stream functions in the functional hierarchy will be addressed and how are they interrelated.
- Defining how debits in stream function will be mitigated by stream credits and how each will be measured.
- Defining criteria upon which to base the success of the mitigation,
- Evaluating mitigation activities through ongoing monitoring programs
- Generating site-specific standard operating procedures for the mitigation program.

A stream functions pyramid framework was developed to describe hierarchical functions of stream parameters that can be utilized to assess the overall function of an aquatic system. This hierarchical pyramid from the EPA document is shown below.



Sections of the EPA report are quoted below to elucidate this function based mitigation strategy. "*Knowing why a project is needed requires some form of functional assessment followed by clear project goals. To successfully restore stream functions, it is necessary to understand how these different functions work together and which restoration techniques influence a given function. It is also imperative to understand that stream functions are interrelated and build on each other in a specific order, a functional hierarchy. If this hierarchy is understood, it is easier to establish project goals. And with clearer goals, it is easier to evaluate project success.*

A large amount of funding for stream restoration is related to compensatory mitigation required as part of Clean Water Act (FWPCA, 1972) Section 404 permits issued by the US Army Corps of Engineers (USACE). ....The 2008 Federal Mitigation Rule recommends that a functional or condition assessment be completed at the impact site to quantify ecological losses (debits) and at the mitigation site to quantify projected ecological gains (credits), which would be realized if the mitigation project is successfully implemented (33 CFR 332.3(f)(1), 2008). Credits generated at the mitigation site should offset the debits estimated at the impact site. Success criteria and performance standards are required to measure mitigation project success and ensure that mitigation projects do indeed generate the amount of credits initially projected," (Executive Summary, Harman et al., 2012).

Within this hierarchical Framework, higher-level functions are supported by lower-level functions, like a pyramid. For example, Hydraulic functions cannot occur without Hydrologic functions, and so on. Per the EPA guidance, the stream functions pyramid is then used to:

1. Set Project Goals: "*A common stream restoration goal that is often stated in stream mitigation plans is the improvement of channel dimension, pattern and profile so that the channel does not aggrade or degrade. This goal primarily addresses channel stability. The Pyramid can be used to develop goals that more directly relate to the improvement of functions…. Once a goal has been established, the Pyramid can be used to develop objectives that call out which parameters, measurement methods, or even performance standards will be used to evaluate the functional improvement. In addition, once function-based goals and objectives have been selected and identified within a certain level, the Pyramid can be used to determine which supporting functions (lower levels) also need to be addressed.*"
2. Develop Function Based Stream Assessment Methods: "*Using the Pyramid as a guide for developing function-based stream assessments will help ensure that a protocol addresses parameters in the correct order based on function. These assessment methodologies should include parameters from each level as it applies to site and/or regional conditions and constraints…. Parameters could also be selected to show functional gain or improvement at a restoration or mitigation site, or functional loss at a proposed impact site. Somerville (2010) provides a good overview of existing function-based assessments, including their strengths and weaknesses.*"
3. Create Standard Operating Procedures for Stream Mitigation Programs: "*The Pyramid can also be used by Interagency Review Teams (IRTs) to develop debit and credit determination methods and performance standards for stream mitigation projects. In addition, if reference reaches are also assessed using a function-based approach, the functional capacity of the mitigation site can be addressed. This will help IRTs to move away from attaching credits to restoring dimension, pattern and profile, and move toward changes in parameters that describe or are themselves functions.*"

The 2008 Mitigation Rule was designed to improve the planning, implementation and management of compensatory mitigation projects. It emphasizes a watershed approach in selecting compensatory mitigation project locations, requires measurable performance standards, requires regular monitoring for all types of compensation, and specifies the components of a complete compensatory mitigation plan. This plan includes assurances for long-term protection of compensation sites, financial assurances, and identification of parties responsible for specific project tasks. The Rule recognizes that science-based rapid function or condition assessment methodologies provide a more objective, systematic and reliable approach to characterize and quantify the expected aquatic resource losses or debits at impact sites, as well as the potential aquatic resource gains or credits at compensatory mitigation sites.

Comments on the MECP:

Summary of the MECP (Denver Water, 2014a).

Section 1 of the MECP, that which Denver will be obligated to carry out, focuses on temperature impacts to Ranch Creek, Fraser River below Crooked Creek, and Colorado River below Windy

Gap and upstream of Williams Fork. Exceedence of either the acute or chronic standards at these four locations will trigger a mitigation response, release of a specified amount of water, during the period July 15 to August 31, whether or not the Project is diverting. If the exceedence is seen at either of the Fraser Basin gages flows will be maintained at one or two locations in the Fraser Basin. If these mitigation actions do not solve temperature problems after 20 years, Denver Water will provide $1 million to address temperature issues in the Fraser Basin.
For channel stability and sediment transport issues, flushing flows will be released for a minimum of 72 consecutive hours in 3 out of 10 years on the Fraser River, St. Louis Creek, Vasquez Creek, and Ranch Creek. Decisions on the timing and location of flushing flows will be made by Denver Water and the Learn By Doing Board (LBD). Again, if these measures prove ineffective after 20 years, Denver will provide $1 million for projects to enhance channel stability and sediment transport in the Fraser Basin.

Cutthroat Trout and Fish Habitat mitigations are also planned in which Denver will provide financing for habitat enhancements. By providing this funding, Denver will be in compliance with the mitigation requirements of the project.

Finally, the regulated mitigation plan specifies that mitigation is only required for New Project water as follows.

"*After the Project is constructed, daily reservoir accounting will first credit the water diverted by Denver Water from the Williams Fork and Fraser basins to fill the existing, "Old Water" capacity of Gross Reservoir, which is 41,811 AF. When the amount of Old Water in storage equals 41,800 AF, the next increment of water put into storage at Gross Reservoir from the … basins will be counted as "Project Water." The Old Water is the first water stored in Gross Reservoir and the first water taken out of storage. Project water does not include water stored from South Boulder Creek or flow-through water*."

Diversions for Denver Water's existing system are not subject to mitigation requirements. Though it is not clear, it appears that, if Denver is diverting Old Water at the time of the temperature exceedence, mitigation measures are not required. This is extremely unclear and needs to be expanded.

The second section of the MECP, noted as Voluntary Enhancements for Aquatic Resources, includes money for aquatic restoration and upgrades to wastewater treatment plants, a monitoring program to evaluate the aquatic ecology of streams in the basins as flow diversions increase, pilot studies for best operational practices that mitigate temperature and channel stability issues, enhancements to water flow in the Colorado River below Windy Gap, and a commitment to designated CWCB instream flows, water rights that are junior to Denver Water's water rights, and regular bypass flows. All of the voluntary enhancements would be directed by the LBD board consisting of Denver Water, Grand County, Northern Colorado Water Conservancy District, Middle Park Water Conservancy District, Colorado River Conservation District, Trout Unlimited, and the Colorado Parks and Wildlife (CPW). None of the items noted in Section II of the MECP would be obligatory.

Comments on Section 1 of the MECP:

First and foremost, project related impacts noted in the FEIS are vastly understated. Based on the independent review of firm yield of the proposed expansion of Gross Reservoir all of the additional diversions above measured historical diversions will be required to provide 18,000 AF/Y of firm yield at a frequency required by the LP2 screening criteria (Buchanan 2014). Therefore the appropriate baseline for impacts is the post-Moffat historical record not the full use model scenario.

The mitigation plan does not follow a function-based framework. Omissions in the plan are:

- No discussion of purpose or goal of the mitigation; what are its expected benefits or end results of the mitigation. What stream sections are to be mitigated and how were those discussed in the MECP selected? Which are considered debit stretches and how do the benefits and costs balance?
- The plan does not provide a method or monitoring plan to evaluate the success of the mitigation. Other than temperature measurements taken at four locations, two in the Fraser basin and two on the Colorado River, no other monitoring is included in Section 1 of the MECP. To evaluate how functional a stream segment is and whether conditions are improving due to mitigation efforts, requires ongoing collection of data to assess the aquatic function of the stream segment (described in each portion of the stream functions pyramid above). In fact, the voluntary LBD monitoring program noted in section II of the MECP includes many of the components used to evaluate mitigation projects based on a stream functions pyramid framework (Harman et al., 2012). The LBD monitoring program needs to be folded into Section 1 of the mitigation plan.
- Standard operation procedures need to be developed to clarify how mitigation will take place, for instance, currently, if the temperature criteria are exceeded the LBD will determine which of Denver Water's facilities should bypass 250 AF etc. While this process continues, temperatures in the streams are at the acute level, therefore, a timely and quick response is required. Other SOPS include monitoring methods and locations to achieve comparable data.
- A major omission in the MECP is the criteria by which success of the mitigation is assessed. In many instances, it is noted that by performing an action, Denver is in compliance with regulatory measures regardless of whether the action has the intended positive impact on stream function. This is not the intent of mitigation efforts.

The structure and function of the LBD board is unclear. How will decisions be made? Will decisions need to be unanimously approved by all on the board? Will the public and other federal and state agencies be able to comment on decisions of the LBD? If measures taken by the LBD impact downstream senior water rights holders, how will that be handled? It seems that at least the National Forest Service on whose land the bulk of the diversion and conveyance structures stand, and state and federal agencies such as the EPA and CDPHE need to have a voice in LBD decisions.

In the MECP all of the voluntary enhancements, including many qualified and necessary actions to improve the aquatic function of the upper Colorado River, are voluntary. So it is possible that under some circumstances, none of the voluntary enhancements would occur. Since Denver Water and Grand County believe that these actions are required to maintain the integrity of the watersheds the voluntary measures should be placed under Section 1 of the MECP to assure that they are carried out. It seems that ideas presented in the second section of the MECP relate to ongoing professional management of Denver's existing diversion system that, could be implemented with or without the proposed project.

Furthermore we echo Boulder County's assessment that the "FEIS is so lacking in necessary project details that we still don't know the full impacts, and therefore, what acceptable mitigation measures need to be applied" (Domenico et al, 2014) is correct. Denver Water has been toting in the media its "mitigation agreements" however these cannot fully be measured against the current impact analysis in the FEIS.

D. The Corps must conduct additional analysis to make a reasoned decision on the Section 404 permit.

The Corps must deny a Section 404 permit if there is insufficient information available "to make a reasonable judgment as to whether the proposed discharge will comply with" EPA's 404(b)(1) Guidelines. 40 C.F.R. § 230.12(a)(3)(iv). Because the FEIS does not fully analyze several reasonable alternatives to the proposed Moffat project and it does not adequately discuss the project's many significant environmental impacts, the Corps cannot issue the Section 404 permit unless it conducts additional analysis. Accordingly, based on the existing record before the agency, the Corps must deny the Section 404 permit.

The Boulder County Commissioners conclude that the "Proposed project should not be approved unless and until there is, at a minimum, a description of the project design and its implementation that is specific enough that its impacts can be known. As it currently stands, the FEIS does not provide and adequate description of the project because it does not describe what its design will be, how it will be constructed, or what impact its construction will have upon the environment and the surrounding community" (Domenico et al 2014).

We also echo Boulder County in their sentiment that there are still "important decisions, having serious consequences on [our] citizens, and that there decisions should be made before, and not after, the Record of Decision is issued" (Domenico et al 2014). These decisions include previously stated impacts such as; the tree disposal method, construction impacts, and more.

Furthermore, in the Section 404 (b)(1) process, the applicant and Corps must select the least environmentally damaging practicable alternative (LEDPA) as the preferred project and must demonstrate (1) why it is the LEDPA and (2) that there are no other less adverse practicable alternatives. Appendix K, "Section 404(b)(1) Guidelines Compliance" does not comply with these regulations for public review. Response #910-274 (FEIS, Appendix N) concerning the LEDPA says, "The Corps evaluated compliance with NEPA and CWA . . . and has not yet determined the least environmentally damaging practicable alternative (LEDPA). The Final LEDPA determination will be made as part of the combined Environmental Impact Statement (EIS) 404 Record of Decision (ROD)." For this reason the request for the addition of a reopener clause in the ROD is reiterated here (see "Section 404 (b)(1) alternatives analysis").

III. Other comments pertaining to the FEIS:

A. The FEIS fails to adequately address climate change impacts

The recent National Climate Assessment (NCA) chapter on water resources (Georgakakos et al., 2014) projects significant impacts on water resources and management due to future climate change in the southwest United States. According to this report, due to changes in streamflow, current management practices will become less effective. The Southwest is a region projected to have large impacts on recharge rates, thus reducing water availability for reservoirs. The runoff reductions for the Colorado River in particular are expected to be on the order of 10-30% by the year 2050 (Barnett and Pierce, 2009), and future climate change will lead to reductions in groundwater supplies (Crosbie et al., 2013; Taylor et al., 2013).

In terms of climate processes (not considering human use), future water supplies depend on precipitation and temperature, which effects evaporation. The NCA (Georgakakos et al., 2014) makes the point that future predictions of precipitation in general circulation models (GCMs) are uncertain; however, all GCMs are quite consistent in their prediction of higher temperatures due to climate change. Processes influencing water storage (runoff, streamflow, and soil moisture) are all dependent on both precipitation and temperature and can thus still be predicted using GCMs temperature predictions. These GCMs indicate a reduction in both streamflow and soil moisture and since there is general agreement among the GCMs, we can be confident in this projection. The NCA states that “confidence is high” that these downward trends will continue, thus making water shortages more likely in the future.

A study by Seager et al. (2012) investigates projections of surface water availability for the southwest United States, with a particular focus on the region encompassing the headwaters of the Colorado River. Using simulations from the Coupled Model Intercomparison Project Five (CMIP5), they examine changes in precipitation, evaporation, soil moisture and runoff. For the Colorado River headwaters, they project reduced soil moisture and runoff, leading to a decline in Colorado River flow. The reduction is mainly driven by an increase in evaporation that, despite a potential increase in precipitation, will reduce soil moisture and runoff.

Though predictions of precipitation in the future climate are less certain among climate models, the influence of temperature on evaporation is well known and predictable. As temperature increases, evaporation (through the latent heat flux) will increase. Not only does this effect water availability for stream flow, it will also create more evaporation from the surface of reservoirs. By increasing Gross Reservoir from 418 to 818 square feet of surface area, water loss from the reservoir will significantly increase, making the use of reservoirs to maintain water supply less efficient in the future.

The FEIS states on page 12 of the Executive Summary that there is currently “no accepted scientific method for taking the general concepts associated with climate change and transforming them into incremental changes in stream flow or reservoir levels;” however, there have been numerous studies that use stream flow or land surface models to project stream flow, reservoir levels, and water deliveries (Barnett and Pierce, 2009; McCabe and Wolock, 2007;

Vano et al., 2012 among many others) in the future. Therefore, the impact of climate change can be assessed now.

An example of one such study is Barnett and Pierce (2009). This study uses the Colorado River Budget Model (CBRM), which is a "simple water budget model" that calculates inflows and outflows of the Colorado River. One main conclusion from this investigation is that current water deliveries along the Colorado River are not sustainable in a future climate where river flow reduces by as little as 10% (note the projection above was for a 10-30% reduction). They find water deliveries to be unsustainable even if the flow of the Colorado River were to revert to its long-term mean, which is lower than current observed flows (see below discussion of putting river flow estimates in historical context). Their estimate is that current deliveries associated with the Colorado River might be reduced up to 20% in the future. This study also finds that levels in reservoirs relying on the Colorado River will decline in the future. Their figure 3b shows that the likelihood of Colorado reservoirs being at least 80% full, though likely in the 1980s, declines drastically with there being a less than 10% chance of 80% capacity by the year 2030. Their study includes the effect of climate variability, namely that the El Niño/Southern Oscillation causes unusually wet and dry years on interannual timescales; however, they predict that the intermittent wet years are not enough to overcome reduced flows and keep reservoirs at capacity. They further state that these shortfalls "are likely manageable through a program of water reuse, conservation, transfers between users, and other measures."

It has been clearly shown that future projections of water availability for storage in reservoirs along the Colorado River will be reduced in future climate scenarios, thus making the expansion of Gross Reservoir potentially pointless since there will likely not be enough flow from the Colorado River headwaters to fill this extra storage. Additionally, the tools to assess the effects of climate change on river flow are currently available. The FEIS does not take any of the aforementioned climate change impacts into consideration at all, though it is clear that the information to do so exists.

All of the estimates made of river flow in Section I of this document were made using observed data from the 20th Century; however, studies have shown that compared to previous centuries throughout history, the 20th Century was relatively wet (Barnett and Pierce, 2009), especially in the early part of the century (Stockton and Jacoby, 1976). This means that all estimates created using 20th Century data are likely overestimates of river flow. This overestimation combined with reductions in stream flow due to climate change indicate that flow reductions will be even greater than estimated. Both the impacts of climate change on headwater regions as well as viewing current observed gauge data in relation to paleoreconstructions should be taken into account when estimating whether the increase in storage capacity of Gross Reservoir can even be met in the future. The FEIS does not address these issues at all.

The FEIS excludes climate change from project consideration while Denver Water publicly includes climate change in project consideration.

As stated in Chapter 4, page 47 of the FEIS, climate change is not evaluated in the FEIS:
"*However, a generally-accepted scientific method by which current climate change information is translated into predictable stream flow changes and assimilated into water supply decision-*

making is still not available. Therefore, quantitative climate change-induced stream flow predictions are not evaluated in this EIS."

But, as stated in an interview on public radio on April 30th, 2014, by David Little, Director of Planning for Denver Water, climate change is used by Denver Water in their presentation of the preferred alternative to the public as a valid point for consideration:

Interviewer: "How much of the Gross Reservoir project do you think depends upon the assumption of growth in the metro area?"
David Little: "Well we sized the project based on what the site would produce. The growth in the metropolitan area will far outstrip the water supply that's going to be provided by Gross reservoir." … "But that assumes that the past is good indication of the future. You start throwing in the equation of global climate change and with our conservation program in this project we could be in a situation that we're just staying even with what we have right now for our customers, even though our customer base is growing at a phenomenal rate. "

Full recording of the 1-hour radio interview/panel is in Appendix B: References, as is an audio excerpt of the preceding text.

B. There are still questions regarding the FEIS Bypass Flows

The bypass flow agreement with the USFS and subsequent revisions is noted on page 3-28 of the FEIS. The Clinton Reservoir revision is noted as: "*Under the 1992 Clinton Reservoir agreement, Denver Water agreed that it would not reduce the bypass flows unless mandatory restrictions were imposed on its customers …. However, Denver Water reserved the right to reduce bypass flows whenever mandatory in-house domestic use of water is imposed in the area served by Denver Water*." Historical reductions in bypass flows are noted FEIS Table 3.1-9. Bypass flows were reduced consistently over the period September 2001 through July 23, 2004 and possibly beyond that date. What mandatory restrictions on "in-house domestic" use was imposed on Denver customers during this time? Also, if flows are not measured at the diversion gates how does Denver Water determine if the required flows are being bypassed to the stream segments below the diversion points. Are the USGS gage flows, which include flows entering the creeks below the diversion points, utilized for this purpose? Was that the intent of the bypass flow agreements?

Miscellaneous Comments

Figure 3.1-3 of the FEIS: Use of 1936 to 1994 averages hide the true depletion of stream flow at Hot Sulphur Springs caused by multiple upstream trans-mountain diversions. The impact of current diversions at this location is under-represented in Figure 3.1-3. The 1985 to 1994 average more accurately shows the true depletion of stream flow at this station.

Page 3-44 FEIS: "*This figure* (3.1-3) *also demonstrates the effects of trans-basin diversions and increased water use over time*." According to Table 3.1-14 of the FEIS, of the total average annual diversions and water use (316,646 AF/YR), 315,446 AF/YR or 99.6 percent are due to trans-mountain diversions and evaporation in storage reservoirs associated with the diversions. Only 1,200 AF/YR or 0.4 percent are due to increased water use in the basin; truly an insignificant amount when compared to the impact of trans-mountain diversions on stream flows on the Colorado River.

Page 4-174 FEIS: Flow reduction and Water Temperature comment: The EIS claims that reduction in stream flows is not related to increases in stream temperature. A regression analysis using historical data was done at a number of stations to prove this point; taking stream flow alone and performing a regression analysis against stream temperature showed no correlation between the two parameters. However, results of the regression analyses were not included in the EIS, the stations used in the analysis were not mentioned, and though there are currently problems with high stream temperatures the historical record will not adequately describe the situation when flows are depleted by 50 to 100 percent after the proposed project (See indirect effects comment section). In addition, a better indicator of stream temperature might be stream depth. In the same section, the EIS mentions other factors that contribute to increases in stream temperature as follows: "*Reductions in flow rates in a reach of stream affect stream temperatures primarily by increasing the surface area of a stream in relation to the volume of water in the reach. ….Other influences on stream water temperature include reduction of shade (for example, through disturbance of riparian vegetation from livestock grazing or back erosion due to rapidly varying flow rates), increases in width-to-depth ratio due to increased sedimentation or reduced flows, reduced flow due to upstream diversions or storage and changes in vegetation, land use, or other conditions that alter groundwater flows. A review of approved TMDLs for water temperature in mountainous streams (NMED 1999, 2002; UDEQ 2010) showed that loss of riparian vegetation, an increase in sedimentation, and reduction of late summer flows were identified as contributors to changes in water temperatures,*" (FEIS page 4-174). This section contradicts itself. It appears that low flows do influence stream temperatures. Please provide the actual data used in and results of the regression analysis to support the EIS statements.

C. Denver Water must complete a system-wide EIS before Moffat

U.S. District Court, Consent Decree, Civil Action No. 77-W-306, Denver v. Andrus, 1979, otherwise known as the "Foothills Agreement" mandates the creation and approval of a system-wide EIS (SEIS) prior to construction of any supply projects by Denver Water.

A brief summary of the history leading to the signing of the "Foothills Agreement" (February 14, 1980) is in the integrated water resource plan prepared by the Denver Water Department (DWD) (2002). The "negotiated settlement" referenced in this summary is the Foothills Agreement. "Denver Water had to agree that before building any future supply facilities, it would conduct a system-wide environmental impact study to evaluate options and alternatives for future water supply and demand. Denver Water also had to commit to implementing a water conservation program intended to reach certain targeted levels over the coming two decades. To determine whether the levels were reached, the EPA would monitor the conservation efforts."

Therefore, the Moffat Collection System cannot be built until after a signed record of decision (ROD) is produced for a system-wide EIS. The summary says the system-wide EIS was “combined” with the Two Forks EIS. Actually, it was overwhelmed by the Two Forks EIS. The EIS that went to the U.S. Environmental Protection Agency dedicated all of four pages to the descriptions and impact analyses for all of the other projects that the DWD wanted to build over the planning timeframe. It was grossly inadequate for meeting the letter or intent of the Foothills Agreement. Furthermore, Even if the system-wide EIS had been adequate, it was vetoed as part of the Two Forks EIS. Therefore, there is no ROD for the system-wide EIS and it cannot be construed as completed. The Foothills Agreement was signed on February 14, 1980. Its provisions were, and remain, legally binding on all the parties. The commitment was for the system-wide EIS to consider both site-specific and cumulative effects of all of the projects the DWD wanted to build (Bacow and Wheeler, 1984; Carpenter and Kennedy, 1988). When the system-wide EIS process was started, this was interpreted as 50 years beyond 1985, through 2035.

To date, Denver Water has not completed, and received a ROD for, a system-wide EIS. Without a signed ROD for a system-wide EIS, construction of the Moffat Collection System cannot be built without violating the Foothills Agreement. Any actions to build this project would result in lawsuits that the DWD and U.S. Army Corps of Engineers (USACE), which is the federal agency charged with preparing the system-wide EIS, would likely lose.

Based on this information, it is inappropriate for the USACE and other federal agencies to be preparing an EIS ROD or considering any other actions related to the Moffat Collection System. This project needs to be shelved until the mandated system-wide EIS is completed and has a signed ROD.

D. Impacts to Boulder County and its Residents are not Adequately Addressed

No agreement of any kind has been made between Boulder County and Denver Water, and the attempt at an Intergovernmental Agreement (IGA) failed.

During a two-day public hearing (December 20, 2012 and January 7, 2013) the Boulder County Commissioners considered a draft Intergovernmental Agreement between Denver Water and Boulder County. After a combined 5 hours and 45 minutes of public hearing, predominantly public testimony, the Boulder County Commissioners unanimously decided not the sign the Intergovernmental Agreement, not to put it to a vote, and not to hear comment from staff. Further, the Commissioners stated that they would wait until the release of the Final EIS in order to see the actual impacts of the proposed project prior to making any decisions with regard to any potential Intergovernmental Agreement.

The Executive Summary of the FEIS is required to point out areas of significant controversy or disagreement. The fact that the Boulder County Commissioners turned down an attempt by Denver Water to get an IGA in place, in lieu of a 1041 Construction / Land Use permit deserves mention in the Executive Summary, yet it is not mentioned.

The full video recording of both public hearings is attached.

The preferred alternative contradicts Boulder County’s Comprehensive Plan

Boulder County’s Comprehensive Plan is very clear in its core purpose:

“Environmental preservation is a dominant theme of the Plan.” Page 14, Boulder County Comprehensive Plan. Winiger Ridge, which would be inundated by construction of the preferred alternative, is specifically identified as “Natural Landmark” in Boulder County’s Comprehensive Plan. Page 33, Boulder County Comprehensive Plan. “Natural Landmarks are defined as prominent landscape features that distinguish a specific locality in Boulder County and are important because of the views they afford, their value as scenic vistas and backdrops, and the intrinsic value they hold as wildlife or plant habitats, natural areas, park and open space preserves, and open land areas. … Natural Landmarks are designated for scenic, visual and aesthetic values, providing a record of the natural heritage of Boulder County.” Page 32, Boulder County Comprehensive Plan.

The Boulder County Comprehensive Plan goes on to define specific Objectives for Natural Landmarks:

“The chief objective of the goals and policies is to protect and conserve unique or critical environmental resources through the encouragement of compatibility between proposed development and designated Natural Landmarks. Additional objectives include: To mitigate negative impacts to Landmarks and insure proposed development does not harm, degrade, or impair the purposes or values for which the Natural Landmark was designated; To provide assistance, incentives and regulations for land owners to maintain Natural Landmarks.” Page 32, Boulder County Comprehensive Plan.

And details regarding Natural Landmarks are further clarified in the Natural Landmark Policies detailed in the Boulder County Comprehensive Plan:

“Natural Landmarks Policies:

- ER 1.01: Natural Landmarks and natural areas as identified in the Environmental Resources Element, and as may be identified from time to time or pursuant to 36-10-101, CRS, as amended, shall be protected from destruction or harmful alteration.
- ER 1.02: Land use proposals which could have a potential adverse impact to Natural Landmarks shall be dealt with on a case-by-case basis. Depending on the scale of the proposal and the scope of the adverse impacts, the county may determine that a site specific evaluation of the impacts is warranted and will be required of the applicant.
- ER 1.03: Boulder County shall work with municipalities which, by virtue of ownership or lease, control unincorporated land where areas/sites detailed in ER1.01 are located for achieving the provisions of policy ER1.01.
- ER 1.04: Boulder County, utilizing county staff, volunteers, and professionals, shall continue researching potential county Natural Landmarks. The research will be to update the Environmental Resources Element, adding qualified areas and Landmarks to those currently designated in the Boulder County Comprehensive Plan.
- ER 1.05: Designated Natural Landmarks which also have other environmental designations (e.g. critical wildlife habitats, wetlands, rare plant sites, environmental conservation areas, etc.) will be dealt with according to all appropriate policies and regulations.

- ER 1.06: The county shall identify and work to assure the preservation of critical wildlife habitats, Natural Landmarks, environmental conservation areas, and significant agricultural land.
- ER 1.07: Areas that are considered as valuable scenic vistas, such as the foothills portion of Boulder County, shall be preserved as much as possible in their natural state.
- ER 1.08: The county shall use its open space program as one means of achieving its environmental resources and cultural preservation goals.
- ER 1.09: The Parks and Open Space Department shall conduct analyses of existing and potential Natural Landmarks for the purpose of identifying land ownership and a feasible program for protection of the feature(s) and/or vistas of the Landmark. Buffer zones will be designated to appropriately insulate Natural Landmarks from detrimental land use encroachments.
- ER 1.10: From time to time Natural Landmark designations may be revised or deleted to reflect changing conditions or new categories of designation." Pages 33-34, Boulder County Comprehensive Plan.

The FEIS fails to give any consideration for, or recognition of, Boulder County's Comprehensive Plan as a whole and for the specific designation of Winiger Ridge as a Natural Landmark in Boulder County. To the contrary, Winiger Ridge, specifically identified in Boulder County's Comprehensive Plan as a Natural Landmark "for scenic, visual and aesthetic values, providing a record of the natural heritage of Boulder County" has been slated for quarrying and inundation.

Impacts to crucial elk habitat and changes in elk migration corridors have not be addressed.

Boulder County's Comprehensive Plan states: "The county will work towards protecting critical elk range and migration routes through reducing development potential and by working with landowners and management agencies to minimize human disturbance and provide seasonal habitat needs." (ER 4.09). The FEIS states: "Construction of Gross Reservoir would impact crucial elk habitat and may change elk migration corridors in the area causing a moderate impact." (ES.7.10). No agreement has been made between Denver Water and Boulder County dealing with these impacts.

Sanctuaries and refuges should be documented in the FEIS.

The project area for the proposed alternative includes an area of Boulder County specifically protected in Boulder County's Comprehensive Plan: Winiger Ridge as a Natural Landmark. Consequently, it is likely that "Sanctuaries and Refuges" as defined in 40 CFR Part 230 Section 404(b)(1) of the Clean Water Act exist within the project area. These areas should be identified, accounted for, and impacts mitigated for in FEIS.

The FEIS contradicts itself with regard to trout habitat impacts.

The executive summary boldly states: "There would be no changes to water quality, riparian vegetation, or channel geomorphology in the Fraser, Williams Fork, Colorado, Blue, South Platte rivers and South Boulder Creek that would affect the suitability of habitat for fish and other aquatic biological resources" (FEIS Executive Summary, Page 55). In Chapter 4, the following statement contradicts that assertion:

"There would be mostly minimal changes in trout habitat availability. However, there would be increased bank instability in Segments 1 and 2 of South Boulder Creek, which could alter habitat somewhat. The increases in runoff flows could have an effect on benthic invertebrate populations as well. The Proposed Action with RFFAs would result in minor adverse cumulative impacts and could result in decreased density of macroinvertebrates, or macroinvertebrate community composition could shift towards species that prefer fast-moving water" (FEIS Chapter 4, page 515).

Denver Water's truck test was inappropriately conducted and failed to prove viability of the truck hauling option.

On August 8th, 2013 Denver Water conducted a test-run of loaded semi trucks carrying aggregate along Highway 72 and Gross Dam Road to Gross Reservoir. The test was intended to illustrate the viability of the truck hauling option. The test run was filmed by Denver Water via helicopter and GoPro cameras mounted to some of the truck cabs. Additionally, private citizens recorded video of the test via GoPro cameras mounted to a private vehicle. All of Denver Water's footage as well as all of the private citizen footage is included with this comment letter.
Some highlights of the truck test include:

- One of the 8 trucks broke down on the way up the canyon and was abandoned on a pull-out. (Still there at 5pm)
- The "loaded" trucks were loaded to approximately 1/3 capacity.
- The drivers were being paid $100/hr (3 to 4 times their regular rate).
- The trucks dominated the road on nearly every corner, crossing over clear to the far-side shoulder on many turns and were forced to do excruciatingly slow multi-point back-and-forth turns to shimmy around the intersection of highway 72 and Gross Dam Road.
- The trucks averaged a 15-20mph trip to the reservoir (a 40mph average was used for calculations in the Haul Study referenced in the Boulder County draft IGA).

These highlighted issues, as well as several other observable conditions illuminated by the truck test, illustrate the fact that 26,000 semi truck runs to and from the staging site hauling materials could not be performed without putting the public's safety at a significant and unacceptable level of risk.

E. Water Usage

A large percentage of Coloradans live without any outdoor water usage.

Forty-eight percent of Denver Water's total retail treated water is used by single-family homes. The average single-family residential customer uses 50 percent of total water for outdoor use. This totals roughly 60,000 acre-feet annually. That's 333% the volume of water that the Moffat Collection System would potentially yield. (Denver Water, N.D.)

Meanwhile, a large percentage of Colorado residents, sourcing their water from groundwater wells, are prohibited from outdoor water usage: "Ground water wells are the principle source of water for most homeowners in rural areas of Colorado. There are over 200,000 permits for ground water wells currently issued in our state and approximately 4,000 new permits are requested annually. Most of these wells are used for households and are considered "exempt" from the administration within the water rights priority system. They require a permit from the State Engineer, and are limited to 15 gallons of water per minute. Some exempt wells are further limited to in-house use only when lot sizes are smaller than 35 acres." (Private Wells for Home Use, E. Marx, R. Waskom and D. Wolf, N.D.) See Appendix C for resources.

F. The FEIS fails to recognize the "Environmental Pool" with regard to minimizing problems with floating debris, decaying vegetation and water quality concerns.

From the DEIS: "In order to minimize problems with floating debris, decaying vegetation and water quality concerns, all trees would be removed between the normal pool elevation (7,282 feet) and 7,410 feet, which is 10 feet above the 72,000 AF expansion elevation." (DEIS Chapter 2, 2-34)

From the FEIS: "Under the Proposed Action, a 77,000 AF enlargement would be constructed at Gross Reservoir. Of the 77,000 AF enlargement, 72,000 AF would be utilized to provide new firm yield to Denver Water's system and 5,000 AF would be an Environmental Pool for mitigation. The estimated ground disturbance for the Proposed Action conservatively assumed the inundation area (i.e., the area between elevation 7,282 and 7,400 feet), plus 10 feet above the expanded reservoir pool to account for potential tree removal and other construction-related activities. The additional area of inundation associated with the Environmental Pool (i.e., the area between elevation 7,400 and 7,406 feet) is within the impact area. Thus, the impact analysis of ground-disturbance associated with the Proposed Action with or without the Environmental Pool would be the same." (FEIS Executive Summary, ES-13)

With the addition of the 5,000 AF Environmental Pool (6 feet of elevation), the expansion elevation with regard to removal of trees should be updated to 7,416 – which is 10 feet above the 77,000 AF enlargement (which now includes the Environmental Pool). As it stands in the FEIS, the elevation difference between a full reservoir at 7,406 feet and the area cleared of trees to minimize problems with floating debris, decaying vegetation and water quality concerns, would be a mere 4 feet.

Increasing the elevation of the area to be cleared of trees from the FEIS-proposed 7,410 feet and the appropriate 7,416 feet will contribute significantly to ground-disturbance associated with the Proposed Action including impacts to wetlands, riparian areas, and Upper South Boulder Creek inundation. These impacts must be properly analyzed and mitigated.

G. The Colorado River Cooperative Agreement (CRCA) was signed by 18 Western Slope entities in September, 2013.

The Agreement stipulates the following:

With the exception of Grand County (which is a consulting agency in the NEPA process for the Moffat Project), the West Slope Signatories agree that the concerns raised in the comment letters they submitted on the October 2009 Draft EIS for the Moffat Project will be resolved by the combination of (1) the benefits that will accrue to the West Slope pursuant to the terms of this Agreement, plus (2) the environmental mitigation requirement and conditions that will be imposed by the federal and state permitting agencies in the permits and approvals issued for the Moffat Project. Accordingly, the West Slope Signatories other than Grand County agree not to oppose the issuance of any local, state and federal approvals for the Moffat Project, including those permits listed in Attachment P (Denver Water, 2012).

Discussion:

Several of these entities, including Grand County, submitted detailed critiques of the DEIS for the Moffat Project. These comments raised numerous important concerns regarding impacts and mitigation and stipulations in the Blue River Decree. The CRCA requires the signatories to agree that these concerns are met by the agreement and by all other requirements and conditions of other agencies. In other words, these entities are prevented from "opposing" the Moffat Project in any way. What "opposing" means is not clear but apparently Denver Water has silenced key West Slope players who might have had additional concerns that the agreement does not sufficiently address. This stipulation of the agreement violates 40 CFR Part 1506.6(a) regarding public comment. The agreement also appears to violate the regulation against using monetary compensation as a form of mitigation. In the CRCA signatories agree that the "benefits" given to them compensate in part for their "concerns."

Denver Water refers to the CRCP as "paving the way" for the Gross Reservoir expansion.[1] It does this by proposing mitigation and "benefits" in exchange for no resistance from the signatories. While the plans might be useful to these entities, and might help to mitigate some of the impacts of the Moffat Project, preventing further comment subverts their opportunity to engage in the FEIS process. Furthermore, these agreements were negotiated without pubic comment.

Neither the CRCP nor the Grand County plan is included in the FEIS. In the Grand County plan Denver Water states that it will request the Corps to include its regulatory obligations as permit terms and conditions, circumventing the FEIS process. These agreements are hailed as milestones in cooperation and in protecting the Fraser River and its tributaries. The public should have the opportunity to study these agreements under the mandated provisions of an environmental impact statement. 40 CFR 1502.9(c) requires agencies to prepare a supplemental EIS if "there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts."

The CRCA also stipulates that the signatories agree that litigation concerning the Blue River Decree will be resolved, "The West Slope Signatories shall support and cooperate in any legal or administrative proceedings necessary to implement the provision of this Agreement related to the Blue River Decree." (Id, p. 28). The cornerstone of the Blue River Decree is that before taking more water from the Western Slope, Denver Water must maximize its use of reusable water. The scope of the legal issues concerning the Blue River Decree is beyond this additional consideration. If however, the mandate that Denver Water exhaust its reusable return flows before diverting more water from the Western Slope, then the Blue River Decree is essentially

[1] Denver Water, (2013) Comprehensive Annual Financial Report p. I-18.

voided through the CRCA, and the Western Slope entities will have lost an important avenue for keeping western slope water on the western slope.

H. The following Mitigation Requests Need to be Addressed:

Should a project be approved, the following specific mitigation requests to be included as permit conditions in the Record of Decision:

1. Construction:
Peak construction period: April 15 – October 15 during years in which mass concrete placement will occur. At the altitude of the canyon roads heavy April snow is likely and winter snow begins mid-October. This is the safest period for heavy truck traffic in Coal Creek Canyon and Gross Dam Road.
Time of day: trucks hauling materials for concrete placement on Hwy 72 and Gross
Dam Road will not operate between the hours of 7:30 a.m. — 9:00 a.m., 4:30 p.m.—6:00 p.m., 10:00 p.m.—9:00 a.m. All other trucks, including logging trucks, will operate only from 9 a.m.—4:30 p.m.
Day restrictions: Trucks hauling project materials and logging trucks trucks will not operate on Sunday or holidays.
Oversized trucks: oversized truck requiring permits will follow the above conditions.
Worker transportation: a park-and-ride near the entrance to Coal Creek Canyon on
Hwy 72 will be used to transport workers to the site.
Use of diesel motors: all vehicles and equipment using diesel motors will be equipped with noise dampening devices and will operate between 8:00 a.m. and 5:00 p.m. on weekdays only.
Blasting: blasting will occur between 8:00 a.m. and 6:00 p.m. only on weekdays.

2. Road safety
Pull-outs: all existing pullouts on Hwy 72 from the entrance to the canyon to the turn onto Gross Dam road will be enlarged and lengthened.
Up-lane: please check John's section on traffic to see if he includes this
Bicycle lane: The sides of Hwy should be widened to accommodate bicycles
Canyon courtesy: trucks will pull over to let passenger cars pass when followed by two vehicles or more.

3. Materials
Should any construction project at Gross Dam be permitted, it must be done via Roller Compacted Concrete (RCC) because the low cement content and use of fly ash in RCC cause less heat to be generated while curing than conventional mass concrete placements resulting in many time and cost benefits over conventional mass concrete; these include higher rates of concrete placement, lower material costs and lower costs associated with post-cooling and formwork.

This is a formal request to the Corps to prepare a supplemental EIS to address the additional mitigation and enhancement proposals for Grand, Summit and Eagle Counties that are not covered in the FEIS.

CONCLUSION

In summary, there are fatal flaws in the proposed Moffat Project as described in the Final Environmental Impact statement. These include inaccurate, inadequate, and misleading analyses that skew the potential project environmental and social impacts. If the project is allowed to go forward irreversible effects to our precious natural resources would occur on both sides of the Continental Divide; fish, people and businesses that depend on healthy rivers would be affected. Furthermore, if this project goes the Fraser and Upper Colorado Rivers, as shown above, will be severally depleted and the Moffat Project will not be in compliance with Section 404(b)(1) regulations.

APPENDIX A:

ADDENDUMS

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August 24, 2018

Via E-Mail

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Re: Request For Supplemental NEPA Review By The Corps For The Moffat Collection System Project In Light Of Significant New Information Bearing On The Proposed Action And Its Impacts

On behalf of the nonprofit organization Save The Colorado, I hereby request that the U.S. Army Copy of Engineers ("Corps") conduct supplemental environmental analysis pursuant to the National Environmental Policy Act ("NEPA"), 42 U.S.C. §§ 4321-4370m, by preparing a supplemental environmental impact statement ("SEIS") or, at bare minimum, a supplemental environmental assessment ("SEA") to address and evaluate myriad new circumstances and significant information relevant to this project and its environmental impacts. As explained below, **we request a response from the Corps by no later than October 26, 2018** informing Save The Colorado whether the Corps intends to conduct any supplemental NEPA review, and, if not, explaining the reasons why the Corps has declined to take this action.

BACKGROUND

I. STATUTORY AND REGULATORY FRAMEWORK

Congress created NEPA more than four decades ago "[t]o declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment . . . ." 42 U.S.C. § 4321. In light of this mandate, the Supreme Court has reasoned that NEPA is "intended to reduce or eliminate environmental damage and to promote 'the understanding of the ecological systems and natural resources important to' the United States." *Dep't of Transp. v. Pub. Citizen*, 541 U.S. 752, 756 (2004) (quoting 42 U.S.C. § 4321).

In achieving NEPA's substantive goals, Congress created two specific mechanisms through which federal agencies must evaluate the environmental and related impacts of a particular federal action—an EIS and an EA. *See* 42 U.S.C. § 4332(c). These procedural mechanisms are designed to inject environmental considerations "in the agency decisionmaking process itself," and to "'help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment.'" *Pub. Citizen*, 541 U.S. at 768-69 (emphasis added) (quoting 40 C.F.R. § 1500.1(c)). Therefore, "NEPA's core focus [is] on improving agency decisionmaking," *Pub. Citizen*, 541 U.S. at 769 n.2, and specifically on ensuring that agencies take a "hard look" at potential environmental impacts and environmentally enhancing alternatives "as part of the agency's process of deciding whether to pursue a particular federal action." *Baltimore Gas and Elec. Co. v. Natural Res. Def. Council*, 462 U.S. 87, 100 (1983). The alternatives analysis "is the heart" of an EIS or EA. 40 C.F.R. § 1502.14. NEPA's implementing regulations require that the agency "present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public." *Id.*

An EIS must be prepared by an agency for every "major Federal action significantly affecting the quality of the human environment." 42 U.S.C. § 4332(c). Under the Council on Environmental Quality's ("CEQ") regulations that implement NEPA, "significance" requires consideration of both context and intensity. Where a significant environmental impact is not expected, the agency must still prepare an EA and a Finding of No Significant Impact ("FONSI"). *Id.* §§ 1508.9, 1501.3. Where an EA or EIS has been previously prepared, NEPA's regulations require an agency to supplement its prior NEPA review when "[t]he agency makes substantial changes in the proposed action that are relevant to environmental concerns," or "[t]here are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts." 40 C.F.R. § 1502.9(c).

II. FACTUAL BACKGROUND

The Corps commenced its decisionmaking and NEPA review process for the Moffat Collection System Project in September 2003. *See* Corps, *Environmental Impact Statement – Moffat Collection System Project*, http://www.nwo.usace.army.mil/Missions/Regulatory-Program/Colorado/EIS-Moffat/. The Corps issued its Final EIS on April 25, 2014, and the agency issued its Record of Decision ("ROD") authorizing this project on July 6, 2017. *Id.*

In the more than four years that have passed since the Corps completed its most recent environmental analysis for this project in the April 2014 Final EIS—and even in the year that has passed since the Corps' July 2017 ROD—numerous pieces of critically significant information underlying this project have come to light that call into serious question the scientific and legal assessment previously conducted by the Corps as the lead agency for this project. Those changed circumstances and significant new information are explained in more detail below, along with a request for the Corps to conduct supplemental NEPA review to address these new circumstances and information to ensure that the NEPA process for this project complies with federal law.

DISCUSSION

There are several key circumstances that have changed or new information that has arisen since the Corps issued its Final EIS and ROD, which undercut the Corps' prior NEPA evaluation for this project and crucial assumptions underpinning the purpose and need for this project, impacts of the project, and the range of reasonable alternatives in light of ballooning project costs. In short, Save The Colorado views the following materials to be highly relevant to demonstrating the need for the Corps to conduct supplemental NEPA review for this project:

- The Corps is the lead agency with primary jurisdiction over the Moffat Collection System Project; however, the Federal Energy Regulatory Commission ("FERC") is serving as a cooperating agency. Although FERC's jurisdiction is limited to the hydroelectric licensing aspect of the project, FERC prepared a Supplemental EA in February 2018 that purports to tier off of the Corps' April 2014 Final EIS. *See* FERC, February 2018 Supplemental EA (Exhibit 1). In the Supplemental EA, FERC acknowledged that the Corps' April 2014 Final EIS is incomplete in certain respects: "The Final EIS includes analysis of *some of the effects* to the Gross Reservoir Project"; "[h]owever, at the time the Final EIS was produced, *not all aspects of the plans for enlarging Gross Reservoir had been completed*." *Id.* at iv (emphases added). Thus, as the Corps' cooperating agency has conceded, the Corps' Final EIS and ROD fail to consider all relevant impacts of the project. Because the Corps—rather than FERC—is the lead agency charged with primary jurisdiction over this project, including analyzing *all* project effects as required by NEPA (and the Clean Water Act), the Corps must supplement its Final EIS to account for all impacts of the project and any new "aspects of the plans for enlarging Gross Reservoir" that have now been finalized.

- As part of the FERC process, several important materials have come to light that undercut key assumptions in the Corps' Final EIS and ROD. Most critically, the Corps' ROD assumed that Denver Water's preferred alternative would cost no more than $187.9 million, *see* Corps ROD at 10, and used that benchmark as a means of assessing the practicability of other alternatives on cost and logistical grounds. However, during the FERC process, for the first time it has become clear that the *actual* project costs for Denver Water's preferred alternative will be at least $380 million, *see* Exhibit 2 (May 16, 2017 Denver Water Response to Comments (excerpts))—which is more than *double* the assumption used by the Corps' in its Final EIS and ROD—and Denver Water has suggested more recently that project costs are actually closer to $464 million for the preferred alternative. *See* Exhibit 3 (February 2018 Denver Water Fact Sheet). Because the alternatives analysis depends in large part on determining whether less environmentally damaging alternatives that are somewhat costlier are "reasonable" under NEPA or "practicable" under the Clean Water Act, the massive discrepancy between the cost estimate adopted by the Corps in its Final EIS and ROD and the actual cost estimate now being presented by Denver Water requires a reconsideration of alternatives in light of more recent and more accurate information provided during the FERC proceedings. Because the Corps is the lead agency for this project—and the *only* agency evaluating alternatives under NEPA and the Clean Water Act—the Corps must conduct further environmental review to comply with federal law.

- In response to FERC's Supplemental EA, which again acknowledged certain deficiencies in the Corps' Final EIS and ROD without actually resolving those inadequacies, Save The Colorado worked with several recognized experts with subject matter expertise concerning aspects of this project to assist FERC and the Corps in better understanding and evaluating the effects of this project, and alternatives to the preferred action, which I hereby attach to be addressed in the Corps' supplemental NEPA review process. *See* Exhibit 4 (April 9, 2018 Comments on Supplemental EA and Expert Reports). These comments and expert reports are all highly relevant to the issues under the Corps' jurisdiction for this project, and raise significant new information never before considered by the Corps (or FERC) in any existing NEPA review.

- In response to FERC's Supplemental EA, Boulder County—i.e., the municipality with jurisdiction over this project—submitted detailed comments raising significant new concerns with the Corps' NEPA process for this project, and providing information undermining certain aspects of the Corps' Final EIS, ROD, and decisionmaking process. *See* Exhibit 5 (March 20, 2018 Boulder County Comments on Supplemental EA). In particular, Boulder County raised concerns with "the staleness of the data in the FEIS and the failure to consider the impacts of climate change upon the Moffat Collection System project and streams that will be dewatered as a result of the project." *Id.* at 2. Boulder County explained that these issues "were not addressed by the Corps in the FEIS or by the FERC in the EA or elsewhere." *Id.* Further, Boulder County raised significant concerns that this project is not even needed in light of current water demand data. *Id.* at 2-5. As a result, this significant new information from the county government located where this project will be built requires a "hard look" by the Corps through the supplemental NEPA review process.

- On August 23, 2018, Save The Colorado and several other conservation organizations formally submitted to the Corps, the U.S. Fish and Wildlife Service, and others a 60-day notice letter (along with an expert report by Dr. Brett Johnson) raising numerous legal violations under the Endangered Species Act ("ESA") in connection with the U.S. Fish and Wildlife Service's June 17, 2016 Biological Opinion for green lineage cutthroat trout. *See* Exhibit 6 (August 23, 2018 ESA 60-Day Notice Letter and Expert Report). As explained in the notice letter, the Corps and the Service must reinitiate Section 7 consultation under the ESA to bring this project into compliance with federal law. Likewise, because the effects to ESA-listed cutthroat trout have not been adequately addressed through the ESA consultation process, the Corps should take a hard look at the impacts to this federally protected species as part of its supplemental NEPA review process.

The information highlighted above individually and collectively constitutes "substantial changes in the proposed action that are relevant to environmental concerns" or "significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts," 40 C.F.R. § 1502.9(c)(1), none of which has ever been addressed by the Corps' Final EIS or ROD (or FERC's Supplemental EA). Thus, because lead agencies "shall prepare supplements" to final EISs where either of those criteria are satisfied, *id.*, the Corps must conduct supplemental NEPA review and issue a Supplemental EIS (or at least a Supplemental EA) addressing these vitally important issues that are central to the Corps' analysis of project impacts, a reasonable range of alternatives, and the ultimate decision as to whether the Corps should authorize this project under Section 404 of the Clean Water Act. In conducting supplemental NEPA review, Save The Colorado strongly urges the Corps to subject that document to public comment and input, in light of the controversial nature of this project and the immense public interest in this project shown to date by Colorado residents.

CONCLUSION

For the reasons explained above, Save The Colorado believes that the Corps—as the lead agency for this project—must conduct supplemental NEPA review as directed by the CEQ's NEPA regulations. Please let me know by **no later than October 26, 2018** if the Corps intends to prepare a Supplemental EIS or EA in response to this letter and the significant new information attached hereto. If the Corps decides not to conduct any further NEPA review despite the new information set forth in this letter, please provide a written response by October 26 explaining the reasons why the Corps has declined this request. I look forward to hearing from the Corps about this matter. Please let me know if you would like to schedule a conference call to discuss this matter in person.

Respectfully submitted,

William S. Eubanks II

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April 9, 2018

Kimberly D. Bose
Secretary, Federal Energy Regulatory Commission
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Submitted electronically via the Commission's eFiling and eComment systems at http://www.ferc.gov/docs-filing/efiling.asp *;* http://www.ferc.gov/docs-filing/ecomment.asp ; and peter.yarrington@ferc.gov

Re: **FERC Project No. 2035-099**
SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT FOR AMENDMENT OF HYDROPOWER LICENSE
Gross Reservoir Hydroelectric Project—FERC Project No. 2035-099, Colorado

Dear Secretary Bose and Mr. Yarrington:

Save the Colorado and The Environment Group of Colorado appreciate the opportunity to submit these comments on the Supplemental Environmental Assessment (SEA) released by the Federal Energy Regulatory Commission (FERC or the Commission) on February 12, 2018 as part of FERC Docket 2035-099, the Gross Reservoir Hydroelectric Project ("Gross Dam and Reservoir") which is a component of the overall Moffat Collection System Project ("Moffat Project").

On March 26, 2018, Save The Colorado, filed a Motion to Intervene Out of Time in this matter. As of this submission, the Commission has not granted nor denied that motion. By filing these comments, Save The Colorado intends to take advantage of the public comment period for this matter but maintains its claims that its needs for effective participation in this matter can only be met through intervenor status.

These comments are dependent on the work of several qualified experts who have prepared technical reports in their respective fields. These reports are attached here and referenced throughout this document.

1. Introduction & Summary of Comment

A central question presented by the SEA is whether the facts, the science, the record, and the law support the conclusion that the Gross Dam and Reservoir project, as currently proposed, would not significantly affect the quality of the human environment. As explained below, and in comments attached to or incorporated into this letter by reference, the "Finding Of No Significant Impact" (FONSI) is unsupported.

On the existing record, the project is not entitled to federal approvals. Licensing and permits should be denied by the Commission and Cooperating Agencies including the U.S. Army Corps of Engineers (Corps). Should the agencies seek to conduct additional environmental analysis to address the deficiencies in existing NEPA, a Supplemental Environmental Impact Statement (SEIS) should be prepared with the Corps as lead agency.

The SEA (at pages iv and 5) affirms that the hydropower component is incidental to the project. The SEA acknowledges that existing NEPA prepared by the Corps is inadequate. "However, at the time the Final EIS was produced, not all aspects of the plans for enlarging Gross Reservoir had been completed, and not all aspects of the proposed license amendment had been finalized." SEA at 4. New components of the project and new information require supplemental NEPA analysis to comply with the statute before approvals or permits can issue. Important aspects of the project remain conjectural, frustrating NEPA's goals of informed decision-making and meaningful public participation.

The SEA ignored NEPA's alternatives requirement. This matters because reasonable and viable alternatives exist that satisfy the purpose and need, and better advance statutory goals including environmental protection. The project fails the public interest balancing test under the Federal Power Act.

The SEA exhibits a misunderstanding of this complex project, and consistently under-states or mis-states impacts. The conclusion that the project will not have significant impacts is unsupported by the record, and contradicted by the objective analysis in comments provided by experts without a vested interest in project approval.

Below, this comment further explains these points by reviewing specific legal requirements, facts in or missing from the record, new information, the best available science, and the content of the SEA.

2. NEPA's Supplement Requirement

EIS Supplements are governed by Council of Environmental Quality (CEQ) regulations.

(c) Agencies:

(1) Shall prepare supplements to either draft or final environmental impact statements if:

(i) <u>The agency makes substantial changes in the proposed action that are relevant to environmental concerns</u>; or

(ii) <u>There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts</u>.

(2) May also prepare supplements when the agency determines that <u>the purposes of the Act will be furthered by doing so</u>.

> (3) Shall adopt procedures for introducing a supplement into its formal administrative record, if such a record exists.
>
> (4) Shall prepare, circulate, and file a supplement to a statement in the same fashion (exclusive of scoping) as a draft and final statement unless alternative procedures are approved by the Council.

40 C.F.R. §1502.9(c) (emphasis added).

Here, substantial changes were proposed since the FEIS published by the Corps in 2014, new circumstances and information exist, and NEPA will be furthered by preparing an SEIS under parts (1) and (2) above. Part (4) provides for preparing and the Supplement in the same manner as the original EIS. That requires an SEIS with the Corps as lead agency, rather than an SEA published by another agency.

Consistent with the CEQ regulations, the Corps' NEPA guidance provides for a supplemental EIS under the circumstances present here. See Appendix B to Part 325—NEPA Implementation Procedures for the Regulatory Program – cites to 33 CFR 230.13(b). See http://www.poa.usace.army.mil/Portals/34/docs/regulatory/33%20CFR%20Part%20325%20Appendix%20B%20.pdf at page 10. That regulation provides (emphasis added below):

> (b)Supplements. A supplement to the draft or final EIS should be prepared whenever required as discussed in 40 CFR 1502.09(c). A supplement to a draft EIS should be prepared and filed in the same manner as a draft EIS and should be titled "Supplement I", "Supplement II", etc. The final EIS should address the changes noted in the supplement and substantive comments received as a result of circulation of the document. A supplement to a final EIS should be prepared and filed first as a draft supplement and then as a final supplement. Supplements will be filed and circulated in the same manner as a draft and final EIS[.]

Thus, Corps NEPA regulations require supplements when there are significant new circumstances or information, and where substantial changes relevant to environmental concerns are proposed. Regulations and guidance both provide for multiple supplements, filed and circulated in the same manner as a DEIS.

This position is supported by NEPA precedent. See Bundorf v. Jewell, 142 F. Supp. 3d 1138, 1150–51 (D. Nev.), clarified on denial of reconsideration, 142 F. Supp. 3d 1133 (D. Nev. 2015) (When "a major federal action remains to occur. Federal Defendants must prepare an SEIS that addresses the new information about golden eagles in and around the Project area."). Here, the Commission's pending decision is a major federal action that remains to occur, and project construction is not scheduled to start until 2020 under the most optimistic scenario.

The Corps has been the lead agency for the NEPA component of the project since 2003. Over that time, Corps staff has developed a knowledge base on this complex and multi-faceted project that is not generally shared by staff at the Commission.

The SEA (at page iv) recognizes the complexity of the Denver Water proposal, and outlines the overall project:

> In this supplemental environmental assessment (Supplemental EA), Federal Energy Regulatory Commission (Commission or FERC) staff reviews the environmental effects

> of the City and County of Denver, Colorado's (Denver Water) November 25, 2016 application to amend the license for its Gross Reservoir Hydroelectric Project No. 2035 to raise the elevation of the project's Gross Dam and increase storage in the project's Gross Reservoir.
>
> Gross Reservoir is a component of Denver Water's Moffat Collection System, which is a large, complex water collection and storage system which moves water from the west side of the Continental Divide to the east side, providing municipal water supply for Denver and the surrounding area. Denver Water proposes enlarging Gross Reservoir and amending the project license because the enlargement would be necessary in order to store the water in the enlarged system.

The summary establishes that a fundamental and necessary project component is moving water from the West Slope to the Front Range for use by Denver Water.

Given that the hydro-power component of the proposal is incidental to those aspects of the project subject to Corps jurisdiction, the Corps is the appropriate lead agency for NEPA. The Corps is equally or more knowledgeable than the Commission regarding the dam design and construction issues covered in the SEA. This choice of lead agency is reinforced by the special legal requirements and procedures applying to the Commission's docket on this matter, including aspects that could make it more difficult for concerned citizens and NGOs to participate fully in Commission proceedings, or to exercise their legal right to challenge NEPA documents.[1]

3. Substantial Changes, Significant Impacts, and New Information

As currently proposed, the Moffat Project differs significantly from the version originally proposed to the Corps in 2003, and subsequently analyzed in the 2007 DEIS and the 2014 FEIS. Among the most striking differences between 2003 and 2018 is that existing approvals and the tentative FONSI in the SEA are un-informed by current data going to the purpose and need. Specifically, Denver Water's application relies almost exclusively on 15 years of data from before 2002, and ignores 14 years of data, trends, and graphs for the post-2002 period that establish the project is not needed, nor is there any need on the planning horizon. The expert comments of Gordon McCurry and Lisa Buchanan address this issue as summarized below and in attached appendices.

In short, since 2002, water use and demand within Denver Water's service area are "decoupled" from recent population or job growth, meaning that although population has increased, water use and water demand have decreased. Despite comprehensive documentation of decoupling being the most significant and relevant development since the project was originally proposed, the SEA lacks a single reference to the concept. That omission alone renders the SEA inadequate.

The fact that the project is unneeded today matters because of the substantial socioeconomic and environmental impacts that makes it highly controversial. Denver Water seeks federal regulatory approvals for project components that would:

- Build the tallest dam in the history of the State of Colorado (at 470 feet);
- Approximately double the size and triple the capacity of the existing Gross Reservoir;

[1] Save the Colorado has filed a "Motion to Intervene" in the FERC docket for Gross, but is not currently a party to that proceeding.

- Undertake the largest and most expensive construction project in the 157-year history of Boulder County at a cost estimated to range from $380-450 million according to a 2015 Denver Water Fact Sheet;[2]
- Significant components of the design and construction of the dam are newly proposed, including but not limited to the "Roller Compacted Concrete" design and whether to replace the proposed auxiliary spillway with a saddle dam;
- Implement a Forest Service settlement reached during the pendency of the FERC proceeding, aspiring to address certain impacts including but not limited to impacts and mitigation related to sensitive and protected wetlands habitat and the forest ecosystem but omitting much substantial information;
- Require the clearcutting and removal of more than 200,000 trees including patches of old growth forests;
- Establish the "Osprey Point" quarry on-site with the capacity to produce as much as 1.6 million tons (approximately 1 million cubic yards) of finished aggregate material for the dam;
- Build a concrete plant on site in close proximity to residences;
- Require 24/7 construction activities for more than four years under the current construction schedule, compromising the quality of life of thousands of residents in the Gross Reservoir area who are drawn to the area for the quiet, stillness, isolation, and scenic beauty;
- Result in high levels of truck traffic on narrow, winding mountain roads used by residents and visitors to access homes and recreational amenities (a total estimate of truck trips is not provided by the SEA but moving off-site construction materials to the site is currently estimated at 6,552 trips);
- Transportation impacts for heavy materials would include moving significant (but unspecified) tonnage of highly toxic fly ash from a Wyoming location 350 miles away; significant quantities of cement from a South-Central Colorado location approximately 148 miles away; and a currently estimated 50,000 tons of vegetative material down the canyon roads from the project site;
- Workers would be transported to and from the site daily;
- Cause elevated levels of mercury in Gross Reservoir that are expected to necessitate a fish consumption advisory for humans but no mitigation to prevent impacts to the food chain or natural ecosystem;
- Inundate Forsythe Falls under the expanded Gross Reservoir, one of the leading National Forest features and mid-elevation hikes in Boulder County and rated among the top ten waterfalls in Colorado's Front Range within an hour of metro Denver;
- Further contribute to existing conditions on South Boulder Creek below the dam whereby winter stream temperatures prevail year-round to the detriment of the fishery and other aquatic life forms;
- Log or otherwise impact hundreds of acres of elk winter concentration areas;
- Further alter flows, temperatures and the community of aquatic life in both the South Boulder Creek and Upper Colorado River watersheds on both sides of the Continental Divide;
- Divert 15,000 to 18,000 acre-feet per year (AFY) of additional water (in average or high runoff years) from headwaters streams in the Upper Colorado River watershed on the West Slope, notwithstanding existing data that in approximately 1/3 to 1/2 of impacted

[2] "Boulder County was one of the original 17 counties organized by an enabling act of the first Colorado Territorial Legislature on Nov. 1, 1861." See https://www.bouldercounty.org/government/about-boulder-county/history/

Upper Colorado streams the fisheries are already classified as “collapsed” or near collapse; and the fish populations as past, near, or on the brink of the “ecosystem tipping point”;

- Detrimentally impact and result in “take” (mortality) to the greenback lineage cutthroat trout in a substantial proportion (5 of 60) of the remaining streams on the West Slope providing habitat for this at risk and newly identified native lineage currently under review by USFWS ;
- Likely result in water quality violations in the Upper Colorado for limits including e coli, copper, and possibly other heavy metals;
- At the same time, a wealth of new information regarding potential alternatives and the project purpose and need, among other components, has become available since release of the FEIS.

Although some of these impacts were addressed in the Corps’ 2014 FEIS, many of the project components or impacts were not adequately disclosed or analyzed in the EIS, and/or that analysis requires updated based on new information and scientific findings. This includes entirely new information since the FEIS going to major impacts such as the proposed quarry; the concrete plant; the transport of fly ash; tree removal and vegetation disposal; specifics going to the dam design, operation, and safety; aquatic and terrestrial ecological impacts; and socio-economic impacts to residents and the greater project area, including recreational visitors and users.

These observations are consistent with Boulder County’s comment (at page 2) noting the “staleness of the data in the FEIS and the failure to consider the impacts of climate change upon the Moffat Collection System project and streams that will be dewatered as a result of the project.” As Boulder County states: “Whether Denver Water can meet the purpose and need it set for itself is a threshold issue under NEPA (42 U.S.C. § 4332(2)(c); 40 C.F.R. § 1502.13; *Protect Our Communities Foundation v. Jewell,* 825 F.3d 571, 579 (9th Cir. 2016)) and it is still a very relevant issue for the FERC to decide.” Id.

Notwithstanding the impacts outlined above, the concerns of the local government most affected by the construction project, and despite omitting analysis of many of the project comments summarized above, the SEA contains a “FINDING OF NO SIGNIFICANT IMPACT”:

> If the proposed amendment to the Gross Reservoir Hydroelectric Project is approved with Denver Water’s proposed measures, the project would continue to operate while providing protection and enhancements to water quality, aquatic resources, terrestrial resources, recreation, and cultural resources.
>
> Based on our independent analysis, Denver Water’s proposed modifications that were not assessed in the 2014 Final EIS, as mitigated by the environmental measures discussed in this Supplemental EA, would not constitute a major federal action significantly affecting the quality of the human environment.

SEA at 94.

Standing alone, the impacts of several of the individual project components meet and surpass the significance threshold. Considered collectively, the direct, indirect and cumulative impacts of newly proposed or evolving aspects of the project, considered in addition to new information, surpass NEPA’s significance threshold requiring preparation of a Supplemental EIS. In short, the SEA’s proposed “FONSI” finding is unsupported by the record or the facts on the ground.

Denver Water's April 3, 2018 comment on the SEA asserts that "the EIS stands alone as a comprehensive environmental document, thoroughly reviewing all impacts associated with the Moffat Project[.]" However, all impacts were not – and could not be - thoroughly reviewed by the EIS, because significant components of the project have significantly changed since the analysis relied on by the EIS was conducted, and new information and science requires re-opening the EIS and reconsidering whether the project complies with NEPA, the Clean Water Act, the Federal Power Act, and other applicable federal law.

4. **Impacts to the ecological environment and recreation must be balanced against the asserted benefits of the dam, and significant ecological or recreational impacts are grounds for denying the permit.**

The SEA recognizes the applicability of Section 10(a) of the Federal Power Act to the proposed Gross Dam and Reservoir project, but fails to consider parts of the Act requiring the Commission to give equal consideration to protection and enhancement of fish and wildlife, the protection of recreational opportunities, and the preservation of other aspects of environmental quality.

Although these legal requirements appear to have been omitted from the EA, the Conservation Groups identified them in a 1987 FERC decision that denied a proposed license under the Act.

> On October 16, 1986, the President signed the Electric Consumers Protection Act of 1986 (ECPA), Pub.L. No. 99–495, which amended Section 4(e) of the FPA, pertaining to the Commission's licensing authority, by adding the following sentence:
> In deciding whether to issue any license under this Part for any project, the Commission, in addition to the power and development purposes for which licenses are issued, shall give equal consideration to the purposes of energy conservation, the protection, mitigation of damage to, and enhancement of, fish and wildlife (including related spawning grounds and habitat), the protection of recreational opportunities, and the preservation of other aspects of environmental quality.
>
> ECPA also amended Section 10(a) to become Section 10(a)(1) and added the following underscored words:
>
> That the project adopted, including the maps, plans, and specifications, shall be such as in the judgment of the Commission will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of water power development, for the adequate protection, mitigation, and enhancement of fish and wildlife (including related spawning grounds and habitat), and for other beneficial uses, including irrigation, flood control, water supply, and recreational and other purposes referred to in section 4(e).

Northern Lights, Inc., 39 FERC P 61352 (1987), Slip Op at 4-5 (copy available on request).

FERC decisions recognize that ecological and recreational impacts are relevant to its permitting decisions under the Act.

> It is clear that the proposed development would change the ecological environment downstream from Libby Dam and adversely affect the wild riverine fishery. The proposed dam at the crest of Kootenai Falls would impound 3.5 miles of the river, inundating

various rapids including China Rapids, and thereby diminish the re-aeration capability of the river.

The impoundment would also reduce the velocity of the flows and thereby affect the fish-carrying capacity of the river by carrying fewer insects and macroinvertebrates past the mouths of rainbow trout, which are drift feeders (Tr. 7329).

The reduction in the velocities of the flows would also deposit suspended materials on the bottom and thereby change the environment for the benthic macroinvertebrates, which would also affect the number of drifting macroinvertebrates (Ex. 114 at 8). The interacting implications of these and other changes divide the experts and the parties with respect to what would happen to the rainbow trout population between Libby Dam and Kootenai Falls.

While the opponents contend on the basis of evidence that the proposed development would adversely affect the rainbow trout population, Northern Lights *62106 contends otherwise on the basis of other evidence and, in any event, that any adverse impact can be mitigated through restocking. We find in the Circumstances of this case, wherein large amounts have been spent and special efforts have been made by the United States to enhance the rainbow trout fishery downstream from Libby Dam, that the substitution of mitigation measures for the Corps' trout fishery would, on balance, not be in the public interest.

In Namekagon (note 8, supra), the Seventh Circuit said, 216 F.2d at 512, that the Commission has “the right to consider” that there is nothing unusual or unique about a body of water that is impounded by a proposed hydroelectric development, and that such an impoundment would provide recreational opportunities (boating and fishing, in that case) that are comparable to the opportunities found at other nearby lakes. We find that that would be true of the proposed impoundment herein, which would provide flatwater recreational opportunities that are comparable to those of Lake Koocanusa. Particularly because the formation of that lake destroyed 48 miles of wild riverine fishery in Montana (90 miles including Canada), we also find that the existing wild riverine fishing opportunities in the 3.5 miles upstream from the proposed dam are sufficiently unusual or unique to be worth preserving in the public interest.

Downstream from the proposed dam, the flow through the falls would be reduced to a near constant 750 cfs, which Northern Lights contends on the basis of cited evidence (Northern Lights' Opposition at 130) “will likely sustain the aquatic community at a size comparable to what it is under existing conditions.” We have reservations with respect to the credibility of Northern Lights' proof in view of the fact that the proposed near-constant flow of 750 cfs is lower than any recorded flow before the construction of Libby Dam, and is only three-eighths of the minimum discharge authorized at Libby Dam for short periods during emergencies. Furthermore, we cannot ignore the substantial body of evidence to the contrary, including the testimony of Montana's witness May, who has been studying fish populations in the Kootenai River since 1969 as part of his job with the Department of Fish, Wildlife and Parks (Ex. 118 at 2), and who said that the 750 cfs “would result in a markedly lower trout population” in that part of the river (Ex. 118 at 11–12). (See Ex. 116A at 3 to the same effect.) Because of the sharp conflict of expert opinion, our foregoing reservations, and the fact that the impact of the 750 cfs cannot be ascertained (regardless of anyone's opinion) until after the proposed development would be placed into operation, we find that the minimum level of mitigation needed to sustain the fish population (if a license were to be issued) would be to reserve authority to require by-pass flows that are identical to the minimum discharges authorized at Libby Dam.

Northern Lights, Inc., 39 FERC P 61352 (1987), Slip Op at 4-5.

Northern Lights (Slip Op. at 8) concluded and held:

> We conclude, pursuant to Section 10(a)(1) of the FPA, that, even with proposed mitigation measures, the project is not best adapted for beneficial public uses of the Kootenai River. We conclude this based on the proposed project's adverse affect on the *62109 rainbow trout fishery, on the aesthetics of the falls themselves and on related recreation values, as well as on the religious and cultural practices and sites of the Kootenai people. Our conclusion also takes into account the need for the project power and our finding that the minimum acceptable mitigation to sustain the trout population would adversely affect project economics.

In balancing project impacts against environmental impacts, the Commission's SEA acknowledges that the primary purpose of the Gross Reservoir project is water supply, and hydroelectric power production is incidental the primary purpose.

> The need for power is not a determining factor for the proposed project. Power production at the Gross Reservoir hydroelectric facility is incidental to the operation of the project for its primary purpose of water supply. Hydroelectric energy is only generated at the project when flows are released from Gross Reservoir downstream into South Boulder Creek. These releases are based on water supply needs, maintenance of water elevation limits in response to inflows, and other operational variables. Moffat System Water supply operations are not within the Commission's jurisdiction. The operation of the expanded Moffat Collection System would cause the Gross reservoir Project to produce an estimated additional 4.4 GWh of energy per year, an increase of 16.5 percent over the existing facility. Denver Water currently uses the power generated at the project to supply the project powerhouse, the project valve house, and the caretakers' residences and facilities. The remaining power generated is sold to Xcel Energy.
>
> By producing hydroelectricity, the project displaces the need for other power sources such as fossil-fueled facilities, thereby avoiding some power plant emissions and creating an environmental benefit.

SEA at 5-6.

The SEA (at pages 6-7) further provides that the proposed action is raising Gross Dam to increase the capacity of Gross Reservoir:

> The proposed action addressed in this Supplemental EA is Denver Water's proposal to raise Gross Dam by 131 feet to increase the maximum storage capacity of Gross Reservoir. The enlargement would allow Denver Water to store an additional 77,000 acre-feet of water in the reservoir. The new maximum capacity would include an additional 72,000 acre-feet of water for which Denver Water has existing water rights, and a 5,000 acre-foot Environmental Pool that Denver Water would store for the Cities of Boulder and Lafayette.

The 72,000 AF would be diverted from the headwaters of the Upper Colorado across the Continental Divide

Accordingly, the balancing must be conducted based on the water supply component of the project, and the impacts of additional diversions on the West Slope are a direct result of the proposed action. The SEA is largely silent on both the water supply issue and impacts to the Upper Colorado. To the extent the record and the facts establish that the water supply benefits are less than stated in the Corps' EIS, the public interest balancing test is not met and the approvals sought by applicant Denver Water are unwarranted. This conclusion is reinforced to the extent the SEA (and/or the EIS) understate or omit discussion of project impacts, or the likely effectiveness of potential mitigation at reducing impacts.

The purpose and need analysis continues to relay on stale water supply data collected before the overall NEPA process commenced in 2002. But definitive new information that has become available during the course of the permit review process conclusively establishes that Denver Water's projected need for the additional water supply has not materialized. At the same time, Denver Water and its customers have taken important steps to reduce water demand and secure supplies between 2002 and 2018.

Both additional conservation savings and concrete progress on the demand and supply front are projected and/or approved for implementation in the near-term future. These trends and new information are reviewed in the SEA comment letters of Gordon McCurry and Lisa Buchanan. Buchanan's analysis and graphs (Figures 1 and 2) concludes that "total per capita use has trended downward between 2004 and 2016." Buchanan at 6. Contrary to the analysis and projections for the purpose and need in the FEIS, Buchanan's review and figures establishes the "negative slope of the actual water use trend line indicating that actual water use in the 2000s has decreased over time, likely due to successful water conservation efforts by Denver Water." Id. at 5.

The expert comments of John Woodling, PhD, Woodling Aquatics, and Geoff Elliot/Grand Environmental Services establish that substantial environmental impacts will result from the project, and that the SEA analysis of such impacts was inadequate, inaccurate, or misleading.

According to Woodling's review:

> The Final EIS was written in such a manner as to guide the reader to the conclusion that diversion of flows from the Study area may improve fisheries. The message was conveyed that high stream flows are harmful and low flows beneficial. Actually aquatic communities respond to the total flow regime which includes elevated spring flows during the snowmelt period to maintain stream channel integrity. The value of both low flows and high flows was distorted. In addition, the inevitable increases in stream temperature were minimized while potential decreases in water quality due to increased metal concentrations were not described in adequate detail.

Woodling Assessment at 2.

Woodling's historical perspective notes that:

> The stream channels of the Fraser River basin and South Boulder Creek basin were formed and maintained over eons. These channels are now responding to changes in

flows that have existed only for decades. The proposed additional diversions of water and the manner in which the water is moved and then used will further alter not only South Boulder Creek but the Fraser River system.

Id. at 5.

Elliot's Review presents three conclusions summarizing concerns about the environmental analysis and findings.

Our conclusions are:

1. Environmental analysis in the EA/FEIS and Final Mitigation Plan is impossible to follow due to complex technical arguments based upon an incomplete environmental baseline. Indeed, the Corps fails to recognize the past, present, and reasonably foreseeable impacts upon special aquatic sites from profound dewatering of the Fraser River headwaters (60-100% depletions depending upon where measured (Buchanan 2015)), focusing instead upon "incremental effects" of the DW proposed action. Likewise in the Boulder Creek drainage where flows have increased for decades, we see complex technical arguments that de-emphasize existing degradation of special aquatic sites.
2. The Corps fails to take a watershed approach to the environmental analysis contrary to their own guidelines and those of sister agencies. Several widely accepted rapid-assessment protocols are available that could have offered a more holistic evaluation of environmental baseline and likely impacts, promoting more interagency, interdisciplinary project review with results in plain language. Instead, the Corps opts for convoluted, data-choked discussions that gloss over ecological concerns.
3. Proposed mitigations ignore CEQ guidelines calling for systematic accountability and mechanisms to accomplish goals of NEPA and the Clean Water Act. Rather than taking a comprehensive, watershed approach, the Corps presents mitigations tied to limited actions rather than a clear path toward results.

Elliot at 1.

Substantial ecological impacts to sensitive environmental resources are inadequately analyzed or go unrecognized by the SEA.

The SEA must take a hard look at potential impacts to the threatened Preble Meadow Jumping Mouse. It lives in riparian habitat, and the impacted area of South Boulder Creek, below the dam, is in the "Current Range" for this species.[3] According to the SEA at 39, "the FWS

[3] See https://www.fws.gov/mountain-prairie/es/species/mammals/preble/CRITICAL%20HABITAT/2010_Critical_Habitat_Maps/PMJM_CriticalHabitat_Units5_6_7.pdf (map showing stretches of South Boulder Creek as Critical Habitat); https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=A0C2; and https://www.fws.gov/mountain-prairie/es/preblesMeadowJumpingMouse.php https://www.fws.gov/mountain-prairie/es/species/mammals/preble/CRITICAL%20HABITAT/CRITICALHABITATindex.htm#habitat https://www.fws.gov/mountain-

concurred with the Corp's determination that enlarging Gross Reservoir is not likely to adversely affect the Preble's meadow jumping mouse because, although it has the potential to occur in the project area, it is not known or expected to be present." It is uncertain how FWS is defining the project area and whether the agency has considered impacts to South Boulder Creek riparian areas below Gross Dam, including critical habitat.

5. **FERC's Agency Responsibilities**

The Commission must establish that it has complied with its agency responsibilities under NEPA, including 40 CFR § 1506.5 "Agency responsibility":

> (a)Information. If an agency requires an applicant to submit environmental information for possible use by the agency in preparing an environmental impact statement, then the agency should assist the applicant by outlining the types of information required. The agency shall independently evaluate the information submitted and shall be responsible for its accuracy. If the agency chooses to use the information submitted by the applicant in the environmental impact statement, either directly or by reference, then the names of the persons responsible for the independent evaluation shall be included in the list of preparers (§ 1502.17). It is the intent of this paragraph that acceptable work not be redone, but that it be verified by the agency.
>
> (b)Environmental assessments. If an agency permits an applicant to prepare an environmental assessment, the agency, besides fulfilling the requirements of paragraph (a) of this section, shall make its own evaluation of the environmental issues and take responsibility for the scope and content of the environmental assessment.
>
> (c)Environmental impact statements. Except as provided in §§ 1506.2 and 1506.3 any environmental impact statement prepared pursuant to the requirements of NEPA shall be prepared directly by or by a contractor selected by the lead agency or where appropriate under § 1501.6(b), a cooperating agency. It is the intent of these regulations that the contractor be chosen solely by the lead agency, or by the lead agency in cooperation with cooperating agencies, or where appropriate by a cooperating agency to avoid any conflict of interest. Contractors shall execute a disclosure statement prepared by the lead agency, or where appropriate the cooperating agency, specifying that they have no financial or other interest in the outcome of the project. If the document is prepared by contract, the responsible Federal official shall furnish guidance and participate in the preparation and shall independently evaluate the statement prior to its approval and take responsibility for its scope and contents. Nothing in this section is intended to prohibit any agency from requesting any person to submit information to it or to prohibit any person from submitting information to any agency.

As currently written, the SEA appears to rely on many assertions provided by the applicant (Denver Water), without being independently evaluated by the Commission, which is ultimately responsible for the accuracy of the information and analysis in the SEA under 1506.

To cite one example, the SEA refers to "predicted cooler summer outflow temperatures, resulting in a maximum outflow temperature of 9°Celsius (C), in comparison to 14.6°C under

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prairie/es/species/mammals/preble/CRITICAL%20HABITAT/2010_Critical_Habitat_Maps/PMJM_Critical Habitat_Units5_6_7.pdf .

existing conditions" without any meaningful analysis of how these winter temperatures impact the aquatic ecosystem.

The SEA conflicts with and is ignorant of the scientific analysis of impacts to South Boulder Creek below the dam from the State of Colorado's Conditional 401 permit. That analysis found that South Boulder Creek below the dam will be impacted by releases of far colder water. Releases come from the bottom of the reservoir, which will be far deeper and colder than for the current dam. Absent any dam (natural regime), water temperatures in the creek would peak in late July at close to 20 degrees centigrade. State 401 Rationale at 10-11, A-2 and A-5. With the existing dam, temperature peaks in late September at 13-15 degrees. Id. at A-4. With the new dam, summer water temperatures would "remain relatively constant at 7 or 8 degrees." Id. at A-5. This number is lower than that from the SEA, which omits reference to the following statement from state agency scientists:

> In other words, the alteration of the pattern is sufficiently extreme that South Boulder Creek below the reservoir is likely to be in attainment the winter numeric standard throughout the year. That offers little opportunity for fish growth and would suppress productivity of the benthic invertebrates, which are an important food resource for the fish.

Id. at A-5.

The SEA recites several conditions from the State's 401 review, but failed to analyze the findings as required by NEPA.

The State's review is supported by longstanding concerns of Boulder County Open Space and Mountain Parks regarding impacts to Walker Ranch, one of the crown gems of the County's world class open space system. Walker Ranch includes a 3.5 mile stretch of South Boulder Creek just below Gross Dam that will be impacted by the colder flows and freezing year-round temperatures. The County's 1985 Walker Ranch Management Plan cited a 1964 study which found that, after the existing dam was built: "Fish are using their energy for sustenance, not growth," and that "[c]old water also slows growth of plant and insect food." See http://www.colorado.edu/geography/class_homepages/geog_4430_s08/walkerrnachmplan.pdf at 11-12.

6. Individual SEA Sections on Effects

The official scope of the SEA is stated at page iv and repeated at page 6.

> Specifically, this Supplemental EA analyzes the effects of: (1) revisions in certain details of dam raise construction activities, such as relocation of the on-site quarry; (2) potential replacement of the proposed auxiliary spillway with a saddle dam; (3) certain aspects of tree clearing and inundation to a new maximum reservoir elevation of 7,406 feet mean sea level not addressed in the Final EIS; (4) effects of changes in project operation such as revisions to the ramping rates required under the license; (5) modifications to project recreation facilities required under the license; (6) modification to the project boundary; (7) effects of environmental mitigation plans and other mitigation measures Denver Water proposes; and (8) effects of Denver Water's compliance with statutory requirements.

This section reviews these areas below.

a. Dam Raise Construction Activities

Information related to dam raise construction activities alone establish that this component of the project will have significant environmental impacts. The new on-site quarry location was first raised in the ROD for the FEIS, after the close of public comment on that document.

The new quarry location is purportedly analyzed by several reports prepared after issuance of the 2014 FEIS and never subject to public review or comment.

On September 13, 2016, Denver Water published a Final Quarry Location Report: Impact Minimization and Avoidance Measures. This Quarry Location Report provides:

> Denver Water proposes to modify the Project to minimize impacts by: 1) producing all of the aggregate material (both sand and gravel) from an on-site quarry, and 2) relocating the quarry site to a location on Denver Water property within the new reservoir inundation area such that all or nearly all of the quarry would be submerged during normal high-water operations.

Quarry Location Report at 2-3, available online at http://cdm16021.contentdm.oclc.org/utils/getfile/collection/p16021coll7/id/4145/filename/4146.pdf

The 2016 Quarry Location Report in turn relies on four additional previously published studies, all of which were conducted and released in 2015 and 2016, *after* the FEIS was published. Id. at 2.

Denver Water also commissioned a noise study in February 2017. The study was completed in May 2017 and submitted to the Corps without ever being subject to public input or comment. The study is titled the *Gross Dam Noise Impact Report* (Behrens and Associates, Inc. 2017). It was attached to the ROD as a reference to Attachment B, available online at http://cdm16021.contentdm.oclc.org/utils/getfile/collection/p16021coll7/id/4100/filename/4101.pdf. The Behrens Noise Report is also attached Denver Water's FERC Response to Comments as Attachment 1 (before the Federal Energy Regulatory Commission).

The new quarry location and the studies prepared by Denver Water constitute new circumstances and information that could in result in significant impacts not analyzed in the FEIS. The County and citizens never had a chance to review or comment on the proposal or the multiple "expert" reports administered exclusively by Denver Water without local participation. Further, the proposed Osprey Point site has never been subject to public, other agency, or governmental comments by residents, the State of Colorado, or Boulder County.

Questions raised by the new quarry location include:

- The proposed change is apparently intended to address traffic and transportation issues at the expense of residents near Gross, trading severe impacts in one location for another. What is the full cost/benefit analysis of the mitigation value and the potential new or increased impacts of the proposed quarry location?
- How does the on-site quarry that would be inundated by the expanded reservoir affect reservoir permeability, leakage and/or evaporation of stored water; seismicity; and long-term potential for erosion to undermine the dam and reservoir location?

- What permitting would be required at local, state, and federal level?
- What reclamation requirements will be placed on the planned quarry and which agency has or agencies have jurisdiction over such?
- Is the proposal consistent with the Boulder County Comprehensive Plan (BCCP), the current version of which was approved in 2017, and did Denver Water or the Corps make any efforts to determine what BCCP provisions apply to the quarry?
- The Noise Report focused on noise levels and impacts to residents; what are the potential impacts, including potential disturbance and displacement, to wildlife populations such as the elk herd?
- The Quarry Location Report states: "***Temporary impacts*** consist of displacement of wildlife by noise and disturbance resulting from on-site construction, blasting, quarrying, and transport of materials and people." Location Report at 16 (emphasis original). What species and habitat would be impacted, including indirect and cumulative impacts?
- ***"Temporary impacts*** to wildlife due to quarry activities, in particular, ***would be the same regardless of quarry location."*** Id. This unsupported statement establishes that the authors of the Location Report are unqualified to make conclusions on wildlife biology or habitat impacts, underlining the need for public review and comment under NEPA. Wildlife impacts depend on what species and habitat is found at a specific location. What wildlife populations and habitat will be temporarily impacted by the quarry?
- Will quarry activities conducted during or after a harsh winter or other extreme weather or climate-related events stress and cause harm to wildlife?
- Does the new quarry proposal affect the total project cost? By how much or within what range (taking all cost factors into account)?
- Do changes in project cost impact the Corps' alternative screening process and analysis, both under NEPA and the Clean Water Act (with the "Least Environmentally Damaging Practicable Alternative" requirement)?
- Has the applicant obtained requisite quarry-related permits, required for construction and linked to significant environmental and social impacts; and should federal permits issue before such state or local processes going to impacts and mitigation are final?
- The newly proposed Osprey Point quarry would be 14-16 acres, but the ROD and SEA claim that wetlands impacts and post-construction mitigation and reclamation would be minimal, because the site would be inundated. This assumes that the expanded Gross Reservoir would fill enough to inundate the area. This may not be a safe assumption in light of climate change, increasing competition for Colorado River water, and the potential for future compact calls in the event of sustained drought or supply pinches. What level of fill is required to fully obviate mitigation and reclamation requirements or concerns, if that is possible at all?
- What are the potential downstream impacts from the quarry to water quality, the fishery, and other aquatic resources in South Boulder Creek?
- What about potential impacts to the Gross Reservoir aquatic environment from either a reclaimed or an un-reclaimed quarry?
- Denver Water, citing their consultant's private report, asserts in their FERC proceeding that, "noise levels at the EIS quarry and at the Osprey Point quarry will be below local

noise ordinances." However, this assertion is contradicted by the statement in the Quarry Location Report that, "[o]n-site construction noise may periodically exceed the EPA noise threshold of 70 dBA for public exposure" which further asserts, without apparent explanation, that "the public would not be exposed to these levels on a continuous basis." Location Report at 20. Hundreds of residents who live near the reservoir and the proposed quarry site are reasonably concerned about the new proposal as sound carries for great distances in the Gross Reservoir area which is among the quietest soundscapes of any residential area in Boulder County. What is the actual projected level of construction noise and will it be in compliance with County ordinances?

b. Potential Replacement of the Auxiliary Spillway with a Saddle Dam

Amazingly, fifteen years after initial NEPA "scoping" of this project, neither the Commission, the Corps, nor Denver Water can answer a fundamental question going to the proposed design and construction of the proposed new dam.

According to the SEA:

> The auxiliary spillway included in the Final EIS for the Moffat Collection System Project may be unnecessary. In the Final EIS, the auxiliary spillway is located within a topographic saddle about 1 mile south of Gross Dam and is described as a concrete weir structure. Denver Water would determine the need for an auxiliary spillway during final design and in coordination with the FERC Division of Dam Safety and Inspections and the Independent Board of Consultants. Regardless, there is a topographic saddle along the reservoir rim that requires a small water impounding structure (either the auxiliary spillway or a saddle dam). If the inflow design flood can be accommodated within the primary spillway at the dam and an auxiliary spillway is not required, then Denver Water would construct a small saddle dam in the topographic saddle in lieu of the spillway. The footprints of the auxiliary spillway and the saddle dam are similar in scope, size, and site disturbance limits.

In other words, the design is currently speculative and a fundamental component has not yet been decided

The SEA infers that some impacts will be similar because the footprints of the two options are similar. By omitting any discussion of alternatives, the EA fails to acknowledge that the footprint of the Protective Alternatives proposed by the Conservation Groups would be zero, compared to the only alternative analyzed in the SEA.

The SEA asserts that "[t]here would be no major change to the existing outlet works. Preliminary analyses show that the system is capable of withstanding the increased reservoir head. As part of the final design, Denver Water would evaluate the existing piping and discharge valves for the new hydrostatic conditions.

Another significant issue omitted from the SEA is dam safety and the risk of failure, especially in the light of concerns being raised by geologists or seismologists regarding whether the site is appropriate for the scale and design of the project including design features first announced in the SEA and proceedings before the Commission. Climate science tells us to expect more

frequent and severe extreme weather events. Is this cause for concern regarding dam safety? How might the on-site quarry and years of blasting bedrock for aggregate increase the risk of dam failure?
According to a newly released DRAFT Hazard Mitigation Plan commissioned by the City of Boulder, "[t]he failure of Gross dam would impact 3,020 structures, with a total structural and contents value of $4.82 billion." Draft Plan at 1.142, available online at https://www-static.bouldercolorado.gov/docs/COB_Hazard_Mitigation_Plan_Draft1-25-18-1-201801250850.pdf?_ga=2.38249763.1626439252.1523130270-1511331044.1480021696 . This information must be analyzed in an SEIS with updated review for the risk associated with the larger proposed dam storing up to triple the water, including review of geology, seismology, and the potential for climate change to increase risks for catastrophic or previously unforeseen events.

c. Effects of changes in project operation such as revisions to the ramping rates required under the license

Project operations would change significantly if the project were built, and the resulting effects would also be significant. Denver Water is proposing to build the tallest dam in the history of the State of Colorado.[4] Standing alone, that fact is significant.

In addition to the height of the dam, the capacity of an already large high-altitude reservoir would be approximately tripled to 118,811 AF.

d. Clearcutting of Hundreds of Thousands of Trees and Inundation

The logging component of the project will significantly impact the environment. The impacts of clearcutting some 200,000 trees for the expanded reservoir are analyzed in Comments on Vegetation Removal and Associated Activities for the Moffat Collection System Project Gross Reservoir Enlargement, incorporated by reference into the Groups comment. Rocky Smith, the author of those comments, has more than 30 years of experience reviewing the environmental impacts of forest management projects in Colorado.

According the Smith's comments, steep topography on the forests to be logged raised concerns about access, erosion, and removal of vegetation. Smith Review at 3-4. Air quality impacts could be significant and require additional analysis. Id. At 4-5. Mitigation plans for erosion and soils are speculative or incomplete. Id. At 5-6. The potentially significant impacts of helicopter methods are undisclosed. Id. At 7. The SEA fails to address the cumulative impacts of logging in conjunction with Gross and the Forsythe II project on adjacent lands and wildlife habitat, including ridges that border the project area. Id.

Transportation of forest debris, including removal of stumps and logs, raises safety concerns and conflicts which require additional analysis. Id. at 8. Smith notes that proposed

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[4] At the close of "Water Year 2011-12," Colorado had 1,965 "jurisdictional dams", according to the State Engineer and the Colorado Division of Water Resources. Colorado defines "jurisdictional dams as "[d]ams that are greater than ten feet high as measured at the spillway, that impound a reservoir with twenty acres or more in surface area, or one hundred acre-feet or more in reservoir capacity at the high water line qualify as Jurisdictional." C.R.S. 37-87-105.1. See https://www.colorado.gov/pacific/sites/default/files/13WaterResources0927AnnualReportonDamSafety.pdf at page 9.

compensatory mitigation would not compensate for impacts to the project area; and notes that the proposed mitigation property is 160 acres, not the 539 acres asserted by the agencies. Id. at 9. Regarding the Toll Property proposed for mitigation, "it is not clear if it provides interior forest habitat, effective habitat, or old growth, which are some other habitat types that would be lost with expanded reservoir clearing and inundation." Id. at 11.

Of special concern are the loss of patches of both old growth forests and developing old growth in ponderosa pine and Douglas fir forest types. Id. "Old-growth in ponderosa pine and Douglas-fir stands is uncommon on the Arapaho-Roosevelt National Forest[5], as most of the stands in this timber type have been logged or otherwise subjected to human manipulation that has degraded or eliminated the stands' ecological and other values as old growth." Id. Because this resource is irreplaceable over the short- to medium term horizon, these impacts to special and rare forest ecosystem types are significant.

The project would violate Forest Plan guidelines providing: "Retain all existing Douglas-fir and ponderosa pine old growth and increase amounts in the future." Id. at 9. Desired future conditions "[e]mphasize old-growth recruitment and retention" and the clearcutting is inconsistent with the Forest Plan goal to "[r]etain the integrity of effective habitat areas". Id. at 10. The loss of hundreds of acres of elk winter concentration areas, severe winter range, and migration corridors would violate the Forest Plan Goal to "[m]aintain the function of key or unique habitats such as…winter ranges,…, migration corridors, animal concentration areas….". Id. Based on impacts to these sensitive forest ecosystems, the clearcutting is also inconsistent with the Boulder County Comprehensive Plan and Environmental Elements designed to protect wildlife and sensitive habitat.

Denver Water prefers that an informed decision on the environmental impacts of this important component of the project be deferred until a few months before the logging project. Denver Water's SEA Comment (at page 20 asserts that the Tree Removal Plan "should be submitted to the Commission at the same time as required in the 4(e) conditions, or '90 days prior to tree removal within the inundation area of the enlarged reservoir.'"

The timing proposed by Denver Water would frustrate NEPA's statutory intent of informed decision-making. As explained in Smith's comments and those of numerous other commentators, including Boulder County, all of the forestry-related components of the project are of intense interest to local residents and others.

In sum, the clear-cutting and removal of 200,000 or more trees in rugged terrain that would generally be considered too steep to log, including old growth forest and sensitive habitats, will result in significant impacts to forest resources and wildlife.

e. **Modifications to Recreation Facilities and Recreation Impacts**

Recreation impacts are of enormous concern for residents near the Gross Dam and Reservoir site, as well as tens of thousands of recreationists on both sides of the Continental Divide.

[5] A 1992 survey found that only one percent of all the old growth on the Arapaho-Roosevelt National Forest was in ponderosa pine/Douglas-fir. The survey results further stated that …"the least old growth exists at the lowest elevations with the most roads". See Lowry, 1992. Ponderosa pine/Doulas-fir is at the lowest elevations of the Arapaho-Roosevelt National Forest in areas that are mostly well-roaded.

Gross Reservoir is the premier destination for boaters, kayakers, canoers, stand-up paddlers, and other visitors in Boulder County, and one of the premier mid- to high elevation reservoirs on the Front Range. Under the project as currently configured, the recreational experience will be severely disrupted during the construction period, and that important natural resources relied on for recreation will be either entirely lost or significantly compromised by the project.

The SEA is largely or entirely silent on adverse impacts to fisheries and recreational fishing from mercury, unnaturally high flows of freezing temperatures below the dam, or unnaturally low flows of warm water on the West Slope. It fails to consider the loss of Forsythe Falls, an irreplaceable recreational resource, to inundation. Any supposed recreational enhancements from a larger reservoir must be balanced against the substantial adverse effects to angling and quiet enjoyment of nature in secluded, undeveloped locations, in addition to the massive construction and transportation impacts to a wide range of recreational users of protected landscapes including the Indian Peaks and James Peak Wilderness Areas, National Forest lands, Walker Ranch, and Eldora Canyon State Park in the South Boulder Creek watershed.

f. Effects and Effectiveness of Mitigation Measures Proposed by Denver Water

The core components of healthy aquatic ecosystems include flows and temperatures within natural ranges, and healthy populations of species from the bottom to the top of the food chain. The SEA ignores these criteria for the three primary aquatic ecosystems that would be impacted by the project: Gross Reservoir, South Boulder Creek below the dam, and the Upper Colorado. Instead, the SEA advances assertions that the project would generally have insignificant or beneficial impacts on aquatic ecosystems.

The SEA summarizes some mitigation associated with the proposal at page 21:

> In its application, Denver Water identifies certain measures contained in a Fish and Wildlife Mitigation Plan, dated June 9, 2011, that it developed with Colorado Parks and Wildlife for expansion of the Moffat Collection System Project. Several measures in the plan would provide mitigation for effects of enlargement of Gross Reservoir, and would be enforced through Colorado DPHE WQC conditions, Forest Service 4(e) conditions, and conditions of a Corps 404 permit.

- Monitor mercury in fish tissue in Gross Reservoir with assistance from Colorado DPHE and Colorado Parks and Wildlife. If the fish tissue analysis indicates that a Fish Consumption Advisory is required, Denver Water would work with Colorado DPHE and Colorado Parks and Wildlife to provide public education, including the posting of fish consumption advisory signs at Gross Reservoir.

- Monitor general water quality parameters (nutrients, organic carbon, metals, major ions, temperature, and chlorophyll a) in Gross Reservoir and submit monitoring results annually to Colorado DPHE.

- Mitigate the permanent loss of jurisdictional wetlands through the use of credits from an approved wetland bank.

- Use pre-construction surveys to identify active nests of migratory birds within the project footprint and time activities to avoid breeding seasons.

- Contact the U.S. Fish and Wildlife Service (FWS), Office of Migratory Birds for permitting requirements prior to the removal or destruction of any migratory bird nests.

Overall, the EA suggests that mitigation would compensate for any adverse impacts. These inferences and the FONSI are unsupported by the record, and inconsistent with the comments on the EA from independent experts and scientists.

On mercury levels, the EA fails to recognize that the so-called "mitigation" consists of monitoring that could result of a fish advisory informing recreational visitors to Gross Reservoir that fish may be unfit for consumption. However, an advisory on signs will do nothing to avoid, minimize or mitigate the impacts to the aquatic ecosystem or the food chain of higher mercury levels.

The SEA fails to consider whether these effects could be significant.

- Condition 13: Work with Colorado DPHE to support a biennial program to monitor mercury in fish tissue in Gross Reservoir. The sampling effort for Gross Reservoir would begin in the first field season after the enlarged reservoir has filled and continue for 5 more years. If mercury levels fall below the level of concern for the last 3 years of sampling, Denver Water's monitoring obligation would end. If there is bioaccumulation of mercury in fish tissue at the end of the 5-year period, the obligation for monitoring would be extended for an additional 5 years. If fish tissue analyses show that a fish consumption advisory is required, Denver Water would work with the Technical Advisory Team 34 of the Colorado Fish Consumption Advisory Committee to provide public education including the posting of signs with associated consumption advisories.

SEA at 37.

Woodling and Elliot provide objective analysis of impacts to aquatic and special aquatic resources that is missing from the SEA or other project NEPA, and point out numerous flaws and inadequacies in the agency analysis.

For example, Elliot's review (at page 6) finds:

> The Gross-Moffat EA/FEIS and Final Mitigation Plan thus stand on at least three weaknesses:
>
> 1. Ignorance or perhaps a misunderstanding of Federal guidance including the watershed approach and widely accepted rapid-assessment protocols that could clarify existing watershed conditions to set the stage for transparent interagency collaboration.
> 2. A significant underestimate of direct, indirect, and cumulative impacts to special aquatic sites in the Fraser River headwaters and Boulder Creek drainage, including riffle-pool complexes and adjacent jurisdictional riparian wetlands.
> 3. No real sense of how stream-riparian systems have been impacted in the analysis area; therefore, no credible baseline upon which to drive mitigation measures likely to be successful.

Elliot's specific findings include:

- **“Profound changes in hydrologic regime in many streams –** from perennial flows to seasonal/intermittent and, in some cases, changes to subterranean flow only. These changes include a profound loss of overall stream discharge, peak and low flows, and timing of flows critical to aquatic species along these stream corridors[.]” Elliot at 6.
- **“Stream evolution trajectory –** loss of high, and in many cases medium and lower flows forces headwater streams into a quasi-entrenchment where most, if not all flows are contained in the same channel. Without natural flows and sediment load and robust HGM processes, it would be impossible to predict how long it will take for these streams to recover naturally into equilibrium systems”. Id. at 7.
- “Mitigation for impacts to Fraser River headwater streams and adjacent riparian zone are difficult to address since the Corps does not recognize the profound indirect and cumulative impacts to these ecosystems including dewatered reaches, 303(d) impairments, and reaches of ecological collapse.” Id. at 8.
- “We do not understand how the proposed MECP “flushing flows,” which are less than present flows, would actually meet promised goals in these 5 stream reaches. Furthermore, the Corps assumes flushing silt from gravels would be effective, when actual observed conditions in the field as gravel and cobble choked with an algae + silt mix, locally known as “rock snot.” Our own experience shows that much higher flows are necessary, actually moving stream bed materials to dislodge the rock snot in order to make the bed more suitable to larger macroinvertebrates such as stonefly.” Id. at 9.
- “Apparently, the Corps accepts almost complete loss of cutthroat trout in the Fraser River headwaters, without disclosing it in the EA/FEIS and Final Mitigation Plan, and offers compensatory mitigation elsewhere in Grand County, with an only limited cash commitment and no guarantee of success.” Id.

On mitigation, Elliot concludes:

> Without disclosure in plain language of past, present, and reasonably foreseeable impacts from diverting 50-100% of native flows from the Fraser River headwaters, it’s difficult to understand how the above measures would mitigate for:
>
> - Profound changes to 80 miles of dewatered streams and their riparian corridors including jurisdictional waters of the US.
> - Significant impacts to some 200 to 600 acres of riparian wetlands.
> - 303(d) listed streams including elevated concentrations of Copper and Arsenic, as well as aquatic life
> - Collapse or near-collapse of aquatic habitats in approximately half of the stream reaches listed in the Final Mitigation Plan
> - Loss of aquatic resources on National Forest System Lands mitigated on lands owned by the City and County of Denver.

Id. at 10.

Woodling’s review includes the following observations and findings for Gross Reservoir and South Boulder Creek:

- "The author of the EA did no analysis to demonstrate that fish populations would increase simply due to a short-term seasonal increase in habitat." Woodling at 6.
- "The EA failed to analyze the interaction of vegetation removal and claims of increased reservoir productivity." Id. at 7.
- "The implementation of Condition 13 in no way will "reduce the likelihood" of an increase in mercury levels in fish in Gross Reservoir if he Moffat Project is completed. No actual mitigation for increased mercury levels is included in the FEIS, the 401 or this EA." Id. at 8.
- "The impact of increased June and July flows on fry survival was not specifically included in the FEIS or EA." Id. at 9.
- "The success of bank stabilization is highly questionable"; and the SEA analysis of impacts to trout "is incomplete, contains factual errors and is misleading to some degree." Id. 9 and 10.
- "The description of fish in this section of South Boulder Creek is superficial and incomplete. Some of the observations are in error. The description and analysis would have to be done again in detail, using on-site field studies to actual impacts to trout in South Boulder Creek upstream of Gross Reservoir." Id. at 10.
- "The EA and the FEIS both fail to describe the habitat of the South Boulder Creek upstream of Gross reservoir. Only superficial level of analysis and comparison was performed. Additional work would be needed to accurately assess both the aquatic habitat and fisheries of this stream reach. This is the same conclusion that could be applied to each section of the EA and FEIS that address aquatic resources." Id. at 11.
- Below the dam, "an analysis of any environment based on a single variable is not adequate when attempting to describe the impacts of a project where factors other than the amount of usable habitat are also being altered." Id. at 12.
- "The FEIS needed a detailed analysis of how the extremely low water temperatures in South Boulder Creek post-project would impact fishery populations, and not just trout. The FEIS did not include a detailed analysis of the impacts of temperature on fish[.]" Id. at 13.
- "Decreased temperature and reduced growth rate of fish are two factors that are of paramount importance when analyzing the impact of the Moffat Project on South Boulder Creek. Neither was addressed in the EA or the FEIS." Id. at 14.
- "Neither the FEIS nor the EA have described the benthic community of South Boulder Creek adequately. No determination can be made concerning the relationship of aquatic macroinvertebrates and lower stream temperature regimes that would be present if the Moffat Project is completed. More detail is needed to determine if mitigation programs are needed." Id. at 15.
- "Monitoring is not mitigation. Mitigation actions are supposed to lead to an environmentally preferred outcome (Sutley 2011)." Id. at 16.

On mitigation, Woodling concludes:

> The EA did not include any mitigation action in South Boulder Creek that would actually mitigate for the environmental impacts associated with the Moffat Project. A series of monitoring programs was included in the EA and listed as mitigation even though no environmental improvement results from monitoring. One possible project exists. A multi-stage release from Gross Reservoir would eliminate all environmental impacts in South Boulder Creek downstream of Gross Reservoir. Denver Water refuses to consider this option. Thus mitigation like the FEIS and EA is actually an ineffective and empty process.

Id. at 17.

The Commission's February 7, 2018 ESA consultation letter to the U.S. Fish & Wildlife Service establishes that increased diversions from the West Slope are a fundamental and necessary component of the project, and that the proposed enlargement of the Reservoir is needed to store increased diversions transported to Gross Reservoir through Moffat Tunnel.

> The Moffat System diverts flows from tributaries of the Colorado River on the west slope of the Rocky Mountains and stores them, along with flows in South Boulder Creek, in Gross Reservoir. Denver Water proposes to increase diversions through the Moffat Tunnel into South Boulder Creek, and then into Gross Reservoir, requiring the reservoir to be enlarged.
>
> The Gross Reservoir Hydroelectric Project includes Gross Dam, Gross Reservoir, and facilities used for power generation. Because enlarging the reservoir requires Commission approval, Denver Water has filed an application to amend its license**1** to raise Gross Dam by 131 feet and to increase the maximum storage in Gross Reservoir from 41,811 to 118,811 acre-feet. Following the proposed enlargement, operation of the hydropower project would continue to be incidental to operation of the Moffat System for municipal water supply.

Thus, the project's impacts to headwaters streams of the Upper Colorado on the West Slope are a direct result of that part of the project under the Commission's jurisdiction. Arguing in the alternative, those impacts are indirect or cumulative impacts under NEPA.

Elliot finds that impacts were significantly under-stated.

> The Corps does not take comprehensive, holistic look at past, present, and reasonably foreseeable impacts to the Fraser River headwaters and Boulder Creek watershed. Instead, they downplay or substantially ignore existing watershed conditions, natural functions, and significant cumulative impacts to special aquatic sites including riffle-pool complexes and adjacent jurisdictional riparian wetlands. Focusing on proposed incremental increases in trans-mountain diversions and deliveries to Gross Reservoir leads to significant underestimates of impacts to Waters of the US.

Elliot Review at 3.

To the extent the existing NEPA analysis in the Corps' EIS is incomplete, inaccurate, or uninformed, these deficiencies must be addressed and remedied by a Supplemental EIS that fully complies with NEPA, including the alternatives and new information provisions.

7. **Compliance with Statutory Requirements**

Permits cannot issue and construction cannot proceed if the project as currently proposed does not comply with statutory requirements. The SEA appears intended to attempt to remedy NEPA analysis originally conducted by the Corps which is now recognized to have been incomplete or inadequate.

The FONSI can only stand if the current project configuration and environmental review complies with statutory requirements, based on information now available. However, neither the FONSI nor the 2017 ROD and permit issuance by the Corps is supported by the record at this time.

The SEA establishes that the hydropower component of the project: 1) is not the primary purpose of the project, 2) depends on the diversion of natural flows from the Upper Colorado, and 3) further depends on sufficient diversions from the Upper Colorado to ensure a minimum pool in the reservoir at all times.

> As reviewed above in section 2.2 *Need for Power,* hydroelectric energy is only generated at the Gross Reservoir Project when flows are released for water supply needs, maintenance of water elevation limits in response to inflows, and other operational variables, and these operations are not within the Commission's jurisdiction. As part of the Moffat Collection System, Gross Reservoir is used to store and release native flows from upper South Boulder Creek, as well as water diverted from the West Slope of the Rocky Mountains through the Moffat Collection System's Moffat Tunnel. When Gross Reservoir storage is less than 12,000 acre-feet, there is a potential dam safety issue related to rocks and sediment possibly being transported to the outlet works and causing damage.

SEA at 13.

The Commission's determination regarding statutory compliance must take all comments on this SEA into account. Collectively, before final federal approvals are granted, responsible agencies must ensure compliance with NEPA requirements including the duty to consider new information, take the best available science into account, assess direct, indirect and cumulative impacts, and objectively analyze reasonable alternatives; to satisfy the public interest balancing test under the Federal Power Act; and to ensure that the project is the "Least Environmentally Damaging Environmental Alternative under the Clean Water Act.

8. Costs and Alternative Analysis

Despite the fact that the SEA appears to be intended to cure NEPA deficiencies in the existing FEIS and ROD issued by the Corps in 2017, the EA avoids any discussion of alternatives to the proposed action.

Alternatives are the heart of the NEPA process.

> When a federal agency prepares an Environmental Impact Statement (EIS), it must consider "all reasonable alternatives" in depth. 40 C.F.R. § 1502.14. No decision is more important than delimiting what these "reasonable alternatives" are. That choice, and the ensuing analysis, forms "the heart of the environmental impact statement." 40 C.F.R. § 1502.14.

Simmons v U.S. Army Corps of Engineers, 120 F.3d 664 (7th Cir. 1997) (emphasis added).

In Simmons, the 7th Circuit remanded the Corps' approval of the proposed dam because the Corps failed to establish that it considered reasonable alternatives and deferred too heavily to the project proponent's assertions considering the need to develop the proposed water project.

New information and expert comments establish the need to revisit the biased, uninformed, or incomplete alternatives analysis from the FEIS. The project cost issue alone is reason for revisiting the alternatives analysis, which also goes to the heart of determinations as to the LEDPA under the Clean Water Act and the public interest balancing test under the Clean Water Act.

Fundamental components of the project have changed since the FEIS, and the proposed changes will have substantially different environmental impacts. By itself, the absence of any mention of the only proven mitigation for freezing stream temperatures below the dam, a Multi-Level Outlet Works (MLOW) is a fatal flaw in the SEA. Alternative methods of dam design, construction methods, tree harvest, and removal of forest products are all appropriate for alternatives analysis.

The Corps' ROD was based on a "Total Capital Construction Costs" estimate of $139.9 million for FEIS alternatives comparisons. However, the total cost presented to FERC is approximately $380 million; and a 2015 Denver Water Fact Sheet presents a cost estimate ranging from $380 to $450 million. Using a cost estimate that appears to be 1/3 or less of the actual project cost unacceptably skewed alternatives analysis where numerous alternatives were screened out on cost grounds.

The Environment Group has calculated that over 25,000 truck trips will be necessary for transporting construction materials. The rail spur alternative much be revisited on this issue.

Denver Water's April 3, 2018 comment letter on the SEA addresses alternatives in the context of relative costs. "Page 7 of Denver Water's letter provides explanation about the increase in estimated costs, which would be reflected in all alternatives in the EIS, due primarily to construction cost trends indexes and inflation. Even after providing this answer, the cost will continue to increase with projected inflation and construction cost trends indexes."

Denver Water's assertion leaves out salient and material facts regarding alternatives and costs. The SEA, and Denver Water, fail to recognize that the relatively low cost Accelerated Conservation Program" has achieved and exceeded expectations at essentially the original level of projected funding. At approximately $10 million per year, the Accelerated Conservation Program budget is less than 3% of the *lower* end $380 million and only 2.2% of the higher $450 estimate. Major components of the environmentally sound alternatives are far less affected by construction cost trends indexes than the Gross Dam alternative.

Alternatives rejected by the FEIS, such as re-use and underground storage in gravel pits, are actually being pursued because Denver Water has determined they are cost-effective approaches. According to McCurry's Review at page 8, gravel pit storage alternatives need to be assessed including new information about Denver Water's gravel pit storage reservoir in the Easter Plains.

> Denver Water's Downstream Reservoir Program that includes nine reservoirs with an estimated storage volume of 32,200 AF (see https://www.denverwater.org/ your-water/water-supply-and-planning/downstream-reservoir-program). With such a significant amount of gravel pit storage planned by Denver Water, it is not clear why

> these downstream reservoirs and their storage were not included fully in any of the alternatives.

This new information requires revisiting alternatives screening and the compliance of the proposed dam with federal law, but the SEA lacks any discussion of alternatives. According to Denver Water's release on the Eastern Plains initiative, the reservoirs can be used for exchanges, they allow more efficient use or re-use of existing diversions from the West Slope, and will help the agency "adapt to future demands to ensure a reliable water supply." See https://denverwatertap.org/2018/03/12/downstream-reservoirs/. The 10.5 billion gallons of storage in the nine reservoirs currently planned amounts to 32,000 AF (assuming our calculations are correct), or approximately double the additional diversions sought under the proposed Moffat Project in wet or average runoff years; and close to half the increased capacity of the proposed Gross Reservoir expansion. The ability of this initiative to obviate the asserted "need" for Moffat must be analyzed.

Dr. McCurry's Review assesses alternatives to the proposed action at pages 3-9.

> As stated in Section 2.0 of the FEIS, CEQ regulations include the requirement to rigorously explore and objectively evaluate all reasonable alternatives (40 CFR 1502.14[a]). However, the selection process appears to have been biased so as to only retain items that were desirable from the standpoint of the applicant.
>
> The EIS identified 303 potential water supply sources and infrastructure components that could potentially become part of alternatives to meet the project's Purpose and Need. A multiphase process was used to screen and assemble these components into five alternatives. Although a phased approach to evaluating system components is appropriate, there were many decisions made to retain or reject certain components that appear to be in violation of the applicable regulations.

McCurry Review at 4.

Dr. McCurry's review of the screening criteria and step-by-step process used to rule out any approaches but Denver Water's proposed expansion of Gross Dam and Reservoir establishes that the analysis was marred by inherent bias.

> As stated in Section 2.0 of the FEIS, CEQ regulations include the requirement to rigorously explore and objectively evaluate all reasonable alternatives (40 CFR 1502.14[a]). However, the selection process appears to have been biased so as to only retain items that were desirable from the standpoint of the applicant. His review cites to bias at pages 1, 2, 6, 8 and 10.

Id. at 1.

McCurry's comments establish that alternatives including underground water storage appear to be feasible, cost-effective, and less environmentally damaging that the preferred alternative.

McCurry specifically cites 11 environmental impacts enumerated in the EIS that indicate the proposed alternative is more impactful that qualifying reasonable alternatives unanalyzed or rejected to date, and concludes:

> It is inconceivable that the preferred alternative, with this range and magnitude of permanent environmental impacts, could be considered the least environmentally damaging practicable alternative as is required by the Corps. Based on the above analyses presented in the FEIS, the preferred alternative appears to be inconsistent with the legal requirements under the Clean Water Act and NEPA as discussed above.

McCurry Review at 9.

McCurry concludes that supplemental environmental analysis is needed before approvals should issue, and that such analysis:

> will identify the numerous errors, omissions and biases present in the FEIS, including those presented in this memorandum, that cause the preferred alternative and the process by which it was selected to be viewed as not being in compliance with the applicable statutory requirements. Most of the deficiencies in the FEIS are due to the outdated nature of many of the technical elements upon which it is based. These include the basis for the project's Purpose and Need, the process of evaluating alternatives, and the assessment of the least environmentally damaging practicable alternative.

Id. at 10.

Also relevant to alternatives is Denver Water's commitment to approximately $500 million in improvements in its North System Renewal program. See https://www.denverwater.org/sites/default/files/north-system-renewal-tunnel-fact-sheet.pdf. Pipelines and treatment plant improvements might do significantly more than the relatively small quantities of additional water to be stored under the proposed project to address Denver Water concerns about system balance and resiliency which are a component of the purpose and need. Save the Colorado's analysis of the balance issue is that the project would only result in a relatively minor, incremental shift of 81 to 79% for the South System and 19 to 21% for the North System.

The EIS alternatives analysis was biased. It must be revisited in light of new information going to costs, environmental impacts, and the feasibility of less environmentally impactful alternatives

9. **Conclusion**

The constants from the FEIS to the SEA regarding the construction and design of the dam are the location and duration of the project. The construction method, the source of materials, and the design have either changed or remain subject to future change. Substantial components relevant to environmental impacts, mitigation, the effectiveness of proposed mitigation, and net environmental impacts have changed or warrant new analysis based on current information and objective expert reviews.

Informed decision-making depends on reviewing "concrete" pre-construction plans, not tentative plans subject to change absent a future opportunity for public and expert review and comment. The changed or uncertain components of the dam construction go to substantial components of the project that will significantly impact thousands of residents.

New information and objective expert reviews establish that the fundamental components of healthy aquatic and terrestrial ecosystems will be compromised by the project as currently proposed, in ways omitted, under-stated or unmentioned by the SEA.

Alternatives analysis is absent from the SEA even as new information establishes that more environmentally sound alternatives are available. NEPA further requires new analysis of direct and indirect impacts to the Upper Colorado on the West Slope.

The project is unneeded. The NEPA analysis fails to support the approvals sought by the applicant. The assertion of Commission staff that impacts would be insignificant do not hold water. The project involves the highest dam in Colorado history, the biggest construction project in Boulder County history, and substantial impacts to aquatic and terrestrial ecosystems and sensitive resources on both sides of the Continental Divide, including in one of the most environmentally conscious counties in the nation, and to the main river system in the entire Southwest U.S.

The SEA fails to adequately address the many deficiencies of the Corps' FEIS, including both those identified by the Commission and those that were not acknowledged in the SEA but are described above. Consequently, the Commission has erred the staff's recommendation of accepting the SEA and FONSI for this license application. The Commission must suspend its licensing procedure until the requirements for environmental review under NEPA and other federal laws are met. Due to the complexities of the project and the legal requirements established above, the Commission must request that the Corps' complete a SEIS to address the deficiencies and must review and accept that SEIS before completing the licensing process.

Respectfully,

Mike Chiropolos
Attorney for Save the Colorado and The Environment Group of Colorado

cc: Tim Carey & Kiel Downing
Moffat EIS Project Managers, U.S. Army Corps of Engineers
Omaha District, Denver Regulatory Office

Deb Thomas, Acting Administrator, EPA Region 8

Philip S. Strobel, Director, U.S. E.P.A. Region 8 Compliance and Review Program

LIST OF EXHIBITS AND ATTACHMENTS TO COMMENT:

- Gordon McCurry, PhD, McCurry Hydrology LLC: Comments on "Supplemental Environmental Assessment for Amendment of Hydropower License - Gross Reservoir Hydroelectric Project, FERC Project No. 2035-099"
- Geoff Elliot, Grand Environmental Services: Gross-Moffat Supplemental EA, Considerations for Special Aquatic Resources
- John Woodling, PhD, Woodling Aquatics: Aquatic Resources Assessment Of Supplemental Environmental Assessment For Denver Water's Proposed Moffat Collection System Project
- Rocky Smith: Comments on Vegetation Removal and Associated Activities for the Moffat Collection System Project, Gross Reservoir Enlargement
- Lisa Buchanan, LRB Hydrology & Analytics, Actual Versus Projected Water Demand For Denver Water Customers (19 Attachments support Buchanan's Comment, attached as LRB ATT 1-19)

The Colorado River Protection Alternative

The Moffat Collection System Project is an unnecessary boondoggle that would further drain and destroy the Upper Colorado River and its tributaries

EXECUTIVE SUMMARY

It's time for a new era of Western water management that focuses on 21st century technology and values rather than 20th century dams, diversions, and river destruction. Denver Water's proposed "Moffat Collection System Project" would further drain and destroy the tributaries to the Colorado River and affirm 19th century thinking about how to serve water to cities.

As Denver's population grows, it is being "decoupled" from old-fashioned water supply mentality. Denver is using less and less water each year due to conservation, but Denver Water says it needs more water. The facts prove otherwise, that Denver will need less water, not more, as it grows.

The proposed Moffat Collection System Project won't help Denver Water more reliably serve water. In fact, the project adds just 2% to the system, but would cost over $350 million, money which should be spent achieving real gains, not further draining and destroying the tributaries to the Colorado River and causing massive environmental damage with the expansion of Gross Dam and Reservoir.

The permitting process and documents for the project are extremely flawed by failing to consider alternatives other than river destruction and dam expansion. In fact, the "Screening Criteria" used in the permitting documents violate the National Environmental Policy Act by inappropriately favoring river diversions and dam expansion at the expense of less damaging alternatives.

The Moffat Collection System Project is not the least environmentally damaging practicable alternative (LEDPA). Many less environmentally damaging alternatives were "screened out" inappropriately, including using the existing system more efficiently, investing in water conservation, building pipelines to move current water supplies, water reuse and recycling, storing water in underground aquifers, and leasing or buying water from farmers.

Nineteenth century ideas about draining and damming rivers have no place in 21st century water supply decisions. Water conservation can achieve dramatically more gains. The project won't better serve Denver Water's constituents. And, the permitting documents have failed to follow the law.

The U.S. Army Corps of Engineers (Corps) needs to address many failings in the permitting documents before making a permit decision for the project. Afterwards, the Corps should deny a permit to the project.

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         2. Denver Water failed to accurately assess the costs and proven nature of the technology
         3. Denver Water failed to consider increased reuse water that would not be available to the Moffat Collection System

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Colorado River Protection Alternative

1. A New Era of Western River Management – The Proposed Moffat Project, a 20th Century Solution to 21st Century Problem

As we move through the second decade of the 21st century it is clear that the world is rapidly changing. In the western United States that means we are discovering a need to reshape our relationship with our rivers and the water they provide.

First, climate change is here. We are experiencing rising temperatures throughout the nation, particularly in the Southwest U.S. Precipitation change is variable, but declining in much of region. Even with minor increases in snowfall, the end result will be less water in the streams due to a hotter and drier climate. Even if water providers build new storage, the water may not be there to fill more reservoirs – in fact, the current reservoirs, Mead and Powell, continue to decline in water level[1].

Second, at the same time, the west is changing. Population is growing, shifting to cities, and people and jobs are shifting away from the traditional extractive industries. People are understanding the landscape as more than a pantry, and recreational businesses are booming. Further, even though population is growing, it is becoming "decoupled" from water supply – in other words, due to increased water conservation, more people do not necessarily need more water. This is true in many Colorado River basin cities[2],[3], has been pointed out in reports from the U.S. Bureau of Reclamation[4], and even has been proudly touted by Denver Water which is the applicant for the Moffat Collection System Project[5] (Moffat).

Third, the pressure on the Colorado River continues to escalate. Demand exceeds supply – simply put, more water is taken out of the river than flows into it[6]. The Colorado River is a vital element of our western heritage, yet it is also the most managed and plumbed river in the world and completely drained dry before it reaches the Gulf of California[7]. Nearly 40 million people rely on the river, as does the entire nation as people across the U.S. consume crops grown with water from the Colorado River.

Further, the Upper Colorado River – exactly where the Moffat Project is proposed – is already seriously drained and depleted. In Grand County, 72% of the Colorado has already been drained out to Front Range cities and farms. If the Moffat Collection System Project (and the Windy Gap Firming Project) are built, that will increase to 82% (see figure below. Source: U.S. EPA).

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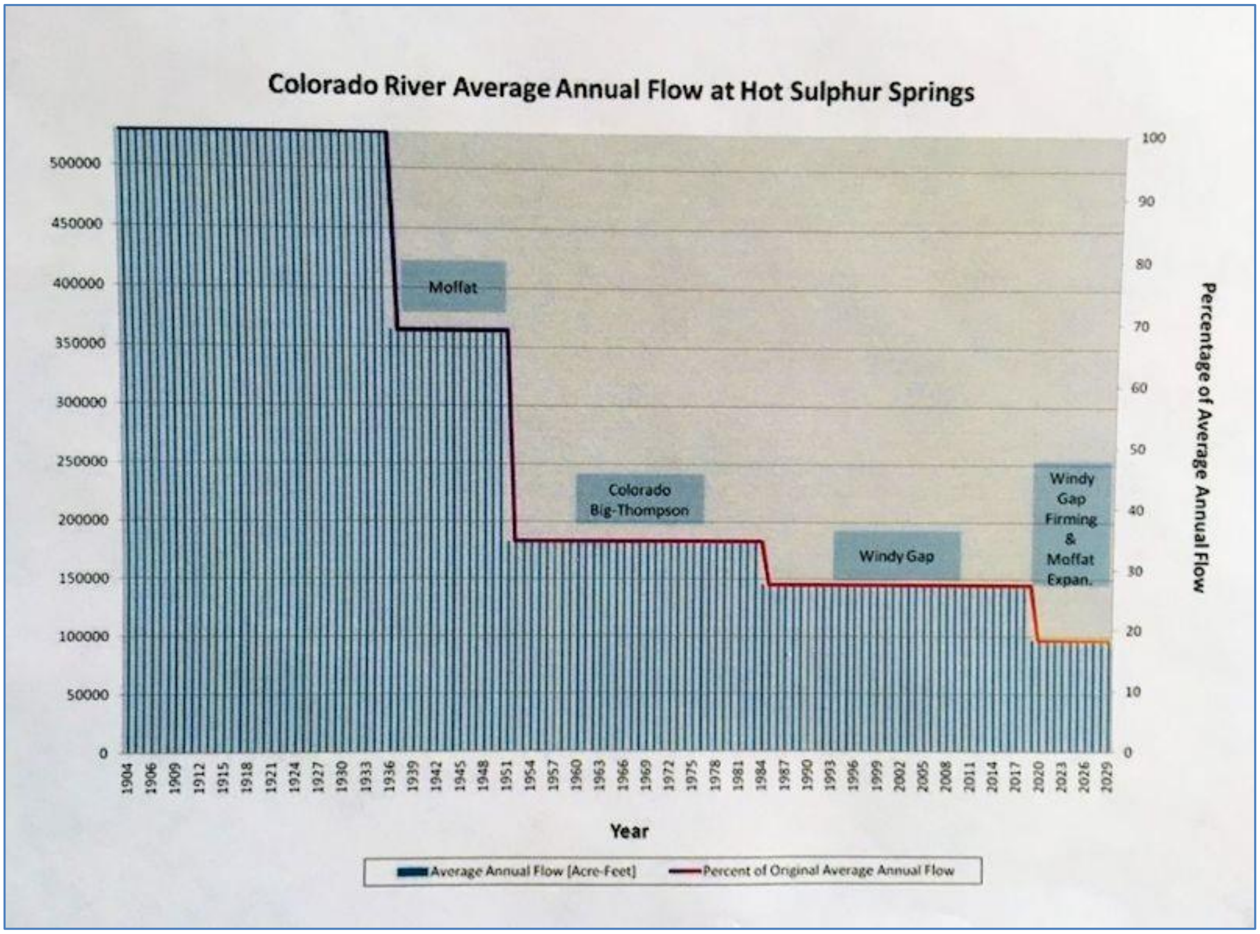
1 http://www.reviewjournal.com/news/water-environment/lake-mead-hits-new-record-low
2 http://www.inkstain.net/fleck/2016/04/san-diegos-great-water-use-decoupling/
3 https://www.islandpress.org/book/water-is-for-fighting-over
4 http://www.usbr.gov/climate/secure/docs/2016secure/2016SECUREReport-chapter3.pdf
5 http://www.savethecolorado.org/blog/press-release-denver-waters-moffat-collection-system-project-delayed-again/
6 http://www.usbr.gov/watersmart/bsp/docs/finalreport/ColoradoRiver/CRBS_Executive_Summary_FINAL.pdf
7 http://www.smithsonianmag.com/ist/?next=/science-nature/the-colorado-river-runs-dry-61427169/



If the Moffat Project is built, it would increase the likelihood of a compact call on the Colorado River, thus destabilizing water supply and politics in the entire Southwest U.S.[8] Colorado and other Upper Basin states have the most to lose – and greatest risk – in this scenario.

While these seismic shifts have been re-shaping the western approach to river and water management, Denver Water has kept its head down and plunged forward with its 20th century big-storage plan – the Moffat Collection System Project. The Moffat project was formally proposed in 2003,[9] but conceived long before that. Despite Denver Water's conservation-based response to the drought conditions of the early 2000s, the agency has remained steadfast in its old-fashioned approach to serving population growth along the Front Range.

Critically, the Moffat project embraces the two now debunked notions that, in the past, have lead western water managers down a destructive path:

- Population growth is necessarily accompanied by increased water demand.

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[8] http://www.savethecolorado.org/blog/wp-content/uploads/2015/08/STC-letter-corps-Moffat-CompactCall-Final-8-27-2015.pdf

[9] "Intent To Prepare [sic] an Environmental Impact Statement for Denver Water's Moffat Collection System Project," *68 FR 54432*, September 17, 2003.

- Water availability is a function of storage – if you build it, it will fill.

By holding on to these false assumptions, Denver Water has painted itself into a corner where the only answer it can see is to construct another large storage project. A broader view of the situation along the Front Range, however, clearly shows that:

- The Moffat project is not needed now or in the foreseeable future.
- Even if the "needs" Denver Water identifies were real:
    - The Moffat project was selected through a fatally flawed process.
    - The Moffat project fails to fully address the asserted needs.
    - There are less environmentally damaging and practicable alternatives.

The time has come for Denver Water to recognize that the Moffat project is not the answer to the challenges it faces. In the remainder of this document, Save The Colorado documents why the Moffat project is a dead-end and presents its vision for an alternative that is protective of the Colorado River and meets the actual needs of Denver Water's customers. If Denver Water fails to pull the plug on its own, the Corps is obligated whether the project should be approved under NEPA, the LEDPA standard, and other applicable federal law.

2. Denver Water Does Not Need the Moffat Project

Denver Water undeniably faces diverse challenges as it seeks to provide high quality and reliable water supplies to a growing population. Unfortunately, rather than seizing the opportunity to remake the agency using an array of 21st century tools to address these various challenges, Denver Water—with the endorsement of the US Army Corps of Engineers ("Corps")—attempted to justify the Moffat project by bundling purposes that would have been better served independently. Although the agency began its permitting process with four "purposes," these were grouped into two "needs" in the FEIS:

- Firm Yield – the "need" for 18,000 AF/year of additional firm yield:
    - Growing Demand
- Location – the "need" for a more balanced overall system that is less dependent on the South Platte and Blue River sources and related infrastructure:
    - Vulnerability – reduce the risk that a negative natural or human-caused disaster could have a significant impact on the ability to meet demand.
    - Reliability – the risk that the Moffat Water Treatment Plant (WTP) will not have water when needed and so will be unavailable.
    - Flexibility – the risk that an outage in the remainder of the system could not be offset by the Moffat WTP.[10]

[10] US Army Corps of Engineers, *Moffat Collection System Project Final Environmental Impact Statement*, April 2014 ("FEIS"), page 1-2.

By choosing to address these disparate purposes through a single project, Denver Water and the Corps dictated that any solution to the "location" purposes also must incorporate delivery of 18,000 AF/year of new firm yield to the Moffat Collection System. As a practical matter, additional firm yield is the real goal of the Moffat project. Denver Water has said as much itself early in the project:

> The purpose of the Moffat System Project is to increase Denver Water's supply by 18,000 AF/yr. Denver Water would then be able to meet an additional 18,000 AF/yr of demand per year.[11]

Despite the inappropriate weighting of firm yield in the permitting process, Save The Colorado will here address both of Denver Water's asserted "needs."

a. Denver Water has Adequate Water to Meet Foreseeable Demand

When first proposed in 2003, the Moffat project was touted as the solution to what was then a looming concern, the projected need for 18,000 AF/year of additional firm yield within Denver Water's system beginning in 2016.[12]

At that time, Denver Water projected an average annual demand of 345,000 AF/year by 2016.[13] Fortunately, the slowly progressing Moffat permitting process has given us an extraordinary opportunity to take the long view on this situation. The reality in 2016 is quite different than had been predicted – total water use for the Denver Water system for the ten years ending 2014 was an average of 305,188 AF/year, with actual demand (exclusive of system inefficiencies) averaging 236,999 AF/year.[14] Further, Denver Water has itself reported that in 2015, "[Denver Water] recorded the lowest demand for water since 1970, despite a population increase of 400,000 people."[15]

There is no demand for the additional firm yield that the Moffat project is intended to provide. The forecasts for growing demand were wrong – per capita demand has continued to decline and even in the face of a growing population, Denver Water's already developed water resources have been more than sufficient.

This is an admittedly simple, yet telling, take on the firm yield "need" that Denver Water claims. On deeper examination, the results are the same – Denver Water does not now, or in the foreseeable future, need the additional firm yield that the Moffat project has been designed to provide. Save The

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[11] US Army Corps of Engineers, *Responses to Comments from Grand County on the Moffat Collection System Project EIS-Alternatives Screening Report (Agency Review Draft)*, October 2007 ("Response to Grand County"), page 24.
[12] *68 FR 54432* (with clarification that "near-term" is defined as 2016 explicitly referenced in US Army Corps of Engineers, *Moffat Collection System Project Draft Environmental Impact Statement*, October 2009 ("DEIS"), page ES-4).
[13] DEIS, page ES-15.
[14] Denver Water, *2014 Comprehensive Annual Financial Report*, April 2015 ("2014 Annual Report," http://www.denverwater.org/docs/assets/167EBB42-B13F-876E-E6562DF4237142C2/ 2014_annual_report.pdf, last viewed June 2, 2016), page III-64 ("Water Supply, Use, and Storage 2005-2014"). The two figures cited were calculated from, respectively, the average of "Total Water Use" and the average of the sum of "Total Treated Water Delivered" and "Raw Water Deliveries" for the ten years documented. The 2015 report was not available at the time of this analysis.
[15] Denver Water, *WaterNews: March 2016* (http://www.denverwater.org/AboutUs/WaterNews1/ March2016/, last viewed June 2, 2016).

Colorado has previously presented the Corps with a detailed discussion of the flaws with the firm yield "need" – see our letter: ***The Demand Analysis in the Final Environmental Impact Statement for the Moffat Collection System Project is Fatally Flawed and Must Be Redone*.**[16]

It should also be noted that the demand modeling used in the FEIS is based on unrestricted demand; i.e., how much water Denver Water's customers would demand with absolutely no disincentives to consume.[17] This does not in any way represent a real-world situation. Denver Water itself has been aggressive about promoting conservation, setting a "10-year goal of cutting water use 22 percent from 2007 through the end of 2016.[18] Despite more than a decade of effective conservation and historically low water demand (due to demand levelling off or decreasing), Denver Water has carried its demand targets from the initial planning steps of the Moffat project into the FEIS.[19]

By only considering alternatives that would result in 18,000 AF/year of new firm yield, the options for addressing the other issues raised as purposes for the Moffat project are dramatically constrained. <u>The Corps must reconsider the firm yield need asserted by Denver Water incorporating the analysis presented by Save The Colorado. If the Corps finds that the need has not been adequately established, the Corps must reconsider the project Purpose and Need Statement without incorporating the firm yield need.</u>

<u>Because the avowed need for new firm yield is the primary justification for the proponent's preferred alternative, the projects cannot be approved if such need is unsupported. The inquiry stops here, and the proposed projects must be denied. Nonetheless, arguing in the alternative, Save the Colorado proceeds to address Denver Water's secondary justifications below.</u>

b. <u>Denver Water's Need for Infrastructure Improvements is not Established</u>

Secondary rationales are also discussed in the EIS. However, Denver Water has not asserted that these considerations independently justify the proposed projects. As explained below, they do not.

The vulnerability, reliability, and flexibility purposes relate to Denver Water's infrastructure, which Denver Water describes as divided between a north system (the Moffat Collection System) and a south system. Through these "location" purposes, Denver Water seeks to be less reliant on the south system.[20] The Moffat WTP is generally operated as a summer peaking plant (providing the last margin of treated water for times of high demand); additionally, raw water is furnished from the Moffat Collection

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[16] Letter from Save The Colorado to US Army Corps of Engineers, October 7, 2015 ("Demand Letter").
[17] FEIS, pages 1-15, 1-17.
[18] *WaterNews: March 2016*
[19] *Compare* DEIS Table 1-1 (2030 unrestricted demand of 427,500 AF/year) with FEIS Table 1-1 (2032 unrestricted demand of 432,700 AF/Year).
[20] FEIS, pages 1-4, 1-11.

System to the northern raw water customers.[21] Denver Water would like to have year-round operation of the Moffat WTP and to increase the redundancy in its systems.[22]

While increasing redundancy and addressing the identified purposes could be seen as a generally desirable step, the Corps failed to establish:

- The level of redundancy that would be sufficient to meet Denver Water's purposes.
- The impact of failing to meet unrestricted demand during an outage or system shortfall.

Denver Water already has a partially redundant system that can respond to system issues, with multiple treatment plants and independent collection systems.[23] The potential of this redundancy was demonstrated by the agency's response to low water availability during the early 2000s drought.[24] Although Denver Water partly relies on this period as evidence to justify its preferred alternative, they fail to establish that actual harm occurred as a result of the shortages.[25]

Nor does the EIS establish that the preferred alternative would obviate the need for future emergency measures such as the modest strategies that proved effective in previous droughts. Importantly the EIS fails to consider the extent to which vastly increased public awareness of water conservation and climate change are likely to avoid, or reduce, the need for future emergency measures or increase the likelihood that early warning (pre-emergency) and emergency measures operate effectively to avoid shortages.

The vulnerability of Denver Water's south system and the potential impact on customers of a disruption may be overstated in the FEIS. The system is described as:

> Approximately 90% of overall available reservoir storage and 80% of available water supplies rely on the unimpeded operation of Denver's South System, particularly Strontia Springs Reservoir. Loss of operation of any portion of the South System could require more water from the Moffat Collection System to meet customer's water demands.[26]

In contrast, information provided in the FEIS documents indicate that there are only a few critical points within the South System that would necessarily cause a large-scale disruption. The South Platte and Blue River collection sub-systems appear to be entirely independent until the Strontia Springs reservoir.[27] Conduits 20 and 26 and the WTPs appear to be independent of each other and likely could operate independently.[28] As Denver Water points out, "during periods of low demand" (presumably outside of

[21] FEIS, pages 1-11, 1-12,
[22] FEIS, pages 1-26 – 1-28.
[23] FEIS, pages 1-11, 1-12.
[24] FEIS, pages 1-11, 1-26.
[25] FEIS, page 1-26 (stating that "Denver Water would have run out of water if it had not implemented emergency measures" but not documenting the costs or impacts of those emergency measures).
[26] FEIS at 1-27 (emphasis added).
[27] FEIS, Figure 1-1.
[28] *Ibid.*

the summer landscape irrigation period) any one WTP can "serve most areas" of its system.[29] As noted above, the Moffat WTP is a peaking plant, used primarily during times of high use; the loss of the Moffat WTP and a compromised ability to provide treated water for lawn irrigation does not rise to the level of an emergency in our arid climate.[30] Limiting outdoor irrigation to precipitation levels is otherwise known as natural conditions, under which native flora have thrived for many millennia. Consequently, "unimpeded operation of Denver's South System," although desired, is not required, nor does "loss of operation of any portion of the South System" necessarily lead to increased load on the Moffat WTP.

The consideration of "need" in the FEIS also does not appear to take into consideration other improvements currently planned by Denver Water. Specifically, expansion of the Foothills WTP to double its capacity has been contemplated.[31] Clearly, such a significant change to Denver Water's South System could impact the dynamics of the system and alter the potential secondary need for the Moffat project asserted in the FEIS.

The Corps must independently, through a quantitative and documented analysis, evaluate the benefit to Denver Water's customers that would result from the systems changes identified as the "location need." Specifically, the Corps must compare the level of redundancy sought by Denver Water with that of other regional water providers, document the actual risk of outages and other system compromises, compare the likely impacts to indoor water use versus outdoor irrigation, and the ability of other infrastructure improvements planned by Denver Water to meet the purposes identified here.

3. Regardless of "Need," the Moffat Project is the Wrong Answer

Save The Colorado rejects Denver Water's claims of need for all of the reasons outlined above. Even if this need is accepted, though, the Moffat project should not be permitted.

a. The Moffat Project was Selected through a Fatally-Flawed Process

The permitting process for the Moffat project incorporated an alternative screening scheme that winnowed down a selection of concepts to the preferred alternative based on the ability of the alternatives to meet the project's Purpose and Need Statement, be cost-effective, and meet other criteria. This screening process suffered from a number of fatal flaws.

i. The Purpose and Need Statement Inappropriately Favored Firm Yield

As described above, the Corps allowed Denver Water to adopt a Purpose and Need Statement for its permitting process that bundles all of the challenges that Denver Water sees in the future into one package. Denver Water does not at any point document the appropriateness of dealing with all of its

[29] FEIS, page 1-12; Response to Grand County, page 7.
[30] FEIS at 1-11, 1-12.
[31] Denver Board of Water Commissioners, *Water for Tomorrow – The History, Results, Projections and Update of the Integrated Resource Plan*, February 2002 ("IRP," http://www.denverwater.org/docs/assets/ DDA6502B-BCDF-1B42-D6B27D086AD6731A/MasterDocIRPOnline1.pdf, last viewed June 2, 2016), page 4.

issues in this single project and, by combining them in this fashion, effectively eliminates from consideration potentially less environmentally damaging and practicable alternatives. Denver Water's choice to consider all of the challenges as one bundle implies an interdependence between very different aspects of the water supply system. It is clear to even the casual reviewer that there is not necessarily a correlation among all of the purposes under consideration, especially in regards to the relationship between the "firm yield" and "location" needs.

Importantly, by bundling these "location" purposes with the "firm yield need," Denver Water precludes any consideration of solutions to these issues that do not depend on new water – to be diverted from headwaters streams in Grand County to an enlarged Gross Dam in Boulder County - in the system.[32] Denver Water has significantly tainted the entire permitting process through this choice of convenience when the issues may have been properly considered independently or in small groups.

Three factors in the primary screen derive directly from the arbitrary Purpose and Need Statement (PN1, PN2, and PN3); another two criteria derive directly from the firm yield purpose (LP1 and LP2). All of these screening criteria eliminate alternatives that might have significantly addressed the Denver Water's purposes.[33] The latter two criteria (LP1 and LP2), intended to simplify the overall project yet provide the large firm yield desired by Denver Water, eliminate from consideration a variety of dispersed system solutions to the infrastructure issues. Further, these criteria are based on an assumption that the project components should be of approximately equivalent size and eliminate from consideration small elements that might be paired with larger components to meet the disparate purposes. The only justification for 15,000 AF floor is the broad and unsupported statement that a project composed of smaller elements would be "probably too complex to reasonably implement and manage."[34] Importantly, these criteria eliminate alternative 403 – expanded non-potable reuse.

The Corps must reconsider the Purpose and Need Statement for the Moffat project and evaluate the appropriateness of bundling the four purposes that Denver Water claims into two integrated needs. The Corps must consider the feasibility of Denver Water addressing its purposes independently or in smaller bundles of two or three. The Corps must also reconsider the alternatives screening in light of any changes to the Purpose and Need Statement that are developed. The FEIS must address the fundamental question of whether Denver Water's core purpose and need – providing water to customers consistent with the restraints imposed by the natural environment – can be achieved without additional transbasin diversions across the Continental Divide. Because Denver Water has failed to update its Integrated Resources Plan with scenarios it will pursue if Moffat permits are not granted at this time, the Corps must independently analyze Denver Water's ability to operate in a scenario under which the paper rights to Colorado River Water are not exercised at this time.

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[32] FEIS, pages 2-8 – 2-9, (stating that the "most significant criteria" in the screening process were PN2, LP1, LP2, and EC1).

[33] *Ibid.*; *see also,* URS, *Moffat Collection System Projection EIS Denver Water Alternatives Screening Report*, August 2007 ("Alternatives Screening Report"), pages 2-5 – 2-18.

[34] FEIS, Table 2-1.

ii. The Permitting Process Did Not Adequately Consider a Full Range of Alternatives

Although Denver Water claims to have considered a wide range of alternatives to meet its needs, there were in reality very few uniquely different concepts considered. Save The Colorado counted 307 line items in the primary screen. Of these, only one was classified as demand reduction and three were classified as re-use. The process was clearly skewed towards traditional water projects with 263 new or expanded storage concepts.[35] This might have been less objectionable in the last century, before conservation emerged as the most effective means of managing finite water resources across the arid Southwest. Sooner or later, conservation must be the preferred strategy, because supplies cannot come anywhere near supporting projected population increases at the levels of consumption relied on by Denver Water's outdated projections relied on for the FEIS. The sooner conservation and re-use strategies take hold, the less irreversible and unacceptable impacts will further degrade our environment and stream ecosystems.

Further, by Denver Water's own admission, there was little meaningful difference between the alternatives considered in the final analysis:

> Among the three groups of alternatives, the differences with respect to average annual stream flow depletions on the West Slope were 5% or less. All alternative groups would divert water in a similar pattern, capturing primarily peak flows during wet and average years.[36]

<u>The Corps must reconsider the alternatives screening process to ensure that a meaningful range of alternatives are analyzed in the permitting process. Specifically, the Corps must broaden the Purpose and Need Statement so as not exclude practicable options for meeting the project purposes and generate a broader range of alternatives for the screening process. Reasonable alternatives that will allow Denver Water to continue operating and supplying its customers are available. Denver Water has simply declined to *publicly* consider contingency plans in the event Moffat is not permitted, built, or operated as hoped for. As population grows and the climate warms across the Colorado Basin, the likelihood increases that Moffat as designed cannot reliably supply the desired quantities of water. It is incumbent on any governmental agency such as Denver Water to publicly conduct such contingency planning so that a robust and informed public debate can chart the best course of action.</u>

iii. The Alternative Screening Process Inappropriately Favored Large Storage Projects

By specifying a Purpose and Need Statement that was inappropriately narrow and by not considering a meaningful range of alternatives, Denver Water put tight constraints on the possible outcomes of the alternative screening process. This flaw was compounded by screening process that was itself flawed

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[35] Alternatives Screening Report, Table A-2.

[36] Response to Grand County, page 19.

and firmly entrenched in outdated water management thinking. The process as a whole pre-ordained the outcome, leaving no choice but to endorse the Denver Water's preferred option.

The screening process used in the Moffat project permitting scheme was complex, incorporating a number of different "screens" at different steps.[37] Unfortunately, the process, although highly structured, was far from rigorous and did nothing to ensure a meaningful range of alternatives were given a hard look as required under NEPA. Rather, it served the project proponents as a filter to remove competing options from consideration prior to the analyses that would have shown the advantages of these other approaches.

The Moffat FEIS could be likened to the efforts of the utility industry when they proposed the construction of hundreds of new coal-fired power plants across the nation 10-20 years ago. Using the assumptions, projections and "facts" advanced by the utilities and the coal industry, the seemingly inescapable conclusion was that significant increases in coal-fired electricity was the only way America or the West could meet future energy demand without catastrophic consequences. History has shown differently. Few if any additional coal plants have been built, and it is now clear that the vast majority of plants once deemed absolutely necessary by industry "experts" are unneeded, and will never be built. Denver Water's failure to adjust its strategic planning to reflect the success of conservation and other alternatives to new transbasin diversions and dams is analogous to the electric utilities' inability to plan for the phase-out of coal power under forced to do so by regulatory bodies and public opinion.

The screening process began with a large pool of general concepts that was subjected to a filter functioning as a gatekeeper for alternatives.[38] The filter was built from the inappropriately constrained Purpose and Need Statement, a historical view of available technology and practicality, and very general environmental impacts.[39] The vast majority of the concepts were eliminated at this step, with very limited review and apparently no public vetting.[40] It is important to note that the project under consideration was conceived over a decade ago; the screening process that led to selection of the proposed Moffat project was itself conducted in 2005.[41] This reliance on outdated information directly impacted the alternatives screening process; direct potable reuse was eliminated for failing the "proven technology" screen (ET1) based on the now nearly 20-year old findings of a 1998 study.[42]

Similarly, the 1a screen used the imagined ability to have the project online by 2016 as a filtering criterion ("PN3").[43] As we are now in 2016 and no project has even been permitted let alone constructed, this criterion is clearly inappropriate. It is also apparent that the proposed Moffat project

[37] FEIS, page 2-3.
[38] FEIS, pages 2-4 – 2-10.
[39] *Ibid.*
[40] FEIS, Table 2-3.
[41] Alternatives Screening Report, page 2-1.
[42] Alternatives Screening Report, pages 2-10 – 2-11.
[43] Alternatives Screening Report, Table 2-1.

also was not capable of completion by 2016 and therefore should have been eliminated from further consideration.

After this radical filtering, the concepts were fashioned into more specific alternatives. The institutional bias is very apparent at this step – the FEIS opens its description of screen 1b:

> The objective of Screen 1b was to <u>match a potential water supply source with water storage and conveyance components</u> to formulate possible Project alternatives that would meet the Project Purpose and Need.[44]

Clearly, only approaches that fit the traditional model of new water and storage were to be advanced at this stage. Conservation or operational changes that might meet the purposes of the project but did not result in a physical pool of water, never had a chance for consideration.

The third screening round ("1c") was entirely based on general cost estimates. This screening process used the cost estimates and an arbitrary standard as proxies for "practicableness" – a critical criterion of the permitting process.[45] No additional factors of the potential success of an alternative were addressed. The mere availability of cheaper options does not render more expensive options impracticable. An explicit look at ability to pay would be required to make such a judgment, and would need to factor other economic impacts such as lost opportunity costs resulting from development of other alternatives. Further, as with technological feasibility, the assumptions about cost were based on information through the turn of the century and are now quite dated. In this screening process, cost effectively trumped all other potential impacts in determining which alternatives would be given serious consideration. This is plainly inconsistent with NEPA's "hard look" requirements.

Finally, it should be noted that the criteria were not applied consistently in the screening process. For example, gravel pit storage and deep aquifer storage were "skipped" through preliminary screen due to uncertainty (the inability to generate firm responses to the filtering criteria).[46] No explanation is provided for why these concepts were given the benefit of the doubt while others were eliminated due to unproven technology or other uncertainties.

<u>The Corps must reconsider the alternatives screening process and ensure that it meets the intent and requirements of NEPA and the Clean Water Act. Specifically, the Corps must evaluate the process for structural bias and predetermined outcome as well as its ability to generate a meaningful range of alternatives, inappropriate or dated criteria that are not valid measures of the practicality or impacts of an alternative, and consistent application of criteria.</u>

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[44] FEIS, page 2-10.
[45] FEIS, pages 2-15 – 2-16, Table 2-5; Alternatives Screening Report, page 4-1.
[46] Alternatives Screening Report, page 2-23.

b. <u>The Moffat Project Fails to Fully Address the "Needs" Claimed by Denver Water</u>

Denver Water has claimed that it must fulfill its "location need" (the flexibility, vulnerability, and reliability purposes) through this project and not just increase its available firm yield. Unfortunately, Denver Water has set out too many pots to be filled by the proposed diversions; the Moffat project simply cannot do everything that Denver Water suggests it will. Save The Colorado has addressed these shortfalls in detail in an earlier comment letter – see our letter: ***The Claims in the Final Environmental Impact Statement for the Moffat Collection System Project that the Project will Help Denver Water "Balance" its System are Inaccurate***.[47]

In the end, despite the attempts to cast this proposal as a tool to address many of Denver Water's issues, the proposed Moffat project is about diverting and storing more West Slope water. Denver Water has stated as much itself, although not in the FEIS:

> The purpose of the Moffat Collection System Project EIS is to develop 18,000 AF of firm yield that can be used in the Moffat System by treated and raw water customers during drought periods[…] Gross Reservoir, which in turn is filled from additional diversions from the Williams Fork and Fraser basins, and South Boulder Creek, primarily during wet years following a drought. The majority of this "new" water is then kept in storage in Gross Reservoir until a drought occurs. Meanwhile, during most years, the additional 18,000 AF/year of demand is met from Denver Water's additional water supplies throughout its collection system including the South Platte River, the Blue River, the Moffat Collection system, and from exchanges… <u>Denver Water indicates that it was very important for their customers to have this supply available for the drought, even though it is rarely used.</u> Use of water in the enlarged Gross Reservoir and the other project components that provide the 18,000 AF of firm yield would likewise be used in drought conditions, but Denver Water would continue to use its additional system-wide supplies in most years.[48]

Therefore, if the additional water stored in Gross Reservoir is held for drought relief it cannot be used to satisfy the other purposes that Denver Water has claimed are essential purposes of this project. <u>The Corps must independently evaluate Denver Water's intended operations of the expanded Gross Reservoir under the proposed Moffat project and the ability of those operations to meet the stated purposes and needs as documented in the FEIS.</u>

Further, the future of availability of West Slope water has been called into question by the combined impacts on the Colorado River of overuse and climate change. It is increasing likely that a compact call will result – Save The Colorado has clearly documented these concerns in an earlier comment letter – see our letter: **FEIS for Moffat Collection System Project failed to analyze impact of diversions on the**

[47] Letter from Save The Colorado to US Army Corps of Engineers, March 1, 2016.
[48] Response to Grand County, page 22 (emphasis added).

Colorado River Compact, climate change, looming "shortages," and increasing the likelihood of a "Compact Call."[49]

c. The Moffat Project is not the Least Environmentally Damaging Practicable Alternative

Save The Colorado and numerous other organizations, individuals, and agencies have provided extensive comments on the proposed Moffat project and the massive environmental damage that would accompany its construction and operation.[50]

The Corps may only permit the least environmentally damaging and practicable alternative that meets the purpose and need of the project. By using an inappropriately constrained Purpose and Need Statement, Denver Water has sought to make the proposed Moffat project the only available option. By taking a broader approach and considering the actual purposes that Denver Water claimed needed to be met, a wider range of alternatives is available for consideration. Save The Colorado outlines some of these in the following chapter.

The Corps must consider a meaningfully broad range of alternative when conducting the LEDPA analysis required under the Clean Water Act. Specifically, the Corps must broaden the Purpose and Need Statement so as not exclude practicable options for meeting the project purposes and generate a broader range of alternatives for the screening process.

4. Denver Water Can Serve Its Customers without the Proposed Moffat Project

Save The Colorado has established that the Moffat project is not needed and, even if it were needed some decades in the future, the proposed project is not the right solution to the challenges that Denver Water would face. If the Corps determines that some aspect of Denver Water's need is valid, there are a variety of ways that each of the issues can be addressed. Save The Colorado presents below a conceptual list of approaches that could be applied to creative problem solving to develop a project or projects that help Denver Water fill its theoretical future need more directly and with less impact on Colorado's rivers and communities.

a. Improving Reliability and Flexibility and Reducing Vulnerability

Denver Water is fortunate to have a system that draws from several geographically diverse water sources.[51] This provides a built-in measure of redundancy that allows for a very robust system. The potential redundancy of the system is offset by a skewing of the system volume to the southern

[49] Letter from Save The Colorado to US Army Corps of Engineers, August 27, 2015.
[50] *See* FEIS, Appendix N.
[51] FEIS, Figure 1-1.

components.[52] Denver Water would like to increase the reliability and flexibility and decrease the vulnerability of its system to man-made and natural threats by augmenting its northern components.[53]

Clearly, there are numerous possibilities for achieving the operational improvements (the "location need") that Denver Water seeks without increasing the firm yield provided through the Moffat Collection System. Many such concepts were proposed in the alternative screening process but discarded inappropriately.[54] Before permitting any project addressing the purposes that Denver Water has identified for the Moffat project, the Corps must respond to Save The Colorado's comments below.

i. Improved Raw Water Connection between the North and South Systems

A North/South interconnect would allow for transport of raw water for treatment to the Moffat Water Treatment Plant on an as-needed basis. This option could also be paired with any of the storage options discussed below to increase operational flexibility. An interconnect would more thoroughly integrate the Moffat WTP into Denver Water's collection system without the expense and impact of un-needed additional diversions and a large surface impoundment. This option was given only token consideration in the alternatives screening process (with the alternatives that were passed to the 1c screen eliminated due to cost).[55] The Corps must fully analysis the potential effectiveness and impacts of viable north/south interconnect alternatives.

ii. Strontia Springs Bypass

As discussed above, the South Platte and Lake Dillon collection sub-systems are entirely independent until joining at the Strontia Springs Reservoir. Elements of the south system downstream of Strontia Springs also provide a good degree of redundancy. By Denver Water's own statements, "during periods of low demand" (presumably outside of the summer landscape irrigation period) any one WTP can "serve most areas" of its system.[56] A bypass to Strontia Springs providing direct access to Conduits 20 and 26, and using Cheesman and Dillon Reservoirs as the regulating tools may maintain much of the system functionality even if Strontia Springs—the one true single point vulnerability in the system—were compromised.[57] Arguably, designing the water supply system to such a level that it can maintain unrestricted landscape irrigation (lawn watering) during the confluence of a drought and system failure is not a rational approach. The Corps must fully analysis the potential effectiveness and impacts of viable Strontia Springs alternatives.

iii. Aquifer or Gravel Pit Storage in Strategic Locations Accessible to both North and South Systems

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[52] FEIS, page 1-4.
[53] FEIS, page 1-11.
[54] Alternatives Screening Report, Table A-2.
[55] FEIS, Tables 2-4 and 2-5 (Alternative 4a, 5a, and 5b); note that Save The Colorado is not explicitly endorsing these interconnect concepts and calls on the Corps to consider other, less costly options.
[56] FEIS, page 1-12; Response to Grand County, page 7.
[57] FEIS, Figure 1-1.

Moving already diverted water from large reservoirs down to underground storage that could be accessed from any of Denver Water's water treatment plants could meet the "location need" while also reducing system losses due to evaporation. Denver Water acknowledges aquifer storage can be superior to reservoirs and "tends to be comparatively less costly, has no evaporation, has a lower impact to communities and the environment, and has fewer permitting challenges."[58] Denver Water is currently pursuing a study of the technology; [59] if it had been started when the permitting process began, this would likely be established practice today.

Denver Water states that they plan on 32,200 AF of gravel pit (downstream reservoir storage).[60] As early as 2000, gravel pits were seen as a substitute for the vetoed Two Forks reservoir and identified as having a potential of 18,500 AF.[61] Denver Water's 2007 IRP referenced 30,000 AF of shared gravel pit storage on the South Platte:

> In a cooperative action with a water supplier outside the Combined Service Area, as anticipated in the Resource Statement, an agreement with South Adams County Water and Sanitation District has grown over the years into an effort that will add as much as 30,000 acre-feet of gravel pit storage downstream on the South Platte River;

However, the FEIS (at 2-22), appears to only recognize 5,000 AF of potential gravel storage, and caps System Refinement Projects below what appears to be reasonably achievable or already in progress.

The City of Englewood's comment letter[62] on the Chatfield DEIS indicates that Denver Water is on the verge of procuring significant quantities of new re-usable return flows when ongoing negotiations involving "the 1940 Agreement" result in a settlement or decree in an ongoing water court docket.

> Currently, Denver Water does not have enough reusable effluent to fill 64,000 acre feet of downstream gravel pit storage every year. Denver Water annually imports an average of approximately 72,000 acre-feet of water from near Dillon Colorado through the Roberts Tunnel, approximately SO% of which result in reusable return flows suitable for exchange. [Bates expert report, 04CW121] Denver Water's reusable Roberts Tunnel return flows thus total only about 36,000 acre feet on average. Denver also imports water from upper Colorado tributaries near Granby Colorado through the Moffat Tunnel. Because of an agreement Denver made in 1940 ("1940 Agreement") that absolves it of responsibility for replacing certain reservoir evaporation, Denver is precluded from reusing return flows from Moffat Tunnel water. [12CWOOS application]. However, Denver Water is actively working to dissolve the 1940 Agreement and if successful, will be able to reuse about 11,500 acre feet of Moffat Tunnel return flows. [Bates

[58] Denver Water, *Aquifer Storage and Recovery Study* (http://www.denverwater.org/ConstructionProjects/ConstructionWorkAffectingCustomers/ASR/, last viewed June 2, 2016).

[59] Allen Best, "Will Denver's future water reservoirs lie underfoot and not behind dams?" *Mountain Town News*, April 26, 2016 (http://mountaintownnews.net/2016/04/26/will-denvers-aquifers-be-its-next-reservoir/, last viewed June 2, 2016).

[60] Denver Water, *Downstream Reservoir Program*, (http://www.denverwater.org/SupplyPlanning/WaterSupplyProjects/DownstreamReservoirProject/, last viewed June 2, 2016).

[61] Cathy Proctor, "Denver's water reservoir future is in the pits," *Denver Business Journal*, December 20, 2000 (http://www.bizjournals.com/denver/stories/2000/12/11/story13.html, last viewed June 2, 2016)

[62] http://www.savethecolorado.org/blog/wp-content/uploads/2016/06/Chatfield-DEIS-Comment-letter.pdf

report] In addition, the Gross Reservoir expansion, will, if implemented, allow Denver Water to store up to 72,000 acre feet of additional water in Gross Reservoir per year.3 [Gross DEIS at pp] Assuming that Denver Water uses half that amount on average and that 50% of that water results in reusable return flows (this also assumes the 1940 Agreement is dissolved), Denver Water will obtain an average of 18,000 acre feet of reusable return flows per year. [JTW Gross comment letter] Though not located on the South Platte River, the Gross Reservoir expansion is also likely to reduce flows in the South Platte River according to the Corps' 'own DEIS for that project. [See Moffat Collection System Project ("Gross") DEIS at Appx. H, HI-12 to HI-IS]. These future reductions to South Platte River water supply are sufficiently likely and foreseeable that the Colorado Division of Wildlife (CDOW) expressed concern with the consequences of reduced flow in the South Platte River, particularly in winter months. [See Gross DEIS, Comment Report (State), at 40].

The total of these return flows, 36,000 + 11,500 + 18,000, equals just over 64,000 acre feet, which is sufficient to fill and re-fill the downstream gravel pit reservoirs and allow Denver Water to exchange 64,000 acre feet per year to Chatfield, or higher on the South Platte, with devastating effects on the South Platte segment below Chatfield.

Denver Water's expanded exchange capacity, coupled with its right to divert 10, 78S acre feet into storage at Chatfield, will consume all native inflow into Chatfield in an average water year.

<u>The Corps must fully analysis the potential effectiveness and impacts of viable aquifer and gravel pit storage systems as elements of alternatives that would address Denver Water's purposes without additional diversions. The FEIS is fatally flawed to the extent significant new sources of re-usable water, return flows, and/or storage may be available in the future, but have not been analyzed to date.</u>

iv. Development of Shared Operations with Aurora Water or Other Providers

Denver Water identified the possibility of shared operations with Aurora Water in the alternatives screening process but discarded it due to a claimed infeasibility to deliver water to the Moffat Collection System.[63] Such an option may provide a much greater redundancy than the small gains presented by the proposed Moffat project. Shared operations deserve a full vetting and impact review. <u>The Corps must fully analysis the potential effectiveness and impacts of viable alternatives incorporating shared operations with Aurora or other providers.</u>

The WISE Partnership and Prairie Waters require comprehensive analysis regarding how they are already contributing to Denver Water operations and management, and how such projects may be replicable alternatives in combination with other environmentally friendlier approaches than the Moffat proposals.[64] WISE is

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[63] Alternatives Screening Report, Table A-2 (ID # 310).

[64] See http://www.denverwater.org/SupplyPlanning/WaterSupplyProjects/WISE/, https://www.sdaco.org/m/downloads/2015/A%20Regional%20Partnership%20for%20Sustainable%20Water%20Future%20(F-1).pdf

> Seventeen entities, including Denver Water, have joined forces on a project that will supply area residents with more water while minimizing the need to buy new water rights. [. . .]
>
> Denver Water saw Aurora Water's underused infrastructure as an opportunity to capture reusable water in the South Platte for a new reserve supply that can be used during emergencies.
>
> At the project's completion, Denver Water expects to capture about 15,000 acre-feet of unused supply — enough to serve almost 38,000 homes. When Denver Water doesn't need that emergency supply, it plans to sell the excess to South Metro, which relies heavily on nonrenewable aquifers and wells.[65]

Not only is Denver Water capturing approximately the same quantity of water that Moffat would provide, it candidly admits that the water is expected to be available for sale when not needed. WISE must be fully analyzed before Moffat is approved, because WISE appears to make Moffat unneeded and redundant.

v. Construction of an Additional Water Treatment Plant

Denver Water could address many of the concerns they raise concerning the "location need" by constructing a third water treatment plant that is accessible to the South System. The organization has contemplated expanding the Foothills WTP;[66] if the funding for this project were directed to a new facility, Denver Water could achieve a significant measure of redundancy. <u>The Corps must fully analysis the potential effectiveness and impacts of viable alternatives incorporating the construction of an additional water treatment plant accessible to the Denver Water south system.</u>

vi. Buyback or Restructure of Raw Water Contracts

Denver Water claims that some of the proposed new water is needed to meet raw water contracts, but fails to consider buying back or restructuring those contracts as an alternative to Moffat. These options were discarded in the alternatives screening process as lacking certainty of completion within the mandated timeframe.[67] As discussed above, uncertainty was not applied evenly across the board and the timeframe imposed on the screening process can no longer be seen as reasonable. Further, the uncertainty claimed was not documented in meaningful fashion. These options deserve a thorough review to determine their feasibility and ability to address both the "location need" and effectively provide "new firm yield" for Denver Water in-house customers. <u>The Corps must fully analysis the potential effectiveness and impacts of viable alternatives incorporating sale, buyback, or restricting of existing Denver Water raw water contracts.</u>

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[65] http://www.rmpbs.org/blogs/science-nature/wise-water-project-will-benefit-several-entities/
[66] IRP, page 4.
[67] Alternatives Screening Report, Table A-2 (ID #306 and 501)

b. Meeting Future Demand Without Moffat & the Colorado Constitution

Save The Colorado has demonstrated that Denver Water does not need additional firm yield now or in the planning time frame.[68] In fact, there is no concrete evidence that Denver Water will ever need to expand its supplies.[69]

If, however, decades in the future, Denver Water was to experience water use growth that indicated that shortages might be possible, there are many options for the provider to serve additional customers without increasing river diversions or use of unsustainable groundwater. These options may be grouped into three strategies:

1. More Efficient Use of Existing Supplies
2. Reuse of Existing Supplies
3. Acquisition of Currently Developed Supplies

All of these approaches offer Denver Water the opportunity to supply the needs of their customers without the significant environmental impacts associated with additional river diversions.

In addition, the FEIS has not addressed the applicability of the provision in Colorado's Constitution providing that, in time of shortage, domestic water use has preference over all other uses. This preference would be triggered by any prolonged droughts leading to emergency situations, and would appear to provide for satisfying domestic uses from other sources. It bears repeating that domestic uses are only responsible for approximately 10% of all diversions and uses – so adequate domestic supplies would appear to be available even in prolonged or unprecedented droughts.

i. More Efficient Use of Existing Supplies

Conservation must be the foundation of any efforts to deal with an expanding water customer base. No one disputes that there is a limited amount of water available for use in Colorado – the real question is, "do we conserve now while the rivers are still flowing or later when we have drained them dry?"

Although Denver Water has undertaken significant conservation efforts over the last decade, the assertion in the FEIS that the "low-hanging fruit" has been captured and that conservation returns will hence forth be more difficult and expensive is not supported by any meaningful documentation.[70] Denver Water itself, in public materials not related to the Moffat project, continues to pursue aggressive conservation efforts.[71]

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[68] *See*, *generally*, Demand Letter.
[69] *Ibid.*
[70] Demand Letter, page 14.
[71] Denver Water, *Water Conservation Plan Update-Draft*, undated ("Conservation Update," http://denverwater.org/docs/assets/A71A6797-CA8C-1371-9FD95F082563B2BB/DenverWaterConservationPlanUpdate.pdf, last viewed June 2, 2016), page 19 ("Moving forward, a measurable objective of 1,000 acre-feet of active savings per year has been established for this Conservation Plan Update"); Denver Water, *Denver Water's Conservation Plan* (http://www.denverwater.org/ Conservation/ConservationPlan/, last viewed June 2,

The flat-lined conservation incorporated into the FEIS demand modeling simply fails to reflect the reality of what is possible or even likely.[72] In response to the recent drought, communities in California are achieving water use reductions of 25%,[73] while Denver Water has proposed long-term reductions of 16,000 AF/year – less than 5%.

Water conservation is generally considered in two categories: passive and active. Passive conservation results from changes to the physical delivery and/or consumption systems that do not require ongoing efforts or behavioral changes, e.g. low-flow toilets or low-flow shower heads.[74] Once in place, these changes keep producing a benefit (reduced consumption) indefinitely. Active conservation, on the other hand, requires ongoing action (or inaction) on the part of either the water customer or the water provider, e.g., watering restrictions and leak detection.[75] Both passive and active conservation measures are available to Denver Water to offset additional demand that would otherwise result from a growing customer base.

Denver Water has incorporated some passive conservation into its demand modeling (natural replacement of fixtures) but does not appear to have explicitly contemplated increased standards or new technology.[76] The Corps must review current and proposed building standards and model the impact of natural replacement and installation of new fixtures in new building on projected demand.

A substantial amount of the water diverted from West Slope rivers and sent over the Continental Divide goes to irrigate private residential lawns – half of the average water use by Denver Water's single family residential users (48% of the customer base) is outdoor watering, and overall 43% of Denver Water's treated water goes to outdoor use.[77] Importantly, the Moffat project is proposed to meet this last increment of demand – demand that is likely to be highest during hot and dry years due to lawn irrigation need. Both Denver Water's own data and a recent report from Bureau of Reclamation demonstrate large variations from year to year in water demand in the region that includes Denver Water's service area.[78] As it is reasonable to assume that indoor water use would not vary by such a wide margin year-to-year, it is very likely that this variation results primarily from outdoor water use, with much if not most of that being lawn irrigation. Consequently, much of this variation represents a potential conservation target, and it decries Denver Water's assertion that all of the "low-hanging fruit" of conservation savings have been captured.[79] These year-to-year variations exceed the firm yield that

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2016), ("Denver Water's conservation plan aims to accelerate the pace of water conservation in its service area and reduce overall water use from pre-2002 drought usage by 22 percent by 2016.")

[72] Demand Letter, pages 13 – 14.

[73] State of California, *Top Story: California Meets Governor's Conservation Mandate for Seventh Straight Month*, February 2, 2016 (http://drought.ca.gov/topstory/top-story-54.html, last viewed June 2, 2016).

[74] Conservation Update, page 13.

[75] *Ibid*.

[76] FEIS, page 1-4 and Table 1-1; Response to Grand County, page 9.

[77] Denver Water, *Water Use* (http://www.denverwater.org/SupplyPlanning/WaterUse/, last viewed June 2, 2016); Response to Grand County, page 13.

[78] 2014 Annual Report, III-64; US Bureau of Reclamation, *2016 SECURE Water Act Report to Congress - Chapter 3: Colorado River Basin*, March 2016 (http://www.usbr.gov/climate/secure/docs/2016secure/ 2016SECUREReport-chapter3.pdf, last viewed June 2, 2016), page 3-8.

[79] FEIS, Appendix A-1 page 5

might be provided by the Moffat project.[80] Turf removal or replacement with low-water requirement varieties is therefore a very attractive conservation option and has been identified as a high return option by the state.[81] The Corps must analyze the potential for turf removal and replacement within Denver Water's customer service area and the cost and water saving benefit that would be afforded by various levels of implementation.

Denver Water's modeling based on unrestricted demand is counter to now-accepted practice where providers such as the East Cherry Creek Valley Water & Sanitation District are instituting seasonal watering schedules as a matter of course.[82] The Corps must analyze the potential for water savings that would be afforded by various implementation levels of watering restriction schedules.

Another potential target for conservation not addressed by Denver Water in the Moffat project permitting effort are the operational factors lumped together in the agency's annual reports as "Other Uses" – these "include, but are not limited to, evaporation, carriage losses, seepage losses, Chatfield bypasses, flood bypasses, substitution and releases for power production and maintenance project."[83] "Other Uses" ranges from 38,000 AFY to 101,000 AFY over the last decade (16%-43% of Denver Water use).[84] There is no meaningful disclosure or analysis of these "other uses" in the FEIS. The Corps must document the water demands associated with Denver Water's "other uses" and consider how they may be reduced or altered to extend the ability of the agency's existing water supplies to meet customer demand.

ii. Reuse of Existing Supplies

Denver Water, while listing potable and non-potable reuse as options for incorporation into alternatives, fails to give them serious consideration. Much of Denver Water's argument against reuse, however, can be easily seen to be based on false premises and reuse for both potable and non-potable uses should be given consideration.

1. Denver Water failed to fully account for its reusable water pool

Denver Water demises the argument that it can claim reuse of its full allotment of Blue River water because this water is mixed with legally non-reusable water[85]. This assertion is bizarre at best, substituting an odd physical interpretation for an appreciation of the underlying legal theory. Similarly, Denver Water dismisses the potential resolution of the 1940 Consolidated Ditch Agreement that

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[80] 2014 Annual Report, III-64 (the average year-to-year variation for the ten-year period is 33,324 AF).
[81] Aquacraft Inc., SWSI 2010 Municipal and Industrial Water Conservation Strategies, January 2011 (http://cwcb.state.co.us/water-management/water-supply-planning/Documents/SWSI2010/Appendix%20L_SWSI%202010%20Municipal%20and%20Industrial%20Water%20Conservation%20Strategies.pdf, last viewed June 2, 2016), page 45.
[82] ECCV Water & Sanitation District, *Watering Schedule* (http://www.eccv.org/conservation/residential-conservation/watering-schedule, last viewed June 2, 2016).
[83] 2014 Annual Report, III-64.
[84] *Ibid*.
[85] AR 276-03 at 13 (Asserting that as fully consumable water is not physically distinguishable from non-fully consumable water at treatment plants, Denver Water must assume that they are consumed in equal parts).

currently restricts the reuse of much of its transmountain diversion water as having too uncertain a time frame, although they do not provide any documentation of the current status of litigation of negotiations over that agreement. In fact, Denver Water and other parties are on the verge of an historic settlement with the ditch companies that could provide as much as 15,000 AFY of "new" re-used water to the system. CITE/

Further, Denver Water by its own admission does not yet incorporate lawn irrigation return flows into its reusable water calculation.[86] The Corps must conduct an independent assessment of the availability of fully-consumable water addressing these concerns.

2. Denver Water failed to accurately assess the costs and proven nature of the technology.

Denver Water's evaluation of the technology available for treatment and reuse reflects the state of the art of nearly two decades ago even though this is a rapidly advancing field.[87] Cost was used to eliminate several alternatives although these estimates were based on now-dated information.[88]

Further, the Prairie Waters project is dismissed as a poor analog based on four disputable assertions:

1. The Prairie Waters is a fundamentally bigger project – Denver Water may seek to undertake a similarly ambitious project to meet its currently projected needs (even though Save The Colorado disputes these) and potentially also serve as a regional provider.
2. The Prairie Waters project represents the frontier of proven technology – now that the project is established and itself proven, this technology cannot be seen as speculative.
3. The Prairie Waters project has a larger unutilized effluent stream – see above.
4. The Prairie Waters project is based on a high risk tolerance due to a lack of senior rights to meet drought needs – Denver Water's rationale for the Moffat project is a lack of available water for a drought condition (rights or not) and the Prairie Waters project can longer be considered high risk.[89]

Denver Water also asserts that the Prairie Waters project cannot be seen as an example of an alternative due to the need to blend produced water to offset high levels of total dissolved solids.[90] Denver Water however provides no evidence why such an approach would not work in the Denver Water system. The Corps must complete an independent assessment of the costs and technological feasibility of integrating potable and non-potable reuse water into the Denver Water system.

[86] Alternatives Screening Report, page 2-20.
[87] Alternatives Screening Report, pages 2-10 – 2-11; Bruce Finley, "Colorado tapping dirty water to extend life of the pure stuff," *Denver Post*, April 21, 2016 (http://www.denverpost.com/2016/04/21/colorado-tapping-dirty-water-to-extend-life-of-the-pure-stuff/, last viewed June 2, 2016).
[88] FEIS, Table 2-5 (Alternatives 6a, 6b, 7a, 7b, and 14).
[89] Response to Grand County, page 19.
[90] Response to Grand County, page 26.

3. **Denver Water failed to consider increased reuse water that would not be available to the Moffat Collection System.**

The alternative concept incorporating expanded non-potable reuse was discarded due to a limited availability of demand served by the WTP.[91] This dismissal ignores the potential for non-potable reuse in the remainder of Denver Water's system that could offset the need for "new" water in the Moffat Collection System. The Corps must independently evaluate the potential for non-potable reuse in the entire Denver Water system and its ability to offset the "need" for additional diversions.

iii. Acquisition of Currently Developed Supplies

The transfer of water from agricultural to municipal uses has been a cornerstone of municipal water development for decades. Colorado has a long and successful history of providing water to growing municipalities by transferring water from farms to cities. This "Traditional Transfer Method" (TTM) is often pejoratively called "buy and dry" as towns and cities buy water from farmers to meet municipal needs. In fact, over the last decade, water from approximately 400,000 acres of farms[92] has been transferred from farms to cities in Colorado – TTMs is often the easiest, fastest, and most practicable method for municipalities to get more water. In northern Colorado over the last 25 years, water from approximately 420,000 acres of farm has been transferred to cities via TTMs[93]. Further, the Colorado Water Plan indicates that Colorado farmers will transfer water from 500,000 – 700,000 acres of farms by the year 2050[94].

TTM transfers have occurred over the history of Colorado involving hundreds of thousands of acre feet of water with little or no federal or state environmental-regulatory action required (including under the Clean Water Act) because little or no environmental damage occurs. Moreover, these TTMs occur between a willing buyer and a willing seller, and often the sellers (farmers) reap substantial profits from the business transaction. Save The Colorado supports the private property rights of farmers to sell their water to cities via TTMs.

Arguments against these transfers generally focus on the need to preserve agriculture as an element of Colorado's heritage. What is often missing in this discussion is a sober assessment of the number of willing sellers (i.e., agricultural producers who are looking to get out of the business) and the amount of agricultural water been separated from the land by development of that land (i.e., urban growth agricultural transfers).

Population growth, especially in the areas served by Denver Water's northern raw water contract customers often results in loss of agricultural lands to urban and suburban development. A report by

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[91] Alternatives Screening Report, Table A-14 (ID #403).
[92] https://www.yourwatercolorado.org/component/content/article/130-headwaters-magazine/headwaters-fall-2012-rooted-in-colorado/551-the-ever-evolving-farmer
[93] Public testimony, Weld County Commissioner Sean Conway at Fort Collins City Council meeting, September 1, 2015
[94] https://www.colorado.gov/pacific/sites/default/files/FINAL-2ndDraftClean-Appendices-2015%20Revised.pdf (page 208)

Western Resource Advocates detailed this transition in Northern Colorado.[95] Until local communities or the state take a legal and enforceable stand against such conversions, it must be accepted that the lost agricultural lands free up previously diverted and used water that can be applied to the needs of the growing population.

Additional water may be acquired through traditional (one-time purchase of underlying rights) and non-traditional (leasing and other innovative approaches to reduce the buy-and-dry impact) transfers of agricultural water to urban uses. Careful targeting of acquisition by Denver Water can help mitigate the impacts of "drying" on agricultural communities, particularly a sensitivity to maintaining existing sustainable agricultural communities.

Denver Water discarded numerous alternatives incorporating agricultural transfers due to cost, relying again on what are now much outdated data. The Corps must conduct an independent analysis of the availability and cost of water acquired through agricultural transfer and must in particular identify water that is likely to be freed from agricultural use due to urban and suburban development.

5. Conclusion

The proposed Moffat Collection System Project is a 20th Century "solution" and does not solve, 21st Century water management challenges. The unnecessary project relies on over 100-year old approaches rather than 21st century technology and values. Conservation, healthy rivers, and urban xeriscaping are proven winners for Colorado. Moffat is predicated on wasteful water use, dewatering rivers, and maintaining Kentucky bluegrass landscaping.

Denver Water is attempting to exercise relatively senior water rights from already seriously depleted headwaters streams in the Colorado River Basin. Denver Water does not need this water now, or any time soon, and will never need the water if it continues to pursue conservation and the other supply and re-use strategies detailed above. Save the Colorado identifies multiple sources of quantities of "new" water that approach, equal, or exceed that which Moffat would provide. Alternatives in the process of being studied or implemented, but not adequately analyzed (or unmentioned) in the FEIS, include Project WISE, Prairie Waters, and the 1940 Agreement negotiations. Conservation in combination with a Natural Conditions approach recognizing Denver is located in an arid environment would obviate the need for any new water or new diversions.

The Moffat project attempts to ensure that Denver Water customers can maintain inappropriate outdoor landscapes during a prolonged drought, instead of accepting reality. Reality involves water scarcity, climate change, increasing competition for finite Colorado River Basin supplies, and increasing

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[95] Western Resource Advocates, *A Better Future for the Poudre River*, December 2012 (http://westernresourceadvocates.org/publications/a-better-future-for-the-poudre-river/, last viewed June 2, 2016), pages 24 – 26.

risks of unacceptable impacts to an already over-stressed Colorado River ecosystem from the headwaters to the mouth.

The proposed Moffat project:

- Won't help Denver Water more reliably serve water.
- Would cost over $350 million, money which should be spent achieving real gains, not further draining and destroying the tributaries to the Colorado River and causing massive environmental damage with the expansion of Gross Dam and Reservoir.
- Is using flawed permitting processes and documents that violate NEPA by inappropriately screening out less environmentally damaging alternatives.
- Is not the least environmentally damaging practicable alternative (LEDPA).

The U.S. Army Corps of Engineers (Corps) needs to address many failings in the permitting documents before making a permit decision for the project, as described in the comments above. As documented above, Moffat is not needed. If built, it is undisputed that Moffat would have enormous environmental and socio-economic impacts. Despite Denver Water's efforts to establish otherwise in the FEIS, Moffat is not the Least Environmentally Practicable Alternative. The Corps should deny a permit for the project.

From:	Will Schaleben
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 2:22:11 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Will Schaleben
1425 Sierra Dr

Boulder, CO 80302-7846
3032345678

From:	Lyra Mayfield
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 2:06:52 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely, Lyra Mayfield

Lyra Mayfield
1340 King Ave
lyramayfield@gmail.com
Boulder, CO 80302
7203522631

From:	Diane Bergstrom
To:	Gross Reservoir SI-20-0003
Subject:	#SI-20-0003: Gross Reservoir & Dam Expansion
Date:	Friday, November 13, 2020 1:27:05 PM

Dear Commissioners,

Please review ALL the information available on the dam expansion, including the scientific evidence, biological evidence, human impact surveys, environmental impact information and wildlife impact studies. It is now time for science to be respected again, not discarded for corporate or governmental greed.

I am AGAINST the expansion, to be clear, for all the categories listed above. We don't need it. It's being ramrodded around legalities. Our wildlife has suffered enough with unprecedented fires and migration patterns have been altered with vast losses of life. The air quality has been greatly compromised with the fires. We don't need to compromise it further. Nor pollute the numerous water sources of streams, rivers and ground water, causing permanent damage that affects Colorado's flora, fauna and people. Agriculture and tourism greatly rely on the Colorado River which is now one of the most threatened rivers.

Please listen to your constituents and crush this. Denver Water couldn't do their damage in Southern Colorado through their intended Two Forks Dam project as it was appropriately rejected and crushed by the EPA. With the new administration and increased pressure to address the climate crisis, the EPA will be strengthened and challenged to again, reject these type of destructive unnecessary project disasters.

Be the ones who stand up, for your constituents, your environment, your county, and crush this.

Thank you,
Diane Bergstrom

From:	Pataricia Foss
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 1:00:42 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Pataricia Foss
2983 Bison Dr.

Boulder, CO 80302
303-444-0060

From:	Lindsay Alexander
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 12:53:40 PM

Dear Boulder County Commissioners and Staff,

I live next door to the West entrance to Gross Dam Reservoir. I strongly oppose the Gross Dam expansion for several reasons. Having been a resident of Boulder country for the last 10 years, I urge you strongly to reject this expansion. Living this close to the projected work site, and having such gaping holes in their project "plans", it only makes sense to reject this application. A project of this magnitude needs to have a completed 1041, and this is clearly not the case and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous

errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Lindsay

Lindsay Alexander
2001 County Road 68

Nederland, Colorado 80466-9692
3032427400

From: Jason Alexander
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Friday, November 13, 2020 12:52:45 PM

Dear Boulder County Commissioners and Staff,

I live next door to the West entrance to Gross Dam Reservoir. I strongly oppose the Gross Dam expansion for several reasons. Having been a resident of Boulder country for the last 10 years, I urge you strongly to reject this expansion. Living this close to the projected work site, and having such gaping holes in their project "plans", it only makes sense to reject this application. A project of this magnitude needs to have a completed 1041, and this is clearly not the case and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous

errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Jason Alexander
2001 County Road 68

Nederland, Colorado 80466-9692
4027308731

From:	Megan Ottinger
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 12:51:25 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Megan Ottinger
255 Forsythe Rd

Nederland, CO 80466
7206352885

From:	Steve Paul
To:	Boulder County Board of Commissioners
Cc:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir Expansion
Date:	Friday, November 13, 2020 12:49:04 PM

Dear Commissioners
I have been part of the Flagstaff Mountain community for 27 years, and own property adjacent to Gross Reservoir. The expansion project is a disaster for this wonderful environment and its local residents, as well as Boulder County residents as a whole. This project must be seriously questioned as part of the 1041 review.

The Denver Water application is incomplete. Many of its “plans” need to be rigorously inspected as it is our community and county that will withstand the impacts of this huge project.

The Army Corps’ Environmental Impact Statement record of decision violates the National Environmental Policy Act in that it does not establish purpose and need or accurately analyze alternatives. In violation of the Clean Water Act, the Corps has failed to choose the least environmentally damaging alternative. The application also violates numerous Boulder County land use codes.

My neighbors and I who live very near the reservoir are concerned about the noise and air pollution as well as traffic this project could cause. We are concerned about the quality of our well water we depend on. The reservoir and nearby Walker Ranch open space are recreational “gems” that would be affected for a long time.

In the big picture of western water management, the reservoir expansion is a poor plan for the Colorado River.

Thank you for your consideration.

Stephen Paul MD
8548 Flagstaff Rd
303 880 4283

From:	Raymond Bridge
To:	Gross Reservoir SI-20-0003
Subject:	Boulder County Audubon Comments
Date:	Friday, November 13, 2020 12:47:20 PM

Boulder County Audubon Society

Commissioners:
The Boulder County Audubon Society thanks you for having asserted and successfully defended your 1041 authority over this project.
We now urge you to reject Denver Water's application.
This massive project would result in severe deleterious effects on the environment and on the quality of life of residents of Boulder County. It would further dewater the Colorado River.

Denver Water's assertions of need for this project are based on outdated demand estimates. It has demonstrated no need for additional transmountain diversions, nor a legitimate need for resiliency in its northern supply network.

Please reject this application.

For the board of Boulder County Audubon Society,

Raymond Bridge, Conservation Chair

From:	mary pettigrew
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 11:28:16 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

mary pettigrew
260 mohawk drive
mary@ampersand-design.com
BOULDER, CO 80303
3034941571

From:	Dara Rotunno
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 11:24:22 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Dara Rotunno
2965 darley ave

Boulder, Co 80305
7209349272

From: Carolyn Stansfield
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Friday, November 13, 2020 10:51:54 AM

Dear Boulder County Commissioners and Staff,

Its heartbreaking to think of the damage to the natural areas around the reservoir if this project comes to fruition- nevermind the gross misuse of our water and impacts on neighborhoods. Please consider the comments below.

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Carolyn Stansfield

Carolyn Stansfield
176 bonnie rd

Nederland, Colorado 80466

From:	Kathy Polizzi
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 10:17:05 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:

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- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

In addition, from a completely personal point of view, I want to comment on what is at stake here. I live on Twin Sisters Road, so the immediate changes from a construction project of this magnitude will be enormous for me. The construction, the noise, the traffic, the epic-scale change to the part of the Earth where I live will all be adverse consequences for me, personally. However, there are bigger consequences for all of us as residents of planet Earth.

Our climate is changing. Precipitation patterns are shifting, particularly in arid regions like the one where we all reside. There is no guarantee there will be sufficient precipitation to regularly supply an expanded Gross Reservoir. This means we will have cut and cleared forest, only to leave a giant, ugly eyesore of a bathtub. Even in the years when the expanded capacity is filled with water, we will have created a much larger surface area for evaporation to do its work. So we will have expended all this energy to move the water from the Western slope in order to lose it to greater evaporation rates in a warmer atmosphere. These are physical processes, they will operate whether we want them to, or not.

Finally, we as a society must stop viewing reservoirs as a consumable resource. By this I mean that there are only a limited number of sites on the planet suitable for reservoir construction, due to the plain facts of topography. As we calculate the costs and benefits of dam construction (and expansion), I fail to see any accounting for the most insidious process of all, which is sedimentation. Over time, sedimentation reduces the storage capacity of every site we choose to use, eventually filling the topographic reservoir and leaving an unsustainable resource for future generations. Consider a few more generations than the construction engineers are planning for, and we will simply have filled whatever bathtub we've constructed into a mudflat. As a society, I believe we must stop treating our topography as a consumable resource. We must consider sustainability, for the sake of the Earth's future generations.

Please reject this application.

Thank you!
Sincerely,
Jim and Kathy Polizzi

Kathy Polizzi

,

From:	Kate Thompson
To:	Boulder County Board of Commissioners
Cc:	Gross Reservoir SI-20-0003
Subject:	Gross Dam Expansion
Date:	Friday, November 13, 2020 9:19:42 AM
Attachments:	Gross Reservoir 1041 .docx

Dear Commissioners

Please see the attached comments regarding the proposed expansion of Gross Reservoir.

sincerely

Kate Thompson

Kate Thompson MA MA CJT
5840 flagstaff Road
Boulder
CO 80302
Existential & Journal Therapy
kate@katethompsontherapy.com

https://www.psychologytoday.com/profile/102786

+1 303 870 5775

See my blog: https://therapeuticjournal.wordpress.com/

November 13, 2020

Subject: Gross Reservoir 1041 Application Comments
grossreservoir@bouldercounty.org
commissioners@bouldercounty.org

Boulder County Commissioners

According to the Boulder County Sustainability Program, *as a county government, we take these priorities to heart and work daily to further the county's long-term vision for well-planned urban development and the preservation of our rural and mountain communities and landscapes. As commissioners, we have always placed a high priority on making sustainability a guiding value for the county. This commitment to environmental sustainability is echoed by our community: a majority of Boulder County residents truly value sustainability as a lifestyle and as a way for us to preserve Boulder County's natural resources.*

The Boulder County Sustainability Mission Statement is to ensure that Boulder County's operations, programs, services, regulations, and decision-making processes reflect our deep commitment to environmental, social, and economic sustainability, while building strong local partnerships to help the broader community and region become healthier and more sustainable.

The Gross Dam is not a sustainable project and goes against the Boulder County Sustainability philosophy and mission statement. Therefore, the Gross Dam Project should not be allowed to proceed, and the application should not be approved by Boulder County.

Please read the following comments to the Denver Water 1041 Application:

Denver Water has failed to develop and implement a real water conservation program in their service area. A very large percentage of water is used for lawn irrigation of non-native blue grass lawn. Other southwestern cities such as Las Vegas have developed aggressive water conservation programs using xeriscapes. The Front Range population including the Denver Water service area needs to live within their available natural resources without sacrificing those natural resources for future generations.

As mentioned in the TEG comments to the Army Corps of Engineers and mentioned in past County Commissioner meetings, the hydraulic data used to justify this project is outdated and does not take climate change properly into account. This failure helps justify the Gross Dam expansion without adequately protecting the associate stream systems and if the dam is really needed. It is possible that after a 7-year construction project the dam will never be filled to capacity due to drought/climate change conditions that have been ignored by Denver Water.

The bottom release of water from the dam will affect aquatic life due to extreme cold temperatures that are below CDPHE water quality standards. Aquatic life will be impacted within our County.

It appears that a new SH 72 intersection and road improvement will be needed for the project to support high volume truck traffic. It appears that the citizens of Boulder County and the state will pay for these improvements instead of Denver Water.

Page 24 Table 4 provides inadequate detail on schedule dates and actions; critical milestones are not well identified and detailed for the interested public reader which is insulting for those citizens being impacted by this project.

Denver Water's 1041 application is incomplete (see below). Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

It is my understanding that CDOT has not performed their own internal environmental impact study regarding proposed changes to SH 72 to support this project. There is no mention about this CDOT study. In fact, CDOT has not been forthcoming with information about this environmental impact study and cancelled a CDOT, Denver Water and TEG meeting in an effort to discuss this impact study.

Denver Water fails to discuss how County officials and professionals will be allowed to visit and audit numerous environmental actions to reduce and mitigate impacts. There needs to be consistent coordination and evaluation meetings with Boulder County being an equal partner for environmental management. An environmental kick off meeting with all locals, state and federal representatives needs to happen and is not discussed in this application. This lack of environmental coordination is a critical deficiency.

Specific Deficiencies

Denver Water continues to have an arrogate attitude. The 1041 application requests a "waiver" in Section 8-503 stating that it does not have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

> Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that **don't yet exist** which are required to exist and to be complete (and should require public review and comment) to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan
- Aquatic Invasive Species Monitoring Plan

- Traffic Management Plan
- Fugitive Dust Control Plan
- Road Maintenance Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County should not consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
- The "Purpose and Need" in the EIS is not accurate and must be redone.
- The "Alternatives" analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

The document needs to be a stand-alone document that follows Boulder County requirements; this application just throws information against the wall to see what will stick with the Commissioners.

Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.
- The application fails to comply with the Boulder Valley Comprehensive Plan.
- The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

- The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage. The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

From:	Larry Barfield
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 9:18:16 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Larry Barfield

Boulder, Colorado 80304

From:	Karen Gerrity
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Opposition to Denver Water"s 1041 application
Date:	Friday, November 13, 2020 8:48:30 AM

Good Morning Commissioners,

Please add my voice to the resounding opposition from area residents regarding the Denver Water's application to increase Gross Reservoir. Please deny their request for a waiver stating that they don't need to comply with Boulder County Land Use Code.

No doubt you are receiving detailed information about the environmental impacts from this proposed project from experts in the field. I won't fill this email with the long litany of environmental devastation to our beloved western Boulder County.

Instead, I appeal to your better angels as you consider this decision.

As a society, we are evolving to a place of enlightenment, where we understand our interconnectedness to all things. We are growing our understanding of how every land use decision impacts the natural environment and these impacts need to be considered deeply.

Draining and storing more of the Colorado River is not the answer for addressing current and future droughts in our state.

Studies have shown that conserving water is the most effective path. My understanding is that it would be much more cost effective for Denver Water to provide funding for energy efficient plumbing fixture upgrades for all their users and they would achieve the same desired outcome. Let's not enable the overuse of water, treating it like an infinite commodity, which of course, we know it is not.

As a resident of Coal Creek Canyon, you represent hope for me and my neighbors. We have faith in you that you will do the right thing. Please don't let us down.

Respectfully yours,

Karen Gerrity

From:	Mary Krayer
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	STOP GROSS DAM EXPANSION
Date:	Friday, November 13, 2020 8:43:08 AM

Dear Boulder County Commissioners,

I believe this application should be rejected not only for the reasons listed below, but also because it is not in alignment with conservation. I'm a native Coloradan and have watched the water issues, drought, and climate change become more of a reality. As our population continues to grow, having enough water will always be an issue. Instead of expanding and building more dams, Denver Water Board should be looking at better water purification systems, replacing old and inefficient water systems, accepting new development plans with rigorous water conservation focusing on xeriscaping with community parks, all homes built with energy/water saving appliances, emphasis and education on conservation.

We all have a responsibility to take care of our planet. Climate change is not going away. Federal authorities have said most of Colorado has /is been in a drought for years; a couple of weeks ago they classified 97% of Colorado in severe to exceptional drought. We need to put more focus on ways to be more environmentally responsible to our planet.

Personally, I would like to know where Denver Water Board thinks the water will come from to necessitate expanding Gross Dam. All the water from the Divide is already spoken for. Perhaps no one on the Board lives on a property with a well, and a slow producing one as the water table becomes more depleted. Look at the devastating fires we have had this year, that are creating their own weather patterns.

I'm a resident of Coal Creek Canyon for 30 years. I believe this will have a negative impact on our community as we only have one direct road to town, for emergency vehicles, school busses, commuting. Thank you for your time.

Sincerely,

Mary Krayer

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
  - The “Purpose and Need” in the EIS is not accurate and must be redone.
  - The “Alternatives” analysis in the EIS is not accurate and must be redone.
  - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
  - The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
  - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

From:	Dianne Fleming
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 8:36:10 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Dianne Fleming
PO Box 1074
117 Spruce Way
Nederland, Colorado 80466
303-258-7758

From:	Tim Hagaman (Integer)
To:	Gross Reservoir SI-20-0003
Subject:	Docket #SI-20-0003: Gross Reservoir & Dam Expansion
Date:	Friday, November 13, 2020 7:47:27 AM

Dear Boulder County,

Please don't allow Denver Water to expand Gross Reservoir Dam. The process is lethal for all that live around it. I live here in Coal Creek and the Pandemic has been hard enough for it's residents. It's proved that Arvada doesn't need the extra water and with all of the Environmental concerns it's just poor planning and development. Making of the concrete alone to expand the Dam will create alarming amounts of CO2 and make an unbearable amount of Noise and air pollution. Denver Water is only perpetuating all that is destroying the Earth by creating this false need for more Water. It will change the whole Western Front and the Colorado River. The impact is just too detrimental during these difficult times. Arvada should begin to conserve their water and not have perfectly manicured lawns. They shouldn't destroy the area where so many animals and humans live for their own Greedy purposes. I beg you, please don't allow Denver Water to expand Gross Reservoir Dam. Thank you for your time.

From:	fred peck
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 7:29:44 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

fred peck
738 pine glade drive

black hawk, CO 80422
3033255289

From: Dave Troutman
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Friday, November 13, 2020 7:17:45 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Dave Troutman
396 CR 442

Grand Lake, CO 80447
813 267-3576

From: Nohn Eckert
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Friday, November 13, 2020 5:22:56 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely, John Eckert

Nohn Eckert
557 Swan River Dr

Be ton Harbor, MI 49022
5742622894

From:	Crystal Gray
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Friday, November 13, 2020 1:01:50 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Crystal Gray

Crystal Gray
1709 Spruce Street

Boulder, CO 80302
303-449-9680

From: Susan Babbitt
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Friday, November 13, 2020 12:25:38 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

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Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Susan Babbitt
319 South Tent Street, #133

Philadelphia, PA 19107
2679689582

From: Tracy Smith
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Thursday, November 12, 2020 11:20:41 PM

Dear Boulder County Commissioners and Staff,

Please take the time to read and study not only the 1041 application from Denver Water but also the enclosed reasons why it is incomplete and should be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Tracy Lorraine Smith

Tracy Smith
45 S. 33rd St.

Boulder, CO 80305
303-494-3774

From:	Peter Rodgers
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 11:16:40 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely, Peter Rodgers

Peter Rodgers

,

From:	Cook Rodgers
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 11:13:17 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely, Cook Rodgers

Cook Rodgers

,

From:	marta
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	"Reject Denver Water"s 1041 application
Date:	Thursday, November 12, 2020 9:51:42 PM

Dear Boulder County Commissioners and Staff

my name is Marta Ballen
I live in boulder county at
72 Lakeshore park road
boulder , colorado
80302 zip code

thank you for your service and time to hear our request

PLEASE simply CAN SOMEONE SUGGEST WAYS IN SOCIETY ON THE FRONT RANGE TO USE LESS WATER
that can be implemented to use less water
this would feel and seem so good instead of all this waste and fear

PLEASE reject denver water's 1041 application
it does not foster harmonious ways of living with our environment

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

From:	Michael Carr
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 9:31:52 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Michael Carr
3260 47th St
208
Boulder, CO 80301

From:	Lysa Wegman-French
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 8:36:10 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code. Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver.
Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Lysa Wegman-French

Lysa Wegman-French
4512 Prado Dr.

Boulder, CO 80303

303-543-0150

From:	Tom Moore
To:	Boulder County Board of Commissioners
Subject:	NO to Gross Reservoir expansion
Date:	Thursday, November 12, 2020 8:27:30 PM

I urge disapproval of Denver Water application to do a major expansion of the Gross Reservoir dam. This certainly looks like a MAJOR BOONDOGGLE.

I understand that they have appealed for a waver of Sec 8-503 of the Boulder County land use code. If this is a claim that the project application is “not for site selection and construction of major facilities of a public utility,” then what is it

Many of us are super concerned about the environmental impacts of this horror. To begin with, the water will be taken from Western Colorado, that already suffers from reduced water inputs. This is very likely a long-term problem in our state. Then there are a great number of trees that will be removed. This is one more attack on habitat for both animals and plants—all for the benefit of Denver’s desires to expand. How much is enough? Perhaps not for us to say, but certainly not for us to support and subsidize.

And then there is traffic up and down Flagstaff. No problems with C02? The entire project will be using loads of gasoline and diesel No problem with CO_2? Concrete is very carbon intensive. The carbon dioxide etc is one of THE MAJOR PROBLEMs of our day! Boulder County should not be complicit regardless of the tears coming from Denver Water and the business & realtors who rank growth over survival on our planet over their profit interests.

Dust, erosion, invasive plants, noise, wrecking our roads with heavy equipment all come to mind immediately. Thanks in advance for opposing this terrible project.

Tom Moore
2830 5th St
Boulder, 80304

From:	Dylan Mitchell
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 8:05:21 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Invasive Plant and Noxious Weed Species Management Plan
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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application. Thank you.

Sincerely,
Dylan Mitchell

Dylan Mitchell

,

From:	Anita Wilks
To:	Beverly Kurtz; Bob Kropfli; Claire Levy; Matt Nicodemus; Karen Foley BRON; Karen Schwimmer; Lane, Eric; Gross Reservoir SI-20-0003
Subject:	New information - 1041 App Gross Res
Date:	Thursday, November 12, 2020 7:53:28 PM

This 1041 application and process are part of a charade being conducted by the Boulder County Board of Commissioners in partnership with Denver Water. By not requesting a rehearing of the Federal Energy Regulatory Commission's (FERC) decision to take jurisdiction over the Gross Dam and Reservoir components of Denver Water's Moffat Collection System Water Supply Project, or appealing that decision to the United States Court of Appeals, the commissioners voluntarily relinquished the county's land use jurisdiction over that project. The county is bound by the FERC licensing order and has no authority whatsoever to enforce any conditions on the project contrary to those in FERC's licensing order, much less deny the 1041 permit. The county commissioners have joined with Denver Water to conduct this charade to placate the public in hopes that we will think we had some input or opportunity to participate and go along with this catastrophic attack on our land and way of life. *I am writing this after consultation with the assistant county attorney assigned to this project.* This explains why the county land use staff have ignored my requests that they put the FERC order licensing the water project on the records of this proceeding. That licensing order explains that, by not requesting a rehearing or appealing to the United States Court of Appeals, the county accepted the licensing order and relinquished all land use control over the water supply project. The planning staff has ignored my requests that they put Boulder County's motion to intervene in the FERC proceedings, and subsequent statement to FERC further outlining Boulder County's objections to the water supply project, on the records of this 1041 proceeding. The planning staff has my ignored my requests to put two letters the county sent to the Army Corps of Engineers objecting to Denver Water's application for a Clean Water Act Section 404 permit and outlining Boulder County's objections to the water supply project on the record of this 1041 proceeding. They want us to forget that these things ever happened as part of the charade in which we are now engaged. The county commissioners have been trying to get this project approved for Denver Water since at least December of 2012 when they called a meeting to quickly and quietly accept an IGA with Denver Water circumventing the 1041 process without the notice to the public required by our land use code. It's been a long battle and many of us have poured much of our life's energy into protecting our water and land from this attack, but the county commissioners and Denver Water have won this battle against us. If you are interested in what protections there might be for our land and water in the FERC licensing order, to which the county commissioners have legally bound us, but you don't have time to peruse the 38-page order if you can find it, I will summarize those protections for you in one word: ZILCH.

From: Kathleen Spear
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Thursday, November 12, 2020 7:29:38 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Kathleen Spear
745 Mapleton Ave

Boulder, CO 80304
8479276454

From:	John Wagner
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 7:27:48 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

John Wagner
137 cherrywood ln

louisville, co 80027

From:	LAURA DOWNING
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Gross Reservoir Expansion
Date:	Thursday, November 12, 2020 7:25:34 PM

You need only to read Boulder County 1041 Regulations to know that requirements have not been met! This environmentally destructive expansion of the reservoir is wrong and must be refused!
Thank you for your serious consideration of this important issue.

Sincerely,
Dr. Laura Middleton Downing
PO Box 2312
Boulder, CO 80306

From:	FRANK LANDIS
To:	Gross Reservoir SI-20-0003
Subject:	Reject Denver Water's 1041 Application Re Gross Reservoir
Date:	Thursday, November 12, 2020 6:01:21 PM

Dear Commissioners,
I urge you to reject Denver Water's attempt to expand Gross Reservoir capacity for many reasons:
The 1041 application is apparently incomplete and lacking many of the required provisions;
and, the increased traffic and construction emissions (dust, vehicle and equipment exhaust, etc) will endanger the health and well-being of many Boulder County residents;
and, this is ultimately yet another diversion of the Colorado River headwaters, moving water from west to east, which is ecologically untenable and morally unconscionable;
and, permanent removal of many acres of trees, as well as the above-mentioned emissions, will exacerbate global warming;
and, on a personal level, I am a 72 year old Boulder County resident who loves to fish in the Gross Dam tailwater, and the proposed expansion will definitely disrupt South Boulder Creek, for least a decade or more — if this is approved, I will lose my best local chance to renew myself for months, if not years, at a time, and I don't have that many left.

Please reject this desecration!

Sincerely,
Frank Landis

FrankLandis880@msn.com
Mobile: (303) 870-4058
880 Pope Drive, Erie Co 80516-6533

From: Jeff Thompson
To: Gross Reservoir SI-20-0003
Subject: Denver Water 1041 Application
Date: Thursday, November 12, 2020 5:54:07 PM

This 1041 application and process are part of a charade being conducted by the Boulder County Board of Commissioners in partnership with Denver Water. By not requesting a rehearing of the Federal Energy Regulatory Commission's (FERC) decision to take jurisdiction over the Gross Dam and Reservoir components of Denver Water's Moffat Collection System Water Supply Project, or appealing that decision to the United States Court of Appeals, the commissioners voluntarily relinquished the county's land use jurisdiction over that project. The county is bound by the FERC licensing order and has no authority whatsoever to enforce any conditions on the project contrary to those in FERC's licensing order, much less deny the 1041 permit. The county commissioners have joined with Denver Water to conduct this charade to placate the public in hopes that we will think we had some input or opportunity to participate and go along with this catastrophic attack on our land and way of life. *I am writing this after consultation with the assistant county attorney assigned to this project.* This explains why the county land use staff have ignored my requests that they put the FERC order licensing the water project on the records of this proceeding. That licensing order explains that, by not requesting a rehearing or appealing to the United States Court of Appeals, the county accepted the licensing order and relinquished all land use control over the water supply project. The planning staff has ignored my requests that they put Boulder County's motion to intervene in the FERC proceedings, and subsequent statement to FERC further outlining Boulder County's objections to the water supply project, on the records of this 1041 proceeding. The planning staff has my ignored my requests to put two letters the county sent to the Army Corps of Engineers objecting to Denver Water's application for a Clean Water Act Section 404 permit and outlining Boulder County's objections to the water supply project on the record of this 1041 proceeding. They want us to forget that these things ever happened as part of the charade in which we are now engaged. The county commissioners have been trying to get this project approved for Denver Water since at least December of 2012 when they called a meeting to quickly and quietly accept an IGA with Denver Water circumventing the 1041 process without the notice to the public required by our land use code. It's been a long battle and many of us have poured much of our life's energy into protecting our water and land from this attack, but the county commissioners and Denver Water have won this battle against us. If you are interested in what protections there might be for our land and water in the FERC licensing order, to which the county commissioners have legally bound us, but you don't have time to peruse the 38-page order if you can find it, I will summarize those protections for you in one word: ZILCH.

From:	Scott Peyton
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 4:43:07 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Scott Peyton
7553 skyway courr

Boulder, Co 80303
3035065838

From:	Laurelyn Baker
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 4:11:59 PM

Dear Boulder County Commissioners and Staff,

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First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Laurelyn Baker
570 Union Ave.

Boulder, COLORADO 80304
3034496209

From:	Laurelyn Baker
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 4:11:37 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
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- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,Laurelyn Baker

Laurelyn Baker
570 Union Ave.

Boulder, COLORADO 80304
3034496209

From:	Sandy Zelasko
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 3:54:25 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Sandy Zelasko
15864 Severino Lane

Valley Center, CA 92082
7607496916

From:	Susan Stephens
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 3:46:33 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Susan Stephens
5475 Tenino Ave
susan@operant.com
Boulder, Colorado 80303
3035546312

From:	Betsy Neely
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 3:26:47 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Betsy Neely
2941 20th Street

Boulder, Colorado 80304
303-443-8094

From:	Don Van Wie
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 3:24:16 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Don Van Wie
206 HAZELWOOD DRIVE
don.vanwie@gmail.com
NEDERLAND, CO 80466
3032580170

From: Andrew Melick
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Thursday, November 12, 2020 3:16:24 PM

Dear Boulder County Commissioners and Staff,

The environmental damage caused by diverting even more water from the Colorado River to turn Denver's unnaturally green landscapes (lawns and golf courses) will be irreparable. Zeroscaping alone would ensure Denver has all the drinking water it needs in perpetuity. Why destroy the riparian ecosystem by building a dam at enormous cost to taxpayers when Denver's water use problem can be solved for free?

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Andrew D. Melick

Andrew Melick
andymelick@hotmail.com
andymelick@hotmail.com
andymelick@hotmail.com, andymelick@hotmail.com andymelick@hotmail.com
andymelick@hotmail.com

From: Emma Sargent
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Thursday, November 12, 2020 3:11:43 PM

Dear Boulder County Commissioners and Staff,

Denver Water's 1041 application for the expansion of Gross Dam is incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Emma Sargent

Emma Sargent
855 Grant Pl

Boulder, Colorado 80302
7205797241

From:	Kenneth Fisher
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 2:15:31 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Kenneth Fisher
1182 Chute Rd.
kjfisher216@hotmail.com
Golden, CO 80403
3036423955

From:	Teagen Blakey
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Reject Denver Water"s 1041 Application
Date:	Thursday, November 12, 2020 2:15:03 PM

Dear Boulder County Land Use, and Boulder County Commissioners,

Despite the many hundreds of pages, Denver Water's 1041 application is woefully incomplete. As it stands it is entirely impossible for Boulder County to properly evaluate the project and the impact it will have on Boulder County given the many missing components of the application. Over the past decade hundreds of residents have turned up to public hearings again and again to point out the inadequacies in Denver Water's plan to expand Gross Reservoir. Despite the years that have gone by Denver Water has still not been able to successfully address those outstanding concerns as is evidenced by their application to Boulder County. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all the deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

**Note, while this letter contains many points made in similar letters, there are additions to my letter throughout.*

Specific issues with the application:

Firstly: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
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For example, take the absence of Denver Water's Tree Removal Plan and Traffic Management Plan. Without a Tree Removal Plan the County does not know if they need to evaluate the impact of such a plan on the Country Roads, which will likely need to be widened, or if they need to evaluate the noise impact of hundreds of helicopter trips in and out to remove trees. Changes to roads and access to the reservoir, as well as the large vehicles required to remove trees will have detrimental effects on recreation management, both in increasing access to areas making recreation harder to manage, and creating dangerous traffic situations with cars trying to maneuver around large vehicles in the same tight spaces.
This leads to the missing Traffic Management Plan. As Boulder County is aware, having pointed out many errors in the plan/permit Denver Water submitted to FERC in the County's motion to intervene, Denver Water has relied on misleading road information to determine their ability to carry out the project. Given Denver Water's previously faulty information, as well as their poorly executed test run with a 14-wheeler trying to navigate Hwy 72 and make the turn onto Gross Dam Rd Boulder County must see a Traffic Management Plan from Denver Water in order to evaluate its accuracy and practicality, as well as the safety consequences (see more under "**Nineth**" below).

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Second: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” If building the tallest dam in Colorado history is not the construction of a major facility of a public utility, I'd like to know what is! Denver Water is incorrect on this point, and therefore must comply with this section of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
    - The “Purpose and Need” in the EIS is not accurate and must be redone.
    - The “Alternatives” analysis in the EIS is not accurate and must be redone.
    - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
    - The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
    - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

Failed to use an adequate alternatives analysis.

- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.
- Incorrect information about number of lanes on roadways, and intended development of roadways.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies. Numbers show that by replacing all of the toilets in Denver with low flush models Denver Water would save more water each year than they estimate they can acquire with an expanded Gross Reservoir.

Seventh: The application also violates Boulder County Land Use Code Section 8-511.D.2, which requires that the environmental capacity exists to sustain the growth and development that may occur as a result of major extensions of domestic water systems. The Colorado River, from which Denver Water would be drawing from, is already one of the most endangered rivers in the county. Combined with climate change and the expected loss of water in the Colorado River Basin there is no environmental capacity for the Colorado River, or its tributaries, to support further growth and development on the Front Range.

Eighth: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Nineth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property, which has been detailed by many speakers in the public hearings on the Gross Reservoir Expansion to date. The most poignant public testimony is possibly that provided by a local trucker at the very end of one of the Commissioners' hearings. In brief he described the consequences of the 14-wheelers coming and going from Gross Reservoir. When a trucker loses control of the vehicle they first aim for a bank to stop the truck, if there isn't one they head into the trees, and if that doesn't stop the truck it goes through a house. What is it like to drive on the mountains roads in a 14-wheeler? Just put your steering wheel 3/4 of the way into the other lane around a blind curve and you can find out. What is left after an inevitable collision with such a big truck on a winding mountain road? He told everyone that the remains are carried out in body bags. As residents in Boulder County we need you to take our safety seriously, and hold Denver Water accountable for meeting those non-negotiable requirements.

Tenth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes, which have at minimum doubled in the area surrounding Gross Reservoir in the last year due to COVID restrictions and recreationists looking to get outside.

In what would be the largest construction project in Boulder County's history it is paramount that the County hold Denver Water's application for the expansion of Gross Reservoir to the highest standards. I firmly believe that Denver Water's time constraints should not affect the County's responsibility to thoroughly evaluate the appliclication, and to deny the application if the application remains incomplete, or in violation of Boulder County's Land Use Code after requests to remedy it.

Thank you for protecting the integrity of Boulder County, and being a strong voice for its residents throughout this process.

Sincerely,

Teagen Blakey

618 Aspen Meadows Rd

Nederland, CO, 80466

From:	GInger IKeda
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 1:57:04 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

GInger IKeda

Boulder, CO 80304

From:	Elizabeth Ellis
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 1:17:54 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Elizabeth Ellis
3005 Carnegie Drive

Boulder, CO 80305
3035133409

From:	Jim Horvath
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 1:16:21 PM

Dear Boulder County Commissioners and Staff,

A year ago, I was visiting Tucson Arizona and picked up a local weekly newspaper. The front-page article was about the Colorado River and the dwindling amount of water in the Basin. Tucson, so many miles from the source of the river gets a large amount of its water from the Colorado as do many other cities. The range extends from places east of Denver, Santé Fe and then west, all the way to San Diego. The river is a trickle when if reaches the Sea of Cortez. Currently, Lake Mead is at about 40% capacity and Lake Powel at 50%. With and annual deficit of nearly one million-acre feet it is unlikely that these and other reservoirs on the system will ever be full again.

The proposed expansion of Gross Reservoir is essentially a continuation of 19th century technology into the 21st century. Large reservoirs make little economic sense in this era of climate change. Seventeen percent of the Colorado River water is currently lost through evaporation. But Denver Water is in the business of selling water as well as evidently building dams. Alternatives such as aqueduct recharge with diverted water or even getting water from the wetter eastern watersheds such as the Missouri have not been addressed as well as water conservation. Instead Denver water wants to raise the height of Gross Dam by 131 feet to fill with potentially non existent water. They assume that after construction is complete it would take at least 7 years for the reservoir to fill. However, it is likely that it will never be filled.

Of course, the Commissioners are primarily concerned with the impact on Boulder County and nearby Jefferson County residents and the environment. The dam expansion would be the largest construction project in Boulder County history with essentially no real benefit to its citizens. The impact of 7 years of construction to the nearby residents would be horrendous and people throughout the county will also be impacted. Wildlife and fish populations will feel the effects. Construction traffic will consist of the hundreds of workers commuting to the project as well as large trucks delivering materials and equipment as well as trucks dealing with the thousands of trees that will have to be removed. Recreation in the areas adjacent to the expansion will probably cease. But perhaps the biggest problem that has not been fully addressed is the increased risk of wildfire. 2020 was the worst year for fires in the history of Colorado. Do we really want to have an exponentially increased risk of fire in this dry area?

And then we have the long-term environmental effects. Last month, I went down Wineger Creek to the reservoir. It was at an extremely low level as it is every fall and winter, an ugly sight. But above the reservoir, the vegetation along the seasonal creek was lush and varied, a narrow band of native trees and brush that hardly exists in Boulder County. Wineger will suffer and Forsythe Canyon will be deluged and the water fall destroyed. The beautiful wild area of South Boulder Creek above the reservoir will be destroyed.

Unfortunately, Denver Water and their partners including the City of Arvada seem to have little concern for any the many issues. This is a $500, 000, 000 project with the backing of huge multinationals who would benefit, but the citizens of Boulder County will not.

Jim Horvath
38 Bonnie Road

Nederland, CO 80466

From:	Charlene Rush
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 12:59:19 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Charlene Rush
2670 Thoroughbred Ct. #835

Allison Park, PA 15101
4129037487

From:	Janis Kelly
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 12:35:24 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Janis Kelly
11753 Hillcrest Road

Golden, Colorado 80403
916-873-4856

From:	Ashleigh Shader
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 12:33:06 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Recreation Adaptive Management Plan for Winiger Ridge
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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Ashleigh Shader

,

From:	Patricia Eaton
To:	Gross Reservoir SI-20-0003
Subject:	Gross Resevoir
Date:	Thursday, November 12, 2020 12:15:42 PM

Once this is okayed, there is no going back. The Denver water application is not valid and should be refused until it is done properly. Also, I think that none of that water should go for fracking. If water is so precious, let’s keep it for our farmers, our animals, and our population. Putting restrictions on water use and emphasizing water conservation should be completely exhausted, before such an extreme step, as Gross Reservoir expansion, be considered!

Thank you so much,

Patricia Eaton

Sent from my iPad

From:	Jodi Connelly
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 12:14:41 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

In addition, this continues to encroach on wildlife already pressured by the growth of Denver sprawl. We do not want to become another California!

Please reject this application.

Thank you!
Sincerely,

Jodi Connelly
23922 Highway 119, #3397
mountaindrums66@gmail.com
Nederland, CO 80466
7209879221

From: Shara Johnson
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003

Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Thursday, November 12, 2020 12:10:12 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Shara Johnson
96 Tejas Lane

Nederland, CO 80466
3032583915

From:	James Curfman
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Reject Denver Water"s 1041 application
Date:	Thursday, November 12, 2020 12:07:44 PM

Dear Boulder County Commissioners

Please allow the comments below to serve as my formal objection to Denver Water's permit application for approval of the Gross Reservoir expansion project. It is my firm belief that Denver Water has not complied with Boulder County's Land Use Code and that Boulder County must not consider this application or deem it complete and must return it to Denver Water for clarification and completion, including the submission of detailed plans describing construction and transportation during throughout the project AND the mitigation of environmental impacts caused by the removal and transport of Colorado River water from Grand and other western slope rivers to Boulder County for temporary storage.

Attached is a letter I wrote in 2009 to the Army Corps of Engineers in opposition to the project which contains relevant information for your consideration as you proceed to approve or deny the application by Denver Water. The arguments contained therein are applicable to this process.

RE: Moffat Collection System Project

Dear Mr. Franklin:

This purpose of this letter is to object to the proposal to enlarge Gross Reservoir to accommodate the anticipated demand by customers of the Denver Water Board (DWB). Regardless of this perceived demand, water is in finite supply regardless of the demand perceived by DWB. To think that every time demand potentially exceeds supply DWB simply resorts to increasing its reserves from the western slope is not sustainable. The impact of this proposed expansion has consequences that are irretrievable and the implications for the future cannot be foreseen.

The impact to local residents living in the footprint and surrounding areas affected by the construction will be massive. Having been employed in the heavy and highway construction and civil engineering industry all my life, both as a contractor and a consultant, I know first-hand the implications of a construction project of this magnitude. I understand the impact that 25-55* daily truck trips up and down the canyon will have on those living not only in the immediate vicinity of the project but also on SH 72. I can picture the impact caused by the addition of 60-100 daily commuter trips by construction workers. Contrary to claims by DWB, I know the existing gravel road from SH72 to Gross Dam (Gross Dam Road) will not withstand the increased truck traffic that is projected to traverse this section. I know that the noise of chainsaws and logging operations combined with the daily operation of earthmoving scrapers, rock crushing, and blasting will have a significant impact to the residents surrounding the reservoir. SH 72 (Coal Creek Canyon) is a very narrow 2 lane road with numerous sharp curves and minimal sight distances. Presently, travel up and down the canyon is moderately dangerous, with serious accidents occurring on a routine basis. Increasing the volume of traffic by the type and quantities described above would surely result in a significant increase in the hazards associated with travel through that corridor.

*This figure is also questionable. See calculations below.

The DWB states that the project will consume "800,000 cubic yards (cy) of material…"   A cubic yard of concrete is comprised of approximately 50% sand. DWB states that all of the "finer, sand-sized material …would be supplemented with material from a Front Range supplier. Other materials, such as flyash and cement, would also be delivered to Gross Reservoir." Using the recent, popular catch phrase, "…you do the math." The sand alone represents 400,000 cy. A cubic foot of sand weighs approximately 105 pounds. 105lbs X 27cf/cy = 2,835 lbs/cy or 1.42 tons per cy. 1.42 tons/cy X 400,000 cy = 568,000 tons. A tractor trailer carries 25 tons of sand, so **the project will require 22,720 loads of sand to be hauled up SH 72 and Gross Dam Road**, to say nothing of the number of loads of cement and flyash. Assuming this quantity was hauled every week day of the year for four years, we would see 25.8 loads hauled per day. But, work will obviously not occur every weekday of the year (exclude holidays, days for cold and snow and those when concrete is not scheduled early and late in the project) and the number of loads will most likely average significantly higher than the 25 to 55 loads per day as claimed by DWB.]

Hard as it may be to imagine, **these impacts are only temporary.** This proposed project has implications that are **permanent**, implications that reach far beyond the inconvenience of a four year construction project. One of the more prominent deer and elk corridors from the Front Range plains to alpine pastures currently courses directly through and around Gross Reservoir. Former Gov. Bill Ritter, while finalizing a wildlife protection agreement between the Colorado and New Mexico stated, "Wildlife is one of the most important resources in the West. It is part of our heritage, and its protection should be part of our legacy." If this project is allowed to proceed, it will fly in direct opposition to that mandate. And, what about the impact to the streams and fish affected by this project? In the early 20th Century, the DWB through imminent domain very nearly destroyed what was S. Boulder Creek from the Moffat tunnel to Gross Dam. Presumably, the beautiful ox-bow stream as it traversed the meadows through Tolland, was dredged, deepened and made arrow- straight, looking more like a canal than a stream, to speed water down to Gross Reservoir. Prior to diverting flows from the western slope, S. Boulder Creek probably saw flows through Rollinsville and Pinecliffe that ranged from 10 to 35 cubic feet per second (cfs), with highs during runoff approaching 140 cfs. After DWB started diverting water through the Moffat tunnel, flows have been increased such that in 2009, average non-runoff flows ranged from between 35 and 55 cfs.   During spring runoff in May, June and July, the water routinely flowed between 250 and 400cfs but spiked on one occasion at nearly 750cfs! Assuming a 273% increase in reservoir capacity, could we experience increased flows of the same magnitude, flows between 683 to nearly 1,300cfs, with spikes exceeding 2,000cfs? (For comparison, the flow of the Colorado River below Glenwood Springs on 3/9/10, after receiving flows from the Blue, Eagle, Roaring Fork, Frying Pan ant Crystal Rivers was 4,280 cfs!) Such flows in this tiny creek bed would be catastrophic to any animal (including fish and aquatic insects currently residing in the river) unfortunate to be caught in its torrent, to say nothing of a human suffering the same fate!

[Note: This letter was originally written in 2009 and Streamflow data has not been updated for this submission. However, the projections contained herein are still applicable.]

And, where will this new water come from? The Fraser River in Grand County was once a world class trout fishery enjoyed by President Dwight Eisenhower, to say nothing of the similar experiences enjoyed by my father and grandfather. Flows in both the Fraser River and the Colorado River below it have been depleted such that trout struggle to survive during its current flows, to say nothing of how those rivers and their dependents will survive when DWB comes calling for additional water to supply the thirsty residents of the Front Range.

DWB proposes to mitigate impacts to both the West and East Slope watersheds by:

- Participating in the Upper Colorado River Endangered Fish Recovery Program
- Monitoring Temperature in the Fraser River and Colorado River
- Establishing a Colorado river Cutthroat Trout Fishery in Grand County
- Restoring riparian areas at Gross Reservoir
- Purchasing compensatory wetland credits in a Wetland Mitigation Bank
- Creating additional Environmental storage in Gross Reservoir to store water for enhanced flows in South Boulder Creek.
- Improving aquatic habitat in the North Fork South Platte River
- Participating in the Platte River Recovery Implementation Program
- Replacing inundated recreation facilities at Gross Reservoir.

While participating in the Upper Colorado River Endangered Fish Recovery Program and establishing a trout fishery (how would one propose to establish a trout fishery without an appropriate quantity of water?) in Grand County is commendable, it does little for the fish in the existing, natural fisheries of the Fraser or Colorado Rivers or the loss of normal river flows or the wildlife that inhabits these rivers. It is difficult to imagine that monitoring the temperature in the Fraser and Colorado River will restore the permanent loss of a viable trout fishery or the loss suffered as the result of no longer being able to enjoy the sight and sounds of a naturally flowing stream as it courses through an open meadow. DWB appears to be offering, almost as a 'throw-in' to make improvements to the S. Platte River. While commendable, shouldn't those mitigation measures have been performed back in the 60's when they first started pulling water from Dillon Reservoir into the S. Platte system? These mitigation efforts feel insignificant and grossly inadequate as compensation for a project of such magnitude.

While I'm unaware of any documented link between the invasion of the Pine Bark Beetle in Colorado and the diversion of water from the western slope to the east, isn't ironic that the two of the most severely impacted counties in all of Colorado, Grand and Summit, are those from which DWB draws their water? Is there a link that should be investigated?

During the 1970's, the same arguments were used in support of the Two Forks project on the Platte River below the town of Deckers. And, after years of similar debate, the DWB was rejected in their attempts for approval, stating that adequate water supplies were available if appropriate conservation efforts were adopted. That argument was deemed to be correct and the same argument is the correct argument today. Colorado is the 6th driest state in the Union but Coloradoans consume the 5th most water per capita of any state in the country. Before a project of this magnitude is considered, we must change the way in which we consume water. By mandating the use of efficient fixtures, by limiting irrigable areas, by re-using reclaimed water for irrigation rather than fresh water, by planting water wise plants and by building communities similar to the very successful Stapleton re-development, the need for additional storage can be averted for years.   These alternatives may represent a paradigm shift from the way Denverites have traditionally consumed water, but the days of using water as though its supply was endless are over. This project is the wrong project for all of the wrong reasons.

Thank you for your consideration.

Respectfully,

James G. Curfman

From:	Spencer Uniss
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	No to Gross Reservoir Epansion
Date:	Thursday, November 12, 2020 12:04:25 PM

Hi,

I am writing to share my discomfort with the things that are planned to take place at Gross Reservoir. In short, this place was singlehandedly the main reason why I now fish and enjoy recreating more outside and near bodys of water. My first time ever catching a fish was at this place and I fear that those will now only be memories I will have to maintain and never be able to share the experience with anyone else and open theirs eyes to the great outdoors. My other concern as a 17 year boulder resident is the amount of traffic the trucks and construction will create and damage to the roads that no way is nearly close the correct estimates. There are many other options to accomplish the goals of this project and I hope you reconsider and suggest elsewhere.

Sincerely,
Spencer Uniss

From:	Diana Leonard
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 12:04:14 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Diana Leonard
5519 Boulder Hills Drive

Longmont, CO 80503
303-772-2785

From:	joybarrett@juno.com
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Please reject Denver Water"s 1041 application until all deficiencies have been addressed
Date:	Thursday, November 12, 2020 11:52:30 AM

Dear Boulder County Commissioners and Gross Reservoir personnel,

As a Ph.D. civil/environmental engineer, long-time Boulder County resident, and life member of the American Water Works Association, I am writing to urge you to reject Denver Water's 1041 application until it complies with Boulder County Land Use Code and all application deficiencies have been addressed. I would like to mention several of those deficiencies briefly.

Denver Water's 1041 application lacks numerous plans, including those for:

- Stormwater Management;
- Erosion Control Reclamation;
- Invasive Plant and Noxious Weed Species Management;
- Aquatic Invasive Species Monitoring; and
- South Boulder Creek Channel Stability and Monitoring.

Denver Water's application is based on the Environmental Impact Statement (EIS) and Record of Decision conducted by the Army Corps of Engineers. Errors in the Army Corps' analysis have led to litigation in federal district court in Denver. Among other failings, the Corps' Record of Decision violated the Clean Water Act by failing to choose the Least Environmentally Damaging Practicable Alternative and associated full cost of the project. The Corps' EIS also did not analyze climate impacts of the project. Denver Water's application fails to comply with the Boulder Valley Comprehensive Plan, and violates Boulder County Land Use Code Section 88-511.C.2.a, which requires the conservation and full utilization of existing municipal water supplies.

So many of the deficiencies in Denver Water's current application to expand Gross Reservoir threaten Boulder County's water resources and ability to remain resilient in the face of increasing challenges from the climate crisis. Please reject Denver Water's 1041 application until all deficiencies and violations have been remedied, including those I've mentioned above.

Thank you for considering this matter, which is so important to our county.

Joy Barrett, Ph.D.
611 Concord Avenue
Boulder, CO 80304
joybarrett@juno.com

From:	judd johnson
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 11:43:07 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

judd johnson
2935 3rd Street

Boulder, CO 80304

From:	Jim McComas
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Reject Denver Water"s 1041 application
Date:	Thursday, November 12, 2020 11:42:23 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
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- Visual Resources Protection Plan
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- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

James McComas

28883 Granite Peak Lane
Golden, CO 80403
303 324-7829

From:	Robert Ratliff
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 11:30:04 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Robert Ratliff
407 16th St

Boulder,

From:	Katie Knapp
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 11:20:57 AM

Dear Boulder County Commissioners and Staff,

Thank you for the opportunity to comment on the 1041 application for the Gross reservoir expansion. I think the application should be denied due to these 2 issues:

1. Threat to downstream residents: Has the consequence of failure been evaluated and communicated? Have the downstream residents been notified? Although dam failures are uncommon - they do happen and the consequences in this case would be absolutely devastating. One thing we should all agree on is that the future is unpredictable. The decisions we make today impact how we are able to handle the uncertainties of the future. Risks from natural and man-made disasters can be mitigated through good planning. Please help mitigate this risk by not increasing the threat. As Gilbert White said, "Floods are acts of God; but flood losses are largely acts of man."

2. Environmental impacts: Water diversions are depleting our natural rivers and destroying riverine ecosystems. The Colorado River basin is over-depleted and cannot support additional development of the Denver metro area. Colorado should be working with other western states to find solutions to this issue and not moving forward with projects that exacerbate the situation.

I appreciate the opportunity to comment and I thank you for consideration of the above in evaluating the proposal.

Sincerely,
Katie Knapp

Katie Knapp

,

From:	Mario Casilio
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross dam expansion project.
Date:	Thursday, November 12, 2020 11:18:44 AM

Hello,

I am a very concerned property owner that lives within a mile of the northwest side of Gross reservoir. I strongly oppose this project. The years of construction noise and many other enviormental impacts will be devastating to the quality of life for the near by residents and wildlife. Please consider the many reasons this project is a bad idea for Boulder county.

Leading statement to the Boulder County Commissioners: Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
    - The "Purpose and Need" in the EIS is not accurate and must be redone.
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- The Corps Record of Decision violated the Clean Water Act:
    - The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
    - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water

supplies.
Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.
Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.
Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Thank you for your consideration,

Mario Casilio
1797 Twin Sisters Ranch
Nederland, CO 80466
303-588-6863

From: John Bradin
To: Gross Reservoir SI-20-0003
Subject: If for no other reason, Colorado is out of water. Dams don''t create water. Water usage in Colorado must be reduced on an absolute level, not on a per capita level
Date: Thursday, November 12, 2020 11:18:18 AM

From:	Hans Rohner
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 11:16:53 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

In addition to the above, I would like to point out that this approach is not sustainable, and what is not sustainable will come to an end. If we don't take the long view, we won't be able to decide the resolution; nature will decide for us, and nature really doesn't care what happens to us. When higher order laws are ignored, lower order laws automatically come into play: ignore prudence when crossing an icy surface, and the law of gravity takes effect.

Please reject this application.

Thank you!
Sincerely,

Hans Rohner
1148 TWIN SISTERS RD
hans@mric.net
NEDERLAND, CO 80466
3035410802

From:	Silvine Farnell
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Denver Water"s 1041 Application
Date:	Thursday, November 12, 2020 11:11:45 AM

Denver Water's 1041 application is incomplete. Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County should not consider this application and should return it to Denver Water for clarification and completion.

From: one brown mouse
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Public Comment on Gross Res. Expansion
Date: Thursday, November 12, 2020 11:00:22 AM

I'm a 30 year resident off east Magnolia Rd writing against the proposed Gross Dam expansion and in hopes of the Commissioners guaranteeing a fair and equal playing field for all Boulder County residents (human and non human).

In addition to equal/fair enforcement of BC permitting cited below, I have other concerns:

1. The disregard for the culturally modified trees (CMT's) most of which are (still) living artifacts left by the native inhabitants (Ute and Arapahoe) of Boulder County. There are dozens upon dozens of these trees that would be removed/killed if the expansion of the dam is permitted by BC. Below is a link to the less than 3 minute trailer on these culturally significant tree's and below that is the link to the full 30 minute documentary "Mystery of the Tree's" found at the bottom of the page link. I have also attached pics of a handful of these currently living artifacts.

The Mystery Tree's documentary is a must watch: Mystery of the Trees Trailer

Mystery of the Trees Trailer

videos

MOUNTAIN

Videos

Marker Tree Revaluation Rinconada Energy Lines Pecos Giant Kiva Chimayo Church Becky's Story Sam P...

2. The extreme noise. We are approx. 1/2 mile as a crow flys to the water. Rarely, but occasionally, firefighters (by air) have practiced techniques at Gross. **The noise generated during those practice days was ONLY bearable because most everyone in the area** understands the extreme fire conditions and **benefits from the practicing and we know it ends in 1-3 days.** The noise and visual of low flying helicopters grabbing and dumping water out my front windows and deck is impressive, however I can't imagine a minute of peace and quiet or a gram of benefit (for humans, domestic animals or wildlife) in the 5 mile radius during the next 8-10 years if the dam expansion is permitted.

Leading statement to the Boulder County Commissioners: Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
  - The “Purpose and Need” in the EIS is not accurate and must be redone.
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- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

In Principle,
Kathleen Chippi
30 year resident of the neighborhood

From:	Devin Detwiler
To:	Gross Reservoir SI-20-0003
Subject:	Gross Resevoir
Date:	Thursday, November 12, 2020 10:35:45 AM

Denver Water's 1041 application is incomplete. Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all the deficiencies below, Boulder County should not consider this application and should return it to Denver Water for clarification and completion.

Specific problems with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. The vast majority of the application simply refers to "plans" that don't yet exist. These plans are required if Denver Water is to comply with the Boulder County Land Use Code. Denver Water needs to state their plans in regard to the following:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
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Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application because these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process, including the Final EIS and Record of Decision, which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

From:	Jared Minkoff
To:	Gross Reservoir SI-20-0003; commissioners@bouldercounty.or
Subject:	Reject Denver Water"s 1041 application
Date:	Thursday, November 12, 2020 10:34:48 AM

Dear Boulder County Commissioners,

We are writing in connection with the HB 1041 application ("Application") submitted by Denver Water ("DW") for the expansion of Gross Reservoir Dam ("Project"). We urge the Board of County Commissioners to deny DW's request both for an expedited review and the Application itself.

The Application should be rejected for numerous reasons, including without limitation that the information is incomplete, obsolete and inaccurate, as well as the material and adverse impact the Project and its construction will have on Boulder County residents and visitors living or utilizing the resources within the vast area affected by this lengthy project.

In numerous instances, DW continues to, in effect, take a position that the 1041 application is inapplicable to the Project. For example, on p35 of the Application, there is reference to [Land Use Code] 8-308.A.2, regarding a major extension of existing domestic water and sewage treatment system. Oddly, DW then looks to the definition of water tank or treatment facility in 4-514 (which is a similar, but importantly, different term under the Land Use Code), rather than the actual definition of the original term in 8-210.O. In this instance, under the proper definition, the term Water Supply System is applicable, a "*system* of pipes, *structures* and *facilities* through which a water supply is obtained, treated and sold or distributed …" (emphasis added). DW's position ignores the context of this definition, in that it references a system, of which the Gross Reservoir Dam is a part.

Similarly, DW argues 8-401.D is inapplicable, because Gross Reservoir only holds raw water. This section addresses expansion of an existing reservoir for a municipal or industrial or domestic treated water use. DW's position is clearly incorrect, erroneously requiring that the reservoir hold treated water, which is nowhere in the applicable Code provisions. Moreover, the definition of reservoir in 8-210.AV again looks to the water storage and treatment system as a whole.

Section 8-507.D details the requirements for all applications. Included in that section are subpart (v), related to air quality, subpart (vi), related to visual aesthetics and nuisance factors, and subpart (viii), transportation impacts. The application fails to address, or is incomplete in addressing, the requirements of these subparts. For example, the nuisance of noise pollution associated with years of tree removal is not addressed. While certain aspects of transportation impacts are addressed, this evaluation is often limited and incomplete. The Application fails to consider the impact of dozens of logging truckloads per day (with a projected total of over 1,400 round trips) on Lazy Z Road and CR 132 on the numerous residential properties along Lazy Z, nor the significant numbers of recreational users (such as runners and bikers) of CR 132, nor the impact these numerous truckloads on the road surfaces themselves.

The project scope and duration is extensive, and significantly downplayed throughout the Application materials. While there is some attention to the number of truckloads of materials
in certain instances, the Application is often short on actual detail, with references to future, to-be-determined plans. Other material categories that are subject to future plans, with no substantiated detail, include tree removal, fire management and response, dust control, road maintenance and quarry operation.

Another significant category left to future plans relates to the disruptive sounds of the various construction related activity. As you are likely aware, sound travels an amazing distance in the mountains. While we are informed that there will be daily blasting in the on-site quarry, there is nearly no discussion of the associated noise issue. Likewise, we are informed that there will be onsite rock crushing, powered by seven diesel engines, but nothing about the noise. DW states that there will be two years of construction activity 24 hours a day during the construction season; recognizing “during concrete placement night work and noise impacts *can be expected*.” (Emphasis added, Application p9). However, there is no further discussion of the specific steps DW will take to mitigate this significant, non-stop, disturbance.

Section 8-511 details the standards for approval of a permit application. Included under 8.511.B.5 are a number of specific considerations, including air quality and visual quality As noted above, the Application is incomplete in this context. Instead of actually addressing these considerations, DW, for example, simply states it “plans to minimize impacts from trucks, such as odors and dust.” (see p349). As there is no current plan in this regard submitted for review, it is impossible for the Application to meet the standards for approval. Likewise, DW makes the incredible claim that despite the proposed removal of hundreds of thousands of trees, the overall appearance of the forest canopy will not change significantly with the Project. No evidence is provided to support this claim.

Further, Section 8-511.C provides additional standards in connection with the review of municipal and industrial water projects, such as the Project. The first subpart provides “The proposal shall emphasize the most efficient use of water…” The application fails in this regard. The projected water usage data provided by DW in Exhibit 2 (DW’s Integrated Resource Plan) is obsolete, with much of it based on year 2000 information. DW’s evaluation of its system water needs should be updated from that two-decade old data. However, DW's website (https://www.denverwater.org/your-water/water-supply-and-planning/water-use) does inform us that approximately 47% of its usage is for single family homes as well as that 50% of single family water use is for outdoor usage - so nearly one-quarter of all DW customer water usage is for non-essential, and thus inefficient, purposes. Further, there are numerous studies which show that Denver has made significant strides in reduction of water use in the past 20 years. None of the data provided by DW reflect these amelioration efforts.

Likewise, other material information provided by DW is obsolete and/or inadequate. The Environmental Impact Statement (Exhibit 5d) dates from April 2014. This document admittedly fails to quantify the impacts of climate change. Further, DW's materials provide little or no recognition of the severe drought conditions that have regularly affected Colorado over the past twenty years, with multiple instances over that time where well over half of the state has experienced severe or worse drought conditions for upwards of a year at a time and the significant increase in fire risk as a result. Failure to account for these circumstances begs the question as to the feasibility of the expanded reservoir to ever achieve its storage capacity. The traffic impact analysis included as Exhibit 4 is similarly inadequate. For example, some of the cited traffic data dates to 2015; moreover, the traffic study on SH72 was conducted on consecutive days in December, a time of year that is well outside of the relevant construction season, and thus not representative of the future impacts of construction traffic.

With respect to the requested expedited review, the application itself is over three hundred pages in length, and references thousands of additional pages of often technical exhibits. Moreover, this is among the largest construction projects in Boulder County, with an anticipated construction period of over six years. Expedited review for a project of this magnitude, coupled with the volume of application data, certainly does not provide the public a reasonable and legitimate opportunity for participation and input, nor does it adequately allow the Board an opportunity to comprehend the many nuances and details of the Project.

Further, DW's rationale for expedited review of the Application is the deadline to start construction contained in the Federal Energy Regulatory Commission (FERC) Order Amending License and Extending License Term—FERC Project 2035-099, July 16, 2020. This is solely a self-made problem. Last year, DW chose to dispute the County's authority to enforce the 1041 requirements as to this project. DW then chose to fight the decision of the County's Director of Land Use before this Board, then again choosing to further the review at the District Court, and once again continuing on to appeal the District Court's affirmation of the initial decision. Curiously, DW dropped its appeal immediately after receipt of the FERC permit this year, and thus acquiesced to the original determination because they wished to move forward with the project given the timeline of the FERC license; not because they were prepared to submit a complete 1041 application or move forward with this project with all the ramifications of the project fully researched. Once again, but for DW's choices, this is not a circumstance necessitating an extraordinary step such as expedited review.

In conclusion, we again urge the Board to both reject DW's request for expedited review as well as the Application itself.

Respectfully,

Jared and Dawn Minkoff
651 Pine Glade Road
Nederland, CO 80466

From:	Timothy Guenthner
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 10:34:04 AM

Dear Boulder County Commissioners and Staff,
I have been involved in the effort to stop the proposed Gross Dam expansion for close to two decades. This was a bad idea 18 years ago and has only gotten worse over the years. It starts with DW's invalid purpose and need statement; proceeds through the defective FEIS; continues through the failure of USACE to exercise their responsibilities to enforce NEPA, the Clean Water Act, and the EPA in issuing their 404 Permit; on to the FERC failed attempt to rectify the faulty FEIS by issuing an equally faulty EA; the mistake by FERC in issuing the order to proceed but imposing an impossible construction deadline; and arrives at this DW submission to Boulder County's 1041 process. What Denver Water has submitted is the same old huge pile of incomplete, incorrect, unmanageable, and incomprehensible "content" and support documentation for their application.

Denver Water submitted its 1041 application for the expansion of Gross Dam, and the application is incomplete and must be rejected. It is the exact same old stuff that we have all been through, reviewing for years - all 30,000 pages. Not only is it incomplete (missing critical plans and details necessary to the project), it is now been made obsolete by two decades of change – ten to twenty year old data ranging from the per capita use of water by front range customers, to project cost estimates, to the success of water conservation efforts, to the reduction of available water due to climate change (along with Denver Water's ongoing denial of our severe and persistent drought).

This application must be rejected and returned to Denver Water to be updated with current and complete input to the 1041 process. It fails completely at meeting the purpose and intent of 1041 and attempts to turn this process into a joke. This project must be put to an end. It will never be compliant with Boulder County’s 1041 process or the county’s comprehensive plans to preserve the quality of life we have here. Conservation is the only answer left to manage our water demands in Colorado. Raising a dam and enlarging a reservoir does not create more water. Unless we stop it, this dam and reservoir will stand as Colorado's last great monument to our stubbornness, climate change denial, and unwillingness to accept change and adapt.

The problems with Denver Water’s 1041 submission include (in more detail)

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan

- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

This application must be rejected.

Sincerely, Tim Guenthner

Timothy Guenthner
546 Lakeshore Drive

Boulder, CO 80302
3036420889

From: Dawn Minkoff
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Thursday, November 12, 2020 10:29:51 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Dawn Christoffersen Minkoff

Dawn Minkoff
651 Pine Glade Road

Nederland, CO 80466
3147199971

From:	Janet Justice-Waddington
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 10:29:24 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

Eighty percent of Gross Dam water goes for agriculture. Also with new legislation Denver Water can lease water in drought years using ATMs
This option was not available when Denver Water first started their campaign for more storage.
Sincerely, Janet Justice-Waddington

Janet Justice-Waddington
11764 Nob Way (Coal Creek Canyon)

Golden, CO 80403
303-642-0926

From:	Stephanie Smith
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 10:21:55 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Stephanie Smith
281 Lakeshore Park Rd

Boulder, CO 80302
3039109800

From:	Boulder County Postmaster
To:	Gross Reservoir SI-20-0003
Subject:	[Postmaster] Content Alert Notification
Date:	Thursday, November 12, 2020 10:19:48 AM

This is a content alert notification message.

The message indicated below matches content alert policies set by the system administrator(s).

Message information:

Sender : "Rich Zirk" <richzirk@me.com>
Intended Recipient : Gross Reservoir SI-20-0003 <grossreservoir@bouldercounty.org>
Message Subject : Denver Water's 1041 Gross Dam Expansion Application is 'Incomplete' and Must Be Rejected
Message Date : Thu, 12 Nov 2020 17:19:37 +0000 (UTC)
Message Status : The message has been placed on HOLD - action required

Content Policies Triggered:

DNS Authentication: DMARC Fail

From:	Beverly Kurtz
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Denver Water 1041 Application for Gross Reservoir expansion project
Date:	Thursday, November 12, 2020 10:12:43 AM
Attachments:	Kurtz Comments 1041 Application 11.2020.pdf

Date: November 12, 2020
To: Boulder County Commissioners
Re: Denver Water's 1041 Application

Transmitted via email

Dear Commissioners,

I am a resident of Lakeshore Park Subdivision on the shores of Gross Reservoir. I built on property here nearly 30 years ago to fulfill my dream of living in the foothills of the Rockies. I hoped that the pristine environment, the dark skies, the silence and the plethora of wildlife would nourish my soul. It did – as did the remarkable family of neighbors found here whom I have grown to love.

Nearly 20 years ago the prospect of a construction project to increase the size of Gross Dam first loomed on the horizon. None of us took it too seriously. We live in Boulder County, one of the most environmentally "woke" and progressive counties in the country. A travesty of this magnitude would never be allowed. Our elected officials and the city and country residents would never let it get far. But we underestimate the determination of Denver Water. So here we are today.

After nearly two decades of fighting this project on every front, it appears that it will likely lay with the Boulder County Commissioners to protect the jewel that is the area surrounding Gross Reservoir. The state's 1041 Statue and the regulations laid out by Boulder County's Land Use Code in Article 8 are the last bastion of defense against Denver Water's proposed devastation. I encourage the Commissioners and your staff to use these regulations and every resource at your disposal to stop this project. The 1041 State Statue was crafted to address exactly the sort of egregious overreach of the Gross Dam Expansion project.

At this point, it is clear that Denver Water's application is incomplete. I'm sure you have received many comments outlining its deficiencies. I urge you to refuse to accept the application as it is and require that Denver Water resubmit a complete application that will meet all of the requirements of Boulder County's codes. Although the federal agencies charged with reviewing Denver Water's plans were not deterred by the lack of detail they provided, Boulder County must rigorously apply their regulations and require that Denver Water provide detailed plans on every aspect of the construction. Then, and only then, will the county be in a position to adequately assess the impact this project will have on the lands and citizens that they are responsible for protecting.

The Boulder Valley Comprehensive Plan is designed to preserve a sustainable future for Boulder Valley and its citizens. Please stand up to Denver Water and insist that they conform to OUR requirements in applying for this approval – and then diligently apply the regulations we have in place to protect Boulder County from this unnecessary and devastating project.

Sincerely,

Beverly Kurtz
546 Lakeshore Drive
Boulder, CO 80302
303-642-0889

Date: November 12, 2020
To: Boulder County Commissioners
Re: Denver Water's 1041 Application

Transmitted via email

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Sincerely,

Beverly Kurtz
546 Lakeshore Drive
Boulder, CO 80302
303-642-0889

From:	Stop Gross Dam Expansion
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Comments on Denver Water''s 1041 Application to expand Gross Reservoir
Date:	Thursday, November 12, 2020 10:01:05 AM
Attachments:	TEG Comments 1041 Application 11.2020.pdf

Date: November 10, 2020

To: Boulder County Commissioners P.O. Box 471Boulder, CO 80306

Re. Input on Denver Water's Gross Reservoir 1041 Application

Transmitted via email

Dear Boulder County Commissioners,

We represent the majority of residents impacted by Denver Water's proposed Gross Reservoir expansion project. This includes the mountain communities surrounding Gross Reservoir, as well as other county residents who recreate in our nearby open spaces. We have over 1200 members who support our fight and our poll numbers indicate that 80% of Boulder county residents vehemently oppose this project.

We are so grateful that Boulder County has been diligent in monitoring and holding Denver Water accountable for their actions over the nearly 20 years that they have been pushing for this project. At this juncture Denver Water has finally conceded that they need approval from the county to move forward and has submitted their 1041 Application for a permit from the county.

The 354 page application references nearly 16,000 pages of reference material. Essentially it regurgitates the same copious amount of data that Denver Water has used time and time again. This data is completely out of date (some of it nearly 30 years old) and lacks any detail that would allow Boulder County to make an informed decision as to whether or not the project would conform to Boulder County's 1041 Regulations.

Our assertion is that there is no way it would be possible for a construction project of this size, which provides absolutely no benefit to the citizens of Boulder county, to be able to meet our strict regulations and conform to the Boulder County Comprehensive Plan. At this point though, it is clearly impossible for Boulder County to adequately determine if that is the case given the severe deficiencies in the application itself. Our team of legal and environmental experts has identified a number of specific issues with the application that are listed below. We urge you to reject the current application as incomplete and that you require Denver Water to resubmit a complete application that addresses all deficiencies, providing comprehensive data and justifications for all aspects of the project so that the county can make an informed decision.

First: The 1041 application requests a “waiver” in **Section 8-503** stating that it doesn’t have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with **Section 8-511 Standards for Approval of a Permit Application** of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision, which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process that has numerous errors including:

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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates **Boulder County Land Use Code Section511.C.2.a**, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates **Boulder County Land Use Code 8-511.I.2** because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates **Boulder County Land Use Code Section 8-511.J.1** because the project is a danger to public health or safety or to property.

Ninth: The application violates **Boulder County Land Use Code Section 8-511.J.2**, which requires compatibility with existing traffic volumes.

Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Sincerely,

TEG Board of Directors

Beverly Kurtz, Jennie Curtis, Timothy Guenthner, Seth Cousin, Josh King

The Environmental Group (TEG)
PO Box 7532
Boulder, CO 80306

STOP
GROSS DAM
EXPANSION

SaveBoulderCounty.org

From:	Afca Natura
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	PLEASE apply the county"s 1041 regulations to DW 1041 Application
Date:	Thursday, November 12, 2020 9:40:37 AM

Dear Commissioners,

You already know because you have probably received over 1000 comments so far from concerned residents that Denver Water's 1041 application is incomplete and that until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

BUT I also want to pint out the following: I am one of a handful of residents living directly on the Gross Reservoir shore and as a Latina mother of two young girls I respectfully ask to consider the environmental justice issue related to the Boulder residents directly impacted by this expansion if approved and our #latino families in #Denver —38% of the pop.—who will bear a disproportionate burden and will pay the bill of this $400 million dam construction project that will devastate the #grossreservoir valley and watershed to the detriment of the health, safety, and environment of its residents so that Denver can have more lawns. Our Latino children will be paying most of the bill for the biggest construction project in the history of Boulder county and the tallest #dam in the state of Colorado. The construction will dynamite the valley, utterly disrupting the peace and security and health of so many and collapsing fisheries and freshwater ecosystems in the West Slope. Please lead the way in assuring that Boulder is where Our Health, Colorado & Conservation Meets a Viable and Just Future and that this build on our environmental stewardship legacy

Please reject this application.

Irene

AFC+A
AMERICAS for CONSERVATION + the ARTS

Irene Vilar
Founder & Director
Americas for Conservation 501(c)(3)
Winner of SHIFT 2020 Award
Winner of Colorado Environmental Education Innovation 2018 Award
Winner of City of Denver Office of Sustainability Community Builder 2016 Love This Place
Winner of City of Denver Mayor's Awards for Excellence in Culture 2017 Imagine 2020

www.americasforconservation.org | www.mvpress.org | www.americaslatinoecofestival.org

From:	Al Burk
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 9:39:00 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Al Burk
31 Thornhill Rd

Lutherville, MD 21093
4432551089

From:	Shreddy Betty
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Gross Reservoir Expansion
Date:	Thursday, November 12, 2020 9:37:11 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
- The "Purpose and Need" in the EIS is not accurate and must be redone.
- The "Alternatives" analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Stephanie Moore

From:	Stephanie Greenman
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir Expansion
Date:	Thursday, November 12, 2020 9:32:20 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for

Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
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- The "Alternatives" analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Stephanie Greenman
Neighbor of Gross Reservoir
Colorado Native

From: Steven Floyd
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Thursday, November 12, 2020 9:32:06 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Steven Floyd
11162 Skye Creeks Way

Golden, CO 80403
214-558-1551

From:	Stephanie Greenman
To:	Gross Reservoir SI-20-0003; commisioners@bouldercounty.org
Subject:	Gross Reservoir Expansion
Date:	Thursday, November 12, 2020 9:30:10 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

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Boulder County cannot consider this application when these plans have not been completed.

Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Stephanie Greenman
Neighbor of Gross Reservoir

Colorado Native

From:	Stephanie Greenman
To:	Gross Reservoir SI-20-0003; commisioner@bouldercounty.org
Subject:	Gross Reservoir Expansion
Date:	Thursday, November 12, 2020 9:28:00 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Stephanie Greenman
Neighbor of Gross Reservoir
Colorado Native

From:	Al Gale
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 9:26:47 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Al Gale
104 Larkspur Court
algale46@gmail.com
Wiggins, CO 80654
3034082545

From:	Katherine Gale
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 9:25:07 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Katherine Gale
14 Aspen Lane
kathygcmt@gmail.com
Golden, CO 80401
9704836922

From:	Joe Greenman
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 9:24:04 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Joe Greenman
398 Crescent Lake Rd

Golden, Colorado 80493

From:	Margaret McKune
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 9:22:36 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Margaret McKune
1709 Pine St, #2

Boulder, CO 80302

From:	Todd Adelman
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 9:20:00 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Todd Adelman
165 Hollow Rd

Glenford, NY 12433
3039311188

From:	Liz Morgan
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 9:19:32 AM

Dear Boulder County Commissioners and Staff,

Denver Water has been trying to push around the people of Boulder for over a decade demanding approval for an unnecessary and grotesque project to destroy habitat and ecosystems in Colorado. After all this time, they still can't demonstrate enough care to submit a complete application. Given their demonstrated lack of compliance and care around the proper planning of the largest proposed construction project in Boulder County history, it is clear that we can not trust them to start ripping out trees, draining rivers, traumatizing wildlife, destroying habitat, creating unsafe driving and road conditions, and making a disgusting mess of our community. THE APPLICATION MUST BE DENIED.

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Liz Morgan

Liz Morgan
PO Box 3113

Buena Vista, CO 81211

From:	Rax Green
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 8:55:57 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Rax Green
Mole Place
Fir Tree Road
Leatherhead, Surrey KT22 8RF

From:	gordon reese
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 8:49:01 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The "Purpose and Need" in the EIS is not accurate and must be redone.
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B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

gordon reese
811 ithaca drive
duxmail@comcast.net
boulder, CO 80305
3037041342

From: Dana Edwards
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Thursday, November 12, 2020 8:46:52 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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B. The Corps Record of Decision violated the Clean Water Act:

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- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Dana Edwards
1893 Colard Ln

Lyons, CO 80540

From:	Harry Smolker
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 8:34:42 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Harry Smolker
150 Hazelwood Dr.

Nederland, CO 80466
845-702-5652

From:	Jolene Kindig
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 8:06:22 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Jolene Kindig
199 Broken Fence Rd.

Boulder, CO 80302
303-443-0683

From:	elizabeth lamanna
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 7:57:34 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

elizabeth lamanna
600 Kalmia Ave

Boulder, Colorado 80304
3155291957

From:	Wynn Waggoner
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 7:56:50 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Wynn Waggoner
7483 Flagstaff Rd

Boulder, CO 80302
3035466199

From:	elizabeth lamanna
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 7:56:16 AM

Dear Boulder County Commissioners and Staff,

As shown in David Attenborough's latest film we must preserve and expand wild spaces in order to survive on planet earth. Denver's overreach into water from the western slope is slowly destroying regions to the west and now to the east in the form of the expansion of Gross Reservoir. Our path needs to be one of conservation not one of gobbling. I am strongly opposed to this project for the reasons below and the reasons of survival.

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

elizabeth lamanna
600 Kalmia

Boulder, Colorado 80304
3155291957

From:	Karina Black
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 7:47:06 AM

Dear Boulder County Commissioners and Staff,

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First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Karina Black
1023 Forest Ave.

Boulder, CO 80304
3039935363

From:	Norval Olson
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 7:43:32 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

As a Coal Creek Canyon resident, I have great concern for the proposed dam enlargement project in our “backyard”. Construction traffic, including heavy semi traffic on Hwy. 72 would create noise, exhaust, dust and other hazards to residents. Accident potential would be high. Loss of the precious shore lands surrounding the reservoir are unconscionable, including the loss of thousands of trees. Colorado is not a water oasis- it is a high desert. Additional diversion of west-slope water from the Colorado River needs to stop. Additional residential development on the front range with irrigated bluegrass lawns needs to stop!

Please reject this application.

Thank you!
Sincerely,

Norval Olson
469 Ronnie Rd.

Golden, CO 80403
303-642-0322

From:	Claudia Parker
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 7:23:03 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Claudia Parker

,

From:	Mary Russell
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 6:51:30 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Mary Russell
31020 Hwy 72
majrussell@msn.com
Golden, CO 80403
3036417645

From:	elizabeth waldner
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 6:45:22 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

elizabeth waldner
4656 sugarloaf Rd

boulder, Colorado 80302
3038869578

From:	Ben Lann
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 6:04:46 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Ben Lann

,

From: Randy Willig
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Thursday, November 12, 2020 4:48:47 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Randy Willig

,

From:	Peter Leuenberger
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 3:17:00 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Peter Leuenberger
679 Cougar Dr
colorado1235@gmail.com
Boulder, CO 80302
7206757255

From:	Duncan Brown
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Thursday, November 12, 2020 1:39:16 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Duncan Brown
8122 E. Sundew Dr.

Tucson, AZ 85710

From: Annika Heumann
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Wednesday, November 11, 2020 10:44:16 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Annika Heumann

Annika Heumann
860 W Moorhead Cir

Boulder, Co 80305
2039935348

From:	Lorri Fay
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 10:08:35 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Lorri Fay
50 Turnagain Ct.

Boulder, CO 80302
3032501464

From:	Harvey Nyberg
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 9:21:25 PM

Dear Boulder County Commissioners and Staff,

Good evening, as a winter resident of Denver, I have been following this issue for several years. Given the dire situation of projected flows within all areas of Colorado due to climate change, it would be an unjustifiable mistake to increase storage when existing storage cannot be protected. The better solution is to put meaningful restrictions on use to conserve the water. Raising this dam is not the answer. It only would cause irreparable harm in these parts of Colorado and create an even worse situation to deal with in the future. In addition, all applicable laws dealing with application;ications for new storage need to be followed to the letter of the law.

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Pit Development and Reclamation Plan
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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use

Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
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B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Harvey Nyberg
609 W Evelyn Street

Lewistown, MT 59457
406-366-5559

From:	Phylleri Ball
To:	Gross Reservoir SI-20-0003
Subject:	No expansion
Date:	Wednesday, November 11, 2020 9:11:29 PM

I object to the expansion of Gross Reservoir. There are ways to decrease water consumption that would eliminate the need for the expansion. The negative environmental impact of expanding Gross Reservoir is totally unacceptable.

Phylleri Ball
Three Sisters Weaving
Nederland, CO

From:	Brooke Watson
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:53:43 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Brooke Watson

,

From:	Diane Ludlow
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:34:58 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Diane Ludlow
9635 Boulder Creek Lane

Reno,, NV 89521-5141
7754199551

From:	Claudia VanWie
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:25:05 PM

Dear Commissioners:

I urge you to stop the expansion of Gross Reservoir.

I was on the Long-Range Planning Commission in the 70s when we studied and adopted the Boulder County Comprehensive Plan. This expansion was not compatible with the goals of the plan then, nor is it now.

I am most concerned about the disruption to the area that will be caused during the building of the dam and thereafter. The roads around the dam will be severely impacted. It will be a major disruption for years to all in the area, and I know your staff is giving you detailed information on this.

Additionally, as you are obviously well aware, we have a major issue in the mountains because of the increased population and use combined with climate change. I am fearful of the impacts of a massive fire in the watershed around Gross Reservoir. The flooding in Four Mile Canyon was certainly far more extensive in 2013 than it would have been had the fire not burned that area in 2010. We know that the likelihood and size of fire in Boulder County continue to increase as the forest ages, the climate changes, and more and more people choose to recreate in the mountains.

I have not been able to find plans for ways Denver Water plans to deal with potential impacts from fire. I was looking for their tree removal plans, erosion control, what they plan to do about invasive weeds such as cheatgrass which is highly flammable and which will come into the disturbed areas, etc. I didn't find a fire management plan, nor did I find data on how a substantially increased run-off might impact the safety of the dam.

Please be very cautious when thinking about Denver coming into Boulder County to destroy so much of our land. The proposed impact there is large and will be lasting.

From everything I have read, it doesn't even seem that Denver really needs the water. Why should they then ask us to bear the consequences?

Claudia VanWie

Claudia VanWie
600 Poplar Ave
ccvanwie@comcast.net
Boulder, CO 80304

From: Leah Johansen, MD
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Wednesday, November 11, 2020 8:20:01 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Leah Johansen, MD
215 Left Fork Rd

Boulder, CO 80302
2183550688

From:	David Hallock
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Docket S1-20-0003 Gross Reservoir Expansion
Date:	Wednesday, November 11, 2020 8:09:10 PM

These comments pertain to Denver Water's 1041 Application to Boulder County for expansion of Gross Reservoir.

First, the application appears to be inadequate and should not be accepted by the County. Too much critical information is missing, such as a detailed traffic management plan, a tree removal plan, and a quarry operation and reclamation plan. Other information appears to be outdated, such as whether or not their proposal is the LEAST environmentally damaging way to meet their water supply needs in the face of a warming planet - water conservation has been working and Denver Water's earlier prediction that they would have water shortages by 2016 if the project was not constructed has not come to fruition. And the subject of climate change is not addressed.

Denver Water is largely relying on the analysis and findings from the EIS. But in a federal process, there is a lot of collateral damage to the environment and to specific animal and plant species and communities. This all occurs because the test for significant impacts is based on whether or not the overall population of the species or community will be placed at risk. By zooming out in scale, individual sensitive animals and plants can be eliminated. Over time, it is death by a thousand cuts, but each cut appears insignificant. It is reductionism at its worst.

The cumulative nature of all individual impacts need to be weighed against the benefits derived from the alternative ways water can be found to meet the needs of a growing human population. This has not been done in Denver Water's application.

Thank you for the opportunity to comment.

David H. Hallock
2478 Eldora Road
Nederland, CO 80466

From:	Kathy Prentice
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:36:37 PM

Dear Boulder County Commissioners and Staff,

As you are aware, Denver Water has submitted its 1041 application for the expansion of Gross Dam. The application has not followed the criteria set forth below and therefore not a valid document for submittal nor consideration.

As a resident of Coal Creek Canyon, we have seen the destruction of our quiet neighborhood community with the current traffic to Gross Dam. Our street is 500 yards from Gross Dam Road and is now a veritable highway connecting Hwy 72 to Gross Dam Road. The noise, pollution, speeders, accidents, property damage (including a wild grass fire in our front yard) caused by careless drivers, endangerment to wildlife, erosion of quality of life are not potential impacts, but realized now. In addition, the recent dam repairs made by Denver Water were horrific. Large dump trucks, semi trucks, and work trucks commuting to the dam are a tiny glimpse of what is to come.

We are a mountain community. We live here. We have built this community together based upon our love and respect of the mountains, wildlife, peacefulness, fresh air and the camaraderie we have nurtured amongst our mountain neighbors. We are elderly who have lived here for over 50 years, we are children on tricycles, we are young couples starting a new life together, we are runners, horseback riders, dog walkers, and bicycle riders sharing Crescent Park Drive with massive traffic.

The impacts we are experiencing now and would increase dramatically and are in direct violation with Boulder Land Use Code 8-511 J.1 /through J.5.

We implore you to review the application and the facts set before you.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!

Sincerely,
Kathy Prentice and Jeff Nicholson

Kathy Prentice
11857 CRESCENT PARK DR

Golden, CO 80403
303.564.1711

From:	Andre Mallinger
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:33:52 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

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- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Andre Mallinger

,

From: GERARD KELLY
To: Gross Reservoir SI-20-0003
Subject: Comments on the Dam Expansion Project
Date: Wednesday, November 11, 2020 7:28:56 PM

Hello and thank you for taking comments on this proposed project.

- Project purpose and need: Based on the potential for increased water conservation and the potential inability to use increased reservoir capacity due to drought and climate change, Denver Water's old, out-dated assumptions to justify project needs and benefits no longer apply. Denver Water needs to make a stronger case to justify the extensive impacts of the project, especially if West Slope water may not be as plentiful and available to the Front Range, regardless of Denver's water rights. In addition, Denver's water conservation efforts have significantly reduced its needs.
- The project would cause extensive environmental impacts on forest lands and their wildlife, as well as along roadways, associated with construction at the reservoir, the dam site, mining and borrow sites, etc. The project footprint is significant. In addition, tens of thousand of trees will be removed, and many acres will be inundated. All of this represents lost or degraded habitat.
- The project would cause extensive social disruption, including increased traffic and noise, throughout the entire project area and region and throughout the multi-year construction period. Also, many acres of extensively used recreational areas and miles of hiking trails will be lost to inundation. In addition, property values would be depressed throughout the period.
- Construction would consume a massive amount of fossil fuel over a long construction period, and the extensive construction traffic would adversely impact air and water quality, ambient noise, and aesthetics.
- Pumping water from the West Slope will significantly degrade the Fraser's, Colorado's and other rivers' water quality, aquatic life, and riparian habitat.
- The project costs far outweigh the benefits, especially as it relates to Boulder County. The County will bear a heavy environmental cost for no benefits.
- Denver Water needs to consider additional alternatives and weigh cost-effectiveness based on anticipated impacts, and current data and projections on climate change and water availability. Expanding Gross Reservoir may not be the most cost-effective, preferred alternative.
- Denver Water and Boulder County need to reconsider the project and its financing based on Covid-19 impacts, such as lost local, state and federal revenue, and other imperative financial demands, such as response to climate change and disaster recovery. There are many more pressing needs than an expanded reservoir whose increased capacity may never be used. Society has limited financial resources and needs to prioritize. This project should not rise high enough on the list to qualify for limited resources.
- Denver Water's 1041 application does not sufficiently address these concerns and provide sufficient mitigation, primarily because it can't. Therefore, **Boulder County should deny the application.**

Gerard Kelly
Boulder, Colorado

From:	Anna Poisson
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:28:02 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
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- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Anna Poisson

Boulder, CO 80302

From:	Joseph Ponisciak
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:07:11 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Joseph Ponisciak
30 Nottingham Dr
jppon4@comcast.net
Willingboro, New Jersey 08046

From:	I. Engle
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:02:48 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Special Status Plants Relocation Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

I. Engle
605 Bosque St.
1ieengle@gmail.com
Village of Tularosa, NM 88352
5755850000

From:	Karin S
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 6:39:24 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Karin S
PO Box 3167

Nederland, Colorado 80466

From: Mai Lowantel-Beare
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Wednesday, November 11, 2020 6:37:59 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Mai Lowantel-Beare
700 Walnut Street
apt 219
Boulder, Colorado 80302
303-447-0431

From:	Ryo Murraygreen
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 6:08:24 PM

Dear Boulder County Commissioners and Staff,

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Ryo Murraygreen
954 Arroyo Chico
naomirachelemail@gmail.com
BOULDER, CO 803029730
3034494031

From:	Victoria Miller
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 5:46:44 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Victoria Miller
15857 Moorpark Street

Encino, CA 91436

From:	Nick Lenssen
To:	Gross Reservoir SI-20-0003
Subject:	Request that Bldr Cty require a complete application from Denver Water before Gross Reservoir proposal is considered by the County
Date:	Wednesday, November 11, 2020 5:41:45 PM

Dear County Commissioners & Staff,

I am writing to request that Boulder County firmly apply strict requirements to Denver Water's 1041 plan to expand Gross Reservoir. Climate change isn't going to be solved or mitigated by building bigger dams, and Denver Water's effort to fast-track its proposed expansion of Gross Reservoir should not be approved or even considered until Denver Water publicly discloses all of its plans in a transparent, and accurate manner. Only by doing so can Boulder County, Denver Water rate-payers, and the public at large be able to evaluate the utility's proposal.

There are a number of specific failings in Denver Water's current draft proposal (and I use the word "draft" consciously, as the application is NOT complete yet):

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code. Gross Dam expansion is clearly a major facility upgrade being proposed by a public utility. It is ludicrous to say otherwise (and I have worked with utilities over my 30+ year career).

Second: Denver Water's 1041 application fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. The vast majority of the application simply refers to "plans" that don't yet exist. These plans are required if Denver Water is to comply with the Boulder County Land Use Code. Denver Water needs to state their plans in regard to the following:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan

Aquatic Invasive Species Monitoring Plan

- Traffic Management Plan
- Fugitive Dust Control Plan
- Road Maintenance Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application because these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Boulder County should not allow the cart to get in front of the horse; that is, the application needs to be complete with all of Denver Water's plans before the County even consider its approval or rejection.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process, including the Final EIS and Record of Decision, which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
    - The “Purpose and Need” in the EIS is not accurate and must be redone.
    - The “Alternatives” analysis in the EIS is not accurate and must be redone.
    - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
    - The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
    - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to

adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application, Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process, which has numerous errors including:

- Failure to use an adequate alternatives analysis.
- Failure to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies. Per my introduction, climate-change drought will not be resolved with more dams. It has been clear for decades that the Colorado River is over-allocated by the Colorado Compact. Colorado, Denver specifically, counting on more Colorado River water to fill an enlarged Gross Dam is highly unlikely to ever be viable. Just examination the low water levels at Lake Mead in Nevada over the past decade, as well as other reservoirs along the Colorado River and its tributaries.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes. I've driven the dirt roads leading to Gross Reservoir. They are not capable of handling the proposed construction traffic.

Thank you for ensuring that Denver Water's application is complete and is in the best interests of Boulder County as well as Denver Water's customers.

Nick Lenssen
1195 Albion Road
Boulder, CO 80305

nklmll@hotmail.com

From: john stevens
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Concerns regarding Docket #SI-20-0003 : State interest Review of Gross Dam Expansion
Date: Wednesday, November 11, 2020 5:32:37 PM

Dear Commissioners E. Jones, Gardner, and M. Jones,

I am a property owner along Gross Dam Road in south Boulder County, and will be directly impacted bay the Gross Dam Expansion project. I have never written you all before but am writing now because my wife and I feel greatly concerned and helpless of what we perceive as unguarded power of Denver Water.

As Commissioners you have undertaken the burden of stewardship of Boulder County. I commend you all for upholding your commitments in the case on the Gross Reservoir Expansion project, and not bowing to bully tactics Denver Water and their Lawyers have brought in efforts to circumvent laws, processes, and regulations they find inconvenient.

I am not a lawyer, and do not have a good understanding of the laws and regulations required of Denver Water in their pursuit to expand Gross Reservoir, so I am at the mercy of multiple organizations and media in which I trust for relevant, pertinent, and truthful information. As citizens of Boulder County, we are at the mercy of trusting in you to continue to exercise your authority, acting in the best interest of County residents, and uphold the laws and regulations of the County.

This all said, we are deeply troubled with information shared with respect to the current Gross Dam Expansion Project status. If the points below are accurate. we're alarmed by the contempt and disrespect for you, the county and the law Denver Water is openly flaunting.

I'm sure you have seen these points prior to this writing, so I respectfully urge that you carefully consider each, and continue to uphold your duty to the county as you listen and decide on the matter before you. Thank you.

Points of concern:

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan

- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
    - The "Purpose and Need" in the EIS is not accurate and must be redone.
    - The "Alternatives" analysis in the EIS is not accurate and must be redone.
    - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
    - The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
    - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Regards,

John Stevens, Sr. Manager, PMP®
(c) 303-949-1677 (h) 303-642-0842
john07347@yahoo.com

From:	Julie Shaffer
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 5:24:30 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Julie Shaffer

,

From:	Stephanie Trasoff
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 5:24:18 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Pit Development and Reclamation Plan
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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Stephanie Trasoff
2447 Crestline St

Ferndale, WA 98248
360-820-0397

From:	Linda Duffy
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 5:20:32 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Linda Duffy
11837 Crescent Park Dr

Golden, CO 80403

From:	charles akins
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 5:19:40 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

charles akins
4500 19th #69

boulder, co 80304
720-502-5995

From:	Carolyn Elliott
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Denver Water"s 1041 application is incomplete
Date:	Wednesday, November 11, 2020 5:19:01 PM

Dear Boulder County Commissioners and Boulder County:

Denver Water's 1041 application is incomplete. Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all the deficiencies below, Boulder County should not consider this application and should return it to Denver Water for clarification and completion.

Specific problems with the application:

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application fails to provide numerous “plans” about how they will construct the expansion and operate the expanded facility. The vast majority of the application simply refers to “plans” that don’t yet exist. These plans are required if Denver Water is to comply with the Boulder County Land Use Code. Denver Water needs to state their plans in regard to the following:

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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
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Boulder County cannot consider this application because these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process, including the Final EIS and Record of Decision, which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- Failure to use an adequate alternatives analysis.
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Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Thank you for your consideration.

--

Carolyn Elliott (she, her, hers)
We live in the shelter of each other. ---A Celtic Saying

From:	David Fulton-Beale
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir Expansion
Date:	Wednesday, November 11, 2020 5:02:50 PM

Hello,

I am writing to oppose the proposed expansion of Gross Reservoir. Denver Water's 1041 application is incomplete. Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all the deficiencies below, Boulder County should not consider this application and should return it to Denver Water for clarification and completion. There are several specific problems with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code.

Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. The vast majority of the application simply refers to "plans" that don't yet exist. These plans are required if Denver Water is to comply with the Boulder County Land Use Code. Denver Water needs to state their plans in regard to the following:

Tree Removal Plan
Quarry Operation Plan
Pit Development and Reclamation Plan
Stormwater Management Plan
Erosion Control Reclamation Plan
Invasive Plant and Noxious Weed Species Management Plan
Fire Management and Response Plan
Special Status Plants Relocation Plan
Aquatic Invasive Species Monitoring Plan
Traffic Management Plan
Fugitive Dust Control Plan
Road Maintenance Plan
Recreation Management Plan
Visual Resources Protection Plan
Historic Properties Management Plan
South Boulder Creek Channel Stability and Monitoring Plan
Road Management Plan (USFS)
Road Maintenance Plan
Restoration and Revegetation Plans
Special Status Plants Relocation Plan
Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
Emergency Action Plan

Recreation Adaptive Management Plan for Winiger Ridge
Boulder County cannot consider this application because these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process, including the Final EIS and Record of Decision, which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

The Corps Record of Decision violates the National Environmental Policy Act:
The "Purpose and Need" in the EIS is not accurate and must be redone.
The "Alternatives" analysis in the EIS is not accurate and must be redone.
The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
The Corps Record of Decision violated the Clean Water Act:
The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
The full cost of the project was not considered in choosing the LEDPA.
The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.
Fourth: Throughout the application, Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process, which has numerous errors including:
Failure to use an adequate alternatives analysis.
Failure to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Thank you for taking the time to consider this issue.

David Fulton-Beale

From:	Laurie Dameron
To:	Gross Reservoir SI-20-0003
Subject:	my comments
Date:	Wednesday, November 11, 2020 5:02:36 PM

To whom it may concern,

I am against the expansion of Gross Reservoir. It would require cutting down thousands of trees. Trucks and tractors would need to drive miles every day putting out enormous amounts of CO2. Plus it will disturb residents that live near the highways where they will need to pass and hones that are near the reservoir. The project will use enormous amounts of energy.

Instead I think we need to address our lifestyles and make some changes and be more conservative with water. Folks can get toilets that use less water for reasonable prices these days. I got mine for free from the city of Boulder a few years ago. (I paid $25 for delivery). Also "If it's clear, leave it here, if it's brown flush it down" is a motto at my house. Turning off the faucet while brushing your teeth and being conscious of how much water we use to do dishes, water the garden. Perhaps people should be considering xeriscape instead of grass lawns. It may be time for fewer golf courses. In the 1970's here in Boulder, when it was a low snow year, restaurants would only give you water if you asked for it. We need to strive for zero waste. The Environmental Protection Agency states that over 40% of our greenhouse gases come from the way products are extracted from the earth, produced, transported and even to get rid of uses energy and that striving for zero waste is one of the easiest and quickest ways to fight climate change. Folks also need to educate themselves on what is recyclable and compostable as contamination continues to be the biggest problem with zero waste (contamination means putting the wrong items in the wrong bins and if a bin is too contaminated it ends up in the landfill.) We all share this planet and we ALL need to be fighting climate change every day to ensure a future for our children!

thank you,

Laurie Dameron
2635 Mapleton Ave
Boulder, CO 80304

Happy Holidays!

YOU ARE A PART OF THE SOLUTION!!!

Laurie D

Laurie Dameron
Windchime Productions
www.LaurieDameron.com
303-449-3529
Windchimel@aol.com
Chair of Environmental and Sustainable Development
Business and Professional Women since 2015 (BPW Colorado)
Past Chair of Environment 2016-2020 (NFBPWC)

From:	Christopher Beers
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 5:01:42 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Christopher Beers
266 FORSYTHE RD
afterbeatdrum@gmail.com
Nederland, CO 80466
7208375410

From:	Mark Glenn
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 4:54:11 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Mark Glenn
2800 17th Street
markpglenn@gmail.com
Boulder, CO 80304
9704852510

From:	R Carol Cushman
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir expansion
Date:	Wednesday, November 11, 2020 4:36:16 PM

Dear Boulder County Commissioners and Staff,

We have hiked in the foothills above Boulder for half a century and love the Forsythe Trail and the other areas surrounding Gross Reservoir. PLEASE DO NOT LET THESE BEAUTIFUL AREAS BE DROWNED.

Please reject the application of the Denver Water Board.

Thank you!
Ruth Carol and Glenn Cushman
Authors of Boulder Hiking Trails and the monthly "Nature Walk" column in the Boulder Camera

From:	James Morris
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 4:02:33 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.
In general, the dam expansion is unnecessary and will damage wildlife, water quality, air quality, and recreation. It will only benefit real estate developers, water traders, and large scale construction companies. It will harm native species. It will pollute the air. It will destroy forests which are necessary to reduce global warming.
First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

James Morris
60 S. 33 rd St.
jimcmorris@gmail.com
Boulder, CO 80305
3034446430

From:	Julia Chase
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 3:42:18 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Julia Chase
179 Frontier Lane

Nederland, CO 80466
303-886-1807

From:	Jean Whitman-Shelby
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 3:36:37 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Jean Whitman-Shelby
14 Northwood Lane

Marquette, Michigan 49855
906 458-0509

From:	Boulder County Postmaster
To:	Gross Reservoir SI-20-0003
Subject:	[Postmaster] Content Alert Notification
Date:	Wednesday, November 11, 2020 3:27:06 PM

This is a content alert notification message.

The message indicated below matches content alert policies set by the system administrator(s).

Message information:

Sender : "Tedd Beegle" <teddngwen@peoplepc.com>
Intended Recipient : Gross Reservoir SI-20-0003 <grossreservoir@bouldercounty.org>
Message Subject : Denver Water's 1041 Gross Dam Expansion Application is 'Incomplete' and Must Be Rejected
Message Date : Wed, 11 Nov 2020 22:26:53 +0000 (UTC)
Message Status : The message has been placed on HOLD - action required

Content Policies Triggered:

DNS Authentication: DMARC Fail

From:	Barbara Fahey
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 3:25:50 PM

Dear Boulder County Commissioners and Staff,

Im writing about Denver Water's 1041 application for the expansion of Gross Dam. I am against the expansion of this dam and believe the application is incomplete and should be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Barbara Fahey

Barbara Fahey

Boulder, CO 80304

From:	Jennie Hammers
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 3:24:12 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Jennie Hammers
PO Box 1202

Nederland, CO 80466

From:	Jennie Hammers
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 3:22:29 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Invasive Plant and Noxious Weed Species Management Plan
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- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
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- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
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- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Jennie Hammers

Nederland, CO 80466

From: John Andrews
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Wednesday, November 11, 2020 3:18:05 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

John Andrews
510 Logan Mill Rd

Boulder, CO 80302

From:	Oliver Smith
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 3:15:38 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Oliver Smith
634 2nd Ave

Lyons, CO 80540-1581
5094997382

From:	august schultz
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 3:11:22 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

august schultz
4116 S holloway drive

holladay, UT 84124
801-554-0261

From:	Ellen Middleditch
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 3:09:37 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Ellen Middleditch
621 Paige Loop

Los Alamos, NM 87547
5054123408

From:	Deanne Grover
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 3:01:14 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Deanne Grover

, 80503

From:	Sue Thompson
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 2:59:09 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely, Sue and Dave Thompson

Sue Thompson
1059 Twin Sisters Rd.

Nederland, CO 80466
720-361-9360

From:	Arthur J Altree
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 2:23:51 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Arthur J Altree
91 Perro Place

Durango, CO 81301-8368
9703859575

From:	Vicki Quarles
To:	Gross Reservoir SI-20-0003
Subject:	Stop Gross Reservoir Expansion!
Date:	Wednesday, November 11, 2020 2:20:40 PM

We just elected a President who actually cares about the environment. There are many issues that still need to be addressed. Let's please do the right thing. Thank you for thoughtful consideration!

Denver Water's 1041 application is incomplete. Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all the deficiencies below, Boulder County should not consider this application and should return it to Denver Water for clarification and completion.

Specific problems with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. The vast majority of the application simply refers to "plans" that don't yet exist. These plans are required if Denver Water is to comply with the Boulder County Land Use Code. Denver Water needs to state their plans in regard to the following:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Road Maintenance Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)

- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application because these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process, including the Final EIS and Record of Decision, which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
  - The "Purpose and Need" in the EIS is not accurate and must be redone.
  - The "Alternatives" analysis in the EIS is not accurate and must be redone.
  - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
  - The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
  - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application, Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process, which has numerous errors including:

- Failure to use an adequate alternatives analysis.
- Failure to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

--
Peace, Vicki

"Adopt the pace of nature: her secret is patience." Ralph Waldo Emerson

"The secret of a good old age is simply an honorable pact with solitude." Gabriel Garcia Marquez

"Nobody can go back and start a new beginning, but anyone can start today and make a new ending." Maria Robinson

"What happens to you does not matter: what you become through those experiences is all that is significant. This is the true meaning of life." Paraphrased from Buddhist philosophy

From: Henriette Hagg
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Wednesday, November 11, 2020 2:03:10 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Henriette

Henriette Hagg

Golden, CO 80403
3038881549

From:	Karen Hollweg
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Require a complete application from Denver Water !
Date:	Wednesday, November 11, 2020 1:58:06 PM

Commissioners,
Please know that I strongly support you in deferring consideration of Denver Water's 1041 application until it is complete.

Denver Water, as any applicant, must be required to
(1) prepare and submit all plans required to comply with and
(2) meet all provisions in
our County Land Use Code. Referring to previously prepared federal documents is not adequate to provide you with what you need to make this important decision.

I know that you will do a careful review and make a thoughtful decision regarding this matter, but first, you need the applicant to complete their part.

THANK YOU for ALL you do !
Karen

Karen S. Hollweg
4440 Greenbriar Blvd
Boulder, CO 80305
303-494-2016 home & v-mail
Cell 703-801-5722
khollweg@stanfordalumni.org

From:	Tim M Hogan
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir
Date:	Wednesday, November 11, 2020 1:31:01 PM
Attachments:	GrossDamReservoirComments_Nov-2020.docx

11 November 2020

Friends,

My first exposure to Gross (Dam) Reservoir occurred in the 1980s with citizen conservation work as a volunteer with the Boulder County Nature Association. The reservoir was embedded in the larger Winiger Ridge area, a critical migration corridor for elk and other large mammals moving from the high mountains to the lower foothills during the winter months.

Boulder and the greater Denver metropolitan region were smaller and, in many ways, more hospitable in those days. Alas, the twenty-first Century has caught up with us. The Front Range has become a magnet for growth with immigration and attendant populations fueling unbridled expansion. This has been exacerbated with the juggernaut of expanding economies.

In addition, the specter of climate disruption has changed the game as our environment has become warmer and less predictable with fires, erratic precipitation, and a host of other variables. In the context of the proposed expansion of the reservoir lies the viability of the Colorado River; a river course of water defining our region with unpredictable rains and snow.

In short, the Front Range of the Southern Rockies can no longer depend on easy fixes. Every aspect of our economy and life-ways must be re-examined – be it population numbers, availability of resources, or the beauty and fragility of precious natural areas. Dams are not the answer. The health of the plants and animals that make up the communities of grasslands, forests, and mountains, these priceless ecosystems upon which we all depend must not be forsaken.

The integrity of Denver Water is not to be trusted, time and time again they have dismissed the concerns of Boulder County. It is hard to not see this application as one more scatter-shot attempt to get what they want on the fly. The majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with Section 8-308.A.4 of the Boulder County Land Use Code.

By my count, 23 'plans' have been ignored or dismissed. Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

In addition, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. These egregious oversights include violation of the National Environmental Policy Act (NEPA), the Clean Water Act, and the Endangered Species Act (ESA).

Furthermore, Denver Water has deferred to analysis and conclusions in the Federal Energy Regulatory Commission's (FERC) license amendment process which has numerous errors including 1) a failure to use an adequate alternatives analysis, and 2) a failure to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Finally, Denver Water fails to comply with the Boulder Valley Comprehensive Plan and violates numerous sections throughout the Boulder County Land Use Code. These include Sec. 8-511.C.2.a (conservation and utilization of existing municipal water supplies); Sec. 8-511.I.2 (resource preservation); Sec. 8-511.J.1 (danger to public health, safety, or property); 8-511.J.2 (compatibility with existing traffic volumes).

Let me return to my opening reflections. Since the latter decades of the twentieth century our home-ground here in the Front Range has been abused by a thousand cuts. Redoubts in the mountains have been discovered by others, and quiet neighborhoods closer to home have been taken over by recent transplants. Climate disruption is no longer something coming, it has arrived. The advent of Covid-19 has highlighted the impacts of humanity across the planet, opening our eyes to the plight of Mother Earth. Profound moral choices must be made concerning our decisions on South Boulder Creek, both as it pertains to Gross Reservoir and to floodplains down in the valley. Ninety percent of the earth has been appropriated by our species. We carry the burden of the sixth extinction on our backs.

We are fortunate to live in a place where those who came before us had the foresight to recognize the beauty of these lands and worked to set aside relatively large parcels for their natural values. In recent years, we seem to have lost that spirit, forgetting we each need to lighten our steps if their ecological integrity is to survive. We need to revivify the covenant we had with nature that has begun unravelling, to embrace an ethic of stewardship, and, in the words of Barry Lopez, rediscover that spot "between the extremes of nature and civilization where it is possible to live without regret."

I would like to suggest to my neighbors – and are we not all neighbors? – that we begin to view these lands as a commons. Not the commons of tragedy on which individuals pursue their singular ends, but rather a commons of sharing and cooperation. A bestowal upon which the citizenry as a whole has come to an agreement as to what is best for the plant and animal communities that flourish here, and for those of us who are fortunate enough to share it with this more-than-human-world. This can become the context in which we restore, and begin to make reparation, with these lands and with each other.

In the end, we need the solace and calm of wild nature to be whole. To be held by the gaze of a wild animal, to be nourished by a quiet trail. And beauty, beauty most of all, is essential.

Tim Hogan
2540 6th Street
Boulder, CO 80304
303.444.5577

11 November 2020

Friends,

My first exposure to Gross (Dam) Reservoir occurred in the 1980s with citizen conservation work as a volunteer with the Boulder County Nature Association. The reservoir was embedded in the larger Winiger Ridge area, a critical migration corridor for elk and other large mammals moving from the high mountains to the lower foothills during the winter months.

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In short, the Front Range of the Southern Rockies can no longer depend on easy fixes. Every aspect of our economy and life-ways must be re-examined – be it population numbers, availability of resources, or the beauty and fragility of precious natural areas. Dams are not the answer. The health of the plants and animals that make up the communities of grasslands, forests, and mountains, these priceless ecosystems upon which we all depend must not be forsaken.

The integrity of Denver Water is not to be trusted, time and time again they have dismissed the concerns of Boulder County. It is hard to not see this application as one more scatter-shot attempt to get what they want on the fly. The majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with Section 8-308.A.4 of the Boulder County Land Use Code.

By my count, 23 ‘plans’ have been ignored or dismissed. Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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Furthermore, Denver Water has deferred to analysis and conclusions in the Federal Energy Regulatory Commission’s (FERC) license amendment process which has numerous errors including 1) a failure to use an adequate alternatives analysis, and 2) a failure to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Finally, Denver Water fails to comply with the Boulder Valley Comprehensive Plan and violates numerous sections throughout the Boulder County Land Use Code. These include Sec. 8-511.C.2.a (conservation and utilization of existing municipal water supplies); Sec. 8-511.I.2 (resource preservation); Sec. 8-511.J.1 (danger to public health, safety, or property); 8-511.J.2 (compatibility with existing traffic volumes).

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We are fortunate to live in a place where those who came before us had the foresight to recognize the beauty of these lands and worked to set aside relatively large parcels for their natural values. In recent years, we seem to have lost that spirit, forgetting we each need to lighten our steps if their ecological integrity is to survive. We need to revivify the covenant we had with nature that has begun unravelling, to embrace an ethic of stewardship, and, in the words of Barry Lopez, rediscover that spot "between the extremes of nature and civilization where it is possible to live without regret."

I would like to suggest to my neighbors – and are we not all neighbors? – that we begin to view these lands as a commons. Not the commons of tragedy on which individuals pursue their singular ends, but rather a commons of sharing and cooperation. A bestowal upon which the citizenry as a whole has come to an agreement as to what is best for the plant and animal communities that flourish here, and for those of us who are fortunate enough to share it with this more-than-human-world. This can become the context in which we restore, and begin to make reparation, with these lands and with each other.

In the end, we need the solace and calm of wild nature to be whole. To be held by the gaze of a wild animal, to be nourished by a quiet trail. And beauty, beauty most of all, is essential.

Tim Hogan
2540 6th Street
Boulder, CO 80304
303.444.5577

From:	Daniel Friend
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 1:23:32 PM

Dear Boulder County Commissioners and Staff,

We understand that water resources are limited, and that we live in a time period in which environmental issues are often ignored for the benefit of an outdated "growth" scenario. The 1041 application of Denver Water for the expansion of Gross Dam/Reservoir is substantially incomplete, and approval of the application would signal Boulder County's complicity in environmental depredation and incomplete assessment of water/environmental politics. The application of Denver Water should be rejected.

As noted by others, the 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code.The assertion that Denver Water's application is not a “site selection and construction of major facilities of a public utility” is patently absurd. A complete application would comply with this section of the Land Use Code.

The County Commissioners (and the public) should not have to guess about the content and viability of the numerous plans which must be implemented to support the application. As you know, required plans for

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
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- Emergency Action Plan
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- Capital Improvement Plan or Facilities Master Plan

are missing or substandard.

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

As noted by others, throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Throughout the application, Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous known errors including:
- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

The application substantively fails to comply with the Boulder Valley Comprehensive Plan.

The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies; it is also not compatible with resource preservation and does not minimize resource damage; it is a danger to public health or safety or to property (Section 8-511.J.1); it does not ensure compatibility with existing traffic volumes (Section 8-511.J.2).

We ask that the Commissioners reject this application.

Thank you!
Sincerely,
Dan Friend

Daniel Friend
3817 Silver Plume Cir

Boulder, CO 80305
303-842-0672

From:	Cassandra Gobrecht
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 1:12:49 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Cassandra Gobrecht
1262-B Milo

Lafayette, CO 80026
7207712367

From:	Boulder County Postmaster
To:	Gross Reservoir SI-20-0003
Subject:	[Postmaster] Content Alert Notification
Date:	Wednesday, November 11, 2020 1:12:34 PM

This is a content alert notification message.

The message indicated below matches content alert policies set by the system administrator(s).

Message information:

Sender : "Lisa Thomas" <earlliver@me.com>
Intended Recipient : Gross Reservoir SI-20-0003 <grossreservoir@bouldercounty.org>
Message Subject : Denver Water's 1041 Gross Dam Expansion Application is 'Incomplete' and Must Be Rejected
Message Date : Wed, 11 Nov 2020 20:12:20 +0000 (UTC)
Message Status : The message has been placed on HOLD - action required

Content Policies Triggered:

DNS Authentication: DMARC Fail

From:	kithikes@aol.com
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Comments regarding Denver Water 1041 Application
Date:	Wednesday, November 11, 2020 12:50:05 PM
Attachments:	Final Gross Comments.doc

Dear Commissioners:

Please review the attached Word file containing my comments on Denver Water's 1041 Application.
Kindly let me know that you receive this!

Respectfully,
Kathleen G. Coddington
Kithikes@aol.com   3039311865

To: Boulder County Commissioners Nov. 11, 2020

My husband and I have been residents of the Lakeshore Park Community adjacent to Gross Reservoir for 42 years. We have been against Denver Water's proposal to expand Gross Dam since the beginning. Our belief is that conservation should be the key to Denver's perceived future water shortage, not the construction of a mega dam that annihilates forests, wildlife habitat, and quietude in a relatively pristine area of Boulder County where people flock to outrun the pressures of daily life and to search out the peace that only Nature can deliver.

I don't think a project of this size and degree of destruction should even be considered at this point in time where wildfires have recently raged across our state and a COVID pandemic is at near record intensity. Wildlife and humans have been forced out of their homes and there is much rebuilding and mitigation to be done. We have new county commissioners coming on board that will need to thoroughly inform themselves of the consequences of a Moffat Expansion, and how it would affect the lives of many Boulder County residents not only during the construction, but also post-expansion, defining effects of more traffic up Flagstaff, high density recreation at Gross Rez where there already exists a real dearth of parking, not enough oversight of illegal campers and campfires at current levels, a loss of wildlife corridors which keep our wild friends out of the neighborhoods, and if constructed, would demand more emergency response to 911 calls. This is neither the time nor the place for such a damaging project. It goes against many of the Boulder County Land Use mandates, and sacrifices irreplaceable viewsheds for more growth in Denver, when there are other options to sustain the water needs of that population through conservation, through underground storage in aquifers, through stricter building codes, etc.

The FEIS smacked of rushed and incomplete conclusions, and did not factor in climate change in it's projections. We live in a warmer world, with less precipitation. A larger reservoir would perhaps never fill completely, and even if it did, a much larger surface area would mean more water lost through evaporation. Underground storage is a much better solution and was not adequately addressed or studied in the FEIS, or in the recent 1041 Application presented by Denver Water. Common sense dictates you don't pull more water out of rivers and tributaries on the Western Slope at a time when those areas are suffering from drought, pestilence, fires, and a pandemic. We need more investigation into the Least Environmentally Damaging Practicable Alternative under NEPA guidelines.

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion. The Commissioners need to take their time analyzing Denver Water's 1041 Application, and not be intimidated by Denver Water's purported need for fast action based on FERC's timeline proposed in July 2020. ALL the deficiencies not addressed in their 1041 Application will surface too late and be beyond remediation if they are not called out NOW ..

Specific issues with the 1041 Application:

<u>First:</u> The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

<u>Second:</u> Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan- e.g. noise level monitoring for a 24 hr. batch plant and blasting for aggregate, method for getting aggregate to batch plant , what noise levels and what night light exposure too much for area residents to tolerate?
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan

- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan – esp. with increased day traffic and congestion on Flagstaff and Coal Creek Canyon. Who are the first responders to a fire or ambulance call on North Shore in particular, since South Shore access will be closed?
- Special Status Plants Relocation Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan – how control increased speeding through the Lakeshore neighborhood by recreationists? How keep people off flammable grasses where recreationists now park along Flagstaff Rd. because the North Shore parking lot fills up?
- Fugitive Dust Control Plan
- Road Maintenance Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans—how ensure continued privacy for residents that abut Denver Water property line? Homes along Flagstaff and on North Shore of reservoir already are subject to increasing trespassers, illegal camping on their property, impromptu picnics by reservoir visitors on private lands in Lakeshore, wildlife friendly fencing on wildlife corridors already needing repairs along Flagstaff
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

<u>Third:</u> Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have

numerous errors, ARE NOW VERY OUTDATED, and are under dispute and litigation in federal district court in Denver.

- The Corps Record of Decision violates the National Environmental Policy Act:
  - The "Purpose and Need" in the EIS is not accurate and must be redone.
  - The "Alternatives" analysis in the EIS is not accurate and must be redone. Underground storage in aquifers is barely mentioned or researched.
  - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project. It does not factor in recent damages, needs of residents , changes caused by forest fires and drought, esp. on Western Slope.
- The Corps Record of Decision violated the Clean Water Act:
  - The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
  - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek. Failed to consider resident water wells future integrity in the stakeholder area, or decline in property values during 6-8 years of construction and mitigation near the Lakeshore, Gross Dam Rd., and Coal Creek neighborhoods.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan, e.g. regarding preservation of viewsheds

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property. (What is the plan for additional parking near North Shore for overflow that comes with increased visitation, that doesn't negatively impact residents with noise issues, or increase potential for igniting flammable grasses off shoulders of Flagstaff where overflow now parks?)

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Additionally, in their 1041 Application, Denver Water states "increased earthquake activity from lubricated faults is not anticipated" and "dam raise expansion may increase the potential for reservoir induced seismicity, but not at substantial levels" – definitely not enough definition here. One would need to see the complete finished building plan to better determine that.

Trading Toll property as mitigation for submersion / destruction of forest lands for wildlife habitat in Gross Rez area doesn't really compensate for those areas lost.

Denver Water proposes a whole laundry list of "promises" that likely will never be kept ; sadly, the destruction of viewsheds, wildlife habitat and lives, and quality of life for the area's human residents will be permanent, and certainly counter to Boulder County Land Use codes. Most of Denver Water's public outreach for this massive project has been on the Coal Creek corridor and not at Lakeshore Park, which is also directly impacted and is at Ground Zero for noise and traffic impacts once recreation access is rerouted to the North Shore because of closures on the South Shore and at Osprey Point.

In conclusion, we urge the Commissioners to return Denver Water's 1041 Application, citing its incomplete status and need for further clarity. The FEIS document is obsolete in places due to climate change, and was never a full disclosure document ; it really should have been reworked and updated prior to Denver Water filing the 1041 Application.

Thank you for your time and commitment to Boulder County values!

Respectfully,

Kathleen Coddington

3 Lakeshore Park Road

From:	Andrey Weinstein
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 12:46:17 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Andrey Weinstein
11586 Coal Creek Heights Dr.
phdrey@gmail.com
Golden, CO 80403
3036015070

From:	Dawn Ferro
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 12:45:21 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Dawn Ferro
1061 CHURCH STREET
dferro59@gmail.com
SAN FRANCISCO, CA 94114-3414
4156508003

From:	Boulder County Postmaster
To:	Gross Reservoir SI-20-0003
Subject:	[Postmaster] Content Alert Notification
Date:	Wednesday, November 11, 2020 12:43:08 PM

This is a content alert notification message.

The message indicated below matches content alert policies set by the system administrator(s).

Message information:

Sender : "Brian Walton" <bwalton@rof.net>
Intended Recipient : Gross Reservoir SI-20-0003 <grossreservoir@bouldercounty.org>
Message Subject : Denver Water's 1041 Gross Dam Expansion Application is 'Incomplete' and Must Be Rejected
Message Date : Wed, 11 Nov 2020 19:42:28 +0000 (UTC)
Message Status : The message has been placed on HOLD - action required

Content Policies Triggered:

DNS Authentication: DMARC Fail

From:	Karen Dike
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 12:34:06 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Karen Dike
708 Hayden Ct

Longmont, CO 80503

From:	Karen Burroughs
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 12:32:36 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
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- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Karen Burroughs
303 Tall Pines Ct
karen@lustre.us
Canton, Ga 30114
4077583033

From:	Barbara Howard
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 12:29:01 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Pit Development and Reclamation Plan
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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Barbara Howard
1617 Cornell Dr SE
mayakeresa@earthlink.net
Albuquerque, New Mexico 87106

From:	Stephen La Serra
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 12:23:05 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Visual Resources Protection Plan
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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Stephen La Serra
52 High St.

Stoneham, Ma. 02180

From:	Stephen La Serra
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 12:22:12 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Stephen La Serra
52 High St.

Stoneham, Ma. 02180

From:	Charlene Kerchevall
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 12:22:02 PM

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Charlene Kerchevall
533 South Nevada Street

Oceanside, c 92054-4040
760-967-7673

From:	John Belcher
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Gross Dam expansion - comment on fire risk
Date:	Wednesday, November 11, 2020 12:15:49 PM

Commissioners,

Following a horrendous year of wildfires, a review of Denver Water's application reveals a startling lack of concern for the fire risk generated by the proposed **six year** project. The project involves hundreds of workers, few of which will be Denver Water employees, and few of which will reside anywhere near the project. The level of knowledge, concern, and care among these workers will be much varied and much less than the residents most exposed to the fire risk. How many of the workers will be smokers? As with all human activity, the potential for negligence, errors in judgment, unfortunate coincidence (freak accidents), and even purposeful destruction – arson - is ever present. Given the scale of the proposed project and the often occurring dry to drought conditions in the forests, the likelihood of wildfires is substantial.

The proposed project will also involve a few hundred vehicle trips per day through a good deal of forested lands. Many of these will involve heavy trucks and machinery. Generation of sparks will be a threat. The coincidence of the season of most active operations and environmental hot, dry and windy conditions raises the risk.

Barely a mention of fire risk is included in the application. From page 333 of the 1041 Draft: "The USFS, Denver Water, and other agencies have conducted and will continue to implement programs to reduce the potential for wildfire. Construction activities at the site and vehicle movement along the access routes may cause a temporary increase in the potential for initiation of wildfires. With standard safety precautions and training of construction workers, fires are likely to be quickly contained or extinguished and are not expected to adversely affect forest and other vegetation. Per USFS Section 4€ Condition 20 (Fire Management and Response Plan), Denver Water will develop a new Fire Management and Response Plan to reduce the risk of wildfires at and near Gross Reservoir."

"*…may cause a temporary increase in the potential…"* indicates a lack of serios concern.

"*…fires are likely to be quickly contained or extinguished…"* is in direct conflict with our experiences this year.

"*…Denver Water will develop a new Fire Management and Response Plan…".* No fire risk mitigation occurs in the Draft. As is the case throughout the Draft, the "plan" is yet to be developed, so how can the Commissioners rule as to its adequacy? The application should be rejected.

Thank you.

John and Carol Belcher
1899 CR 68J
Nederland, CO 80466
303-877-4583

From:	Jane Enterline
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 12:07:38 PM

Dear Boulder County Commissioners and Staff,

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First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Jane Enterline
2420 Bluff St

Boulder, CO 80304
2066184231

From:	Steven Wallace
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 12:07:23 PM

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Steven Wallace
1902 Lydia Dr

Lafayette, CO 80026-1307
720-333-8865

From:	Michael Dye
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 12:05:02 PM

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Michael Dye
491 west spring street

Nederland, Co 80466
7206350417

From:	Andrew Schelling
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 11:55:54 AM

Dear Boulder County Commissioners and Staff,

I am following a personal note with the email comment prepared by "Save the Colorado," but want to make this a bit more vivid. The disruption to my own life on Sugarloaf might prove minimal, but my son in law rives to work in Golden every day through Coal Creek Canyon. He and my daughter live near the top of the Canyon, and I am concerned for their inconvenience, yes,—but moreso for the danger posed by several years of heavy equipment, blasting, log trucks, and so forth, that they will have to negotiate. All for a reservoir of larger dimension which in no way benefits them, or myself and my neighbors. The noise, congestion, contamination, and possible dangers of accident make this expansion a terrible idea for those of us nearby in Boulder and Gilpin Counties. Please do what you can to listen to the voices of citizens and evaluate the impacts. Thank you.

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- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Andrew Schelling
625 Labelle Rd

Boulder, Colorado 80302
3034401048

From:	Bernard Filla
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 11:54:37 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Bernard Filla
55 Aspen Grove Court
PO Box 186
Nederland, CO 80466
3037869761

From:	Judy Marsh
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 11:46:08 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Judy Marsh
3562 Inglewood Blvd.

Los Angeles, California 90066
3103979450

From:	Elizabeth Milford
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 11:40:06 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Elizabeth Milford
628 Amherst Dr SE

Albuquerque, NM 87106
5052554667

From:	Elizabeth Milford
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 11:39:13 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Elizabeth Milford

,

From:	David Bahr
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Reject Denver Water 1041 Gross Reservoir application
Date:	Wednesday, November 11, 2020 11:37:29 AM

Dear Boulder County Commissioners and Boulder County Community Planning & Permitting Department:

I am a climate scientist, and I am writing to you about Gross Reservoir as an expert on water resources. I invented one of the two techniques used to predict sea level rise from melting mountain glaciers, I was a contributing author to the United Nations 2013 IPCC report, and I have a deep scientific understanding of water in the American West.

Denver Water has ignored climate change impacts on the proposed Gross Reservoir expansion, and as such, their 1041 application is incomplete and should be rejected. Climate scientists, including me, predict significant losses of water in the Colorado River Basin and high probabilities of extended droughts over the next century. The unsurprising scientific conclusion is that Denver Water will not have enough water to fill the reservoir except in a vanishingly small number of years over the lifetime of the dam. Expanding the reservoir would create little more than a monument to climate denial.

Neither the Army Corp of Engineers nor FERC considered climate change to be within the scope of their Gross Reservoir reviews. It is therefore incumbent on Boulder County to address the relevant climate science and to reject Denver Water's 1041 application.

Please contact me if you or your staff have any questions about the climate science and its relationship to Gross Reservoir.

Sincerely,
David Bahr, PhD
303-249-7468

95 Meadowland Ct.
Nederland, CO 80466

From: Richard Ley Armstrong
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Joining the fight against expansion of Gross Reservoir -
Date: Wednesday, November 11, 2020 11:23:25 AM

As a concerned resident of Boulder County, I am writing to oppose Denver Water's application to expand Gross Reservoir. Denver Water's application does not comply with the Boulder Valley Comprehensive Plan, and in addition it violates several of Boulder County Land Use codes.

Because Denver Water's current 1041 application is incomplete, Denver Water must submit an application that complies with the Boulder County Land Use Code and addresses numerous deficiencies. Boulder County should not consider this application and should return it to Denver Water for clarification and completion.

In addition, while Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process, including the Final EIS and Record of Decision (which have numerous errors and are under dispute and litigation in federal district court) -- it appears to me that the Army Corps assessment is more of an engineering feasibility study than an environmental impact statement.

Finally, although not fully quantified, it has been suggested that implementing conservative water use and increased use of water saving technologies could eliminate the need for the expansion of Gross Reservoir.

Approval of this expansion would be destructive to the Boulder County environment and I encourage the Boulder County commissioners to reject this application.

Wishing you total success in this effort.

Thanks,

Richard L. Armstrong

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process, including the Final EIS and Record of Decision, which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

From:	Ilene Flax
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 11:21:51 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Ilene Flax

Ilene Flax
2836 Elm Avenue
Flax.ilene@gmail.com
Boulder, CO 80305
7203738362

From:	Donald Scott
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 11:21:21 AM

Dear Boulder County Commissioners and Staff,

As someone who has spent much quality time in Boulder County, some with family and some with colleagues, and who appreciates its beauty and friendliness, I oppose any expansion of Gross Dam. Such an expansion threatens the area with the kind of over-development which always comes with damming of rivers. So I support the following:

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’

Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Donald Scott
310 South Carson

Carson City, Nevada 89701
805 704 1482

From:	Brett Curry
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 11:20:43 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Brett Curry

Brett Curry
201 Skyline Drive

Golden, CO 80403
206-327-0743

From:	Marilyn Hoff
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 11:20:34 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Marilyn Hoff
PO Box 295
marigayl@netzero.net
El Prado, NM 87529-0295
5057761111

From:	Robyn Smith
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 11:20:24 AM

Apologies for the lack of a personalized response, however, below is a comprehensive argument to reject Denver Water's application which I fully endorse.

I encourage you use your authority to hold Denver Water to the highest possible standard under the law in order to prevent further damage and depletion of the Colorado river.

Thank you for your time and all that you do!

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Robyn Smith

Robyn Smith
1969 Circle Drive

Vail, Colorado 81657
9175967618

From:	Shelley Majsterek
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 11:06:42 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Fugitive Dust Control Plan
- Recreation Management Plan
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- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Shelley Majsterek
214 E Stanford Ave

Ellensburg, WA 98926
5098592570

From:	Alexander Vollmer
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 10:48:20 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Alexander Vollmer
26 narragansett cove

san rafael, ca 94901
4157854949

From:	Diana Maxwell
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 10:45:26 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Diana Maxwell
210 Hopi Pl

Boulder, CO 80303

From:	Lou Vincent
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 10:34:27 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Lou Vincent
202 Remuda Lane
lou.vincent9@gmail.com
Lafayette, CO 80026
7032099959

From:	Lou Vincent
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 10:34:09 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Lou Vincent
202 Remuda Lane
lou.vincent9@gmail.com
Lafayette, CO 80026
7032099959

From:	Sandra Zinghini
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 10:33:38 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
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- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Sandra Zinghini
117 Spruce Way

NEDERLAND, CO 80466
6318892929

From: Rodney Merrill
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Wednesday, November 11, 2020 10:19:44 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Rodney Merrill
1233 Carleton Street

Berkeley, CA 94702
000-000-0000

From:	Boulder County Postmaster
To:	Gross Reservoir SI-20-0003
Subject:	[Postmaster] Content Alert Notification
Date:	Wednesday, November 11, 2020 10:16:57 AM

This is a content alert notification message.

The message indicated below matches content alert policies set by the
system administrator(s).

Message information:

Sender : "Maddie Woods" <woodsml@me.com>
Intended Recipient : Gross Reservoir SI-20-0003 <grossreservoir@bouldercounty.org>
Message Subject : Denver Water's 1041 Gross Dam Expansion Application is 'Incomplete' and Must Be Rejected
Message Date : Wed, 11 Nov 2020 17:16:43 +0000 (UTC)
Message Status : The message has been placed on HOLD - action required

Content Policies Triggered:

DNS Authentication: DMARC Fail

From:	mcd918@aol.com
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water application 1041;The expansion of Gross Dam Reservoir
Date:	Wednesday, November 11, 2020 10:16:07 AM

Dear Boulder County Commissioners and staff,

There are problems with Denver Waters application 1041 being incomplete and I am requesting the application be rejected until it is complete.
The application does not comply with the section 8-308.A.4 of the land use code.
I am requesting you do not grant Denver Water a waiver in section 8-503 of the application because Denver Water must comply with this section of the land use code and provide the detailed plans that are required.

The land use code is one of the many important issues Denver Water has not addressed. There are numerous errors and violations throughout their application that also need to be reviewed.

I am vehemently opposed to the expansion of Gross reservoir for a wide variety of logical reasons and also because I will be affected personally by the negative impact of this invasive, unnecessary, long term project, since I live very near the Gross Reservoir area.

I will stand in opposition with the many neighbors and neighborhoods that will be severely and negatively impacted if this expansion is allowed to proceed.

Please reject this application,
Thank you,
Sincerely,

Mary DiGennaro
7384 Magnolia Dr.
Nederland, Co. 80466
Boulder County
303-258-3239

From: Louise Murphy
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Wednesday, November 11, 2020 10:12:52 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Louise Murphy

Louise Murphy

,

From:	Larry Utter
To:	Gross Reservoir SI-20-0003
Subject:	Reject Gross Dam Expansion Application
Date:	Wednesday, November 11, 2020 9:43:18 AM

Dear Boulder County Commissioners and Staff,

I feel any further transfer of water from the Western Slope/Colorado River drainage is unwise considering the current long term reduced flow of the Colorado River due to long term drought brought on by worsening climate change. Current downstream commitments for Colorado River water currently cannot be met and downstream reservoirs are often at half capacity. Western Colorado residents and agriculture also have increasing needs for water. This is no time to take take further water from the Colorado River drainage and transfer it over the Continental Divide to the Front Range. The Front Range cities should employ further methods to conserve the water they have to meet their needs.

Further, Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and should be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
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B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!

Sincerely,

Larry Utter
5464 Ptarmigan Circle
Boulder, CO 80301

From: Bill Butler
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Wednesday, November 11, 2020 9:36:54 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Bill Butler
pob 3327

Jefferson County, CO, co 80437

From:	Cliff Long
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 9:34:05 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:

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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Cliff Long
118 Linwood Drive
cliffalong@gmail.com
Albemarle, NC 28001
7043874520

From:	suzanne watson
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 9:31:52 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

suzanne watson
PO Box 96

Gardner, Colorado 81040-5044

From:	Samantha Bush
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 9:31:23 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Samantha Bush
1119 Monroe St apt 214

Beatrice, NE 68310
9702016239

From:	Dan Perez
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 9:30:53 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Dan Perez
314 W 66th st
Draphaelp@gmail.com
Los Angeles, CALIFORNIA 90003
3235528220

From:	William Kuepper
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 9:29:21 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
William Kuepper

William Kuepper
329 Forsythe Road

Nederland, CO 80466

From:	Russ Bonny
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 9:28:51 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Russ Bonny

,

From:	Brook Stableford
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 9:28:38 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Brook Stableford
2342 Folsom St

Boulder, CO 80304

From:	Carolyn Meyer
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 9:28:27 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Carolyn Meyer and Kip Kuepper

Carolyn Meyer
329 Forsythe Road

Nederland, CO 80466

From:	Richard Harm
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 9:25:45 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Richard Harm
454 Purrington Road

Petaluma, CA 94952
707-763-8878

From: star pais
To: Gross Reservoir SI-20-0003
Subject: Against Gross Reservoir Expansion
Date: Wednesday, November 11, 2020 9:09:53 AM

To whom it may concern,
As a member of the community that lives within a few miles of Gross Reservoir I am against any expansion of the reservoir. The sustained disruption to the community, health concerns, environmental impacts, and lack of conservation efforts are all important aspects supporting my reasoning that there should be no expansion.
Storing more water is not a solution to the climate change problems that will be faced by future generations on the front range and in the west. As the population continues to rise climate change will decrease the amount of available water and building a bigger dam does not create any more water it just starves it away form other places that are in dire need of it such as the already Parched colorado river.

Starteya Pais

From:	Lynn Staskal Wilson
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:51:52 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

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Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Lynn Staskal Wilson

,

From:	Loree Wilcox
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir expansion for Denver water
Date:	Wednesday, November 11, 2020 8:48:54 AM

To whom it may concern,

I am writing to beg and plead with you to NOT consider the application from Denver Water to expand Gross reservoir!!! This is a pristine piece of Boulder County and an invaluable resource for so many; including residents and those that come from all over, but mainly the diverse wildlife that depend on Gross Reservoir and it's land for water, food, and shelter.

Why doesn't Denver Water have to comply with Section 8-308.A.4 of the Boulder County Land Use Code? This is unacceptable to allow them to bypass this code. ***Boulder county residents voted for land use codes and we expect them to be followed.***

Why don't they have to comply with Section 8-511 of the code?
***They are missing plans from their application that would put them in compliance with the code. These plans need to be in place to preserve and protect the land for the wildlife that depend on Gross Reservoir. These plans need to be in place and approved by the people that live around Gross Reservoir for their roads, their homes, their land's protection from this type of destruction.

Why are they allowed to defer to the Army Corps of Engineers, when we know they are in federal court due to their violations against the National Environment Protection Act AND The Clean Water Act AND The Endangered Species Act?

AND the list goes on as to why this application is inadequate, incomplete and unacceptable to be considered...

Throughout the application, Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process, which has numerous errors including:

- Failure to use an adequate alternatives analysis.
- Failure to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Thank you for hearing me out and listening to the residents of Boulder County,
Loree Wilcox
209 E. Cleveland St
Lafayette 80026

From:	Simon Trevena
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:44:32 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Simon Trevena
5705 Coachwood Trail

Colorado Springs, COLORADO 80919

From:	Rhett Mitchell
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:40:14 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Rhett Mitchell
11616 coal creek Heights dr

Golden, Co 80403
8437080844

From:	Margaret Hostetter
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:33:16 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Margaret Hostetter
135 S 500 W #603

Salt Lake City, UT 84101-4107
8013553570

From:	Kate Warner
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:32:56 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Kate Warner
1429 Columbine Road

Colorado Springs, CO 80907
7193600987

From:	Ronald Silver
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:28:17 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Ronald Silver

,

From: Mona Fansher
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Wednesday, November 11, 2020 8:26:22 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Mona Fansher
11353 salem st
donkeys65@gmail.com
henderson, CO 80640
3038842405

From:	Wendy Frado
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:26:15 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Wendy Frado
6907 Tobias Ave.

Van Nuys, Ca 91405

From:	Rodney Merrill
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:14:53 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Rodney Merrill
1233 Carleton Street

Berkeley, CA 94705
000000000

From:	Matt Reynolds
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:13:42 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Stormwater Management Plan
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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Matt Reynolds

Matt Reynolds
9811 Sugarloaf Raod

Boulder, CO 80302
3032583739

From: Patricia McDonald
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Wednesday, November 11, 2020 8:11:11 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Patricia McDonald
2348 Summerfield Road

Winter Park, Florida 32792

From:	Joyce Frohn
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:10:30 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Joyce Frohn
425 Congress

Oshkosh, WI 54901

From:	Lawrence Crowley
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:07:21 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Lawrence Crowley
441 Pheasant Run

Louisville, CO 80027
3036660640

From:	Dennis Manning
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:06:56 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Dennis Manning
15135 Jessie Dr.
d.w.m@comcast.net
Colorado Springs, CO 80921

From:	Boulder County Postmaster
To:	Gross Reservoir SI-20-0003
Subject:	[Postmaster] Content Alert Notification
Date:	Wednesday, November 11, 2020 8:04:22 AM

This is a content alert notification message.

The message indicated below matches content alert policies set by the system administrator(s).

Message information:

Sender : "Betty Delaney" <piranha@rof.net>
Intended Recipient : Gross Reservoir SI-20-0003 <grossreservoir@bouldercounty.org>
Message Subject : Denver Water's 1041 Gross Dam Expansion Application is 'Incomplete' and Must Be Rejected
Message Date : Wed, 11 Nov 2020 15:03:58 +0000 (UTC)
Message Status : The message has been placed on HOLD - action required

Content Policies Triggered:

DNS Authentication: DMARC Fail

From:	Pam Evans
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:03:46 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Pam Evans
PO BOX 644, Address (Cont)
gardenqueen@gmail.com
Kemp, TX 75143
9034981111

From:	Bill Jenkins
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:03:37 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Bill Jenkins
note: I have always thought of Boulder County as a place where conservation values are a priority. Please deny this application. Thanks

Bill Jenkins
3002 West Elizabeth St.
14F
Fort Collins, CO 80521
9708173695

From:	Gary gclooLooss@earthlink.net
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 8:01:24 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Gary gclooLooss@earthlink.net
143 San Acacia Road

San Acacia, New Mexico 87831
5053061670

From:	Nancy Hediger
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:59:29 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Fire Management and Response Plan
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- Road Maintenance Plan
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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Nancy Hediger
3030 CALLY LN
nancyhediger722@gmail.com
Mohave Valley, AZ 86440
6186962629

From:	Ellen Gutfleisch
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:59:18 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
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- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
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- Road Maintenance Plan
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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Ellen Gutfleisch
N72 W22488 Jeanine Ln

Sussex, WI 53089

From:	Theron Hreno
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:58:06 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
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- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
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- Recreation Management Plan
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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Theron Hreno
Boulder County resident

Theron Hreno
7462 Mt Sherman Rd

Longmont, Colorado 80503

From:	Wayne Wathen
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:57:57 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout. Also, since we are talking about I assume depletion of flows downstream as far as Nebraska, I would assume there would need to be Section 7 consultation and a biological opinion prepared on the impact to the endangered Whooping Crane.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Wayne Wathen
6426 D Silver Mesa Drive

Highlands Ranch, Colorado 80130

From:	Boulder County Postmaster
To:	Gross Reservoir SI-20-0003
Subject:	[Postmaster] Content Alert Notification
Date:	Wednesday, November 11, 2020 7:57:06 AM

This is a content alert notification message.

The message indicated below matches content alert policies set by the
system administrator(s).

Message information:

Sender : "Tyler Komarnycky" <tyler.komar@icloud.com>
Intended Recipient : Gross Reservoir SI-20-0003 <grossreservoir@bouldercounty.org>
Message Subject : Denver Water's 1041 Gross Dam Expansion Application is 'Incomplete' and Must Be Rejected
Message Date : Wed, 11 Nov 2020 14:56:26 +0000 (UTC)
Message Status : The message has been placed on HOLD - action required

Content Policies Triggered:

DNS Authentication: DMARC Fail

From:	Jill Ascher
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:55:19 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Jill Ascher
930 sunshine canyon

Boulder, Co 80302

From: Clifton Bain
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Wednesday, November 11, 2020 7:51:41 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Clifton Bain
PO Box 297
Ciftonbain33@gmail.com
Arroyo Hondo, NM 87513
5757702167

From:	Peter Curia
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:51:12 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
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- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Peter Curia
2048 N 68th Place
pgeometro@gmail.com
Scottsdale, AZ 85257-2637

From:	Aron Ralston
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:50:06 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Aron Ralston
928 Mapleton Ave.

Boulder, CO 80304
9703199030

From:	Elisa Townshend
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:47:21 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Elisa Townshend
1385 Elizabeth St

Denver, Colorado 89206

From:	Richard OBrien
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Gross Reservoir expansion application
Date:	Wednesday, November 11, 2020 7:46:48 AM

Boulder County commissioners,

Please reject Denver Water's application to expand Gross Reservoir. The application is incomplete and does not meet Boulder County requirements.

Reasons to reject the application include:

1. Please reject the request for a “waiver” in Section 8-503; the application must comply with **Section 8-308.A.4** of the Boulder County Land Use Code

2. The application must specify individual “plans” – does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

3. The cited “Army Corps’ Environmental Impact Statement” is not valid.

4. The cited “Federal Energy Regulatory Commission license amendment process” is not valid.

5. The application does not comply with the Boulder Valley Comprehensive Plan.

Richard OBrien
993 E. Moorhead Circle, Apt. 1H
Boulder, CO 80305

From:	Terry Tedesco
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:45:18 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Terry Tedesco

,

From:	P Scoville
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:43:55 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

P Scoville
box 153

hewitt, nj 07421

From:	Sarah Hamilton
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:39:40 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Sarah Hamilton
9087 Tioughanack Rd.
bigguy287@twcny.rr.com
Canastota, New York 13032
bigguy287@twcny.rr.com

From:	Kathleen Cravy
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:38:29 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Kathleen Cravy
1080 South Gilpin Street
kathycravy@q.com
Denver, Colorado 80209
3036981110

From:	Jeffry Scroggins
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:36:56 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Jeffry Scroggins

Cottonwood, AZ 86326

From: Greg Heiden
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Wednesday, November 11, 2020 7:32:55 AM

Dear Boulder County Commissioners and Staff,

It's nothing more than a land grab. With junior water rights and a declining River the additional storage will seldom be utilized. All at the expense of rivers already diminished.

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
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- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
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- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
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- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous

errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Greg Heiden
74384 Rd. 438

Bertrand, NE 68927
(308) 991-5591

From:	Karen Sandburg
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:32:12 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Karen Sandburg
1440 King Ave

Boulder, CO 80302

From:	askeloise@gmail.com askeloise@gmail.com
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:32:03 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

askeloise@gmail.com askeloise@gmail.com
askeloise@gmail.com
askeloise@gmail.com
askeloise@gmail.com, askeloise@gmail.com askeloise@gmail.com
askeloise@gmail.com

From:	JL Angell
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:21:10 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

JL Angell
2391 Ponderosa Rd

Rescue, CA 95672
5305555555

From:	Steve Sanzari-Hall
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:15:49 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Steve Sanzari-Hall
105 Stone Cliff Circle

Golden, CO 80403
720-675-3993

From:	Cheryl Dzubak
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:15:04 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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B. The Corps Record of Decision violated the Clean Water Act:

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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Cheryl Dzubak
69 Elton Avenue,

Yardville, NJ 08620
6095851506

From:	Daniel Sokolov
To:	Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Reservoir Application
Date:	Wednesday, November 11, 2020 7:11:19 AM

Denver Water's 1041 Application to Boulder County for expanding Gross Reservoir is incomplete and disputed. Please instruct Denver water to include plans required, analysis and conclusions needed, and complies with the Boulder Valley Comprehensive Plan and Boulder County Land Use Code.

Thank You,

Daniel Sokolov, Boulder CO

From:	John Reed
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:07:12 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

John Reed
935 TELLER CIRCLE
jreed@indra.com
BOULDER, CO 80303
3034448016

From:	Wendy Kramer
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 7:03:18 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Wendy Kramer
PO Box 1571
wendy@donorsiblingregistry.com
Nederland, CO 80466
3032580902

From:	Phyllis Feigenbaum
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 6:59:44 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Phyllis Feigenbaum
11757 W. Ranch Elsie Rd.

Golden, CO 80403

From:	J Greene
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir Expansion
Date:	Wednesday, November 11, 2020 6:26:48 AM

Leading statement to the Boulder County Commissioners: Denver Water's 1041 application is incomplete. Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all the deficiencies below, Boulder County should not consider this application and should return it to Denver Water for clarification and completion.

Specific problems with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. The vast majority of the application simply refers to "plans" that don't yet exist. These plans are required if Denver Water is to comply with the Boulder County Land Use Code. Denver Water needs to state their plans in regard to the following:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application because these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process, including the Final EIS and Record of Decision, which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
    - The “Purpose and Need” in the EIS is not accurate and must be redone.
    - The “Alternatives” analysis in the EIS is not accurate and must be redone.
    - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
    - The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
    - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application, Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process, which has numerous errors including:

- Failure to use an adequate alternatives analysis.
- Failure to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reconsider the destructive expansion of Gross Reservoir.

Thank you,

- Jeff

Jeff Greene
greener333@yahoo.com
720.352.5605

From:	Nancy Stocker
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 6:11:14 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Nancy Stocker
2885 S Gilpin Street

Denver, CO 80210
303-759-4056

From: Melissa Meyers
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Wednesday, November 11, 2020 6:04:59 AM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Melissa Meyers

,

From:	Christopher Kahl
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Wednesday, November 11, 2020 5:20:15 AM

Dear Boulder County Commissioners and Staff,

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First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Christopher Kahl
63 Wonderland Ave

Golden, CO 80403
7203831044

From:	Cindy Patterson
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 10, 2020 11:10:38 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Cindy Patterson
7069 Bryant way

Wrstminster, CO 80030

From:	John Belcher
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Gross Dam expansion comment - climate impact objection
Date:	Tuesday, November 10, 2020 10:02:40 PM

Commissioners,

This comment is an objection to the proposed Gross Reservoir expansion, specifically to the climate impact from the emission of noxious gases and particulate material. Per Exhibit 14, the project is expected to expel in Tons per year: 15.44 CO2, 46.26 nitrous oxides, .504 sulphur dioxide, and 111.64 particulate matter. So over **six years**, the total of all is 1,043.28 TONS expelled into the atmosphere.

In the Exhibit 14 Conclusion, "The air quality impacts associated with operation of the Project are anticipated to be negligible." 1000 tons of noxious gases and particulates would seem to be non-negligible. Nowhere in the Draft nor the EIS is there any estimated climate impact from this project. The light treatment of the air quality and climate impacts surely do not reach the standards of the Boulder County Land Use Code, section 8-511, Standards for the Approval of a Permit Application. The application should be rejected.

Thank you.

John and Carol Belcher
1899 CR 68J
Nederland, CO 80466
303-877-4583

From:	Elena Klaver
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 10, 2020 9:58:44 PM

Dear Boulder County Commissioners and Staff,

I am writing about the terrible plan for Gross Dam. I am very concerned for the short and long term impacts of this project. As a professional, certified Spanish interpreter who works for international environmental organizations, several of which are involved in working against large scale destructive dams, I urge you to deny this permit, or at the very least dremand full environmental impact assessment. Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous

errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Elena Klaver
PO Box 529

Niwot, CO 80544
303 475 5189

From:	Tom Mulvany
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 10, 2020 9:55:41 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

My wife and I live on the Jefferson County side of the area but travel Hwy 72 on a regular basis. I honestly feel that our quality of life would be affected negatively by the increased truck traffic both up and down Coal Creek Canyon for 5+ years. I have a private well for my domestic water source. This entire Denver Water project will have '0', "Zero", positive affect on my home's water system or any other thing that I can think of.

Thank you!
Sincerely,

Tom Mulvany
31277 Burke Rd

Golden, CO 80403
303-642-7121

From:	John Belcher
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Dam expansion comment - tree removal route
Date:	Tuesday, November 10, 2020 9:02:47 PM

Commissioners,

This comment is an objection to the proposed Gross Reservoir expansion. This particular objection is in regard to tree removal, specifically the hauling of "tree removal materials". The Draft "Plan" states "The tree removal materials are *planned* to be transported away from the site using different routes…" and … "For tree removal from the west side of the Gross Reservoir, the *proposed* route… [emphasis added]. These are NOT plans. These relate to potential actions and routes. This broad brush approach violates Boulder County Land Use Code, section 8-511, Standards for the Approval of a Permit Application. Should the permit be approved by all necessary agencies, including Boulder County, Denver Water will then submit plans for its activities. Input will be sought from various stakeholders, but the reality will be that Denver Water will have its permit and will plow ahead.

The proposed "plan" for hauling logs and chips to the west utilizes trail 359, then an upgraded jeep trail to Lazy Z Rd., Lazy Z to CR 132 (Magnolia Rd), Magnolia west to the Peak to Peak highway, then south to Highway 6. No potential alternative route utilizing CR 68 is suggested, though this seems a possible alternate route, since trail 359 begins at CR 68. Since there is not a specific plan for the west tree removal, this possibility cannot be ruled out, the impact of which would be substantial to residences along CR 68 and a much greater length of Magnolia. Numerous "proposed plans" are included in the 1041 draft, with the possibility of divergence affecting different stakeholders and protections. This draft does not meet the section 8-511 standard and should be rejected.

Thank you.

John and Carol Belcher
1899 CR 68J
Nederland, CO 80466
303-877-4583

From:	Megan Houseweart
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Public comment: No on Gross Res Expansion
Date:	Tuesday, November 10, 2020 8:58:36 PM

Denver Water's 1041 application is incomplete. Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all the deficiencies, Boulder County should not consider this application and should return it to Denver Water for clarification and completion. The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage. The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Megan Wilder
80302

From:	Kim Cameron
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 10, 2020 8:54:25 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Kim Cameron
11587 Brook Road

Golden, Co 80403
7205238061

From:	Rebecca Dickson
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir expansion
Date:	Tuesday, November 10, 2020 8:42:07 PM
Attachments:	image003.png

SIERRA CLUB

Dear Boulder County Commissioners:

Please consider carefully what is at stake in regard to the Gross Reservoir expansion. The Sierra Club has looked carefully into Denver Water's plans and we find the environmental damage that the expansion would cause to be utterly unacceptable. A 131-foot increase in dam height is massive and to do it, many trees would have to be cut down, animal habitats destroyed, Western Slope waterways disrupted, and more. Thus we have long opposed the Gross expansion.

Now that Denver Water has submitted their 1041 application, we still oppose the plans to expand the reservoir. Denver Water does not seem to comprehend the environmental damage that their project will cause because their 1041 application fails to address many key concerns. Below is a list that our partners at The Environmental Group have put together that outlines the deficiencies of Denver Water's submission. We also are concerned that Denver Water's plan is so incomplete. We ask that you delay consideration of Denver Water's plan until you see clear discussion of the following.

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Road Maintenance Plan
- Recreation Management Plan

- Visual Resources Protection Plan
- Historic Properties Management Plan
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- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Failure to address the above concerns is reason enough to ask that Denver Water work on their 1041 application again. They need to demonstrate to residents of Boulder County that they understand the enormity of their own project and its environmental consequences. So far, they have not done that.

Sincerely, The Sierra Club-Indian Peaks Group Executive Committee

Ramesh Bhatt

Rebecca Dickson, chair

Karen Dike

Emma Marion

Xander Martin

Tom Volckhausen

Alana Wilson

From:	John Steele
To:	Gross Reservoir SI-20-0003
Subject:	Comments on Denver Water"s 1041 Application
Date:	Tuesday, November 10, 2020 8:20:33 PM

To whom it may concern:

I reside in Boulder and conservation of our fragile environment and ecosystems is of paramount concern to me. I am extremely concerned about the proposed expansion of Gross Reservoir and it's negative impacts on our environment.

Denver Water's 1041 application is incomplete. Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all the deficiencies below, Boulder County should not consider this application and should return it to Denver Water for clarification and completion.

Specific problems with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. The vast majority of the application simply refers to "plans" that don't yet exist. These plans are required if Denver Water is to comply with the Boulder County Land Use Code. Denver Water needs to state their plans in regard to the following:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application because these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process, including the Final EIS and Record of Decision, which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
    - The “Purpose and Need” in the EIS is not accurate and must be redone.
    - The “Alternatives” analysis in the EIS is not accurate and must be redone.
    - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
    - The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
    - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application, Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process, which has numerous errors including:

- Failure to use an adequate alternatives analysis.
- Failure to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic

Thank you for the opportunity to submit my comments.

Sincerely,

John W. Steele

From:	Betsy Armstrong
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Gross Reservoir expansion
Date:	Tuesday, November 10, 2020 8:15:34 PM

As a citizen of Boulder County, I am writing to oppose Denver Water's application to expand Gross Reservoir. Denver Water's application does not comply with the Boulder Valley Comprehensive Plan, and in addition it violates several of Boulder County Land Use codes.

As a scientist and knowledgable about water usage, I've learned that this expansion is not at all necessary to provide water to downslope users. Nor does the Army Corps of Engineers' EIS take into consideration cumulative impacts, climate change or the influences on the Colorado River.

Approval of this expansion would be destructive to the Boulder County environment and I encourage the Boulder County commissioners to reject this application.

Kind regards,

Betsy R. Armstrong

Betsy Armstrong
Armstrong & Associates
ArmstrongCommunications1@gmail.com

From:	Jodi Crow
To:	Gross Reservoir SI-20-0003
Subject:	1041 Permit Application
Date:	Tuesday, November 10, 2020 8:08:12 PM

Denver Water has submitted its 1041 Permit Application to expand Gross Reservoir to Boulder County. Even though the application is 354 pages long, it does not address many important issues. It should be denied until all issues have been fully addressed.

Get Outlook for iOS

From:	Elizabeth Parker
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 10, 2020 7:55:29 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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- Failed to use an adequate alternatives analysis.
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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Elizabeth Parker
746 Mountain Meadows Road

Boulder, CO 80302
720.272.5768

From: Keith Harper
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Tuesday, November 10, 2020 7:45:31 PM

Hello Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Keith Harper
Boulder, CO

Keith Harper
2825 La Grange Circle

Boulder, CO 80305

From:	Josh Harrod
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 10, 2020 6:33:20 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Josh Harrod
1010 Lazy Z Rd

Nederland, CO 80466

From:	Wayne Hutchison
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 10, 2020 6:28:15 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Wayne Hutchison
1732 N Franklin St

Colorado Springs, Colorado 80907

From: Berndt Savig
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Tuesday, November 10, 2020 6:15:20 PM

Dear Boulder County Commissioners and Staff,

As a long time resident of Boulder county, and as one who has lived near Gross Reservoir for decades, I'd like to share the following with you.

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous

errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Berndt Savig

Berndt Savig
1406 Lakeshore Drive

Boulder, Colorado 80302
303-562-5097

From:	Boulder County Postmaster
To:	Gross Reservoir SI-20-0003
Subject:	[Postmaster] Content Alert Notification
Date:	Tuesday, November 10, 2020 6:05:07 PM

This is a content alert notification message.

The message indicated below matches content alert policies set by the system administrator(s).

Message information:

Sender : "Tracy Rowland" <trrow@me.com>
Intended Recipient : Gross Reservoir SI-20-0003 <grossreservoir@bouldercounty.org>
Message Subject : Denver Water's 1041 Gross Dam Expansion Application is 'Incomplete' and Must Be Rejected
Message Date : Wed, 11 Nov 2020 01:04:56 +0000 (UTC)
Message Status : The message has been placed on HOLD - action required

Content Policies Triggered:

DNS Authentication: DMARC Fail

From:	Jill Willson
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 10, 2020 5:46:55 PM

Dear Boulder County Commissioners and Staff,

I would like to speak on this issue as I live roughly a mile from Gross Dam, so even though I do not live in Boulder County, this issue impacts me significantly.

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
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- Invasive Plant and Noxious Weed Species Management Plan
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- Special Status Plants Relocation Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous

errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:
- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Jill Willson
30244 Spruce Canyon Dr

Golden, CO 80403

From:	Karen Tourian
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Dam proposed expansion; 1041 application
Date:	Tuesday, November 10, 2020 5:41:36 PM

Dear Commissioners:

I would like to comment on Denver Water's proposed expansion of Gross Dam and their 1041 application. A review of this application shows many deficiencies. Denver Water's timelines to meet the Army Corps of Engineers' deadlines for project start do not mandate the approval of an inadequate application, nor a rushed review process by Boulder County.

1- The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Expansion of a reservoir for public drinking water would seem to be exactly what a "major facility of a public utility" includes.

2- Denver Water’s 1041 application completely fails to provide numerous “plans” about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:
- Tree Removal Plan- the project will require the removal of somewhere between 250,000-600,000 trees (per various reports of this project) in the innundation zone. This is not a trivial operation, either in the removal of these trees, or in disposal. Chipping would provide a source of fuel for an unprecedented wildfire, and removal would add hundreds of thousands of additional truck trips down the mountain. Likewise, burning this fuel on site is not a viable option from a safety and air quality standpoint.
- Quarry Operation Plan- since they plan to quarry on site, the construction and operation of this quarry is relevant to the application.
- Pit Development and Reclamation Plan- as much as development of the site is an issue for Boulder County, plans for post-construction restoration of the impacted land are also extremely relevant.
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan- the disturbances caused by the construction are likely to lead to an increase in invasive/noxious weed prevalence. How they plan to manage these plants is relevant, especially in regards to impact on the surrounding properties.
- Fire Management and Response Plan- in addition to the fuel load from hundreds of thousands of felled trees, the amount of construction traffic would be an obstacle to response in any local wildfire situation.
- Special Status Plants Relocation Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan- Denver Water plans for a large number of truck trips per day, which will cause significant traffic issues on Gross Dam Road and Highway 72.
- Fugitive Dust Control Plan- the increased traffic on Gross Dam Road and the quarry will likely produce significant dust in the area.

- Road Maintenance Plan- the road on which the dam sits, and the construction traffic would travel, Gross Dam Road, is a small local dirt/gravel road. Denver Water does not currently adequately manage the section they are responsible for, between Flagstaff Road and the railroad tracks; they do not regularly grade the road, and are slow to clear snow in the winter. There is substantial recreational and local traffic on this road, and the washboard is awful. The increased traffic of large/heavy trucks would require almost daily maintenance of this road.
- Recreation Management Plan- like most outdoor spaces, the area around the reservoir has had a significant increase in use for recreation in the past year; it is not clear how much of this increase will persist in upcoming years. An anticipated reduction in access will put pressure on other surrounding recreational areas.
- Visual Resources Protection Plan- the increased dam size will present a significant blight to the otherwise natural surrounding areas.
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Not mentioned in the list above is the impact of construction to wildlife in the area, for example, the migrating elk herd who travel through this corridor.
Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

3 - Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement (EIS) process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:
The Corps Record of Decision violates the National Environmental Policy Act:
The “Purpose and Need” in the EIS is not accurate and must be redone.
The “Alternatives” analysis in the EIS is not accurate and must be redone.
The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
The Corps Record of Decision violated the Clean Water Act: The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
The full cost of the project was not considered in choosing the LEDPA.
The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

4 - Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:
Failed to use an adequate alternatives analysis.
Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

5 - The application fails to comply with the Boulder Valley Comprehensive Plan.

6 -The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

7 - The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

8 - The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

9 - The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please help protect Boulder County from this futile and misguided project. Thank you for your consideration of these issues.

Kind regards,

Karen Tourian
258 Cougar Dr
Boulder, CO 80302

From:	Laurence Nolan
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 10, 2020 5:37:48 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The "Purpose and Need" in the EIS is not accurate and must be redone.
- The "Alternatives" analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Laurence Nolan
552 Arapahoe Avenue

Boulder, CO 80302

From:	Jan Burton
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 10, 2020 5:26:54 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.
I'm sure you've received numerous form letters with the details of the incomplete items. You understand the procedures much more than I do, but I do believe we should reject the application if it's not complete.

We are in the middle of a drought. We will continue to fight the lack of water. All scientific information, including the IPCC say we will continue to face droughts and fire. We must FIRST try everything we can for conservation: removing grass and replacing it with low-water indigenous plants, recycling rain water, recycling grey water, and encouraging water conservation rather than use (farms).

Let's get to work on water conservation, and let's encourage Denver to do the same.

Please reject this application.

Thank you for your service!
Sincerely,

Jan

Jan Burton
852 11th St

Boulder, co 80302
2146326289

From:	Amanda Kneer
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 10, 2020 5:24:46 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,
Mandy Kneer

Amanda Kneer
83 Sundance Circle
PO Box 1855
Nederland, CO 80466
303-250-0331

From:	Anita Nebel
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 10, 2020 5:10:12 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Pit Development and Reclamation Plan
- Stormwater Management Plan
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- Invasive Plant and Noxious Weed Species Management Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge
- Capital Improvement Plan or Facilities Master Plan

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

A. The Corps Record of Decision violates the National Environmental Policy Act:

- The “Purpose and Need” in the EIS is not accurate and must be redone.
- The “Alternatives” analysis in the EIS is not accurate and must be redone.
- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

B. The Corps Record of Decision violated the Clean Water Act:

- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Anita Nebel
5445 Centennial Trail

Boulder, Colorado 80303
303 489-9498

From:	virginia schick
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners; virginia schick; Robert Rouse
Subject:	Gross Dam Expansion
Date:	Tuesday, November 10, 2020 4:23:24 PM

Nov. 10, 2020,

Dear Boulder County,

I have been a Boulder County resident for 35 years. I have lived on Magnolia Drive as an avid runner, hiker and horseback rider. Gross Dam expansion must not go forward.

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion Specific issues with the application:

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Emergency Action Plan

- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Thank you for your time. Please help our county to resist Gross Dam expansion.

--
Virginia Schick, NBCT
ART College Prep, LLC
Colorado HS Art Educator of the Year, 2014
Art Educator retired
303-396-5558 cell
https://www.artcollegeprep.net/
https://virginiaschick.weebly.com

From: Margie Robinson
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date: Tuesday, November 10, 2020 4:12:19 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how Denver Water will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

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- The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.

C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

Margie Robinson
1101 Lakeshore Dr.

Boulder, CO 80302
303-489-4572

From:	U Kyaw Win
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Gross Dam Expansion Application is "Incomplete" and Must Be Rejected
Date:	Tuesday, November 10, 2020 3:52:57 PM

Dear Boulder County Commissioners and Staff,

Denver Water has submitted its 1041 application for the expansion of Gross Dam, and the application is totally incomplete and must be rejected.

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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C. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Please reject this application.

Thank you!
Sincerely,

U Kyaw Win
8566 Flagstaff Road

Boulder, CO 80302-9531
303 642 0880

From:	David - Home
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Why I believe Denver Water"s 1041 Application should be rejected
Date:	Tuesday, November 10, 2020 3:19:29 PM

Hi,

I believe that Denver Water's 1041 Application should be rejected.

I am a retired mechanic so a lot of this is way over my head but there are a few items that will affect me directly and are easy to understand.

1) Tree Removal. Hundreds of thousands of trees must be removed. Those trees are not going to vanish all by themselves but must be hauled off by tens of thousands of truckloads. I can only assume that many of those truckloads are going to pass right in front of my house on Lazy Z (which is dirt) with the noise and the dust and the danger that come with that. What is Denver Water's plan?

Today, I have a couple dozen vehicles pass in front of my house each day. I can count the number of tractor trailer rigs on the fingers of one hand that pass in a month (2 maybe 3 trailer tractor rigs normally hauling equipment for home construction)... and that is not every month. How many logging truck passages a day will go past my home and my neighbors homes? 100? 200? Plus? How many days a week will these logging & equipment trucks destroy my tranquility and my neighborhood's tranquility. How many years will residents this area be unable to open a window due to the noise and dust? After that suffering, how can we leave when our property values drop to nothing.

In any case, the application violates Boulder County Land Use Code Section 8-511.J.2 which requires compatibility with existing traffic volumes.

2) Denver has a semi-arid, high desert, continental type of climate yet when you drive around Denver you see mostly green grass, trees, flowers and shrubs few of which are compatible with our climate. You also see sprinkler systems everywhere watering everything. This is an inappropriate landscape for a semi-arid, high desert climate and Denver has done little to

conserve water which is a very limited resource.

If Denver just stopped wasting water, they would have plenty for their residents and plenty for future growth. I take this personally too as I am on a low volume well. I don't have water to waste and even if I did it is illegal for me to water outside. Denver Water wants to ruin my life so their residents and future residents can water their grass. We need to adapt to the climate we live in... and furthermore that climate is changing and is getting drier.

Denver Water's application violates Boulder County Land Use Code 8-511.C.2 which requires the conservation and full utilization of existing municipal water supplies. It is also not compatible with resource preservation and does not minimize resource damage.

3) Denver Water's application does not have a plan for traffic management and disruption. Residents here have been living with disruptions for the last two years due to road reconstruction after the 2013 floods. It has been more than a minor inconvenience. It has added considerable time to use the roads and it has added a great deal of expense for any sort of repair your home may need as repair people are unwilling to come up here due to the traffic disruptions. Fortunately, there will be positive as we will get new roads in the canyons when this is finished. How is Denver Water going to deal with minimizing traffic disruptions during the many, many years that this project is going to take?

4) Then there is road maintenance. A lot of the trees removed will have to come out through the Magnolia area. Our roads are dirt. Is Boulder County going to be responsible for the continuous grading necessary to keep these roads usable? The roads were not made for the truck traffic that this project will cause. What about the noise and dust? What about the traffic disruptions? This affects a lot of people. Denver Water needs to have a plan.

In conclusion, I love where I live in a home that has been in my family for many years. It is beautiful, peaceful and quiet up here. I have no desire to move. I am at an age where the length of this project is a substantial portion of my remaining time on this earth. I do not want that time destroyed by the dust and noise of logging trucks and equipment hermetically sealed inside my house. There is nothing positive for Boulder County approving this. For me, it comes down to Denver Water destroying my community so they can water their grass in the future.

Please, Do Not Approve Denver Water's Gross Reservoir Expansion Project.

Sincerely,

David Fitchette
30 Aspen Way
Nederland CO 80466

davidfhouse@aol.com

From:	Brent Warren
To:	Gross Reservoir SI-20-0003
Subject:	gross reservoir objection
Date:	Tuesday, November 10, 2020 3:05:23 PM

Dear Boulder County,

As a forty four year resident of the Magnolia Road area.
With Gross Reservoir just down the road.
I cringe with fear at the idea of this mass construction effort,
which in my view will destroy the major reasons I moved to this area in the first place.

My love for all nature, the peace and quiet, and a personal exploration on living a non harmful existence on a delicate planet.

For a repeat of reasons listed below, ***I register my desire for this project NOT to move forward.***
I am against the project.

Thank you, Brent

Brent Warren
brent.warren884@gmail.com
www.imagelust.com
303 748 8405

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

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Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

From:	Julie Naster
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	comments on dam expansion
Date:	Tuesday, November 10, 2020 2:23:13 PM

To whom it may concern,

I am a Boulder County resident and am concerned about the planned Gross dam expansion. As far as I can understand, this project was conceived 20+ years ago as a way to serve Denver's growth. It seemingly has not taken into account the realities of global warming and frequency of drought in CO. The cost to the surrounding lands and residents will be huge as the project would bring massive construction equipment. pollution, and noise to the area for years and remove half a million trees. And for what? Would the project provide the desired water? Aren't there other means?

The cost for Boulder County is high; the benefit for Boulder County is nil.

Please study the science and needs of Boulder County as you make your decisions.

Thanks,

Julie Naster
julienaster5@gmail.com
303-807-0994
PLEASE NOTE THIS NEW EMAIL ADDRESS AND REPLACE OLD ADDRESS IN YOUR CONTACTS

From:	Doug Benson
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Opposition to Denver Water"s 1041 Application to Expand Gross Reservoir
Date:	Tuesday, November 10, 2020 2:16:17 PM

To the Boulder County Commissioners:

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

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Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

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    - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
    - The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
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Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Thank you,

Doug Benson

597 Pine Glade Road

Nederland, CO 80466

303.258.8361

From:	Susan Merwin
To:	Gross Reservoir SI-20-0003
Subject:	1041 Application
Date:	Tuesday, November 10, 2020 1:30:18 PM

Dear Boulder County Commissioners,

As a citizen of Boulder County I am writing to urge you, on behalf of all of us who live here, to reject Denver Water's 1041 Application to expand Gross Reservoir. We treasure this land and care deeply about its health--and ours too. The expansion is unnecessary (if Denver is worried about water sufficiency, water conservation and restrictions on growth could go a long way). It is difficult for many of us to understand why Denver needs to make profound, irreversible changes in the local environment in order to divert water from the Western slope. Who really benefits from this project? The answer seems to be Developers, and they alone.

In the meantime, while issues of environmental justice are under scrutiny, please reject this 1041 application because of its many flaws. It seems almost insultingly incomplete. Crucial questions regarding construction and maintenance are not even addressed except in vague terms of "plans". Please do not give away Boulder County's right to protect its environment and its people. We look to you for leadership in protecting this beloved land.

Thank you.

Best regards,

Susan Merwin
1850 Folsom Street
Boulder, CO 80302

From:	John Ryan
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Gross Reservoir Expansion Objection
Date:	Tuesday, November 10, 2020 12:06:48 PM

As 25+ year residents of the immediate neighborhood adjacent to Gross Reservoir we are contacting you to express our adamant opposition to the Gross Reservoir expansion. In addition to permanently negatively altering the environment, wildlife habitat, and Colorado River watershed, hundreds of people's quality of life, property values, and very futures will be forever adversely affected. PLEASE STOP THE GROSS RESERVOIR EXPANSION PROJECT !

John Ryan
Janice Walker
1125 Pine Glade Rd
Nederland,Co 80466

From:	Janice Walker
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Gross Reservoir Expansion
Date:	Tuesday, November 10, 2020 11:55:24 AM

As residents of the immediate neighborhood adjacent to Gross Reservoir we are contacting you to express our adamant opposition and deep dismay concerning the Gross Reservoir expansion project. In addition to permanently altering the environment, wildlife habitat, and Colorado River watershed, hundreds of people's quality of life, property values, and futures will be forever adversely affected. PLEASE STOP THE GROSS RESERVOIR EXPANSION !

Janice Walker
John Ryan
1125 Pine Glade Rd
Nederland, Co 80466

From:	Tom Cerny
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Dam expansion project
Date:	Tuesday, November 10, 2020 11:41:21 AM

Dear Sir/Madam,

I am writing you to urge a thorough review of the 1041 application around Denver water's plans to the Gross Dam expansion project.

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Thank you and kind regards,

Thomas Cerny

712 12th st, boulder, Co

From:	Michelle Faurot
To:	"undisclosed-recipients:"@IMSVA2.BOULDERCOUNTY.ORG
Subject:	Denver Water"s Gross Reservoir Expansion Project
Date:	Tuesday, November 10, 2020 9:24:09 AM

To Whom It May Concern,
I grew up on Flagstaff mountain overlooking Gross Reservoir. I would like to express my concern about this project and have listed specific details below.

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code.

Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

Tree Removal Plan
Quarry Operation Plan
Pit Development and Reclamation Plan
Stormwater Management Plan
Erosion Control Reclamation Plan
Invasive Plant and Noxious Weed Species Management Plan
Fire Management and Response Plan
Special Status Plants Relocation Plan
Aquatic Invasive Species Monitoring Plan
Traffic Management Plan
Fugitive Dust Control Plan
Road Maintenance Plan
Recreation Management Plan
Visual Resources Protection Plan
Historic Properties Management Plan
South Boulder Creek Channel Stability and Monitoring Plan
Road Management Plan (USFS)
Road Maintenance Plan
Restoration and Revegetation Plans

Special Status Plants Relocation Plan
Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
Emergency Action Plan
Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

The Corps Record of Decision violates the National Environmental Policy Act:

The "Purpose and Need" in the EIS is not accurate and must be redone.
The "Alternatives" analysis in the EIS is not accurate and must be redone.
The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.

The Corps Record of Decision violated the Clean Water Act:

The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
The full cost of the project was not considered in choosing the LEDPA.

The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

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Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Kindly,

--

Michelle Faurot
+1 303 517 6856

please consider the environment before printing this email

November 3, 2020
Boulder County Commissioners
Subject: Gross Dam expansion project,
Docket #SI-20-0003,
Gross Dam expansion project

We in Coal Creek Canyon and other residents in the vicinity of the expansion project have already voiced their concerns about this absolutely ridiculous project that only shows just how greedy the DWB really is. They have no concern about anyone's needs or wants, only the increased water tap revenues. The environment or peoples safety is not on their priority list. As previously stated, this project will only make all our lives miserable. There will be fatal auto/truck accidents in the canyon. Just what value do they put on a human life? This concern is not in their scope of the project, they really do not care.

I have included a number of articles that review the facts and their negative impacts to the environment and peoples lives. We all must stick together and get this project stopped. Thank you for doing your job so well, it is really appreciated.

Hopefully yours

Anna and Tony Zubricky
80 Outlook Dr.
Coal Creek Canyon

Protect Our Community - Send Comments Now!

The public (and that means everyone - this concerns the Colorado River - the most endangered river in America) comment period has been extended to November 13, 2020 at 4:30 pm. Send your comments to:

grossreservoir@bouldercounty.org

Written comments should be mailed to P.O. Box 471, Boulder, CO 80306 and <u>all comments need the Docket # SI-20-0003: Gross Reservoir & Dam Expansion on the Subject Line</u>.

This deadline is not a hard deadline for submissions of public comment. Public comments will be accepted during the entire duration of the review process and related public hearings. Since any hearings may be virtual due to Covid-19 it is even more critical to inundate our Board of County Commissioners and Planning & Permitting Departments with any and all the concerns people have about the massive and destructive construction project Denver Water wishes to push through and now even sooner due to FERC's (Federal Energy Regulatory Committee) timeline that they get this application done in fewer months than ever before. Beware reading their application if you should - it will contain as much or more of the propaganda Denver Water has been famous for since the initial scoping meeting in 2003.

Engage your friends, neighbors and family to comment - it may be our only hope of saving Coal Creek Canyon and the Northshore of Gross Reservoir from many years of devastation beyond your imagination: noise and air pollution, hazardous chemical exposure, road safety and extended travel times, sharing our two lane roads with massive trucks and long-term extended delays on all our roadways. Depletion of the Colorado River to an extent it may not recover or survive.

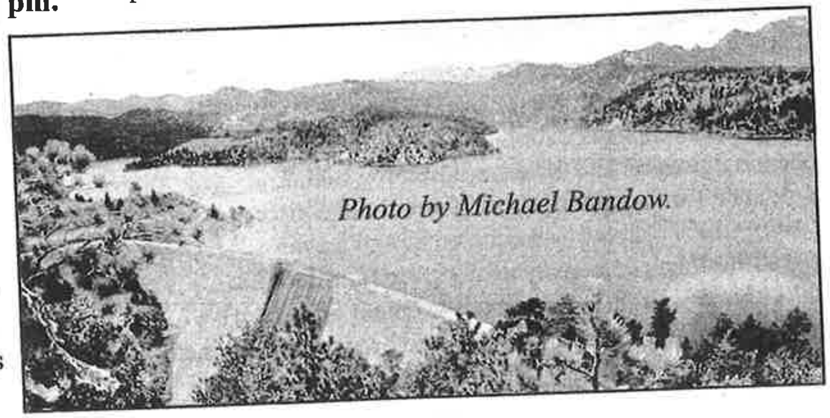


Photo by Michael Bandow.

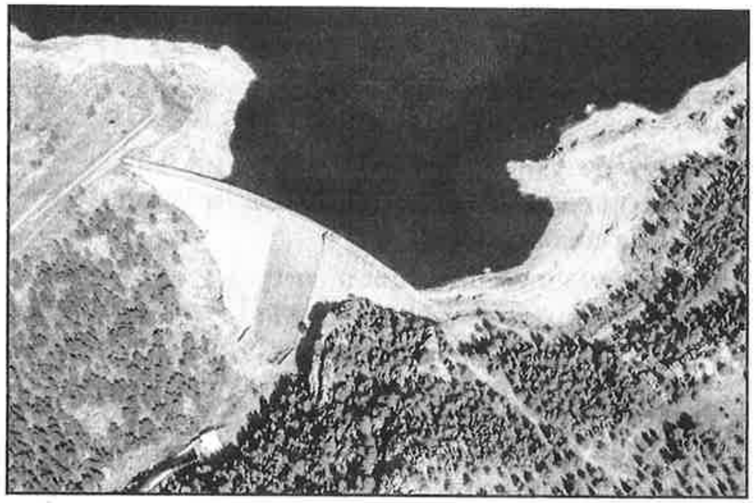
Feel free to use any of the information in this article in your own comments to the Commissioners and Planning Departments. If you know anyone in power or that has access to news personnel then please use your contacts to bring this issue to the attention of folks that may be able to bring State or even Federal opposition to our efforts to kill this project before it goes any further.

In opposition of Denver Water expanding Gross Dam and Reservoir here are a few of the *(Continued on next page.)*

blatant issues listed in **Boulder County's Land Use Code – 1041 Permit Application.**

8-202 Purposes and Intent: *#4 Conserve soil, water, forest resources, and Environmental Resources;* Denver Water intends to produce concrete for a larger dam and this process will use many acre feet of water, disrupt soil at the dam site and along shorelines, and degrade environmental resources. The cement industry is one of the two largest producers of carbon dioxide (CO_2), creating up to 8% of worldwide man-made emissions of this gas, of which 50% is from the chemical process and 40% from burning fuel. The CO_2 produced for the manufacture of structural concrete (using ~14% cement) is estimated at 410˘kg/m^3 (~180˘kg/tonne @ density of 2.3 g/cm^3) (reduced to 290˘kg/m^3 with 30% fly ash replacement of cement). The CO_2 emission from the concrete production is directly proportional to the cement content used in the concrete mix; 900˘kg of CO_2 are emitted for the fabrication of every ton of cement, accounting for 88% of the emissions associated with the average concrete mix. Cement manufacture contributes greenhouse gases both directly through the production of carbon dioxide when calcium carbonate is thermally decomposed, producing lime and carbon dioxide, and also through the use of energy, particularly from the combustion of fossil fuels.

#5 Protect the beauty of the landscape; as noted here producing concrete, making new roads, removal of thousands of mature trees along the shorelines all will destroy the beauty of the existing landscape. *#7 Regulate projects that would otherwise cause excessive noise, water and air pollution and would degrade and threaten the existing environmental quality of the County.* This proposed project would be the largest and most damaging construction project in Boulder County history so it only goes to prove all of these issues would be adversely affected, not only during the construction, but also for decades to come. *#10 Require that municipal and industrial water projects shall emphasize the most efficient use of water, including, to the extent permissible under existing law, the recycling and reuse of water.* Certainly



cement production's massive use and waste of water is in direct conflict with this requirement. Also conservation of water in nearby metro and urban development has a long way to go to stop using Kentucky Bluegrass Sod and mature tree landscaping surrounding all new subdivisions and even commercial building development.

#13 Ensure site selection of arterial highways and interchanges and collector highways occurs so that community traffic needs are met, desirable community patterns are not disrupted, and direct conflict with adopted local government, regional, and state master plans avoided. ALL proposed road construction to accommodate this proposed project will disrupt and are in direct conflict with the two-lane State Highway that is the only main road in and out of this community being impacted. Other arterial roads such as Gross Dam Road, Lazy Z, Tunnel 19 and Miramonte are unimproved and mostly single lane dirt roads that residents must use daily as their only options so Denver Water's mitigation plans are not conducive to this regulation of the 1041 permit either.

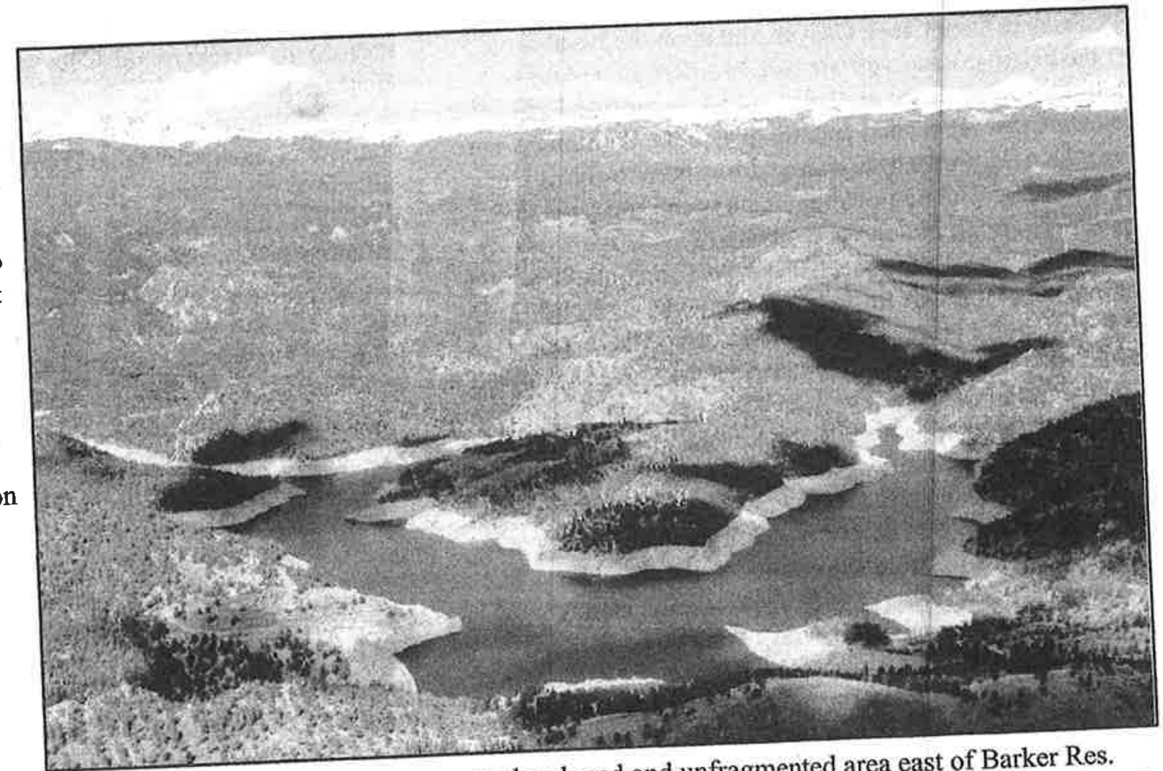
#15, 16 & 17 also pose regulation conflicts from this applicant no matter what design is chosen to mitigate usage. #19 Protect the public health, safety, welfare and the environment. This particular regulation under **8-202 of the 1041** cannot be achieved by this applicant for reasons too numerous to list, but here are but a few: Health of

residents in Coal Creek Canyon and upon the Northshore of the existing Reservoir are sure to suffer air and noise pollution at levels the applicant cannot control and enough to create disease related conditions to not only humans but also the wildlife we hold dear and live here to enjoy. Our very welfare is conditional upon the peace and quiet and natural environment of woodland and forest. Years of construction of the proposed levels will no doubt cause chronic health issues for the residents and also be the reason wildlife leaves to never return. Even the Final Environmental Impact Study listed long-term destruction to aquatic life in a new reservoir of the magnitude that no fish would ever live in its waters again, including stocked fish from upper South Boulder Creek. **At true risk again are the Winiger Ridge Elk Herds and their calving grounds. Boulder County has done extensive study and here is listed those findings by the county itself.**

From Assets.bouldercounty.org Common Name: Winiger Ridge Location (General): West of Gross Res., south of Flagstaff Rd., north of the Boulder County border, east of Magnolia Dr. Size (acres): 3,460 acres Life Zones: Lower Montane, Upper Montane. Rationale and Background: The Winiger Ridge ECA is an area, which has received significant conservation and restoration. Winiger Ridge has long been known as an important wintering area and movement corridor for elk. The area contains two important Foothill Riparian areas along South Boulder Creek (above Gross Reservoir) and Winiger Gulch, both recognized as highly bio diverse regions. The US Forest Service has been working to control unauthorized motorized recreation. Due to significant efforts by private citizens and the US Forest Service, the area between Winiger Gulch and South Boulder Creek serves as an effective core preserve. Naturalness: Roadless area in South Boulder Creek Canyon west of Gross Reservoir. Winiger Ridge is closed to motorized vehicles during winter. Quality and Uniqueness: Elk critical winter range and winter concentration area. Old-growth Ponderosa pine/Douglas fir. Important east/west large-mammal movement corridor. Restoration Potential: All efforts to limit or reverse habitat fragmentation should be pursued.

Common Name: Hawkin Gulch/Walker Ranch/Upper Eldorado Canyon Location (General): West of Eldorado Springs, south of Boulder Canyon Dr., north of the Boulder County border, east of Gross Res. Size (acres): 10,185 acres Life Zones: Lower Montane, Upper Montane. Rationale and Background: This ECA acts to conserve critical resources in the south-central part of the County. This area contains a multitude of significant plants, plant communities, and wildlife and provides an important mountain to prairie link. Walker Ranch is at the center of the Hawkin Gulch/Walker Ranch/Upper Eldorado Canyon ECA and occurs within an area, which initially acquired as Boulder County Open Space. It provides important winter range for elk. The western portion of this ECA, centered on Twin Sisters, is a critical migration corridor for elk and other large mammals; this site became an important habitat connector due to the creation of Gross Reservoir in the 1950s, which is an effective barrier to east-west movement of animals in this part of the county. The canyons and gulches between Flagstaff Drive, Boulder Canyon and Magnolia Road, including Hawkin, Keystone, and Calhoun Gulches, are wild and rugged areas. Upper Eldorado Canyon is another wild and rugged region. Ownership is mixed between Eldorado Canyon State Park and Boulder County Open Space. Running through this area is South Boulder Creek. It is one of the few roadless foothill creeks in the county, the others being Fourmile Canyon Creek and the North St. Vrain Creek. All of the others, including Boulder Creek, Fourmile Creek (the Fourmile Creek that heads to Sunset), Lefthand Creek, James Creek, and South St. Vrain Creek, are impacted by adjacent roads. Naturalness: Several roadless areas in Hawkin Gulch, south half of Walker Ranch, South Draw, Johnson Gulch, Keystone Gulch and Twin Sisters Peak. Quality and Uniqueness: Elk critical winter range and winter concentration area. Old-growth ponderosa pine/Douglas fir. Area is considered good habitat for Mountain Lion and Black Bear due to foothills

(Continued on next page.)



habitat, size and high degree of naturalness. Important east/west and north/south large-mammal movement corridor. Restoration Potential: All efforts to limit or reverse habitat fragmentation should be pursued.

Common Name: Magnolia Location (General): East of Nederland, bounded on the north by Boulder Canyon, west of Winiger Ridge and Gross Res. Size (acres): 7,126 acres Life Zones: Lower Montane, Upper Montane. Rationale and Background: The Magnolia ECA is an area, which has received significant conservation and restoration by Boulder County Parks and Open Space, the USFS, and others. It is relatively unfragmented by roads and development. Additionally, this area has long been known as an important movement corridor for elk. This area is also included in the planning area for the Magnolia Environmental Preservation Plan, which seeks to protect the "unique rural qualities, unfragmented habitats, wildlife, scenic and recreational resources" of the Magnolia area. Naturalness: Relatively undeveloped and unfragmented area east of Barker Res. Much of the area is public land (Boulder County Parks and Open Space, USFS, State of Colorado). Quality and Uniqueness: High quality plant sites and plant diversity. Old-growth Ponderosa pine/Douglas fir. Important east/west large-mammal movement corridor. Restoration Potential: All efforts to limit or reverse habitat fragmentation should be pursued.

8-206 of the 1041 states: *Review or approval of a project by a federal or state agency does not obviate, and will not substitute for, the need to obtain a permit for that project under these regulations.* I.E. The FERC and Army Corps Records of Decision to permit Denver Water's expansion plans are not to override Boulder County's Commissioners representing county residents and interests to protect our county. Neither of those permits have the necessary guidelines to prevent the destruction of our Environment surrounding the existing Dam and Reservoir.

8-210 Definitions – B, 2 c. *Will not cause significant adverse environmental impacts on the unincorporated County; and* **d.** *Will not overburden the infrastructure of the unincorporated County in areas surrounding the proposed service area.* THIS particular regulation of the 1041 addresses again the massive road construction that Denver Water proposes to do to allow their proposed project to be possible. Since this bedroom community has only the one paved State Highway in and out of their homes this is an impossible mitigation by the applicant and any suggestions otherwise are untrue and risk the safety and continued unhindered movements of the existing population.

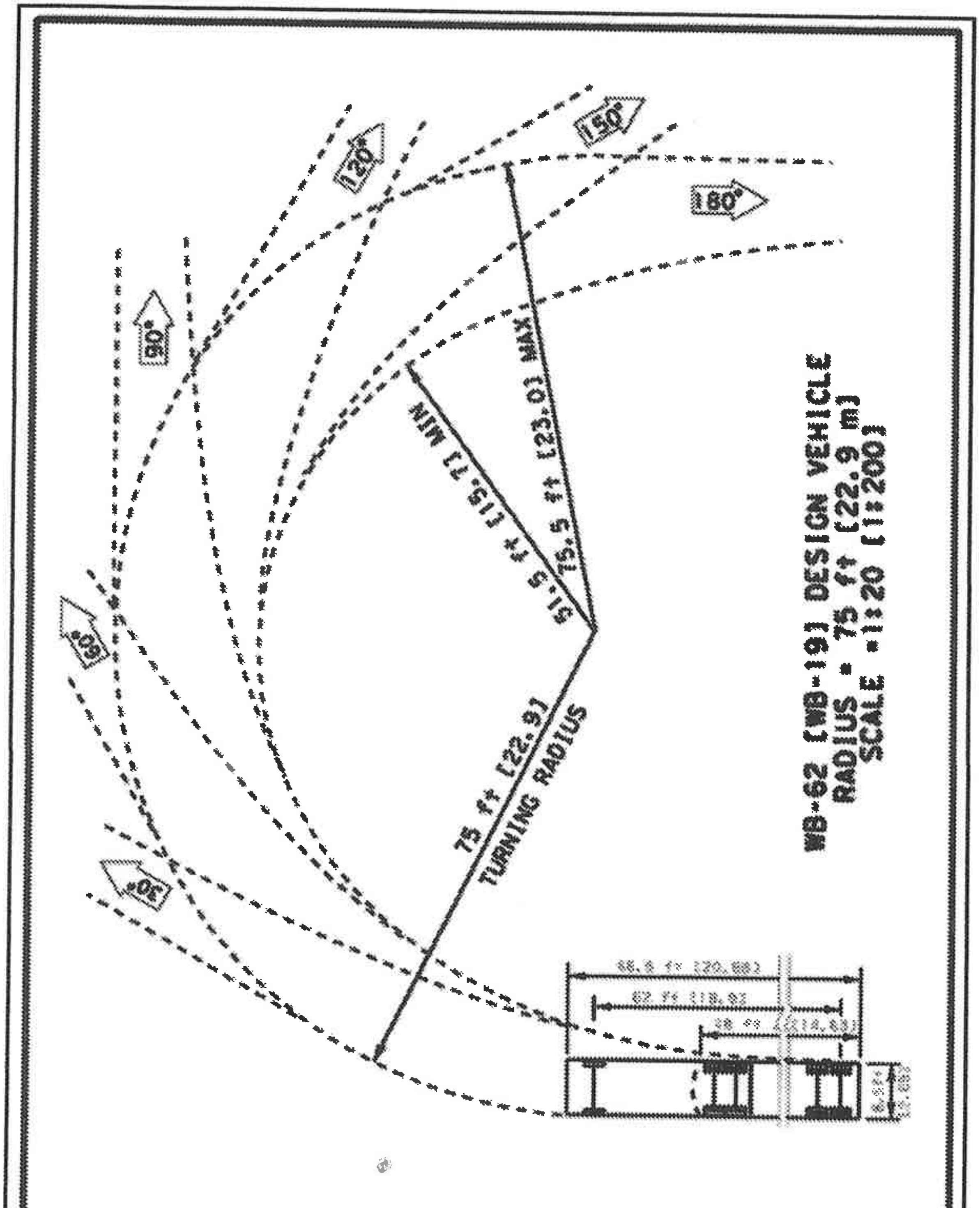
8-401 Specific Water and Sewage Treatment Activities Requiring Permits; H. *Systems, extensions, or projects partly or entirely on land which is designated in accordance with the Boulder County Comprehensive Plan as any of one of the following: (which applies to) critical wildlife habitat.* Winiger Ridge Elk calving grounds.

8-507 D.2.d *A detailed inventory of total commitments already made for current water in terms of taps or other appropriate measurements.* THIS application requirement has always been a point of contention between Denver Water and their opposition, not to mention Denver Water recipients and their Denver customers i.e. their own bylaws and water numbers. Initially Denver Water had sights on a Two Folks Dam in southern Colorado and once that project was rejected and killed by the E.P.A. many years ago the water board set its sights on expanding existing Gross Reservoir. Over the course of many scoping meetings, public hearings and botched IGA's the utility is now using a heretofore and untrue reason – storage stability for growing populations in the Denver Metro and surrounding suburbs they sell water to.

They have never been able to prove a need for the mere 8% an expanded Gross Reservoir might provide to the entire Denver Water system. Real conservation, reuse and recycling of water would allow their existing water system the stability and growth potential they say the expansion of Gross Reservoir might to support growing populations moving to their metropolitan area, not Boulder County.

Too much time and effort has been spent or is warranted to stop this destructive massive proposed project and now that FERC's permit to amend the hydroelectric has put strict timelines on Denver Water's efforts to push this application process through, it is apparent not all the regulations including public comments can be done to satisfy the Federal Energy Regulatory Commission's time standards. In letters between FERC and Denver Water it is most concerning that FERC does have grave issues with who the applicant (Denver Water) will hire for any Dam Construction. The only possible outcome is for Denver Water to be denied Boulder County's 1041 permit and to go on their way by doing the environmentally responsible things they should already be doing – **REAL CONSERVATION.**

By A.M. Wilks



Turning Template for Semi-Trailer with
62 ft [18.9 m] Wheelbase (Radius=75 ft [22.9 m])

Figure 7-5. Turning Template for Semi-Trailer with 62 ft [18.9 m] Wheelbase (Radius = 75 ft [22.9 m], (not to scale). Click here to see a PDF of the image.

From:	Patti Hirsch
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Fwd: Gross Dam Expansion- NO
Date:	Tuesday, November 10, 2020 9:09:11 AM

Dear Commisioners;

The 1041 Application by Denver Water should not be approved. Here are just a few of the reasons:

The Front Range population including the Denver Water service area needs to live within their available natural resources without sacrificing those natural resources for future generations.

The data used to justify this project is outdated and does not take climate change properly into account. It is possible that after a 7-year construction project the dam will never be filled to capacity due to drought/climate change conditions that have been ignored by Denver Water.

The bottom release of water from the dam will affect aquatic life due to extreme cold temperatures that are below CDPHE water quality standards.

The application discusses truck traffic on Flagstaff Road, which is ridiculous. Truck traffic would cause a significant safety risk to citizens and tourists.

This is not a sustainable project and should not be approved.

Sincerely,
Patti Hirsch
Flagstaff Rd

From:	Isak Bromley
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir & Dam Expansion
Date:	Monday, November 9, 2020 8:18:38 PM

Hello,
I’m writing this brief comment in opposition of the expansion of Gross Dam. You might think that expansion is necessary, that the harm that’ll it’ll do to the environment can be justified by the good that it would provide to the public. Thats not true. There are less damaging energy alternatives to depleting the Colorado River. The value of our nature can’t be understated - solving a short term problem with long term damage is a hugely irresponsible approach, and it shouldn’t be allowed to go forward.
Sincerely,
Isak Bromley

From: Suzanne MacAulay
To: Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject: Gross Reservoir
Date: Monday, November 9, 2020 8:03:19 PM

Emailed to:
grossreservoir@bouldercounty.org
commissioners@bouldercounty.org

9 November 2020

TO: Boulder County Commissioners

FROM: Allan L. Lazrus

RE: Gross Reservoir

Thank you for your efforts to ensure the deliberations about the expansion of Gross Reservoir are compliant with the Boulder County Land Use Code. I am a longtime resident of the Magnolia Road community. I purchased my property in this area in the early 1970s. An overwhelmingly magnificent aspect of living here is that we are not far from Gross Reservoir. I have valued its proximity for fifty years.

I have kept abreast of the many facets of this long negotiation with the Denver Water Board's plans to expand Gross Reservoir and at this stage, I urge you to reject their 1041 application for the following reasons:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code.

Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Quarry Operation Plan
Pit Development and Reclamation Plan

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Erosion Control Reclamation Plan
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Fire Management and Response Plan
Special Status Plants Relocation Plan
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Traffic Management Plan
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Emergency Action Plan
Recreation Adaptive Management Plan for Winiger Ridge
Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

The Corps Record of Decision violates the National Environmental Policy Act:
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The Corps Record of Decision violated the Clean Water Act:
The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
The full cost of the project was not considered in choosing the LEDPA.
The Corps Record of Decision violated the Endangered Species Act by failing to adequately

consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

Failed to use an adequate alternatives analysis.
Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Sincerely,

Allan L. Lazrus
60 Aspen Grove Court
Nederland, Colorado
Mailing address:
PO Box 862
Nederland, Colorado 80466

From:	Suzanne MacAulay
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir expansion
Date:	Monday, November 9, 2020 7:04:43 PM

Emailed to: grossreservoir@bouldercounty.org and commissioners@bouldercounty.org

9 November 2020

TO: Boulder County Commissioners

FROM: Dr. Suzanne P MacAulay

RE: Gross Reservoir

I appreciate your sustained involvement during the ins-and-outs of the campaign to expand Gross Reservoir, and your stewardship in terms of what is appropriate for diverse ecosystems throughout the county. Dams are of interest around the nation. Old damns are being dismantled thus improving the ecology of river systems. New dams plus enlargements of existent dams (e.g., Gross Reservoir) are being challenged because of the effect on the ecology of those river systems. Consequently, concern for maintaining or re-establishing the flow of nutrients and sediments vital to the food web arises in light of the knowledge that this too will be stymied by future dam expansions and new construction.

I am part of the Magnolia community and have lived not far from Gross Reservoir since 1984. I dearly love this place and urge you to stand fast in recognizing the incompleteness of Denver Water Board's 1041 application. Until the Denver Water Board accurately and thoroughly assembles an application that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

The following issues with the current 1041 application submitted by the Denver Water Board have been identified:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code.

Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Invasive Plant and Noxious Weed Species Management Plan
Fire Management and Response Plan
Special Status Plants Relocation Plan
Aquatic Invasive Species Monitoring Plan
Traffic Management Plan
Fugitive Dust Control Plan
Road Maintenance Plan
Recreation Management Plan
Visual Resources Protection Plan
Historic Properties Management Plan
South Boulder Creek Channel Stability and Monitoring Plan
Road Management Plan (USFS)
Road Maintenance Plan
Restoration and Revegetation Plans
Special Status Plants Relocation Plan
Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
Emergency Action Plan
Recreation Adaptive Management Plan for Winiger Ridge
Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

The Corps Record of Decision violates the National Environmental Policy Act:
The "Purpose and Need" in the EIS is not accurate and must be redone.
The "Alternatives" analysis in the EIS is not accurate and must be redone.
The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
The Corps Record of Decision violated the Clean Water Act:
The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
The full cost of the project was not considered in choosing the LEDPA.
The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider

and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

Failed to use an adequate alternatives analysis.
Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Sincerely,

Suzanne P MacAulay, PhD

60 Aspen Grove Court

Nederland, Colorado 80466

____

Suzanne P MacAulay, PhD
Professor Emerita
Department of Visual and Performing Arts
University of Colorado, Colorado Springs
1420 Austin Bluffs Parkway
Colorado Springs, Colorado 80918
Phone: 719.473.0441
Email: smacaula@uccs.edu
Mailing address: PO Box 862, Nederland, Colorado 80466

From:	Kathy Gritz
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Denver Water"s 1041 permit application
Date:	Monday, November 9, 2020 6:46:22 PM

To the Boulder County Commissioners:

I am a resident of the North Shore of Gross Reservoir (Lakeshore Park) in Boulder County. I have studied the issue of the development for 12 of the 25 years I've lived in my home here. Not only will the development destroy the peaceful beauty and quiet of this area but will also have farther flung ramifications for the degradation of the Frasier River System and the Colorado River.

The size of the application is large but not large enough to elucidate us on their plans & mitigations of the problems we face as County residents and beyond to experience air & water pollution during the long proposed work to enlarge Gross Dam. The area of Gross Reservoir is in a large basin that stretches from Flagstaff Road in Boulder across and south to Coal Creek Canyon. At night I can hear the trains farther away near Coal Creek Canyon- It's a nice sound . The sound of a cement plant operating for 24 hours a day 7 days a week by itself will be the thing that drives the elk herd (sometimes as large as 200) and other wildlife including humans absolutely crazy. In the summer to not hear the nighthawks and owls would be a terrible loss. And when those animals can't hear each other they may not reproduce and will try to find homes elsewhere.

I've seen the pictures that Denver Water uses to show what the new dam will look like full of water. But the dam as it exists now is normally full only in July for a month or so, then the reservoir is drained & land is uncovered & when developed & denuded of trees will likely erode & look terrible like areas west of here in Arizona and Utah where their reservoirs are just mud puddles. Denver Water did not take any climate change models into account.

How many trees will be removed & by what methods? Is it 200,000 trees or 600,000? Don't we need these trees, especially after all the forest fires to help the carbon-sink? Colorado's air is terrible causing so many people to develop asthma.

I wonder how our residential well water and septic systems could be impacted- or even damaged by the work on the dam. Will Denver Water compensate for residential property damage?

I'm spoiled from living here in the mountains where I can walk to Boulder County Open Space, National Forest and the Gross Dam area. At my age, 66, life is too precious and I cannot imagine being able to continue to live through the devastation of this proposed project therefore will be forced to move and likely sell my house with a major loss in value.

But I'm still here because I believe it's possible that this can be stopped.
Please tell them they need to comply with **Section 8-308.A.4** of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver.

Clean water, clean air, endangered species, public health & safety are at great risk in the balance here. I hope you will do all you can to stop this project.

Best regards
Kathy Gritz

72 Lakeshore Park Rd.
Boulder, CO 80302

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720-289-2285

From:	Brice Johnson
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir
Date:	Monday, November 9, 2020 6:44:36 PM

We are Ned residents and our property backs up to CR68. We are adamantly against the Gross Reservoir expansion. Primarily, we can not regain the forest that will be lost. Boulder County is known for prioritizing our earth and nature, and this would be a blemish on what we say we stand for. There are a multitude of other reasons including pollution from the noise and exhaust; expansion of roads that we want to leave as is; and violation of our mountain life to name a few more. PLEASE, fight to keep our lands untouched.

Thank you,
Brice and Brigitte Johnson
48 Wildflower Court

From:	Paul DeLong
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Dam Expansion - Comments on Denver Water"s 1041 Application to Boulder County
Date:	Monday, November 9, 2020 4:22:42 PM

Dear County Commissioners,

My name is Paul DeLong and I live at 156 Cumberland Gap Rd., Nederland, CO 80466, a short distance from Forest Service 359 and County Rd 68.

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Road Maintenance Plan

- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
  - The "Purpose and Need" in the EIS is not accurate and must be redone.
  - The "Alternatives" analysis in the EIS is not accurate and must be redone.
  - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
  - The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
  - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Warmly,
Paul DeLong
156 Cumberland Gap Rd.
Nederland, CO 80466

From: Lori Thorne-Smith
To: Gross Reservoir SI-20-0003
Cc: Lora Thorne-Smith
Subject: Desperate to stop this horrible plan to wreak havoc on a beautiful area for years to come.
Date: Monday, November 9, 2020 2:56:22 PM

As a 20 year resident of the Gross Reservoir area, I hope and pray that good sense will prevail and this area will escape a senseless profit grab by Denver Water and the Army Corps of Engineers. A calculated and ongoing profit grab that, if not defeated, will virtually destroy the quality of life for human residents, kill thousands of trees, and destroy irrevocably the resident wild life for YEARS AND YEARS to come. According to rational experts who see through and reject this plan, this expansion is not necessary except to line the pockets of Denver Water and The Army Corps of Engineers.

This area should be protected by our Boulder County, state, and federal officials from corporate opportunists who want to profit by senselessly wreaking havoc on an incredible sylvan paradise. I have attended meetings in which the residents of the area, many engineers and other experts have described the horrific damage which will be caused by this plan to expand the reservoir. They've described the impact of construction noise which is expected to be a 24/7 daily roar for miles around and for many YEARS, the destruction of forests, wildlife, roads. We MUST stop this selfish, willful profit-mongering by greedy corporate executives.

Is it worth the destruction of these forest glens to give Denver Water a water supply for endless lawns in the suburbs and other unworthy reasons to destroy a natural area of this beauty? Please make a stand AGAINST reckless profiteering and FOR this natural, unspoiled area which it has fallen to us to enjoy and protect.

Sent from my iPad

From:	Harry Jacobson
To:	Gross Reservoir SI-20-0003
Subject:	Gross Dam.
Date:	Monday, November 9, 2020 2:12:04 PM

Has anyone questioned the fact that there may be closure of National Forests access and open space restrictions for the duration of the dam construction. People aren't very happy with closures now even considering the apparent fire dangers.

Thank you. Harry Jacobson. 1898 County Rd. 68. Nederland

Sent from my iPad

From:	allyn s feinberg
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir & Dam Expansion Comments
Date:	Monday, November 9, 2020 2:09:31 PM
Attachments:	Letter to County Commissioners re Gross Dam expansion Nov 2020.pdf WaterDM Letter Regarding Water Demands and Statement of Need for Gross Reservoir Expansion 2.pdf

Please find attached a letter and report regarding the Gross Reservoir & Dam Expansion from PLAN-Boulder County. This information has also been sent to the Commissioners regular email.

PLAN-Boulder County

planboulder.org

P.O. Box 4682 Boulder, CO 80306

November 10, 2020

To: Boulder County Commissioners

Re: PLAN-Boulder's comments on the Gross Reservoir & Dam Expansion

Dear Commissioners:

PLAN-Boulder County opposes the Gross Reservoir expansion for the following reasons:

1) The dam raising would be the largest construction project in the history of Boulder County and will be hugely disruptive to the environment and region;
2) There is a crisis on the Colorado River and it is irresponsible for the East slope to divert additional water at this time;
3) **Denver doesn't need the water.** Denver has a robust water system already, without expanding Gross Reservoir. Water use in Denver, and across the region has declined. Water conservation and efficiency have been tremendously successful over the past 20 years. Additional per capita reductions are anticipated into the future.

To specifically address Denver Water's statement of need, please find the attached expert report prepared by Peter Mayer, P.E., Principal of Water Demand Management. Mr. Mayer is a national expert in urban water systems, municipal water demands, and demand forecasting. In 2016 he testified as an Expert Witness at the U.S. Supreme Court in FL v. GA, 142 Original of behalf of the State of Georgia. Over his 25-year engineering career he has worked with hundreds of water utilities in Colorado and across the US. Mr. Mayer is also the co-chair of PLAN-Boulder County and we feel fortunate to be able to offer his expertise on this matter.

Mr. Mayer's report addresses the fact that Denver Water's actual water use has declined substantially and the application for the Gross Reservoir Expansion is based on an outdated demand forecast. When an appropriate demand forecast based on current demand is employed, Denver Water's four stated reasons for why it needs the Gross Reservoir expansion become highly questionable. PLAN-Boulder urges you to review Mr. Mayer's analysis, and based on his findings to request that Denver Water resubmit their statement of need for this project with an analysis based on current water use and which takes into consideration the impacts of climate change. We also request that Mr.

Mayer's report be made part of the formal record of Boulder County's 1041 review of Denver Water's proposal.

It would be wrong for the Boulder County Commissioners to approve the Gross Reservoir & Dam Expansion project based on the statement of need presented by Denver Water. The attached analysis clearly shows that Denver Water is in a very different situation than it was when this project was proposed more than 20 years ago. A revised and re-analyzed statement of need is required.

Thank for your careful consideration.

Sincerely,

Allyn Feinberg
Co-Chair, PLAN-Boulder County

November 9, 2020

PLAN-Boulder County
PO Box 4682
Boulder, CO 80306

Expert opinion and analysis regarding water demands and statement of need for the Gross Reservoir Expansion project

To Whom It May Concern:

At the request of PLAN-Boulder County, I have prepared this expert letter report regarding water demand and statement of need pertaining to Docket SI-20-0003: Gross Reservoir & Dam Expansion. This reservoir expansion was proposed by Denver Water and this expert letter report was prepared in response to Boulder County's Areas and Activities of State Interest (1041) review of this project.

In summary, this letter report concludes that the future water demand forecasts offered by Denver Water in support of the Gross Reservoir & Dam Expansion are no longer accurate or even relevant. Water demand has changed in Denver and across Colorado and the United States. Denver Water's documented demands and production have not increased, even as population has grown.

The Gross Reservoir & Dam Expansion will be the largest construction project in the history of Boulder County and will annually remove an additional 18,000 AF of water from the climate change-impacted Colorado River basin. WaterDM reviewed each aspect of Denver Water's "Project Purpose and Need" statement[1] and reviewed Denver Water's actual demand from 2009 – 2019 and determined that the water demands Denver anticipated when the project was conceived have not occurred. As a result, the supply and reliability concerns used to justify the Gross Reservoir Expansion must be reconsidered.

A statement of need and water demand forecast for a project of this size and scope must be based on sound data, reasonable assumptions, and conservative resource principles to ensure the water will not be wasted and that anticipated impacts to the environment are justified. In this case the demand forecast used to justify the project is no longer reasonable or relevant because demand has changed. Water customers across the Western United States have

[1] 8-507.D.7, Requirements Applicable to All Applicants; 8-507.D.7.a, Project Need, from the "Corps ROD (Section 3.0).

successfully implemented effective water efficiency strategies that today have reduced per capita use.

Denver Water has offered a shifting justification for the Gross Reservoir & Dam Expansion project, but no new analysis of water demands, or a revised demand forecast were included in any of their recent filings. The demand projections for Gross Reservoir are derived from Denver Water's 2002 Integrated Water Resources Plan.[2] The Army Corps of Engineers evaluated Denver Water's demand projections in 2004 and again in 2010 and Denver Water's Final Environmental Impact Statement (FEIS) on the project notes that water conservation has been included in Denver Water's projections.[3]

What is not included in Denver Water's FEIS or its application to Boulder County is that fact that over the past ten years, the water demands considered by the Corps and included in Denver Water's analysis and projections have failed to materialize. The Corps based its analysis on the incorrect assumption of the rapid increase in demand that Denver Water had forecast. Since 2010, Denver Water's total water demand has decreased even as population has grown. The evaluation performed by the Corps in 2004 and 2010 was based on an outdated and highly inaccurate demand forecast. A reevaluation is clearly warranted.

This expert letter report provides a detailed review and evaluation of each of Denver Water's "identified four needs" in light of actual water demands, and an updated water demand forecast that reflects both population growth and the impacts of water efficiency. The analysis in this report shows that Denver Water's water demand forecast significantly overstates future demand and is no longer a reasonable representation of likely future demand.

When replaced with a reasonable future demand forecast based on current production trends and anticipated growth, Denver Water's four identified needs in its application appear far less urgent. Denver Water's use has become more efficient, and the need for expanding this existing reservoir with all the impacts that come with it for Boulder County, not to mention the Colorado River, no longer exist. The existing Gross Reservoir and the capacity and reliability it already provides along Denver Water's large integrated system appears sufficient to meet future build-out demand.

Denver Water should update its demand forecast and statement of Project Need to reflect the last 10 years of production on their system and assure Boulder County that there is a compelling need for the reservoir expansion project.

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[2] Denver Water. 2002. Integrated Water Resources Plan. Figure III-4.

[3] U.S. Army Corps of Engineers Omaha Division (USACE). 2009. Moffat Collection System Project Final Environmental Impact Statement (Final EIS). April 25, 2014.

Summary of Qualifications

I am the Principal of Water Demand Management, LLC (WaterDM), based in Boulder, Colorado. WaterDM is a water consulting firm providing expertise and services in the following areas:

- Municipal and industrial water use, research, and analysis
- Demand forecasting
- Water conservation and demand management planning and implementation
- Integrated water resources planning
- Water loss control
- Analysis of municipal water rates and rate structures
- Drought preparedness and response
- Evaluation of changes in demand
- Statistical analysis of water demand and modeling
- Meter technology implementation
- Meter and service line sizing

I have a Master of Science in Engineering (1995) from the University of Colorado, Boulder, and a Bachelor of Arts (1986) from Oberlin College. I am a registered and licensed Professional Engineer in Colorado.

I am a civil engineer and the focus of my career has been on urban water systems and demand management including conservation planning and implementation, rate analysis, water demand research, demand forecasting, drought preparation, utility metering, and water loss control. Since 1995, I have served as a consultant and researcher to urban water providers, US EPA, the Water Research Foundation, the Alliance for Water Efficiency, state governments, and municipal and industrial water users in the US and Canada.

Over my 25-year engineering and consulting career, I have worked with and advised hundreds of water providers and organizations such as the California Department of Water Resources; the Colorado Water Conservation Board; the State of Georgia; the New York City Water Board; the Metropolitan Water District of Southern California; the Marina Coast Water District; Tucson Water; Greeley, CO; Fort Collins, CO; Westminster, CO; Denver, CO; Little Thompson Water District, CO; Security Water and Sanitation District, CO; Scottsdale, AZ; San Antonio, TX; the US EPA; the US Department of Justice; the Alliance for Water Efficiency and many others.

I have served as the principal investigator and lead or co-author of numerous national and state-level water demand research studies including: Residential End Uses of Water (2016, 1999); Assessing Water Demand Patterns to Improve Sizing of Water Meters and Service Lines (2020); Peak Demand Management (2018); Colorado Water Plan and Update (2010, 2018); National Submetering and Allocation Billing Program Study (2004); Water Budgets and Rate Structures (2008); Commercial and Institutional End Uses of Water (2000); and many others.

I am the lead author of the American Water Works Association (AWWA) M22 Sizing Water Service Lines and Meters 3rd. ed. (2014) and 4th ed. (pending). I am co-author of the AWWA G480 Water Conservation Standard (2013 and 2020) and co-author of the Colorado Best Practices Guidebook for Municipal Water Conservation (2010). I served as Trustee of the AWWA Water Conservation Division from 2001-2007 during which time I worked with EPA to create the WaterSense™ program and helped establish the Alliance for Water Efficiency. I have been a Senior Technical Advisor to the Alliance for Water Efficiency since 2007. I am a member of the American Water Works Association, the Alliance for Water Efficiency, the American Water Resources Association, the American Society of Civil Engineers (ASCE), the Colorado Water Congress, and the Colorado River Water Users Association.

In 2016, I testified as an expert witness on municipal and industrial water use at the US Supreme Court (FL v. GA, 142 Original) on behalf of the State of Georgia.

A copy of my curriculum vitae is available at www.waterdm.com.

Gross Reservoir & Dam Expansion Water Demand Forecast

8-507.D7.a, Project Need

Denver Water submitted its Areas and Activities of State Interest (1041) Permit Application to Boulder County for the Gross Reservoir & Dam Expansion Project on September 21, 2020. On page 60 of this application, Section 8-507.D.7.a, addresses the project purpose and need. To justify the reservoir expansion, Denver water presents information from the Final Environmental Impact Statement[4] and from analysis presented by the Army Corps of Engineers[5].

Specifically, Denver Water identifies four needs "in the Moffat Collection system that require resolution." These needs were first presented to the public in 2003 during the National Environmental Policy Act (NEPA) scoping period.[6] The four needs Denver Water identified in its application to Boulder County are:

1. The Reliability Need
2. The Vulnerability Need
3. The Flexibility Need
4. The Firm Yield Need

The fundamental analysis Denver Water presents for all four needs, relies upon the demand forecast prepared for Denver Water's 2002 Integrated Resources Plan as Figure III-4 (reprinted below as Figure 1). The 2002 IRP states that this figure "presents the demand forecast through build-out, along with existing supplies"[7]. This figure shows that Denver Water has an "in-hand" supply of at least 375,000 AF of water. It also forecasts that Denver Water's demand will exceed this available supply in 2028 and possibly in 2014 if a safety factor is considered.

[4] U.S. Army Corps of Engineers Omaha Division (USACE). 2009. Moffat Collection System Project Final Environmental Impact Statement (Final EIS). April 25, 2014.
[5] Army Corps of Engineers. Record of Decision. NWO-2002-80762-DEN, Board of Water Commissioners for the City and County of Denver (Denver Water), Moffat Collection System Project. July 6, 2017.
[6] Denver Water. 2020. Denver Water's Gross Reservoir Expansion Project. Areas and Activities of State Interest (1041) Permit Application
[7] Denver Water. 2002. Integrated Water Resources Plan. Figure III-4.

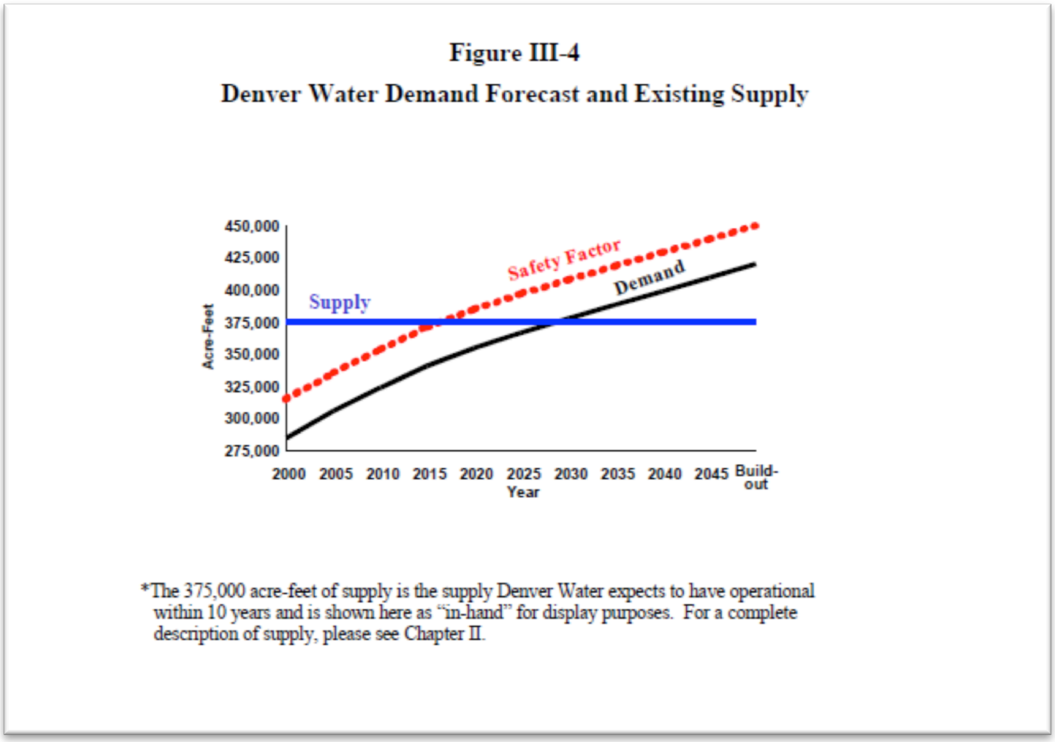

Figure 1: Denver Water Demand Forecast and Existing Supply, 2002 Integrated Water Resources Plan, Figure III-4

Evaluation of Denver Water Demand Forecast

To evaluate the demand forecast Denver Water has relied on to justify the Gross Reservoir & Dam Expansion project, WaterDM obtained Denver Water's Comprehensive Annual Financial Reports (CAFRs) for 2018 and 2019, which include total water production records for 2009 – 2019.[8,9] Denver Water's total production from 2009 – 2019 is shown in Figure 2 along with a usage trend forecast and safety trend forecast.

Denver Water's highest annual water production over the past 10 years occurred in 2012 and was 212,864 AF, which is fully inclusive of all deliveries and non-revenue water. In 2019, Denver Water's total production had reduced to 196,881 AF. Despite all of the growth that has occurred in Denver over the past 10 years, Denver Water's total water use and water production has declined. As a result, in any given year Denver Water may have in excess of 175,000 AF of "in-hand" supply that is not being used to serve its customers. At no point over the last 10 years did Denver Water have less than 150,000 AF of excess supply "in-hand".

To correct for the obvious inaccuracy of Denver Water's 2002 demand forecast, WaterDM developed a simple usage trend forecast based on Denver Water's build-out population growth

[8] Denver Water. 2019. Comprehensive Annual Financial Report For the year ended December 31, 2019 Denver, Colorado

[9] Denver Water. 2018. Comprehensive Annual Financial Report For the year ended December 31, 2019 Denver, Colorado

projection from the 2002 IRP, which is 1,835,000 people in year 2050. WaterDM's forecast does not include any future water efficiency beyond what has occurred to date. The average daily per person use in Denver in 2019 was 131.3 gallons per capita per day (gpcd). WaterDM's Usage Trend Forecast assumes that in 2050 customers use the same 131.3 gpcd on average. In fact, Denver Water customers are going to become even more efficient in the future and use even less water than WaterDM has forecast, but to be conservative GPCD was held at current levels. The Usage Trend Safety Forecast includes a 10% add-on volume as a factor of safety, just as Denver Water did in the 2002 IRP forecast.

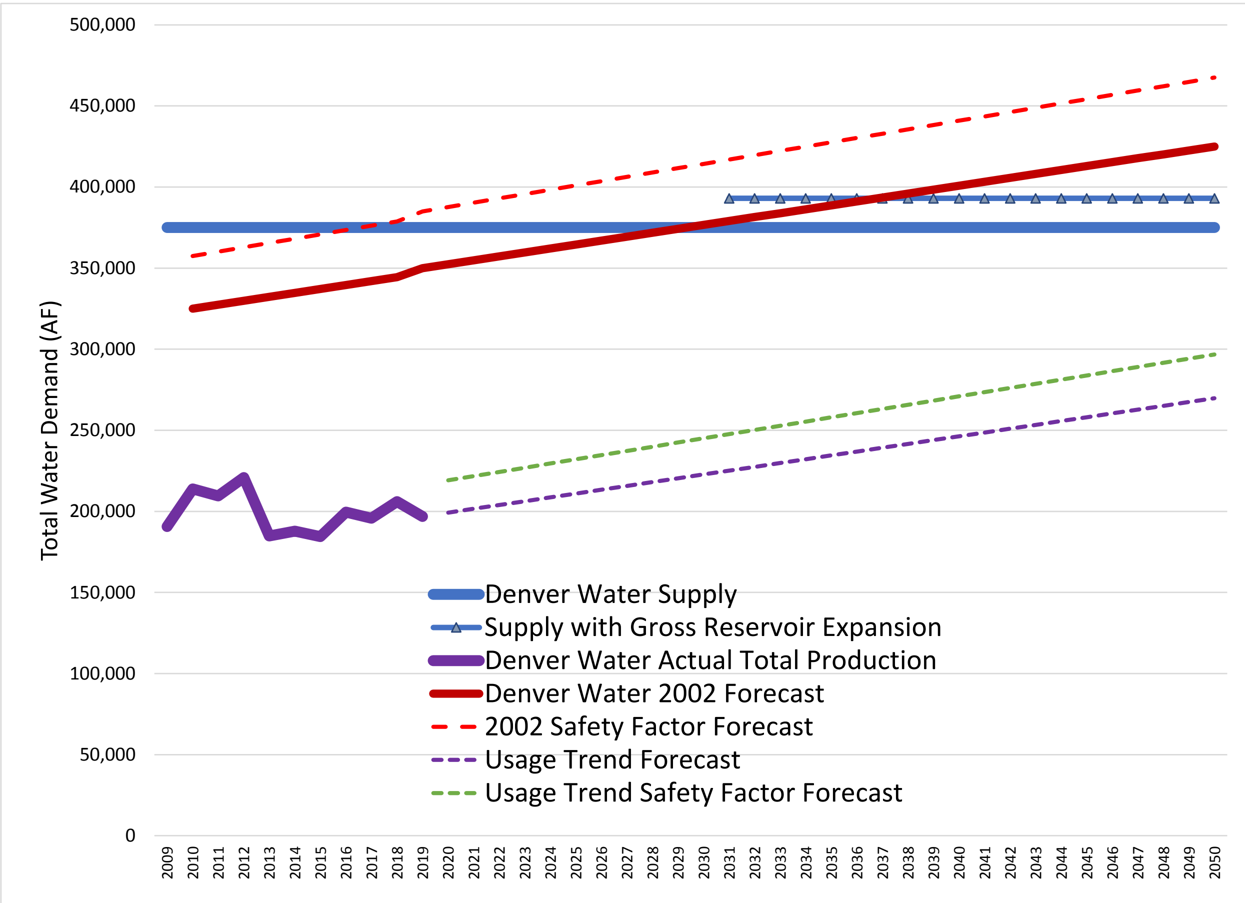

Figure 2: Denver Water Total Production (2009 – 2019) with current usage trend forecast with the 2002 Integrated Water Resources Plan demand forecast

At the buildout population of 1,835,000 using an average of 131.3 gpcd with a 10% safety factor applied, Denver Water is forecast to use 300,000 AF and still has a 75,000 AF buffer – and additional 25%. This would appear to be a comfortable situation for a water supplier in the Front Range.

For comparison, in Denver Water's 2002 forecast, water use was estimated to be 207 gpcd at buildout in 2050. This is 58% higher (75.7 gpcd) than actual in 2019 and an indication of how far off Denver Water's forecast has become. The 2002 forecast is no longer an accurate or reasonable estimate of future demand on the Denver Water system.

Evaluation of Denver Water Needs

WaterDM examined each of Denver Water's "four needs in the Moffat Collection System" that require resolution, in light of the revised demand forecast to determine if they are still legitimate and reasonable. Each need is addressed individually.

The Firm Yield Need

Denver Water's 1041 application to Boulder County states, *"Denver Water's near-term (prior to 2032) water resource strategy and water service obligations, which have occurred since the IRP was developed, have resulted in a need for 18,000 acre-feet per year (AF/yr) of new near-term firm yield. This need was identified after first assuming successful implementation of a conservation program, construction of a non-potable recycling project, and implementation of a system refinement program."*[10]

The Firm Yield Need was what was originally Denver Water's primary rationale for the Gross Reservoir Expansion, when the project was first proposed. As time went by, the Firm Yield Need was deemphasized, as reliability and vulnerability needs were introduced to justify the project. WaterDM's analysis shows exactly why Denver Water chose to deemphasize the Firm Yield Need.

There does not appear to be a reasonable or legitimate need for an additional 18,000 AF of firm yield given actual demand trends. Adding another 18,000 AF through the Gross Reservoir Expansion simply pads what is already an ample water portfolio. As shown in Figure 2, in both the near-term and the long-term, Denver Water has ample water "in-hand" to meet demand even with a 10% factor of safety applied. Denver Water appears to have more "in-hand" water than it needs, somewhere between 75,000 and 175,000 AF available from now until the forecast buildout.

Denver Water should be required to reevaluate and justify the "Firm Yield Need" considering the significant changes in demand that have occurred and the apparent excess supply capacity that it possesses.

The Reliability Need

Denver Water's 1041 application to Boulder County states. *Existing water demands served by Denver Water's Moffat Collection System exceed available supplies from the Moffat Collection System during a drought, causing a water supply reliability problem. In a severe drought, even in*

[10] Denver Water. 2020. Denver Water's Gross Reservoir Expansion Project. Areas and Activities of State Interest (1041) Permit Application (p.60)

a single severe dry year, the Moffat Water Treatment Plant (WTP)—one of three treatment plants in Denver Water's system—is at a significant level of risk of running out of water."[11]

The Reliability Need is what Denver Water has promoted to the top of the list as the rationale for the Gross Reservoir Expansion project, yet the analysis presented in support of this need is remarkably thin. Denver Water's FEIS states that "PACSM modeling" and "2002 operations" indicate that existing water demands would exceed available supplies from the Moffat Collection System during a severe drought, putting the Moffat Water Treatment Plant at a "significant level" of risk of running out of water.[12]

As shown in Figure 2, Denver Water's demand has dramatically changed since 2002 when the modeling and analysis for the risk assessment was conducted. Denver Water must certainly have conducted more recent analysis of its risk assessment that takes into consideration the changes in demand that have occurred.

It is not reasonable to justify a project the size and scope of the Gross Reservoir Expansion based upon an 18-year old reliability analysis, which itself was based on what has become an unrealistic and inflated demand forecast. It is quite likely that the reliability risk to Denver Water's system has changed given the reduced future forecast.

Climate change impacts on the Colorado River basin are also better understood today than they were in 2002. Denver Water's reliability analysis must consider the risk that the 18,000 AF of supply it intends to divert may not be available due to reduced snowpack.

The Boulder County Commissioners should request from Denver Water an updated Reliability Analysis based on current data, an updated demand forecast, and which considers the impacts of climate change.

The Vulnerability Need

Denver Water's 1041 application to Boulder County states, "*Denver Water's Collection System is vulnerable to manmade and natural disasters because 90 percent (%) of available reservoir storage and 80% of available water supplies rely on the unimpeded operation of Strontia Springs Reservoir and other components of Denver's Water's South System.*"[13]

Denver Water reports that their overall water supply system is vulnerable to man-made and natural disasters because 90% of storage and 80% of available water supply is located in their South System. However, a simple analysis shows that storage and supply concerns are hardly changed with the addition of 18,000 AF of firm yield to the North System. Adding the proposed

[11] Denver Water. 2020. Denver Water's Gross Reservoir Expansion Project. Areas and Activities of State Interest (1041) Permit Application (p.60)
[12] USACE. 2003. Scoping Summary – Moffat Collection System Project, p. 3-2. December.
[13] Denver Water. 2020. Denver Water's Gross Reservoir Expansion Project. Areas and Activities of State Interest (1041) Permit Application (p.60)

Moffat Expansion barely decreases Denver Water's reliance on the South System; lowering South System dependence from 81% to 77% of water supply as shown in Table 1. Furthermore, given the changed water demand and revised demand forecast shown in Figure 2, this "vulnerability" needs to be reassessed. How much would increasing the storage capacity of Gross Reservoir and withdrawing an additional 18,000 AF reduce vulnerability – given the existing level of reliability that exists and the likely impacts of climate change.

Table 1: Yield of Denver Water's Systems in AF (adapted from FEIS and Wester Resource Advocates).[14]

	Existing System			*With Moffat Expansion*		
Source	**Supply**	**Percent**	**S. Supply**	**Supply**	**Percent**	**S. Supply**
Roberts Tunnel	93,000	27%	81%	93,000	26%	77%
South Platte	141,000	41%		141,000	39%	
Exchange/Reuse	47,000	14%		47,000	13%	
Moffat Tunnel	64,000	19%		82,000	23%	
TOTAL	**345,000**			**363,000**		

The Boulder County Commissioners should require Denver Water to present an evaluation of the improvements to system vulnerability afforded by the proposed Moffat Expansion and other viable alternatives. For example, if manmade or natural disasters are a concern, one of which might be a tunnel failure (often mentioned by Denver Water), then a greater reliance on one of the tunnel systems would not seem to reduce vulnerability or increase reliability. Improvements to system-wide security (e.g. video cameras, extra patrols), or forest health (because fire is a major concern in the South Platte watershed), may prove to be more economic, and reduce vulnerability more than any of the proposed project alternatives. This analysis has never been presented.

Denver Water has not done an adequate job of presenting the Vulnerability Need in a convincing manner. A revised analysis is warranted before a project of this size and scope and impact is allowed to proceed.

The Flexibility Need

Denver Water's 1041 application to Boulder County states, "*Denver Water's treated water transmission, distribution, and water collection systems are subject to failures and outages caused by routine maintenance, pipe failures, treatment plant problems, and a host of other unpredictable occurrences that are inherent in operating and maintaining a large municipal water supply system. These stresses to Denver Water's ability to meet its customers' water*

[14] Western Resource Advocates. 2010. Comments on the Moffat Collection System Project Draft Environmental Impact Statement (DEIS) and the associated § 404 Permit Application prepared by the U.S. Army Corps of Engineers (USACE).

supply demands require a level of flexibility within system operations that is not presently available."[15]

The analysis Denver Water presents in support of this need is remarkably thin.

Unlike many water providers, Denver Water already has three large, independent water treatment plants, any one of which is capable of meeting the vast majority of Denver Water's customers' water needs during most of the year. In addition, summer-time demands in the entire combined service area can be served by any two plants in times of drought, as evident by operations practiced in 2002.

If the Flexibility Need is in fact real, Denver Water must, at a minimum, provide a quantification of the benefits attributable to the additional flexibility provided by the proposed Moffat Expansion project. Parallel to questions surrounding the vulnerability need, there is not a clear indication that 18,000 AF of additional supply actually provides any substantive benefits to system flexibility.

A helpful starting point would be to determine actual customer service interruptions attributable to the planned and non-planned outages described in Appendix C of the Purpose and Need Report[16] – while there are several listed outages, it is not apparent if any of those outages led to supply interruption at the customer level.

Boulder County deserves to understand how the largest construction project in its history will improve flexibility in Denver Water's system, and what is the actual need for improved flexibility. Denver Water has not provided a convincing argument or analysis to show that this is a legitimate concern. The Boulder County Commissioners should request Denver Water to present substantive analysis on this point.

Conclusions

This letter report concludes that the future water demand forecasts offered by Denver Water in support of the Gross Reservoir & Dam Expansion are no longer accurate or even relevant. Water demand has changed in Denver and across Colorado and the United States. Denver Water's documented demands and production have not increased, even as population has grown over the past 10 years.

The Gross Reservoir & Dam Expansion will be the largest construction project in the history of Boulder County and will annually remove an additional 18,000 AF of water from the climate change-impacted Colorado River basin. WaterDM reviewed each aspect of Denver Water's

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[15] Denver Water. 2020. Denver Water's Gross Reservoir Expansion Project. Areas and Activities of State Interest (1041) Permit Application (p.60)
[16] Denver Board of Water Commissioners. 2004. Purpose and Need Statement for the Moffat Collection System Project. April.

"Project Purpose and Need" statement[17] and reviewed Denver Water's actual demand from 2009 – 2019 and determined that the water demands Denver anticipated when the project was conceived have not occurred. As a result, the supply and reliability concerns used to justify the Gross Reservoir Expansion must be reconsidered.

A statement of need and water demand forecast for a project of this size and scope must be based on sound data, reasonable assumptions, and conservative resource principles to ensure the water will not be wasted and that anticipated impacts to the environment are justified. In this case, the demand forecast used to justify the project is no longer reasonable or relevant because demand has changed. Water customers across the Western United States have successfully implemented effective water efficiency strategies that today have reduced per capita use.

Denver Water has offered a shifting justification for the Gross Reservoir & Dam Expansion project, but no new analysis of water demands, or a revised demand forecast were included in any of their recent filings. The demand projections for Gross Reservoir are derived from Denver Water's 2002 Integrated Water Resources Plan.[18] The Army Corps of Engineers evaluated Denver Water's demand projections in 2004 and again in 2010 and Denver Water's Final Environmental Impact Statement (FEIS) on the project notes that water conservation has been included in Denver Water's projections.[19]

What is not included in Denver Water's FEIS or its application to Boulder County is that fact that over the past ten years, the water demands considered by the Corps and included in Denver Water's analysis and projects have failed to materialize. The Corps based its analysis on the incorrect assumption of a rapid increase in demand, which Denver Water had forecast. Since 2010, Denver Water's total water demand has decreased even as population has grown. The evaluation performed by the Corps in 2004 and 2010 was based on an outdated and highly inaccurate demand forecast. A reevaluation is clearly warranted.

This report provides a detailed review and evaluation of each of Denver Water's "identified four needs" in light of actual water demands and an updated water demand forecast that reflects both population growth and the impacts of water efficiency. The analysis in this report shows that Denver Water's water demand forecast significantly overstates future demand and is no longer a reasonable representation of likely future demand.

When replaced with a reasonable future demand forecast based on current production trends and anticipated growth, Denver Water's four identified needs in its application appear far less urgent. Denver Water's use has become more efficient and the need for expanding this existing reservoir, and all that comes with it for Boulder County, not to mention the Colorado River, no

[17] 8-507.D.7, Requirements Applicable to All Applicants; 8-507.D.7.a, Project Need, from the "Corps ROD (Section 3.0).
[18] Denver Water. 2002. Integrated Water Resources Plan. Figure III-4.
[19] U.S. Army Corps of Engineers Omaha Division (USACE). 2009. Moffat Collection System Project Final Environmental Impact Statement (Final EIS). April 25, 2014.

longer exists. The existing Gross Reservoir and capacity and reliability it already provides along the Denver Water's large integrated system appears sufficient to meet future build-out demand.

Denver Water should update its demand forecast and statement of Project Need to reflect the last 10 years of production on their system and assure Boulder County that there is a need for the reservoir expansion project.

Sincerely,

Peter Mayer, P.E.
Principal

References

Denver Water. 2020. Denver Water's Gross Reservoir Expansion Project. Areas and Activities of State Interest (1041) Permit Application

Denver Water. 2002. Integrated Water Resources Plan.

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Denver Water. 2019. Comprehensive Annual Financial Report For the year ended December 31, 2019 Denver, Colorado

Denver Water. 2018. Comprehensive Annual Financial Report For the year ended December 31, 2019 Denver, Colorado

U.S. Army Corps of Engineers Omaha Division (USACE). 2009. Moffat Collection System Project Final Environmental Impact Statement (Final EIS). April 25, 2014.

U.S. Army Corps of Engineers. Record of Decision. NWO-2002-80762-DEN, Board of Water Commissioners for the City and County of Denver (Denver Water), Moffat Collection System Project. July 6, 2017.

U.S. Army Corps of Engineers. 2003. Scoping Summary – Moffat Collection System Project, p. 3-2. December.

Western Resource Advocates. 2010. Comments on the Moffat Collection System Project Draft Environmental Impact Statement (DEIS) and the associated § 404 Permit Application prepared by the U.S. Army Corps of Engineers (USACE).

From:	Jennifer Stewart
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Gross Reservoir
Date:	Monday, November 9, 2020 1:50:50 PM

Dear Commissioners,

The proposed expansion of Gross Reservoir and all the environmental damage that it will cause make this project a potential disaster.

There is not enough water anywhere to fill an enlarged reservoir, now or in the future.

The disruptions to wild life and local humans will be egregious.

As a resident of the Magnolia community, I am adamantly opposed to this absurd and reckless project.

Jennifer Stewart
1007 Pine Glade Road
Nederland, CO 80466

From:	Jane Manchon
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Asking for refusal of Denver Water''s 1041 Permit
Date:	Monday, November 9, 2020 12:20:43 PM

To Whom It May Concern:

I am writing today to ask that Denver Water's 1041 Permit be refused. I am concerned about the environmental aspects of the propsed expansion and enjoy Gross Reservoir as a serene place to connect to nature leaving the hustle of town behind. I have cited some information below.

Thank you for your consideration.

A concerned citizen,

Jane Manchon

Denver Water's 1041 application is incomplete. Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all the deficiencies below, Boulder County should not consider this application and should return it to Denver Water for clarification and completion.

Specific problems with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. The vast majority of the application simply refers to "plans" that don't yet exist. These plans are required if Denver Water is to comply with the Boulder County Land Use Code. Denver Water needs to state their plans in regard to the following:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan

- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Road Maintenance Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application because these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process, including the Final EIS and Record of Decision, which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
    - The “Purpose and Need” in the EIS is not accurate and must be redone.
    - The “Alternatives” analysis in the EIS is not accurate and must be redone.
    - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
    - The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
    - The full cost of the project was not considered in choosing the

LEDPA.

- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application, Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process, which has numerous errors including:

- Failure to use an adequate alternatives analysis.
- Failure to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

--

Peace and Vitality,
Juniper Jane

Juniper Jane Manchon, LMT
Wellness Professional
Vassar College '11, Fulbright '12

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JuniperMoonHealingArts@gmail.com

Boulder & Denver, CO
(720) 507-8677

From:	bill@billiklerstudio.com
To:	Gross Reservoir SI-20-0003
Subject:	Proposed Gross Reservoir expansion
Date:	Monday, November 9, 2020 12:07:54 PM

Please consider the following comments regarding the proposed expansion of Gross Reservoir by Denver Water:
1) Denver Water's 1041 application is missing various plans that are required to comply with Boulder County Land Use regulations.
2) The application requests a waiver in Section 8-503 that does not comply with Boulder County Land Use Regulations.
3) The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.
4) Boulder County receives the brunt of numerous environmental impacts inherent in this project, including deforestation, noise, dust and constant traffic, but receives none of the benefits.

Thank you for considering my comments on this project, which if implemented, would negatively affect Boulder County residents and environment for years to come.

Bill Ikler   303-258-3858 (cell)
PO Box 873 Nederland, CO 80466
bill@billiklerstudio.com

From:	Megan Eggers Zubaedi
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Reject Denver Water"s 1041 application until complete
Date:	Monday, November 9, 2020 11:31:04 AM

- FROM: Megan Eggers Zubaedi 3335 Darley Avenue Boulder CO 80305
- Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.
-
-
- **Specific issues with the application:**
- **First:** The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.
    - Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

  Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

    - Tree Removal Plan
    - Quarry Operation Plan
    - Pit Development and Reclamation Plan
    - Stormwater Management Plan
    - Erosion Control Reclamation Plan
    - Invasive Plant and Noxious Weed Species Management Plan
    - Fire Management and Response Plan
    - Special Status Plants Relocation Plan
    - Aquatic Invasive Species Monitoring Plan
    - Traffic Management Plan
    - Fugitive Dust Control Plan
    - Road Maintenance Plan
    - Recreation Management Plan
    - Visual Resources Protection Plan

- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
  - The "Purpose and Need" in the EIS is not accurate and must be redone.
  - The "Alternatives" analysis in the EIS is not accurate and must be redone.
  - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
  - The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
  - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2

because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Megan Eggers Zubaedi 3335 Darley Avenue Boulder CO 80305

From:	Jim Drevescraft
To:	Gross Reservoir SI-20-0003
Subject:	Stop Gross Dam Expansion
Date:	Monday, November 9, 2020 11:22:10 AM

I have previously commented about the egregious environmental impact of draining rivers in western Colorado, defoliating Boulder County forested lands by millions of tress, and negatively affecting private property values, all to provide water to a metropolitan area that has other options and is doing little to conserve water usage. These considerations alone should be adequate to deny Denver Water their proposal.

Let us also consider the impact on the residents of western Boulder County (as well as Gilpin and Jefferson residents). There are only a few main routes down from the Nederland/Rollinsville area, including Lefthand Canyon, Boulder Canyon, Coal Creek Canyon, and Golden Gate Canyon. Lefthand and Golden Gate require a long drive to reach the western access points and put Boulder still some distance away. This makes commuting more expensive and adds to pollution from vehicles.

Thus, we are left with Boulder Canyon, which is a very busy roadway and cannot be enlarged, as shown by the seemingly endless repairs being done that make travel more difficult. We are left with Coal Creek Canyon as the alternative.

If thousands of heavy truck trips over years are needed to haul in the dam building supplies and haul out the trees, soil, etc.—all over Highway 72 down Coal Creek Canyon, the result will be gridlock and the effective loss of one of the two preferred routes out of the mountains. This could include emergency escape as well as normal commuting and shopping trips. The trucks will be belching smoke and pollution with negative air quality effects in the area. Recreation from the plains would be cut off, with negative economic impacts on mountain businesses. Traffic accidents with the potential of igniting forest fires would logically be expected to increase with poorly maintained heavy trucks and frustrated car drivers meeting on a two lane road.

To conclude, the Denver Water proposal is an environmental, traffic, economic, pollution, safety, and quality of life disaster for western Boulder, Gilpin, and Jefferson Counties, as well as for the water situation in western Colorado. I will watch with interest if Denver Water is allowed to proceed as stakeholders downriver along the Colorado River prepare their legal responses to what is already a seriously threatened ecosystem.

I respectfully request Boulder County to use every means to stop this project.

Jim Drevescraft
PO Box 266
Nederland, CO 80466-0266
303-642-1588
720-883-7827 (cell)

street address: 759 N. Beaver Rd.

From:	brian whitney
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Please REJECT the Gross Reservoir expansion project
Date:	Monday, November 9, 2020 10:46:18 AM

... for the myriad of reasons myself and others have previously sent in emails.

Brian Whitney
881 Pine Glade Road
Nederland, CO 80466

From:	Ovidio Bermudez, MD
To:	Gross Reservoir SI-20-0003
Subject:	writing in opposition of the Gross Reservoir expansion
Date:	Monday, November 9, 2020 10:41:19 AM

To whom it may concern,
My name is Ovidio Bermudez and I live at 1901 County Road 68J, Nederland, CO 80466. I oppose the expansion of Gross Reservoir for a variety of reasons. Some of these include the damage to Colorado rivers and streams, the impracticality and huge scope of an expansion that does not take into consideration the climate changes taking place, the change in weather patterns (hence the fires), and the impact to the ecology and to the residents of the area. Please do not let this happen.

The best phone number to reach me at should anyone wish to discuss this further is 918.671.7393. The best email address for me is ovidiobermudezmd@yahoo.com

Respectfully,

Ovidio Bermudez

From:	Jane Bunin
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir expansion
Date:	Sunday, November 8, 2020 8:17:02 PM

Dear Boulder County,

Denver Water's 1041 application to expand Gross Reservoir is not complete. It does not address many deficiencies and does not comply with Boulder County Land Use codes.
Denver Water needs to complete the application before Boulder County can consider it.
There are many plans that are not provided.
There are a number of ways in which the application fails to comply with the Boulder Valley Land Use Code.

Thank you for your consideration.

Respectfully,

Jane
Jane Bunin, PhD
4814 W Moorhead Cir
Boulder, CO 80305

From:	Lyn Lowry
To:	Gross Reservoir SI-20-0003
Subject:	Denver Water Application
Date:	Sunday, November 8, 2020 4:24:23 PM

Denver Water's application to the county is incomplete and full of errors. It does have to comply with Section8-308.A.4 of the Land Use Code and it does not bother to provide any of the many plans that affect how it will construct and operate its facility. The environmental statement is inaccurate and much of it is in litigation, and the same goes for the Energy Regulatory amendment. There are numerous other problems and omissions from this application, and unless Denver Water submits a full and accurate proposal, it should not and cannot be considered by the County. Please ship this ridiculous piece of verbosity back to Denver Water and tell them to fix it or forget it.

Thank you,
Lyn Lowry
Longmont

From:	Robert Frey
To:	Gross Reservoir SI-20-0003; Commisioners@bouldercounty.org
Subject:	Denver Water 1041 application
Date:	Sunday, November 8, 2020 4:21:10 PM

. It is my fervent hope that Denver Water's application to expand our nearby Gross Reservoir will be held to the strict scrutiny that such an impactful project requires.
Thank you, Robert Frey, Nederland, CO

Sent from my iPhone

From: heather lazrus
To: Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject: Concerning Gross Reservoir
Date: Sunday, November 8, 2020 12:11:46 PM

Dear Boulder County Commissioners,

Thank you for your continued work to make decisions on Gross Reservoir, within Boulder County, that are in line with the vast majority of your electorate. I am raising a third generation Boulder county resident and am proud to teach him that our local government is accountable to its electorate and upholds justice and environmental protection above commerce and profit. My childhood home is still in my family and is only a few short miles from Gross Reservoir.

Enacting your 1041 authority was an important step. Now, Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

We note several specific issues with the application:

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with Section 8-308.A.4 of the Boulder County Land Use Code.

Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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Pit Development and Reclamation Plan
Stormwater Management Plan
Erosion Control Reclamation Plan
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Special Status Plants Relocation Plan
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Emergency Action Plan
Recreation Adaptive Management Plan for Winiger Ridge
Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

The Corps Record of Decision violates the National Environmental Policy Act:
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The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the

Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

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Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Sincerely,
Heather Lazrus
1707 Ridge Rd
Nederland CO

From:	Ken Bonetti
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir Expansion
Date:	Sunday, November 8, 2020 12:02:53 PM

Dear Boulder County Commissioners and Staff:
I wish to state my strong opposition to County consideration of Denver Water's plan to expand Gross Reservoir due the DW's failure to provide a complete application to the County, it's failure to address numerous important issues detailed below, and the plan's failure to comply with the Boulder Valley Comprehensive Plan and numerous provisions of the Boulder County Land Use Code.

Denver Water's 1041 application is incomplete. Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all the deficiencies below, Boulder County should not consider this application and should return it to Denver Water for clarification and completion.

Denver Water's 1041 application fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. **The vast majority of the application simply refers to "plans" that don't yet exist.** These plans are required if Denver Water is to comply with the Boulder County Land Use Code. Denver Water needs to state their plans in regard to the following:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Road Maintenance Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans

- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County should not consider this application because these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Throughout the application, Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process, which has numerous errors including:

- Failure to use an adequate alternatives analysis.
- Failure to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

The application fails to comply with the Boulder Valley Comprehensive Plan.

Below are several other Boulder County Land Use Code non-compliance items.

- The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.
- The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.
- The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.
- The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

In summary, there is clearly too much wrong with Denver Water's application to be seriously considered by the Boulder County government. The application should be sent back to Denver Water and not considered until the application is complete and all outstanding issues are fully addressed.

Sincerely,

Ken Bonetti

1170 Monroe Dr.

Boulder, CO

From:	Daniel Jacobs
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Resident Response to Denver Water''s 1041 application
Date:	Sunday, November 8, 2020 11:31:55 AM

To whom it may concern,

I am a Boulder resident. I live on Pika Road just off of Flagstaff. I am strongly against Gross Dam Expansion, as well as Denver Water's 1041 Application. Beyond the problem of the utter destruction of the serenity and silence of the area we live for countless years, the application is fraught with issues. Here are just a few:

1. The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code

2. Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:
Tree Removal Plan- Quarry Operation Plan
Pit Development and Reclamation Plan - Stormwater Management Plan - Erosion Control Reclamation Plan - Invasive Plant and Noxious Weed Species Management Plan - Fire Management and Response Plan - Special Status Plants Relocation Plan - Aquatic Invasive Species Monitoring Plan - Traffic Management Plan - Fugitive Dust Control Plan - Road Maintenance Plan - Recreation Management Plan - Visual Resources Protection Plan - Historic Properties Management Plan - South Boulder Creek Channel Stability and Monitoring Plan - Road Management Plan (USFS) - Road Maintenance Plan - Restoration and Revegetation Plans - Special Status Plants Relocation Plan - Reclamation and Revegetation Seed Mixes and Mulch Materials Plan - Emergency Action Plan - Recreation Adaptive Management Plan for Winiger Ridge
Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

3. Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example: The Corps Record of Decision violates the National Environmental Policy Act: The "Purpose and Need" in the EIS is not accurate and must be redone. The "Alternatives" analysis in the EIS is not accurate and must be redone. The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project. The Corps Record of Decision violated the Clean Water Act: The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA). The full cost of the project was not considered in choosing the LEDPA. The Corps Record of Decision violated the Endangered Species Act by failing to

adequately consider and analyze the impacts on the green lineage cutthroat trout.

4 - Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including: Failed to use an adequate alternatives analysis. Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

5 - The application fails to comply with the Boulder Valley Comprehensive Plan.

6 -The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

7 - The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

8 - The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

9 - The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Thank you,
Daniel

From:	Kathleen Saunders
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir
Date:	Sunday, November 8, 2020 11:07:13 AM

Hello again,

It's been a good 2 years? since we went through this process the first time, & not much has changed re: need for specific plans for many issues. What is the hold up?! The public meetings back then made it very clear that most residents DO NOT WANT this Gross Reservoir expansion! & it is not needed!

Research had shown that the current reservoir is very rarely filled nowadays, removal of 300K trees would lead to erosion & loss of wildlife, fishing has already been majorly impacted by river water withdrawals, local homeowners would experience PTSD from all the blasting & construction, roads not equipped for the huge trucks needed etc. +You'd be destroying a major piece of our county to provide Denver more water!

Boulder County needs to pursue its 1041 responsibilities & rights.

Please provide all the necessary information that has been requested to make this extremely important decision.

Sincerely,

Kathleen Saunders-51 year resident
3251 11th Street
Boulder, CO 80304

From:	Carmi Gazit
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	I object to the expansion of gross reservoir
Date:	Sunday, November 8, 2020 10:17:14 AM

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name: carmi gazit
address: 7578 magnolia dr.
NEDERLAND, Colorado 80466
phone: 720-244-1912

Commissioners: Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan
- Aquatic Invasive Species Monitoring Plan
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- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan

Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
    - The "Purpose and Need" in the EIS is not accurate and must be redone.
    - The "Alternatives" analysis in the EIS is not accurate and must be redone.
    - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
    - The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
    - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

From:	Chris Jensen
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Opposition to Denver Water"s 1041 Application
Date:	Sunday, November 8, 2020 10:02:43 AM

I'm writing to express my opposition to Denver Water's 1041 application concerning the expansion of Gross Reservoir. You have the opportunity and the responsibility to prevent this environmentally damaging project from moving forward on the beautiful lands of Boulder County.

It's vital that you hold Denver Water accountable for their incomplete 1041 application. The Boulder Valley Comprehensive Plan and County Land Use Codes were created for important reasons and must be complied with fully, so please do not allow the requested waiver in section 8-503.

Also, we cannot allow an enormous project like this to ignore the REQUIRED detailed and comprehensive plans for critical aspects such as tree removal, erosion control, reclamation and restoration of construction lands, fire management, noxious weed control, traffic management and construction road safety, and more. All of these parts of the proposed construction will have enormous and long-lasting damaging effects on the natural lands of Boulder County, with no benefit to Boulder County residents. Denver Water must be held accountable for complying with every aspect of this application before it is even considered.

In addition, the EIS analysis cited by Denver Water violates important federal environmental laws such as the National Environmental Policy Act, the Clean Water Act, and the Endangered Species Act. Boulder County should be a national leader in upholding these environmental policies and should not succumb to the pressures of a company with its head stuck in outdated, environmentally damaging projects, particularly when achievable conservation solutions exist.

Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion. Even if Denver Water does submit a thorough application at some point in the future, this project will never be of benefit to Boulder County and should be denied.

Thank you,
Christine Jensen
5454 Magnolia Rd Nederland

From:	Alicia Grayson
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Stop Gross Dam Expansion
Date:	Saturday, November 7, 2020 3:38:01 PM

Dear County Commissioners,

I urge you to do everything you can to stop the expansion of Gross Reservoir. It would be a highly destructive project to the environment, animals, humans and trees around the reservoir. There is so much more that can be done with water conservation which would eliminate "the need" for raising the height of the dam. We live in an arid climate and municipalities should do everything possible to support water conservation. This need for serious water conservation is going to increase as we face global warming and increasing drought. It is clear that Denver Water has not fully implemented conservation of the existing water supplies.

Sincerely,
Alicia Grayson
1042 Twin Sisters Rd
Nederland, CO 80466

From: John Campagnoli
To: Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject: Gross Reservoir
Date: Saturday, November 7, 2020 9:46:36 AM

I am a resident of Boulder County. I live less than one mile from the current shoreline of Gross Reservoir. I wish to submit the following comments regarding Denver Water's proposed expansion of the reservoir:

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code.

The application fails to comply with the Boulder Valley Comprehensive Plan.

The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Thank you for your consideration of this issue.
- John Campagnoli

From:	Art Hirsch
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir 1041 Comments
Date:	Saturday, November 7, 2020 9:22:04 AM
Attachments:	Gross Reservoir 1041 Comments.pdf

Please see the attached comments

Art Hirsch
Advocate
303-786-9111 home
720-351-8945 cell

"Unless someone like you cares a whole awful lot,
Nothing is going to get better. It's not."

"*I speak for the trees, for the trees have no tongues*."
― Dr. Seuss, The Lorax

November 11, 2020

Subject: Gross Reservoir 1041 Application Comments
grossreservoir@bouldercounty.org
commissioners@bouldercounty.org

Boulder County Commissioners

According to the Boulder County Sustainability Program, *as a county government, we take these priorities to heart and work daily to further the county's long-term vision for well-planned urban development and the preservation of our rural and mountain communities and landscapes. As commissioners, we have always placed a high priority on making sustainability a guiding value for the county. This commitment to environmental sustainability is echoed by our community: a majority of Boulder County residents truly value sustainability as a lifestyle and as a way for us to preserve Boulder County's natural resources.*

The Boulder County Sustainability Mission Statement is to ensure that Boulder County's operations, programs, services, regulations, and decision-making processes reflect our deep commitment to environmental, social, and economic sustainability, while building strong local partnerships to help the broader community and region become healthier and more sustainable.

The Gross Dam is not a sustainable project and goes against the Boulder County Sustainability philosophy and mission statement. Therefore, the Gross Dam Project should not be allowed to proceed, and the application should not be approved by Boulder County.

The following are my comments to the Denver Water 1041 Application:

Denver Water has failed to develop and implement a real water conservation program in their service area. A very large percentage of water is used for lawn irrigation of non-native blue grass lawn. Other southwestern cities such as Las Vegas have developed aggressive water conservation programs using xeriscapes. The Front Range population including the Denver Water service area needs to live within their available natural resources without sacrificing those natural resources for future generations.

It feels like Denver Water threw this document together using their EIS document. The document references many exhibits that are not well discussed nor easily found. Denver Water fails to make the case why this project is necessary and why Boulder County should approve this application. They have not made the case as to how this improves Boulder County's quality of life.

It is not clear why did Denver Water waited so long to submit this application to the County knowing the FERC deadline is soon approaching thus requiring the public to push back for additional time to review a 300+ page document. It seems like Denver Water was trying to be strategically difficult to the Boulder County citizens and County Commission.

As mentioned in the TEG comments to the Army Corps of Engineers and mentioned in past County Commissioner meetings, the hydraulic data used to justify this project is outdated and does not take climate change properly into account. This failure helps justify the Gross Dam expansion without adequately protecting the associate stream systems and if the dam is really needed. It is possible that after a 7-year construction project the dam will never be filled to capacity due to drought/climate change conditions that have been ignored by Denver Water.

The bottom release of water from the dam will affect aquatic life due to extreme cold temperatures that are below CDPHE water quality standards. Aquatic life will be impacted within our County.

It appears that a new SH 72 intersection and road improvement will be needed for the project to support high volume truck traffic. It appears that the citizens of Boulder County and the state will pay for these improvements instead of Denver Water.

Page 24 Table 4 provides inadequate detail on schedule dates and actions; critical milestones are not well identified and detailed for the interested public reader which is insulting for those citizens being impacted by this project.

Denver Water's 1041 application is incomplete (see below). Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

It is my understanding that CDOT has not performed their own internal environmental impact study regarding proposed changes to SH 72 to support this project. There is no mention about this CDOT study. In fact, CDOT has not been forthcoming with information about this environmental impact study and cancelled a CDOT, Denver Water and TEG meeting in an effort to discuss this impact study.

Denver Water fails to discuss how County officials and professionals will be allowed to visit and audit numerous environmental actions to reduce and mitigate impacts. There needs to be consistent coordination and evaluation meetings with Boulder County being an equal partner for environmental management. An environmental kick off meeting with all locals, state and federal representatives needs to happen and is not discussed in this application. This lack of environmental coordination is a critical deficiency.

Specific Deficiencies

Denver Water continues to have an arrogate attitude. The 1041 application requests a "waiver" in Section 8-503 stating that it does not have to comply with Section 8-308.A.4 of the Boulder County Land Use Code.

> Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that **don't yet exist** which are required to exist and to be complete (and should require public review and comment) to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County should not consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
- The "Purpose and Need" in the EIS is not accurate and must be redone.
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- The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
- The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
- The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

The document needs to be a stand-alone document that follows Boulder County requirements; this application just throws information against the wall to see what will stick with the Commissioners.

Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.
- The application fails to comply with the Boulder Valley Comprehensive Plan.
- The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.
- The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage. The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

It is surprising that the application discusses truck traffic on Flagstaff Road, which is ridiculous. The road is used extensively by hikers and bicyclists within the City of Boulder Parks system; truck traffic would cause a significant safety risk to citizens and tourists. The sharp turns along the road would significantly imped uphill and downhill traffic and safety.

There are many other comments I could provide the Commissioners; however, I think you all understand the main issues and problems with this Gross Reservoir Project. The project is not sustainable for Boulder County terms of environmental, financial, and quality of life aspects.

Thanks for your review

Art Hirsch
5766 Flagstaff Road
Boulder Colorado

From:	Shivani Pechtl
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Reject Denver Water"s 1041 application until complete
Date:	Saturday, November 7, 2020 8:46:53 AM

Shivani Pechtl, LAc. 728 Fourmile Canyon Dr. Boulder, CO

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Road Management Plan (USFS)
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- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

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    - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

with love and grace~
Shivani Pechtl, LAc.
Mindfulness, Somatic Practitioner & Holistic Coach
805.679.1117
www.shivanipechtl.com

From:	Lucien Heart
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Cc:	Anne Heart
Subject:	Denver Water needs to submit more info to complete it"s 1041 application for expansion of Gross Resevoir
Date:	Saturday, November 7, 2020 8:14:40 AM

Hello,

First of all, thank you for your service to the county, and for considering this difficult topic.

To sum up, **please consider Denver Water's 1041 application incomplete. I suggest you reject it until such time that Denver Water can adequately complete and resubmit.** I'll summarize some points below...

It seems absurd that Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” That's completely ridiculous.

Denver Water's applications fails to provide the needed plans for...

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan
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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Denver Water also defers to conclusions in the Army Corps’ Environmental Impact Statement process which has many errors.

And here are some more points:

Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:
    - Failed to use an adequate alternatives analysis.
    - Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.
- The application fails to comply with the Boulder Valley Comprehensive Plan.
- The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.
- The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.
- The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.
- The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Thank you so much for ensuring that Denver Water's application is complete, fair, and responsible

Warmly,

Lucien and Anne Heart

1289 Pine Glade Rd.
Nederland, CO 80466

303-907-7249
SaveBoulderCounty.org

From:	Catherine Ebeling
To:	Gross Reservoir SI-20-0003
Date:	Saturday, November 7, 2020 7:44:51 AM

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.
Specific issues with the application:
First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code.
Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.
Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:
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Recreation Adaptive Management Plan for Winiger Ridge
Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.
Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

The Corps Record of Decision violates the National Environmental Policy Act:The “Purpose and Need” in the EIS is not accurate and must be redone.
The “Alternatives” analysis in the EIS is not accurate and must be redone.
The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
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The full cost of the project was not considered in choosing the LEDPA.
The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.
Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including: Failed to use an adequate alternatives analysis.
Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.
Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.
Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.
Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.
Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.
Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

A Votre Sante!
Catherine

Catherine Ebeling, MSN-PHN, RN
The Health & Hormone Fix
I help women reset their hormones &
feel younger, stronger, sexier.

CatEbeling.com
TheNutritionWatchdog.com
SimpleSmartNutrition, LLC

Author
The Diabetes Fix
Healthy Living Made Easy
The Flat Belly Kitchen
The Top 101 Anti-Aging Superfoods
The Fat Burning Kitchen

Ph: 314 369 6400

“Success is not final, failure is not fatal: it is the courage to continue that counts.”--Winston Churchill

From:	Lueb Popoff
To:	Gross Reservoir SI-20-0003
Subject:	Gross reservoir Expansion
Date:	Friday, November 6, 2020 10:47:25 PM

Dear Boulder County,
This must be stopped! I can't believe Denver Water board has not addressed these issues below in their application.
Regards,Lueb

1 - The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code. Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including: - Tree Removal Plan - Quarry Operation Plan - Pit Development and Reclamation Plan - Stormwater Management Plan - Erosion Control Reclamation Plan - Invasive Plant and Noxious Weed Species Management Plan - Fire Management and Response Plan - Special Status Plants Relocation Plan - Aquatic Invasive Species Monitoring Plan - Traffic Management Plan - Fugitive Dust Control Plan - Road Maintenance Plan - Recreation Management Plan - Visual Resources Protection Plan - Historic Properties Management Plan - South Boulder Creek Channel Stability and Monitoring Plan - Road Management Plan (USFS) - Road Maintenance Plan - Restoration and Revegetation Plans - Special Status Plants Relocation Plan - Reclamation and Revegetation Seed Mixes and Mulch Materials Plan - Emergency Action Plan - Recreation Adaptive Management Plan for Winiger Ridge Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code. 3 - Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example: The Corps Record of Decision violates the National Environmental Policy Act: The "Purpose and Need" in the EIS is not accurate and must be redone. The "Alternatives" analysis in the EIS is not accurate and must be redone. The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project. The Corps Record of Decision violated the Clean Water Act: The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA). The full cost of the project was not considered in choosing the LEDPA. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout. 4 - Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including: Failed to use an adequate alternatives analysis. Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek. 5 - The application

fails to comply with the Boulder Valley Comprehensive Plan. 6 -The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies. 7 - The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage. 8 - The application violates Boulder County Land Use Code Section 8-511.J.1 because the

From:	annie forester
To:	Gross Reservoir SI-20-0003
Subject:	Stop Gross Reservoir expansion
Date:	Friday, November 6, 2020 10:42:56 PM

Dear Boulder County,
This must be stopped! I can't believe Denver Water board has not addressed these issues below in their application.
Regards,Annie

1 - The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with Section 8-308.A.4 of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code. Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including: - Tree Removal Plan - Quarry Operation Plan - Pit Development and Reclamation Plan - Stormwater Management Plan - Erosion Control Reclamation Plan - Invasive Plant and Noxious Weed Species Management Plan - Fire Management and Response Plan - Special Status Plants Relocation Plan - Aquatic Invasive Species Monitoring Plan - Traffic Management Plan - Fugitive Dust Control Plan - Road Maintenance Plan - Recreation Management Plan - Visual Resources Protection Plan - Historic Properties Management Plan - South Boulder Creek Channel Stability and Monitoring Plan - Road Management Plan (USFS) - Road Maintenance Plan - Restoration and Revegetation Plans - Special Status Plants Relocation Plan - Reclamation and Revegetation Seed Mixes and Mulch Materials Plan - Emergency Action Plan - Recreation Adaptive Management Plan for Winiger Ridge Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code. 3 - Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example: The Corps Record of Decision violates the National Environmental Policy Act: The "Purpose and Need" in the EIS is not accurate and must be redone. The "Alternatives" analysis in the EIS is not accurate and must be redone. The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project. The Corps Record of Decision violated the Clean Water Act: The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA). The full cost of the project was not considered in choosing the LEDPA. The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout. 4 - Throughout

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From:	Sandra Garcia
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Refuse 1041 Permit Application
Date:	Friday, November 6, 2020 9:07:02 PM

Boulder County Officials:

As a constituent and long-time resident of Boulder County, I implore you to refuse Denver Water's 1041 application. The application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County **mu**st not consider this application!

1- The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.
2- Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

The Corps Record of Decision violates the National Environmental Policy Act:The "Purpose and Need" in the EIS is not accurate and must be redone.

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The full cost of the project was not considered in choosing the LEDPA.

The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

3- Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including: Failed to use an adequate alternatives analysis.

Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

4- The application completely fails to provide numerous “plans” about how they will construct the expansion and operate the expanded facility. The vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

Restoration and Revegetation Plans

Special Status Plants Relocation Plan

Tree Removal Plan

Quarry Operation Plan

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Visual Resources Protection Plan

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South Boulder Creek Channel Stability and Monitoring Plan

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Road Maintenance Plan

Reclamation and Revegetation Seed Mixes and Mulch Materials Plan

Emergency Action Plan

The list goes on and on with violations. It would be completely irresponsible to consider this.

Boulder County is home to our families and the animals and environment that make it special. Please do not allow this plan to go through without proper regulations!

Thank you,
Sandra Garcia

From:	David / Donna
To:	Gross Reservoir SI-20-0003
Subject:	Denver Water"s Gross Reservoir Expansion Project
Date:	Friday, November 6, 2020 8:19:09 PM

Denver Water's 1041 application is incomplete. Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all the deficiencies below, Boulder County should not consider this application and should return it to Denver Water for clarification and completion. Specific problems with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code. Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. The vast majority of the application simply refers to "plans" that don't yet exist. These plans are required if Denver Water is to comply with the Boulder County Land Use Code. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process, including the Final EIS and Record of Decision, which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
- The Corps Record of Decision violated the Clean Water Act:
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application, Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process, which has numerous errors including:

- Failure to use an adequate alternatives analysis.
- Failure to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

David Rogers
Boulder, CO

From:	timothy Tipton
To:	Gross Reservoir SI-20-0003
Subject:	GROSS Reservoir
Date:	Friday, November 6, 2020 3:36:27 PM

ISSUES—

Specific issues with the application:

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.
Feeling exhausted by the election?

Make a difference locally by acting NOW!
We need EVERYONE to send in comments - the important focus right now is the NUMBER and PASSION of commenters. YOU can help right now with a simple E-mail!

Sent from my iPhone

From:	Tory Capron
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir Expansion Comments
Date:	Friday, November 6, 2020 2:51:54 PM

To Whom It May Concern,

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues

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Boulder County cannot consider this application when these plans have not been completed.

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Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

From:	Anne Pfeffer
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners; Boulder County Board of Commissioners
Subject:	Gross Dam Expansion
Date:	Friday, November 6, 2020 1:39:51 PM

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First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

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- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

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Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

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Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Sincerely,

Anne O Pfeffer

142 Range Rd, Nederland, CO 80466

From:	Paul McCarthy
To:	Gross Reservoir SI-20-0003
Cc:	Teagen Blakey; Magnolia Road
Subject:	Gross Reservoir
Date:	Friday, November 6, 2020 12:38:27 PM

Hello Boulder County Commissioners,
I am writing in opposition to Denver Water's poorly researched plan to expand Gross Reservoir.
1) The initial plan was formed over 20 years ago, much has changed since, climate changes, global warming, changing weather patterns we have all seen. During this time, because of climate change there is less water. We are in a drought and have been for a long time, the forests are dry, fires are all around.
2) Where does the water come from? After years of drought, population expansion, and water diversion to other areas and States, there is a water shortage. The Fraser River has experienced these shortages as well as the Colorado River. We have been in the midst of huge wildfires largely because the area is so dry. Dry meaning no rain, less snow, and drought.
There is a water shortage that has not been taken into account by Denver Water. They have not chosen to update their resources, there simply is not enough water to advance this project.
3) Access to the project is sketchy at best. The roads that are planned to be used will not support the types of trucks and equipment needed for a project of this size. A semi truck cannot safely access Gross Res. From Rt 72, nor CR 68, Lazy Z,as the gravel roads to the reservoir have sharp curves, too sharp to be navigated in one lane by these trucks, too steep to be navigated safely, empty or full, especially full.
4) Residents. This area is occupied by residents, both along the Rt72 route as well as Lazy Z, and CR 68. The noise, dust, vibration will have a lasting effect on the people that live here, destroying the quality of life we have all sought by living here. The other residents, Wildlife, will be affected as well, permanently, as they will not stay, feed, or occupy an area so distressed my this heavy activity. The wildlife are an important part of life here, Mule Deer, Moose, Elk, Mountain Lion, Bobcats, ground inhabitants and abundant bird life, including migratory bird species. All of this will be altered if not completely destroyed by the heavy handed efforts of Denver Water.
5) Denver Water seeks to bypass the permitting required by bulldozing over any objection, in a typical Denver Water way. I implore you to stand firm in your resolve to make Denver Water comply, or better yet, go away.
6) Safety. The traffic, equipment, noise, dust will affect us all we use these roads not only to travel, but walk, walk our dogs, ride our horses, walk with friends and neighbors, exercise, ride our bikes....all of this will stop as it will not be safe with the amount of heavy traffic this project will create. We will lose an important part of our lives, an important part of why we live here.
7) I implore you to look at this carefully and to not be swayed by the arguments and false reasoning presented by Denver Water. There is no good reason to expand Gross Reservoir, there isn't water to use for this expanded monstrosity, there isn't a plan to safely proceed, there is no accounting for the many people and wildlife that live here. In short, I don't think Denver Water cares about this at all. We do.
8) Denver Water is in violation of many of Boulder County's codes. They should be held to the code standards like any one of us. This project is slated to take seven years...not acceptable to those of us that live here. Conservation efforts in the face of water shortages and climate change have eliminated the need to expand this reservoir, above ground storage of water with rising earth temperatures, leads to an excess amount of evaporation, not accounted for by Denver Water. A better approach would be to store water underground, no evaporation.
Please review this application with the residents in mind, the shortage of water, climate change, rising temperatures, and quality of life.
I appreciate your efforts to do the right thing.
Thank you,

Paul McCarthy
24 Wildflower Ct
Nederland, CO
80466
720.203.3731

From:	Liesl J
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir Expansion Project 1041 Application
Date:	Friday, November 6, 2020 12:30:36 PM

Hello,

I am a resident of Nederland, Colorado, and I am writing to express my concerns about Denver Water's 1041 application regarding the Gross Reservoir Expansion Project.

At this time, Denver Water's 1041 application is incomplete. Until Denver Water is has submitted an application that complies with the Boulder County Land Use Code and addresses all its deficiencies, Boulder County must not consider this application or deem it complete, and it must be returned to Denver Water until everything has been clarified and completed.

My first concern is that Denver Water claims it doesn't have to comply with Section 8-308.A.4 by claiming that it is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect on this point, and therefore must comply with this section of the Land Use Code.

Secondly, Denver Water's 1041 application doesn't provide "plans" about how they will construct the expansion and operate the expanded facility. The vast majority of the application refers to plans that don't yet exist, but which are required to exist and to be complete in order to comply with the Boulder County Land Use Code, including plans on: tree removal, erosion control reclamation, fire management and response, invasive plant and aquatic species monitoring, road maintenance, and restoration and revegetation plans. These plans will have a massive impact on the communities, neighbourhoods, and residents near Gross Reservoir, and residents deserve to know the impact this project will have, and the steps that will be taken to mitigate and respond to the issues a project like this would inevitably create. Boulder County cannot consider this application when these plans have not been completed. Without them, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Thirdly, throughout the application Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process, including the Final EIS and Record of Decision which have numbers errors and are currently under dispute and litigation in federal district court in Denver. The Corps Record of Decision violates the National Environmental Policy Act - the "Purpose and Need" and "Alternatives" analysis in the EIS are not accurate and must be redone, and the EIS did not analyse cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project. The Corps Record of Decision also violated the Clean Water Act in failing to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA), and the full cost of the project was not considered in choosing the LEDPA. The Corps Record of Decision also violated the Endangered species Act by failing to adequately consider and analyse the impacts on the green lineage cutthroat trout.

Throughout the application Denver Water also defers to analysis and conclusions in the Federal Regulatory Commission's license amendment process which has numerous errors, including failing to use an adequate alternatives analysis, and failing to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and also downstream in South Boulder Creek.

The application also violates the Boulder County Land Use Code in sections: 8-511.C.2.a (requires conservation and the full utilisation of existing municipal water supplies), 8-511.I.2 (not compatible with resource preservation and does not minimise resource damage), 8-511.J.1 (the project is a danger to public health or safety or to property), and 8-511.J.2 (requires compatibility with existing traffic volumes).

Given this extensive incompletion of the application, and the numerous violations of the Boulder County land Use

Code, and use of Impact Statements that are known to have significant errors and are currently under litigation, Boulder County must not consider this application complete and it must be returned to Denver Water until this issues are clarified and completed.

Best,

Liesl Jensen

From:	Virginia Winter
To:	Boulder County Board of Commissioners
Cc:	Gross Reservoir SI-20-0003
Subject:	V. L. Winter Comments on Denver Water"s 1041 Application to Boulder County
Date:	Friday, November 6, 2020 11:52:05 AM

Dear Boulder County Commissioners:

Thank you for allowing for public comment on this important and complex matter before us and by representative government before YOU. I am a registered voter, property owner and resident citizen of Boulder County and my name and address can be found below under my comments.

To be transparent, I am opposed to the expansion of Gross Reservoir, however am *presently* concerned that Denver Water's 1041 application is incomplete!

Until Denver Water submits an application that complies with the Boulder County Land Use Code and addresses all the deficiencies - of which there are many - Boulder County should not consider this application and should return it to Denver Water for clarification and completion.

One initial problem with the 1041 application as far as I understand it is that ‘it’ requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code. Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

I am particular concerned that throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

And that Denver Water’s 1041 application fails to comply with the Boulder Valley Comprehensive Plan.

There is SO much missing in their application; its taking experts in our scientific and legal community to help average citizens raise proper objections - this in of itself is a travesty!

Don’t let us go down the path of complacency to the swagger of Denver Water - Don’t allow us to degrade our County's ‘ecosystem’. Once undone we can not recover. The expansion of Gross Reservoir ‘would’ have a significantly more lasting detrimental impact than natural wildfire and floods on these lands. Please exercise wise stewardship.

Sincerely,
Virginia L. Winter
2930 Bluff Street #312

Boulder, CO. 80301

p: 303 355 4924

From:	GREGORY RIDDAEL
To:	Gross Reservoir SI-20-0003
Subject:	1041 application - Gross Dam Expansion Project
Date:	Friday, November 6, 2020 10:52:45 AM

I just want to reiterate the info below. Thank you, Gregory Riddael

---------- Original Message ----------
From: GREGORY RIDDAEL <sunburst33@comcast.net>
To: "commissioners@bouldercounty.org" <commissioners@bouldercounty.org>
Date: 11/06/2020 10:11 AM
Subject: 1041 application - Gross Dam Expansion Project

Dear Boulder County Commissioners,

As I have been following this issue over the last couple of years I have been appalled at the number of times Denver Water has tried to circumvent the requirements which have been established for the protection of the citizens of Boulder County and the surrounding communities to push through a project that has already been established as having not only questionable value, but a very real element of long term harm to a large number of humans, wildlife and the land.

The tactics that have been employed by Denver Water in their attempt "to get their way" have been legal, but also immoral, unconscionable, abhorrent, and inexcusable. In short, they have been the actions that have been associated with well-defined traits of the psychopathic mind.

I urge you to carefully consider if their application truly meets all of the requirements of complying with the 1041 Land Use Review application and process, and to fully and completely hold Denver Water to these requirements.

Thank you very much. Sincerely,

Gregory Riddael

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with **Section 8-308.A.4** of the Boulder County Land

Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

<u>Second:</u> Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
- Road Maintenance Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

<u>Third:</u> Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
  - The “Purpose and Need” in the EIS is not accurate and must be redone.
  - The “Alternatives” analysis in the EIS is not accurate and must be redone.
  - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
  - The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
  - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

From:	kc waters guarascio
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Date:	Friday, November 6, 2020 10:48:06 AM

Hello....First, I hope this letter finds you well in these wild times.

I am writing to urge you to vote against the Denver Water Gross Reservoir Expansion Application as it is incomplete and requires further clarification and completion.

THANK YOU for your care and concern and voice in the name of all peoples and land, Osha Waters

Specific issues with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
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- Invasive Plant and Noxious Weed Species Management Plan
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- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
    - The “Purpose and Need” in the EIS is not accurate and must be redone.
    - The “Alternatives” analysis in the EIS is not accurate and must be redone.
    - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
    - The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
    - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

From:	Shivani Pechtl
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Comments--Gross Reservoir Expansion Project
Date:	Friday, November 6, 2020 10:45:18 AM

Please attend to these facts—

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
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- Road Maintenance Plan
- Recreation Management Plan
- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)

- Road Maintenance Plan
- Restoration and Revegetation Plans
- Special Status Plants Relocation Plan
- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
    - The “Purpose and Need” in the EIS is not accurate and must be redone.
    - The “Alternatives” analysis in the EIS is not accurate and must be redone.
    - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
    - The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
    - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

with love and grace~
Shivani Pechtl, LAc
Mindfulness, Somatic Practitioner & Holistic Coach
805.679.1117
www.shivanipechtl.com

From: dakota soifer
To: Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject: STOP Gross Dam Expansion!!
Date: Friday, November 6, 2020 9:07:46 AM

Hi Commissioners,

As a resident of the Lakeshore Community adjacent to the Gross Dam, I have been following Denver Water's planed expansion closely.
As a resident with a young family who views a clean and safe environment for generations to come with the utmost importance I urge you to ensure that Denerv Water goes through the correct and complete process for an expansion.

Thank you,

Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Here is a list of specific issues with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
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- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
  - The “Purpose and Need” in the EIS is not accurate and must be redone.
  - The “Alternatives” analysis in the EIS is not accurate and must be redone.
  - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
  - The Corps failed to choose the “Least Environmentally Damaging Practicable Alternative” (LEDPA).
  - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

--
Dakota Soifer,
Cafe Aion: Chef/Owner
The Hill Boulder: Chair
Boulder, CO

From:	mjfetyko@gmail.com
To:	Gross Reservoir SI-20-0003
Subject:	Gross Dam
Date:	Friday, November 6, 2020 7:52:11 AM

The Denver Water Board is not following the Boulder County regulations and hence should not go forward. As a resident of Coal Creek Canyon this would be detrimental to the quality of life in the canyon.

Please reconsider a different solution. Perhaps growth management.

Mike

Mike Fetyko
mike@dtconstruct.com
720-244-4089

From:	Mary Marsden
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Cc:	Mary Marsden
Subject:	Re: Denver Water"s 1041 Application
Date:	Friday, November 6, 2020 12:13:10 AM

Dear Boulder County Commissioners, November 5, 2020

As a citizen of Boulder County I'm writing to urge you to return Denver Water's 1041 application as it is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

One of several of the areas that are in error and/or incomplete include:
Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
  - The "Purpose and Need" in the EIS is not accurate and must be redone.
  - The "Alternatives" analysis in the EIS is not accurate and must be redone.
  - **The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.**
- The Corps Record of Decision violated the Clean Water Act:
  - The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
  - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

To focus in a bit more, overuse of water, aridification of the West due to climate collapse, growing populations and insatiable demand throughout the Basin and by entities outside of the Basin such as Denver Water are putting extreme pressure on the Colorado River.

The majority of communities up and down the semi-arid Front Range are utterly dependent upon the diverted waters of the upper Colorado River and tributaries. We already divert an immense quantity of water. From an ecological perspective it's obscene. We are under pressure of natural law that charges us to draw and store *less water*, not more. To use less, conserve. The upper and lower basin states and communities of the CO Compact are all feeling the same pressure. They are watching. Nervous and twitchy about their allotment of water. So much is at risk. The dry forests and land, the birds, the waters and all the wild ones are watching.

It's not only an error in the application, but it's unconscionable that the EIS did not analyze *cumulative impacts, climate change*, or a risk of triggering a Compact Call on the Colorado River associated with, or caused by, the project.

I ask you to refuse to consider this application or deem it complete, and return it to Denver Water for clarification and completion.

Thank you for your leadership in serving not only the people of Boulder County but the land and environmental systems that we are all a part of and utterly dependent upon.

Mary E Marsden
180 S 36th Street
Boulder, CO 80305
303-898-3252
mary@beearthnow.com

Mary Marsden
303-898-3252

Boulder, CO
BeEarthNow.com
Payment for sessions and programs via https://www.paypal.me/MaryMarsden

...If we surrender
to earth's intelligence
we could rise up rooted, like trees...

-Rainer Maria Rilke
"Book of Hours"

From:	majrussell@msn.com
To:	Gross Reservoir SI-20-0003
Subject:	Stop Gross Reservoir Expansion
Date:	Thursday, November 5, 2020 7:42:45 PM

Stop the destruction!!

Leading statement to the Boulder County Commissioners: Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a “waiver” in Section 8-503 stating that it doesn’t have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a “site selection and construction of major facilities of a public utility.” Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water’s 1041 application completely fails to provide numerous “plans” about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to “plans” that don’t yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

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- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section "8-511 Standards for Approval of a Permit Application" of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps' Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
  - The "Purpose and Need" in the EIS is not accurate and must be redone.
  - The "Alternatives" analysis in the EIS is not accurate and must be redone.
  - The EIS did not analyze cumulative impacts, climate change, or a Compact Call on the Colorado River associated with, or caused by, the project.
- The Corps Record of Decision violated the Clean Water Act:
  - The Corps failed to choose the "Least Environmentally Damaging Practicable Alternative" (LEDPA).
  - The full cost of the project was not considered in choosing the LEDPA.
- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission's license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

<u>Seventh:</u> The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

<u>Eighth:</u> The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

<u>Ninth:</u> The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes

—

Sent from my T-Mobile 4G LTE device

From:	adam
To:	Gross Reservoir SI-20-0003
Subject:	Opposing Gross Reservoir Expansion
Date:	Thursday, November 5, 2020 7:34:19 PM

To Whom it may concern, I just wanted to make sure to get a comment in during the comment period on this project. As a fisherman of South Boulder creek and a lover of the recreation areas and public access we have around Gross Res, I am vehemently opposed to the expansion of the dam and to the plans Denver Water has for flooding our recreation around the reservoir.

In addition, Denver Water has shown through their actions in recent years on water flow levels, that they do not want to protect and help trout populations, and there's no doubt that turning all of South Boulder creek into a pipeline, and allowing them to remove or alter the flood plain and riparian zones along this river which nature and our coloradoans rely on, would be irresponsible.

Data from Denver water's own site shows they don't need this water to meet the demand of people moving to the area, so why do they really need it? They also said they needed it to help fight fires, but they didn't use that water to put out the fires in and around the area.

Denver water has shown they are bad neighbors, profiting off of Boulder County and there is not enough balance. The money they have promised will surely not be enough to repair the damage let alone replace public access and recreation... They should not imagine that we want to allow them to pump water from the previous Colorado system over here either. They won't even be able to fill the reservoir up.

Finally, the loss of public fishing access to that portion of the headwaters of south boulder creek would be devastating to fishermen and women of all ages. That is one of a VERY SMALL amount of land publicly accessible for trout fishing, and it is some of the finest trout fishing we have anywhere around Denver! To lose this would hurt me and thousands of local fisherman, women and kids deeply.

The canyon is not accessible easily and having to only fish the remote upper section would be extremely difficult or impossible for many, and we can bet Denver Water won't pay to extend trail systems up the entire canyon, it would be logistically challenging and require huge investment of capital

There is so much available climate science and so many logical reasons to look at that support denying this project to Denver water, I ask that you please consider all of them.

Its crazy enough that a private company owns and profits off of our state resource of water here, and that we send it to other states, but to let them have MORE of it would be crazy to many of us.

Thank you so much for your time and have a wonderful evening,

Adam Klagsbrun
Hunter Creek

4656 White Rock Circle Apt 3
Boulder, CO 80301

From:	David William Maclennan
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir: issues with Denver Water"s 1041 application
Date:	Thursday, November 5, 2020 5:32:36 PM

I am a city of Boulder resident, a Colorado River boater and a frequent user of the nearby forest and open space lands that surround Boulder.

I am concerned that Denver Water's 1041 application in relation to the Gross Reservoir expansion is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

- Denver Water claims that the application is not a "site selection and construction of major facilities of a public utility." Denver Water is incorrect, and therefore must comply with this section of the Land Use Code.

Second: Denver Water's 1041 application completely fails to provide numerous "plans" about how they will construct the expansion and operate the expanded facility. In fact, the vast majority of the application simply refers to "plans" that don't yet exist which are required to exist and to be complete to comply with the Boulder County Land Use Code, including:

- Tree Removal Plan
- Quarry Operation Plan
- Pit Development and Reclamation Plan
- Stormwater Management Plan
- Erosion Control Reclamation Plan
- Invasive Plant and Noxious Weed Species Management Plan
- Fire Management and Response Plan
- Special Status Plants Relocation Plan
- Aquatic Invasive Species Monitoring Plan
- Traffic Management Plan
- Fugitive Dust Control Plan
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- Visual Resources Protection Plan
- Historic Properties Management Plan
- South Boulder Creek Channel Stability and Monitoring Plan
- Road Management Plan (USFS)
- Road Maintenance Plan
- Restoration and Revegetation Plans
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- Reclamation and Revegetation Seed Mixes and Mulch Materials Plan
- Emergency Action Plan
- Recreation Adaptive Management Plan for Winiger Ridge

Boulder County cannot consider this application when these plans have not been completed. Without the plans, the application does not comply with Section “8-511 Standards for Approval of a Permit Application” of the Land Use Code.

Third: Throughout the application, Denver Water defers to analysis and conclusions in the Army Corps’ Environmental Impact Statement process including the Final EIS and Record of Decision which have numerous errors and are under dispute and litigation in federal district court in Denver. For example:

- The Corps Record of Decision violates the National Environmental Policy Act:
  - The “Purpose and Need” in the EIS is not accurate and must be redone.
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- The Corps Record of Decision violated the Endangered Species Act by failing to adequately consider and analyze the impacts on the green lineage cutthroat trout.

Fourth: Throughout the application Denver Water defers to analysis and conclusions in the Federal Energy Regulatory Commission’s license amendment process which has numerous errors including:

- Failed to use an adequate alternatives analysis.
- Failed to adequately consider impacts to aquatic biology and water quality in Gross Reservoir and downstream in South Boulder Creek.

Fifth: The application fails to comply with the Boulder Valley Comprehensive Plan.

Sixth: The application violates Boulder County Land Use Code Section 8-511.C.2.a, which requires the conservation and the full utilization of existing municipal water supplies.

Seventh: The application violates Boulder County Land Use Code 8-511.I.2 because it is not compatible with resource preservation and does not minimize resource damage.

Eighth: The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

Ninth: The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

From:	Fred Peck
To:	Gross Reservoir SI-20-0003
Subject:	Gross reservoir expansion
Date:	Thursday, November 5, 2020 4:26:45 PM

Hi there

I am writing to express my opposition to the proposed Gross Reservoir expansion by Denver Water. I do not believe that Denver Water has done enough to achieve enough conservation on the part of its customers. The lawn watering alone is way beyond needed usage levels. I am urging you to vote against any expansion of Gross Reservoir.

Fred Peck

From:	Gregory Pais, ND, DHANP
To:	Gross Reservoir SI-20-0003
Subject:	Comments on Denver Water Gross Resevoir Expansion
Date:	Thursday, November 5, 2020 3:45:47 PM

Hi,
Here are my comments regarding the proposed expansion of Gross Reservoir by Denver Water (I live just a few miles from Gross)

Leading statement to the Boulder County Commissioners: Denver Water's 1041 application is incomplete. Until such time as an application is submitted that complies with the Boulder County Land Use Code and addresses all deficiencies, Boulder County must not consider this application or deem it complete, and must return it to Denver Water for clarification and completion.

Specific issues with the application:

First: The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

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Sincerely
Dr. Pais

Gregory Pais, ND, DHANP
570-974-9294

gpaisnd@mric.net
www.facebook.com/NaturalDoc
twitter.com/gpaisnd

From:	Katie Knapp
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Concerns about Gross Reservoir Expansion
Date:	Thursday, November 5, 2020 2:34:42 PM

Thank you for the opportunity to comment on the 1041 application for the Gross reservoir expansion. I think the application should be denied due to these 2 issues:

1. **Threat to downstream residents:** Has the consequence of failure been evaluated and communicated? Have the downstream residents been notified? Although dam failures are uncommon - they do happen and the consequences in this case would be absolutely devastating. One thing we should all agree on is that the future is unpredictable. The decisions we make today impact how we are able to handle the uncertainties of the future. Risks from natural and man-made disasters can be mitigated through good planning. Please help mitigate this risk by not increasing the threat. As Gilbert White said, "Floods are acts of God; but flood losses are largely acts of man."

2. **Environmental impacts:** Water diversions are depleting our natural rivers and destroying riverine ecosystems. The Colorado River basin is over-depleted and cannot support additional development of the Denver metro area. Colorado should be working with other western states to find solutions to this issue and not moving forward with projects that exacerbate the situation.

I appreciate the opportunity to comment and I thank you for consideration of the above in evaluating the proposal.

Sincerely,

Katie Knapp

From:	Ben Weber
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Comments on Denver Water"s 1041 Application
Date:	Thursday, November 5, 2020 1:52:40 PM

Hi there,

I am a Boulder County resident and I have specific issues with this lengthly application.

The 1041 application requests a "waiver" in Section 8-503 stating that it doesn't have to comply with **Section 8-308.A.4** of the Boulder County Land Use Code.

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The application violates Boulder County Land Use Code Section 8-511.J.1 because the project is a danger to public health or safety or to property.

The application violates Boulder County Land Use Code Section 8-511.J.2, which requires compatibility with existing traffic volumes.

Thank you,
Ben Weber
855 33rd St
Boulder, CO
80303

From:	Anita Wilks
To:	Gross Reservoir SI-20-0003
Subject:	Docket # SI-20-003:Gross Reservoir & Dam Expansion
Date:	Monday, November 2, 2020 12:03:52 PM

In opposition of Denver Water expanding Gross Dam and Reservoir here are a few of the blatant issues listed in Boulder County's Land Use Code -1041 Permit Application.

8-202 Purposes and Intent: #4 Conserve soil, water, forest resources, and Environmental Resources; Denver Water intends to produce concrete for a larger dam and this process will use many acre feet of water, disrupt soil at the dam site and along shorelines, and degrade environmental resources. The cement industry is one of the two largest producers of carbon dioxide (CO_2), creating up to 8% of worldwide man-made emissions of this gas, of which 50% is from the chemical process and 40% from burning fuel. The CO_2 produced for the manufacture of structural concrete (using ~14% cement) is estimated at 410 kg/m3 (~180 kg/tonne @ density of 2.3 g/cm3) (reduced to 290 kg/m3 with 30% fly ash replacement of cement). The CO_2 emission from the concrete production is directly proportional to the cement content used in the concrete mix; 900 kg of CO_2 are emitted for the fabrication of every ton of cement, accounting for 88% of the emissions associated with the average concrete mix. Cement manufacture contributes greenhouse gases both directly through the production of carbon dioxide when calcium carbonate is thermally decomposed, producing lime and carbon dioxide, and also through the use of energy, particularly from the combustion of fossil fuels.

#5 Protect the beauty of the landscape; as noted here producing concrete, making new roads, removal of thousands of mature trees along the shorelines all will destroy the beauty of the existing landscape. #7 Regulate projects that would otherwise cause excessive noise, water and air pollution and would degrade and threaten the existing environmental quality of the County. This proposed project would be the largest and most damaging construction project in Boulder County history so it only goes to prove all of these issues would be adversely affected, not only during the construction, but also for decades to come. #10 Require that municipal and industrial water projects shall emphasize the most efficient use of water, including, to the extent permissible under existing law, the recycling and reuse of water. Certainly cement production's massive use and waste of water is in direct conflict with this requirement. Also conservation of water in nearby metro and urban development has a long way to go to stop using Kentucky Bluegrass Sod and mature tree landscaping surrounding all new subdivisions and even commercial building development.

#13 Ensure site selection of arterial highways and interchanges and collector highways occurs so that community traffic needs are met, desirable community patterns are not disrupted, and direct conflict with adopted local government, regional, and state master plans avoided. ALL proposed road construction to accommodate this proposed project will disrupt and are in direct conflict with the two-lane State Highway that is the only main road in and out of this community being impacted. Other arterial roads such as Gross Dam Road, Lazy Z (Magnolia), Tunnel 19 and Miramonte are unimproved and mostly single lane dirt roads that residents must use daily as their only options so Denver Water's mitigation plans are not conducive to this regulation of the 1041 permit either.

#15, 16 & 17 also pose regulation conflicts from this applicant no matter what design is chosen to mitigate usage. #19 Protect the public health, safety, welfare and the environment. This particular regulation under 8-202 of the 1041 cannot be achieved by this applicant for reasons too numerous to list, but here are but a few: Health of residents in Coal Creek Canyon and upon the Northshore of the existing Reservoir are sure to suffer air and noise pollution at levels the applicant cannot control and enough to create disease related conditions to not only humans but also the wildlife we hold dear and live here to enjoy. Our very welfare is conditional upon the peace and quiet and natural environment of woodland and forest. Years of construction of the proposed levels will no doubt cause chronic health issues for the residents and also be the reason wildlife leaves to never return. Even the Final Environmental Impact Study listed long-term destruction to aquatic life in a new reservoir of the magnitude that no fish would ever live in its waters again, including stocked fish from upper South Boulder Creek. At true risk again are the Winiger Ridge Elk Herds and their calving grounds. Boulder County has done extensive study and here is listed those findings by the county itself.

From Assets.bouldercounty.org Common Name: Winiger Ridge Location (General): West of Gross Res., south of Flagstaff Rd., north of the Boulder County border, east of Magnolia Dr. Size (acres): 3,460 acres Life Zones: Lower

Montane, Upper Montane. Rationale and Background: The Winiger Ridge ECA is an area, which has received significant conservation and restoration. Winiger Ridge has long been known as an important wintering area and movement corridor for elk. The area contains two important Foothill Riparian areas along South Boulder Creek (above Gross Reservoir) and Winiger Gulch, both recognized as highly bio diverse regions. The US Forest Service has been working to control unauthorized motorized recreation. Due to significant efforts by private citizens and the US Forest Service, the area between Winiger Gulch and South Boulder Creek serves as an effective core preserve. Naturalness: Roadless area in South Boulder Creek Canyon west of Gross Reservoir. Winiger Ridge is closed to motorized vehicles during winter. Quality and Uniqueness: Elk critical winter range and winter concentration area. Old-growth Ponderosa pine/Douglas fir. Important east/west large-mammal movement corridor. Restoration Potential: All efforts to limit or reverse habitat fragmentation should be pursued.

Common Name: Hawkin Gulch/Walker Ranch/Upper Eldorado Canyon Location (General): West of Eldorado Springs, south of Boulder Canyon Dr., north of the Boulder County border, east of Gross Res. Size (acres): 10,185 acres Life Zones: Lower Montane, Upper Montane. Rationale and Background: This ECA acts to conserve critical resources in the south-central part of the County. This area contains a multitude of significant plants, plant communities, and wildlife and provides an important mountain to prairie link. Walker Ranch is at the center of the Hawkin Gulch/Walker Ranch/Upper Eldorado Canyon ECA and occurs within an area, which initially acquired as Boulder County Open Space. It provides important winter range for elk. The western portion of this ECA, centered on Twin Sisters, is a critical migration corridor for elk and other large mammals; this site became an important habitat connector due to the creation of Gross Reservoir in the 1950s, which is an effective barrier to east-west movement of animals in this part of the county. The canyons and gulches between Flagstaff Drive, Boulder Canyon and Magnolia Road, including Hawkin, Keystone, and Calhoun Gulches, are wild and rugged areas. Upper Eldorado Canyon is another wild and rugged region. Ownership is mixed between Eldorado Canyon State Park and Boulder County Open Space. Running through this area is South Boulder Creek. It is one of the few roadless foothill creeks in the county, the others being Fourmile Canyon Creek and the North St. Vrain Creek. All of the others, including Boulder Creek, Fourmile Creek (the Fourmile Creek that heads to Sunset), Lefthand Creek, James Creek, and South St. Vrain Creek, are impacted by adjacent roads. Naturalness: Several roadless areas in Hawkin Gulch, south half of Walker Ranch, South Draw, Johnson Gulch, Keystone Gulch and Twin Sisters Peak. Quality and Uniqueness: Elk critical winter range and winter concentration area. Old-growth ponderosa pine/Douglas fir. Area is considered good habitat for Mountain Lion and Black Bear due to foothills habitat, size and high degree of naturalness. Important east/west and north/south large-mammal movement corridor. Restoration Potential: All efforts to limit or reverse habitat fragmentation should be pursued.

Common Name: Magnolia Location (General): East of Nederland, bounded on the north by Boulder Canyon, west of Winiger Ridge and Gross Res. Size (acres): 7,126 acres Life Zones: Lower Montane, Upper Montane. Rationale and Background: The Magnolia ECA is an area, which has received significant conservation and restoration by Boulder County Parks and Open Space, the USFS, and others. It is relatively unfragmented by roads and development. Additionally, this area has long been known as an important movement corridor for elk. This area is also included in the planning area for the Magnolia Environmental Preservation Plan, which seeks to protect the -unique rural qualities, unfragmented habitats, wildlife, scenic and recreational resources+ of the Magnolia area. Naturalness: Relatively undeveloped and unfragmented area east of Barker Res. Much of the area is public land (Boulder County Parks and Open Space, USFS, State of Colorado). Quality and Uniqueness: High quality plant sites and plant diversity. Old-growth Ponderosa pine/Douglas fir. Important east/west large-mammal movement corridor. Restoration Potential: All efforts to limit or reverse habitat fragmentation should be pursued.

8-206 of the 1041 states: Review or approval of a project by a federal or state agency does not obviate, and will not substitute for, the need to obtain a permit for that project under these regulations. i.e. The FERC and Army Corps Records of Decision to permit Denver Water's expansion plans are not to override Boulder County's Commissioners representing county residents and interests to protect our county. Neither of those permits have the necessary guidelines to prevent the destruction of our Environment surrounding the existing Dam and Reservoir.

8-210 Definitions - B, 2 c. Will not cause significant adverse environmental impacts on the unincorporated County; and d. Will not overburden the infrastructure of the unincorporated County in areas surrounding the proposed service area. THIS particular regulation of the 1041 addresses again the massive road construction that Denver Water proposes to do to allow their proposed project to be possible. Since this bedroom community has only the one paved

State Highway in and out of their homes this is an impossible mitigation by the applicant and any suggestions otherwise are untrue and risk the safety and continued unhindered movements of the existing population.

8-401 Specific Water and Sewage Treatment Activities Requiring Permits; H. Systems, extensions, or projects partly or entirely on land which is designated in accordance with the Boulder County Comprehensive Plan as any of one of the following: (which applies to) critical wildlife habitat. Winiger Ridge Elk calving grounds.

8-507 D.2.d A detailed inventory of total commitments already made for current water in terms of taps or other appropriate measurements. THIS application requirement has always been a point of contention between Denver Water and their opposition, not to mention Denver Water recipients and their Denver customers i.e. their own bylaws and water numbers. Initially Denver Water had sights on a Two Folks Dam in southern Colorado and once that project was rejected and killed by the E.P.A. years ago the water board set its sights on expanding the existing Gross Reservoir. Over the course of many scoping meetings, public hearings and botched IGA's the utility is now using a heretofore and untrue reason - storage stability for growing populations in the Denver Metro and surrounding suburbs they sell water to.

They have never been able to prove a need for the mere 8% an expanded Gross Reservoir might provide to the entire Denver Water system. Real conservation, reuse and recycling of water would allow their existing water system the stability and growth potential they say the expansion of Gross Reservoir might to support growing populations moving to the metropolitan area not Boulder County.

Too much time and effort has been spent or is further warranted to stop this destructive massive proposed project and now that FERC's permit to amend the hydroelectric has put strict timelines on Denver Water's efforts to push this application process through, it is apparent not all the regulations including public comments can be done to satisfy the Federal Energy Regulatory Commission's time standards. In letters between FERC and Denver Water it most concerning that FERC does have grave issues with who the applicant (Denver Water) will hire for any Dam Construction. The only possible outcome is for Denver Water to be denied Boulder County's 1041 permit and to go on their way by doing the environmentally responsible things they should already be doing - REAL CONSERVATION.

Anita Wilks -Boulder County Resident at 76 Pine Road, Coal Creek Canyon, Golden, CO 80403 303.642.0362

From:	Zach Pesch
To:	Gross Reservoir SI-20-0003
Subject:	No Expansion
Date:	Wednesday, October 28, 2020 6:20:05 PM

Hi,

I would like to say that I do not support the expansion of Gross reservoir.

Cheers,

Zach

From:	Heather Tsai
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Official Commentary on the Gross Reservoir & Dam Expansion Project
Date:	Tuesday, October 27, 2020 2:17:00 PM

Dear Boulder County,

The purpose of the Gross Dam Expansion project is to create a more convenient and abundant source of water for the people of Denver. I support the purpose of the project but consider the project itself to be entirely contradictory to that goal. Most post-industrial systems have created enormous short-term convenience for day-to-day human lives. Unfortunately, these short-term conveniences are inconvenient to all society in the long-run because they are not aligned with the inherently sustainable and zero-waste model of the cycles of nature. Every aspect of the Gross Dam Reservoir expansion involves disrupting the harmony of nature and will leave a lasting scar on the ecosystem. What we need is a redesign of proper natural water sourcing, transportation and disposal -- waste is naturally quite good fertilizer and exceptionally poor tap water. We do not need a repeat of new-old ways of the ***colonialist mindset*** of conquering nature and the people who live by it.

Sincerely,
Heather Tien Tsai

From: Ann Getches
To: Gross Reservoir SI-20-0003
Subject: Dam(n) comments
Date: Sunday, October 25, 2020 11:22:52 AM

TO: Boulder County Commissioners

FROM: Ann Marks Getches, 386 Forsythe Road, Nederland, CO 80466

RE: Gross Reservoir Expansion

DATE: October, 22, 2020

These questions need to be answered:

1. Cement manufacturing is the 3rd largest industrial source of pollution contributing to sulfur dioxide, nitrogen dioxide and carbon monoxide. What impact does cement production for the dam have on Boulder's air quality. If you were to assign a dollar amount to this degradation what would it be?
2. While there is no legal standing for flora and fauna, nevertheless it is worth something. Can you assign an amount for the loss? Thousands of trees will be cut. Does that have an impact on sequestration of carbon dioxide?
3. Have you made sure the folks on Lazy Z want to have "permanent" improvements made to their road? Not everyone wants Magnolia (or parts thereof) paved.
4. Will there be a helipad? Helicopters and trucks are noisy. What is the cost of the sound pollution and how does Denver Water plan on mitigation? We already suffer excess noise from Denver International Airport.
5. What is in it for Boulder County other than pain, suffering, noise and pollution? Is there compensation for that?
6. If there isn't enough water to fill the dam, how can construction be justified? Colorado River water has already been designated.
7. What if Boulder County agreed to help with costs of underground storage facilities in exchange for some water in case of emergencies (fire contamination of our water) or extreme drought? The non-specific costs (pollutions, etc.) that will fall on Boulder County and don't appear to be part of Denver Water's compensation are huge. The City of Boulder purchased open space in Jefferson County; Wouldn't it be similar for the County to invest with Denver Water in 21st Century technology to save us from unwanted effects to our air, land, flora and fauna. Aquafer storage is expensive but perhaps less harmful to the environment.
8.

An old Spanish proverb goes, God said "Take what you want and pay for it." While Denver Water has agreed to pay for construction costs and dubious benefits, how will it pay for noise and air pollution and habitat destruction? Some things are actually priceless.

From:	Dr. Bea
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir Expansion
Date:	Friday, October 23, 2020 5:56:58 PM

I beg of you, please do not let the proposed expansion of Gross Reservoir proceed any further!

It's such an expensive, ridiculous proposal that has nothing to do with Boulder County and its residents. We who live happily and quietly up here near Gross Reservoir are quaking in our boots thinking of the noise, the trucks, the kicked up dust, and general mayhem that this construction would cost us. It will not benefit us - the residents, hundreds of us - in any way not to mention our property values. The destruction of the wildlife habitat shouldn't be ignored either.

I have lived up here for 20 years on a lovely 4 acre parcel of land on Aspen Meadows . I am retired now and would like to live out my remaining years in peace and quiet. Thank you.

Dr. Bea Knight-Johnson
570 Aspen Meadows Rd.
Nederland, Co 80466

Sent from my iPad

From:	Judy Bohn
To:	Gross Reservoir SI-20-0003
Subject:	Stop Gross Reservoir expansion
Date:	Friday, October 23, 2020 10:00:45 AM

I've been thinking for months that it would be such a shame for the Gross Reservoir expansion to go through because of the impact on the habitat for wildlife. The thought of the clearcutting of more trees along the front range saddens me. But it felt like a trivial reason for opposing the expansion.

Now we're seeing hundreds of thousands of acres of wildlife habitat going up in flames, and the additional acres of habitat that would be destroyed on purpose seem less trivial.

Please stop the Gross Reservoir expansion.

Thank you
Judy Bohn
3784 Moffit Court
Boulder, CO 80304

From:	Richard Reynolds
To:	Gross Reservoir SI-20-0003
Subject:	Comments on Gross Res expansion
Date:	Thursday, October 22, 2020 10:35:36 AM
Attachments:	RReynolds to BoulderCo Oct20_20_DWMoffat comments.docx

Boulder County Planning and Permitting Department and other agencies:

As an earth scientist, I have examined a few aspects of the Moffat Collection System Project in the Final EIS by U.S., Army Corps of Engineers https://www.nwo.usace.army.mil/Missions/Regulatory-Program/Colorado/EIS-Moffat/ prepared by Denver Water. The following comments pertain to sections on Geology and geological hazards (ES.7.6 and 3.5.1.1) and to Air Quality (ES.6.11 and 3.13.0, 3.13.1, 3.13.2).

In these sections, fundamental omissions and incompleteness of analyses suggest that County decision-makers and fellow County residents are being left in the dark about issues that could affect our health, safety, and well-being. On top of these shortcomings, the EIS documents are replete with wishful thinking and contain contradictions of observations and statements bearing ultimately on the safety of County residents.

Please see the attached 7-p.-illustrated WORD document for detailed comments.

Thank you,
Richard Reynolds
4331 Eldorado Springs Dr., Boulder 80303

October 19, 2020

Boulder County agencies, elected officials, and advisory-board members:

As an earth scientist, I have examined a few aspects of the Moffat Collection System Project in the Final EIS by U.S., Army Corps of Engineers https://www.nwo.usace.army.mil/Missions/Regulatory-Program/Colorado/EIS-Moffat/ prepared by Denver Water. The following comments pertain to sections on Geology and geological hazards (ES.7.6 and 3.5.1.1) and to Air Quality (ES.6.11 and 3.13.0, 3.13.1, 3.13.2).

In these sections, fundamental omissions and incompleteness of analyses suggest that County decision-makers and fellow County residents are being left in the dark about issues that could affect our health, safety, and well-being. On top of these shortcomings, the EIS documents are replete with wishful thinking and contain contradictions of observations and statements bearing ultimately on the safety of County residents.

At the very least, failure of the EIS to address certain health and safety issues leads to uncertainty that can generate anxiety -- a health issue by itself.

Below are comments following the headings provided in the EIS documents.

"Geology and geologic impacts"

There are hazards associated with expansion of the dam related to adding water that will increase lake level by 124 ft. These hazards have been obliquely addressed, or not at all, in the EIS.

For example, the EIS makes passing reference to slope failure without adequately considering the range of implications. One possibility is slope failure resulting in landslide and large rock fall into the reservoir. If such slope failure encompassed a large volume and occurred in an instant, a large wave would be inevitably produced. Such waves in lakes and reservoirs are termed "tsunamis" in scientific literature (Strupler et al., 2020 on tsunami potential in lakes). Depending on water level, a large wave could overtop the dam. Such an event could endanger people and structures downstream.

A scenario for slope failure is lubrication of joint (crack) and fracture faces in bedrock by increases in hydraulic pressure with higher lake level. Simultaneously or alternatively, injection of lake water could cause a higher pore pressure in weathered material (clay and breccia, for example) between joints and fractures that could reduce the effective normal strength and hence the shear resistance, both of which stabilize bedrock blocks.

Although it would be difficult to ascribe quantitatively (with probability) a risk to these scenarios, nobody can reasonably deny the possibility of such an outcome. But the writers of the EIS do, making the following hopeful guess: "…it is anticipated that a landslide would not contain sufficient volume to create a wave that could overtop the dam…" (Chapter 5, p. 203). Hence, we are left with uncertainty.

However, recently developed methodology exists to estimate tsunami risk in lakes (see Strupler et al., 2020). If such methodology can be applied to Gross Reservoir, the County may be able to decide, before dam expansion, whether tsunami risks are acceptable.

In sum, I'm astonished that the EIS acknowledges the possibilities of slope failure while disregarding its inevitable consequence, should a large slope fail in an instant.

An extreme consequence is illustrated by the Vajont Dam and reservoir catastrophe in northern Italy in 1963 that wiped out villages and killed about 2,500 people (https://blogs.agu.org/landslideblog/2008/12/11/the-vaiont-vajont-landslide-of-1963).

We will not see anything close to the Vajont event in the case of Gross Reservoir. It's highly curious, however, that even a less severe possibility is discounted especially when the EIS acknowledges the possibility of slope failure. Although somewhat technical, quotations from the report itself serve to illustrate my point:

ES.7.6: "The expansion of Gross Reservoir….may slightly increase the potential for reservoir-induced seismicity. [the reservoir site] may be susceptible to potentially unstable slopes and reservoir rim instability as a result of erosion, seepage, wave action, and water level fluctuations".

3.5.1.1: Geologic Structures
"Geologic structures at Gross Reservoir include faults, shears, joints, veins, and dikes. Faults and shears typically consist of a zone of fractured rock, often intensely fractured, that surrounds one or more clayey to breccia-filled gouge zones. The rock mass at Gross Reservoir also contains numerous smaller faults and shears ….

"The rock is also jointed, with variable orientations, but typically with two nearly vertical joint sets and one low angle joint set. *Thus, the rock mass has a blocky appearance due to the three dimensional interconnected jointing that allows the rock to part into blocks of rock* [my italics] {fig. 1}.

"Areas consisting of massive rock outcrops often also contain exfoliation joints that form parallel to the surface of the outcrop and extend a few feet to tens of feet into the rock mass. *Exfoliation weathering produces large tabular blocks of rock that separate from the rock mass and may slide off steeper slopes*." [my italics]

Figure 1.

Geologic Hazards
"Geologic hazards at Gross Reservoir include erosion and rock fall potential. The rim of Gross Reservoir consists of *weathered granodiorite* that, with the overlying colluvium, soils, and rock fragments, is prone to erosion. Within the reservoir area, *rock fall potential is present at numerous granodiorite outcrops located along and above the rim of the reservoir. The nearly vertical cliffs (300 to 400 feet high) and loose material at the dam site create rock fall potential due to ice-wedging, blasting, sliding, etc*." [my italics] {fig. 2}.

So, the rock has lots of weaknesses, and large bodies of the bedrock on steep slopes are vulnerable to slope failure. If such failure were to occur quickly, a tsunami would be the result.

There is a glaring contradiction in EIS Chapter 3 describing the "bedrock". The bedrock is very old (Precambrian) "granodiorite" (similar to granite). In an introductory sentence, the granodiorite is described as "hard and strong".

The document goes on in more detail: "….there are areas of highly weathered and decomposed granodiorite. Locally, the decomposed granodiorite extends tens of feet into the bedrock and is typically weathered to greater depths along joints and shears. Numerous corestones (a portion of the rock mass that remains unweathered) form in the decomposed granodiorite because rock located between joints and shears does not weather as rapidly as the surrounding … granodiorite. The result is large, rounded, and relatively unweathered blocks of granodiorite or corestones surrounded by the soil-like decomposed granodiorite. In some areas the decomposed rock has been eroded and carried away, leaving behind surfaces covered by large boulders or corestones."

So, the bedrock is not at all consistently "hard". Large areas consist of heavily decomposed rock {figs. 2, 3}.

How large could such a slope-failure event be? Considering only the corestones that appear to be vulnerable to sliding into the reservoir, how big are they? From ground observation and in

Google Earth, the locations and sizes of the corestones are obvious. They appear to range in size on the order of cars, trucks, small buildings, perhaps even small warehouses {figs. 2, 3, 4}..

In addition to sizes of bedrock blocks, slope steepness is an important factor to assess tsunami risk—both topography above water line and bathymetry below. Slopes now above water vary in steepness but are consistently steep toward the west end. Examination of topographic maps before construction of the current dam would elucidate steepness of the subaqueous slopes.

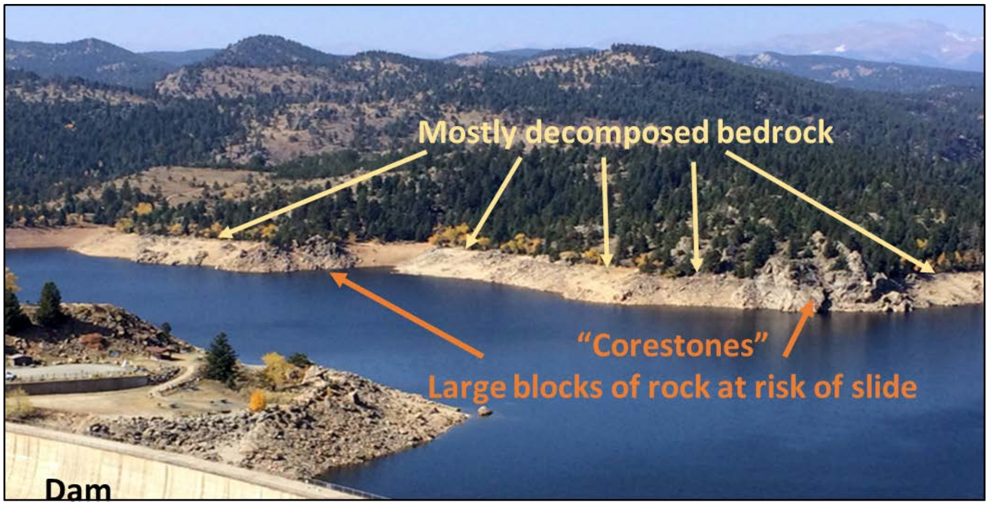

Figure 2.

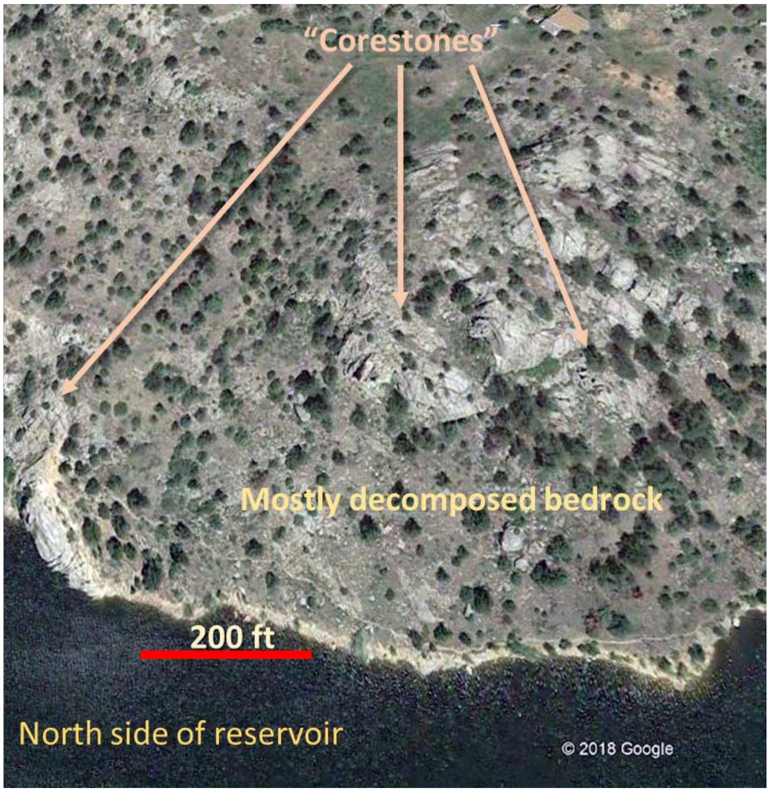

Figure 3. From Google Earth. Map (vertical) view.

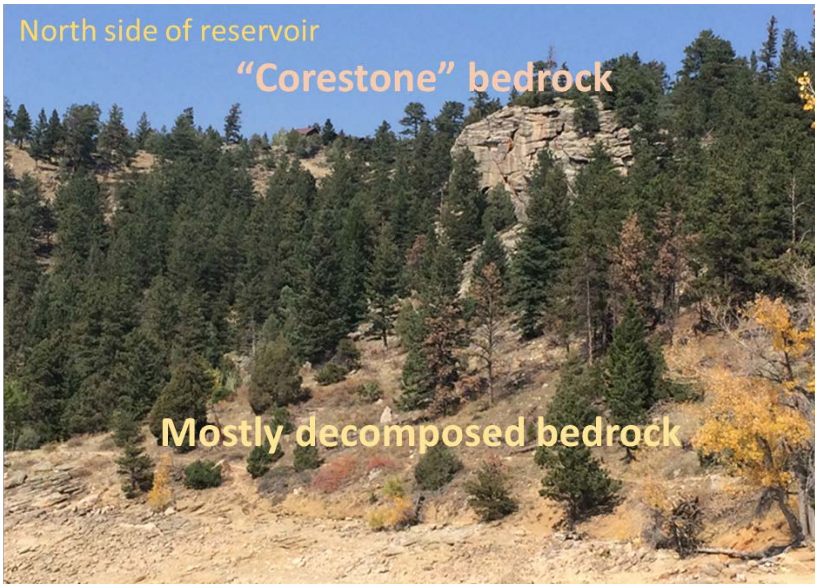

Figure 4.

As another critical issue, I am deeply concerned about the planned location for expansion of the SW arm of the dam. The area of expansion for the SW arm is a surface of deep weathering, known as the Eocene Erosion Surface, which covers much of the foothills in the Front Range {fig. 5}. The deep weathering extends perhaps as deeply as 80 feet, and it could be more (Dethier and Lazarus, 2006). Such weathered bedrock is potentially very weak with respect to holding up the concrete mass of a dam. Furthermore, one should evaluate how water might work its way through such decomposed material. In technical terms, what are the porosity, permeability, and transmissivity -- the rate at which groundwater flows horizontally through an aquifer -- of the weathered material considering also its fractures and joints? Would such groundwater flow undermine the dam structure?

Figure 5. Google Earth image.

I'm not comforted by any of this, considering also the statement in the EIS that:
"Potential issues … ***would be*** *addressed through geotechnical and seismic studies in the design and construction phases … A dam safety analysis* ***would be*** *conducted for any new dam or modification to an existing dam, and designs* ***would be*** *reviewed by Federal and State agencies"* Chapter 5, p,. 204 (my italics and bold). The EIS further states that mitigation and monitoring of hazards are "described in Section 5.5.7" (Chapter 4, p. 407). Section 5.5.7 does not meaningfully address the concerns outlined herein.

These boilerplate statements couldn't be any more vague, meaningless, and disconcerting. So, permission to proceed is sought before assessing hazards in a meaningful way? I realize that this is the way many projects are done (I've seen that before!), but it shouldn't be that way today in our County.

Finally, I want to address **Air Quality (ES.6.11 and Sections 3.13.0, 3.13.1, 3.13.2).**
The air-quality assessments completely miss the points about the potential health effects of airborne particulate matter on people, especially those close to the reservoir as well as those living near dirt haul roads. Sure, the project won't likely affect regional air quality bearing on health of people far from the site, nor will it degrade visibility in Class I viewsheds. But what matters are the particulates --in their sizes, amounts, and compositions -- that are actually respired, regardless of what and where monitoring for particulates is done in the counties of the Denver Metro Area far away from the construction zones. Completely lacking is a meaningful analysis of possible exposure to nearby residents, and thus these residents have every reason for concern and anxiety. The EIS refers to minimal requirements stipulated by EPA. The EIS does not address the real-world conditions to be faced by residents.

As a related matter, EPA has set various standards for certain very small particle sizes (PM10 and PM2.5) and rightly so, as indicated in the EIS. (PM10 refers to particles less than 10-micrometers in aerodynamic diameter; PM2.5 similarly for 2.5 micrometers. A typical human hair has a diameter of about 80 micrometers.) But at the personal level, having these standards does not guarantee healthy air, despite EPA's best efforts. Referring to all airborne dust particles (atmospheric "dust" considered generally to be PM63 -- Total Suspended Particulates), strong epidemiological evidence exists in peer-reviewed scientific literature for severe health impacts caused by TSP (references below).

The analysis of particulate matter in the EIS is mostly boilerplate and amateurish, at best. There are valid reasons to dismiss that analysis as irrelevant and to consider what might actually affect County residents near the construction and transportation areas.

Thank you for your consideration. I would be pleased to discuss these matters further.
The opinions above are my own and do not represent those of any organization or institution.

Sincerely,

Richard Reynolds, Ph.D., University of Colorado, 1975
Adjunct Research Professor, Dept. of Earth Sciences, University of Minnesota, Minneapolis
Senior Scientist, Emeritus, for a federal earth-science agency with 52-years experience in earth-science research.
reynolds331@comcast.net
4331 Eldorado Springs Dr., Boulder, 80303

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From:	Ray Clopton
To:	Gross Reservoir SI-20-0003
Subject:	Gross Dam Expansion
Date:	Tuesday, October 20, 2020 2:05:31 PM

Dear Boulder County Community Planning & Permitting Department,

I believe the Gross Dam Expansion is an unnecessary project that will cause grave environmental devastation and relies on outdated data.

I strongly encourage Boulder County Community Planning & Permitting Department members to deny Denver Water's request to expand Gross Dam. Not only will Boulder County resident receive NO benefit from this expansion, the project will cause irreparable harm to Boulder County residents as well. Over a period of at least 5 years, residents will experience dramatically increased traffic through narrow mountain roads and neighborhoods, environmental damage, noise pollution, potential for toxic contamination of natural resources, safety hazards, and reduced property values.

Please, on behalf of Boulder County citizens, vote to deny the Gross Dam expansion project.

Sincerely,

Ray Clopton
711 Tunnel 19 Rd
Golden, CO 80403

Thanks,

Ray

--

Ray Clopton

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From:	Janet Justice-Waddington
To:	Gross Reservoir SI-20-0003
Subject:	80 % for agriculture
Date:	Monday, October 19, 2020 2:22:07 PM

Please keep in mind that 80% of water usage from Gross Dam goes to agriculture - not residential use.

And, no longer is Buy and Dry necessary - the Colorado Legislature passed a bill allowing ATMs (Alternate Transfer Mechanisms). Denver Water would be allowed to lease water rights from a farmer willing to let land go fallow, or plant a less water dependent crop.

Long ago, 2003 (?) Denver Water said they needed to double Gross Dam capacity or build a dam at Leyden. So much has changed. Not one more drop should be taken from the Colorado River.

Thank you for listening.

Sincerely,

Jan Waddington (born and raised in Boulder, now a 94 yr. old resident of Coal Creek Canyon)

From:	John Shortridge
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir Expansion
Date:	Monday, October 19, 2020 12:43:23 PM

Hello,

I'm writing to express my dismay at the current decision to expand Gross Reservoir and the impact it will have in the surrounding area. I live on County Road 68, and have been at this residence
since 2002. Before that I lived in Gilpin County on South Beaver Creek Road. I've been in this area since 1981.

I have witnessed the rapid growth in Boulder County and surrounding areas with sadness. Our quality of life disappears with each new subdivision and development. Every new home, condo, or apartment
provides 2-3 automobiles or more. It is quite evident traveling around Boulder and the general metro area. The traffic to Nederland and mountain trails and regions have exploded as well.

The reservoir expansion guarantees even more traffic and impact on our environment. Denver needs to get their water elsewhere. Perhaps like proper family planning, they should have considered infrastructure
needs before development. Or perhaps this is that planning for more development. Either way, I object to the impact this construction will have on the area. We don't need it. Enough is enough.

I just hope that Bolder Community Planning & Permitting isn't so greedy that they approve this expansion. I'm concerned that greed is the motivator for much of the continued development Boulder
County has seen in the last 12 or so years. It is possible to say NO.

I appeal to your "better angels" to say NO to this request for expanding Gross Reservoir. I appeal to maintain what we currently have and get on the road to NO to continued development and expansion.

I'm not someone who just wants to keep things the same like the "good ol' days". I just object to this rapid development that is taking us down the road to looking like Southern California with all
of the associated issues and problems they have as a result of unbridled development. We need to hold onto our quality of life which is slipping away with this type of growth.

Thanks for your consideration.

John Shortridge

PO Box 619
Pinecliffe, Co. 80471
303.449.4414

****
John Shortridge
jshortri@rmi.net

Raise your glass to the hard working people
Lets drink to the uncounted heads
Lets think of the wandering millions
Who need leaders but get gamblers instead
-Jagger / Richards

****

From:	Steve Spry
To:	Gross Reservoir SI-20-0003
Subject:	No thanks
Date:	Monday, October 19, 2020 11:31:28 AM

I write to voice opposition to the Gross reservoir expansion project for all the reasons we've heard many times in opposition.

Thanks,

Steve Spry
199 Broken Fence Rd.
Boulder, CO 80302
303-447-2627

From:	Annie Gaddy
To:	Gross Reservoir SI-20-0003
Subject:	PLEASE PREVENT THE GROSS RESERVOIR EXPANSION
Date:	Saturday, October 17, 2020 1:28:30 PM

Everything I know, every article I have read and every bit of research I have done causes me to write to
beg for a vote AGAINST this expansion.
PLEASE do not allow Denver Water to face its agenda on Boulder County.
There are huge negative impacts from this project.
Boulder County residents (human, flora, fauna and animal) should have a say in this matter.
Please hear us.
Sincerely,
Annie Gaddy
Lafayette

From:	Adam Auerbach
To:	Gross Reservoir SI-20-0003
Subject:	Comment
Date:	Friday, October 16, 2020 7:02:37 PM

I am opposed to the expansion.

Thank You,
Adam Auerbach

From:	T Thomas
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Dam Expansion
Date:	Friday, October 16, 2020 9:07:34 AM

Commissioners,

Please take the appropriate amount of time to explore and examine the potential impact of the Gross Dam expansion project. The impact it will have on our environment and community is massive and deserves close scrutiny. Rushing through the examination of documents and proposals can only lead to errors. So please deny Denver Water's request to expedite the process.

Thank you for your time and consideration.

William N. Thomas

From: Marilyn Whittaker
To: Gross Reservoir SI-20-0003
Subject: expansion
Date: Thursday, October 15, 2020 7:49:05 PM

I absolutely cannot understand how this height expansion is even being considered in this day and age after countless dam projects have been discontinued throughout our country based on information about the problems dams bring over time - not at first of course, but years and years later when the silt has accumulated, rainfall causes overflows, the concrete erodes - and that is of course, years later when all of the present commissioners are long gone. And if conservation measures were enforced and not just suggested, this precious water would not be so desperately needed. This is a terrible solution gentlemen - and research history substantiates that. Marilyn Whittaker, 931 Poplar Place, Boulder

From:	ronviviano@aol.com
To:	Gross Reservoir SI-20-0003
Subject:	docket #SI-20-003
Date:	Thursday, October 15, 2020 2:33:43 PM

To Whom It May Concern,

Over the past few years I, like many other residents of Coal Creek Canyon, have met with Denver Water to voice our concerns over the expansion of the Gross Dam. We question even the need for such a dam when studies had shown that were specific conservation practices initiated in Denver it would negate such a project. We have responded in disbelief when told that there would be no ecological damage from the project to animal or bird habitats. One only has to travel to the reservoir to see what will be destroyed by cutting all the trees necessary to raise the water level 130 feet and flooding that habitat. Our canyon is a winding narrow road and we have also voiced safety concerns regarding lumber trucks and other large construction vehicles moving up and down the canyon. Mountain communities have banned fireworks, not only because of fire danger, but due to the impact noise has on wildlife. Yet, they plan to have a quarry located at the reservoir where blasting will be part of the excavation process. I feel that the Army Corps of Engineers was in error to approve Denver Waters application and their conclusion regarding the environmental impact of such a project was malfeasance. Thank you for taking the time to review this decision.

Sincerely, Ronald Viviano

305 Rudi Lane, Golden, Co 80403

From:	Michael Leland
To:	Gross Reservoir SI-20-0003
Cc:	Lazy Z Estates BoD; officers@lazyzestates.org Officers
Subject:	Letter from Lazy Z Estates - Gross Dam Expansion
Date:	Thursday, October 15, 2020 9:45:54 AM
Attachments:	Gross Reservoir and Dam Expansion 10 14 20.pdf

Please find attached a letter from the Lazy Z Estates Board of Directors in opposition to the proposed expansion of Gross Dam Reservoir

Thank you for continuing to support the residents of Boulder County

Sincerely
Michael Leland
President
Lazy Z Estates HOA

--
MICHAEL LELAND
Vice President
History Factory
1233 20th Street NW, Suite 725
Washington DC 20036

Archives Lab
14140 Parke Long Court
Chantilly, VA 20151-1649

Direct: 703.227.9550
Mobile: 619.206.7185
mleland@historyfactory.com
www.historyfactory.com

THE LAZY Z ESTATES HOMEOWNERS' ASSOCIATION
P. O. BOX 374
PINECLIFFE, COLORADO 80471-0374

October 14, 2020

Boulder County Community Planning and Permitting
P. O. Box 471
Boulder, CO 80306

RE: Docket SI-20-0003 Gross Reservoir and Dam Expansion

Dear Sir/Madam:

This letter serves as our strong objection to the Gross Reservoir and Dam Expansion. Our Homeowners' Association is located directly off of Lazy Z Road, and our membership would be significantly impacted by this expansion.

We understand that construction trucks would be accessing the reservoir from County Road 97E, Magnolia Road and Lazy Z Road. These roads are all gravel roads and not safe for large construction vehicles. Additionally, County Road 97E is very narrow and rutted, and was not at all designed for the large construction vehicles proposed as part of the expansion.

These roads are typically not well maintained by Boulder County, and we are concerned (especially now due to the financial impacts to Covid-19) about the increased vehicle traffic, and corresponding increased maintenance cost for these roads. We are further concerned that Boulder County will increase property taxes to pay for road maintenance for a project that the majority of our mountain community is adamantly opposed to.

In addition, there will be a tremendous amount of dust, dirt and noise stirred up from the construction trucks. Our members moved to our community for the peace, solitude and beauty. We enjoy seeing the trees, flowers, and wildlife. This expansion would destroy our reasons for living here. Early estimates were that there could be 2-4 trucks per hour every hour driving up our roads, which is a substantial increase to the normal residential traffic these roads were designed and built for.

The environmental impact on the area surrounding the existing reservoir and dam will be enormous. We have heard that the existing dam is built on a fault line, and if that is correct, a larger reservoir and dam would put additional stress on the fault line and could cause major flooding downstream if the dam were to break. We are certain the county is aware of these impacts so we will not go into additional details here.

We value Boulder County's long history and commitment to championing open space, ensuring the County's natural beauty remains undisturbed, and the importance its leaders place on maintaining the quality of life for its residents. Please continue this legacy by continuing to oppose the expansion of Gross Dam Reservoir.

Sincerely,

Mi Leland

Michael Leland,
President
Lazy Z Estates

CC: Board of Directors and Officers of Lazy Z Estates

From:	Paul DeLong
To:	Gross Reservoir SI-20-0003
Subject:	IMPORTANT: Proposed Gross Reservoir Expansion
Date:	Tuesday, October 13, 2020 8:52:30 PM

Greetings,

I have lived just a few miles from Gross Reservoir for 22 years. I am writing to express my strong opposition to the proposed expansion of Gross Reservoir. This project will have a devastating impact on Boulder County and the environment. My understanding is that Denver Water has submitted their 1041 Application and it gives a response date for comments of October 14, 2020. This is simply not adequate time for people to properly review the application and submit their comments. The county must not rush. The public comment period needs to be extended for at least an additional 30 days.

Please do not allow the proposed expansion of Gross Reservoir!

Best Regards,
Paul & Rebecca DeLong
156 Cumberland Gap Rd.
Nederland, Colorado
(303) 417-0627

From:	Gerard Kelly
To:	Gross Reservoir SI-20-0003
Cc:	gerardkelly49@comcast.net
Subject:	Gross Reservoir Dam Expansion Proposal
Date:	Tuesday, October 13, 2020 3:44:51 PM

I want the Boulder County Community Planning & Permitting Department (Department), in its review of the Denver Water 1041 application, to consider whether Denver Water has sufficiently demonstrated the need for the proposed project and whether it will be able to use the increased capacity it proposes to build. These considerations are critical to determine the project's benefits and assess all related environmental, social and economic costs. The Department has to determine whether the benefits, including any realized by Boulder County and its citizens, justify the enormous costs that will be experienced by County citizens, its wildlife and environment.

The purpose and need for the project was presented in the US Army Corps of Engineers Environmental Impact Statement (EIS) and Record of Decision years ago. However, the data used to support the purpose and need in that document are very dated and no longer valid, especially in light of the 20-year drought we are now experiencing and new information on projected climate change. Denver Water's application needs to demonstrate purpose and need, and how they can be realistically achieved based on up-to-date data, including Denver's current and projected water usage, new water conservation measures, and aggressive application of all available conservation measures.

Most importantly, Denver Water needs to re-evaluate the future flows within the Fraser River and its capacity to provide enough water to the Gross Reservoir to justify the enormous dollar cost of the project, and the enormous social and economic disruption and environmental destruction. The Denver Water application needs to address the impacts of diversion on the Fraser and Colorado Rivers, including its fisheries, and whether the transfer of water will increase the reservoir's storage capacity significantly enough to achieve the revised project purpose and need – in the near-term and the long-term.

In addition, Denver Water needs to present a re-evaluation of its other project alternatives presented in the EIS based on current data, and develop new alternatives as appropriate based on revisions to the project's purpose and need. Such analysis may yield another preferred action that does not include expansion of the Gross Dam and impact Boulder County nearly as much.

Thank you for your consideration of my comments.
Sincerely,
Gerard Kelly
Boulder County resident

Sent from Mail for Windows 10

From:	Shelly Ceurvorst
To:	Gross Reservoir SI-20-0003
Subject:	SI-20-0003
Date:	Tuesday, October 13, 2020 9:12:49 AM

Dear Commissioners,

In regard to the expansion of Gross Reservoir it seems that you are the last line to be drawn in the sand on a project that greatly impacts CO resources, Boulder County flora and fauna, and the local mountain communities. You will have heard all these arguments before but we will reiterate them and add our voices to those saying “no” this is not needed and is not a good idea.

Taking more water from the Colorado River to send to Denver is just wrong. It negatively impacts the whole ecosystem downstream. Raising the dam height means lost habitat in Boulder County. These are the bigger picture items.

At a local level the impact to the mountain communities will be tremendous. Imagine living on the East side of Gross Dam Rd, as we do, and having 17 fly ash semis **per hour**, 50-101 employee commuting vehicles **per day** and additional logging trucks using this access road, as cited in the traffic study for the peak construction period in 2026. Those trucks drive all the way down Coal Creek Canyon impacting traffic flow. According to the study the increased drive time on the main highway will be 20 minutes or so and there was no added time listed while driving Gross Dam Rd, but there will be added time for sure. Road rage and frustrated drivers will most likely result in poor judgement in passing large trucks putting people at risk. The local fire department, which we volunteer with, will be impacted with respect to responding to incidents.

There are certainly other issues such as noise and air pollution from the cement plant operations that will be established on site. All these impacts for water, going to Denver, when studies have shown that conservation and high density housing indicates they really don’t need it.

Take a hard look at what is best for the Colorado River, the county you live in, and the mountain communities you represent. Vote “no” on this project.

Sincerely,
Joe and Shelly Ceurvorst

Sent from my iPad

From: David William Maclennan
To: Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject: Gross Dam Expansion Activities of State Interest (1041) Review Notification
Date: Tuesday, October 13, 2020 8:35:56 AM

I am aware that there is currently a deadline of October 14 2020 (tomorrow) for comments on the Activities of State Interest (1041) Review.

As an interested party I am concerned that this deadline for comments is too soon for those who wish to actually review the details of the application (354 pages, plus supporting documentation) AND provide meaningful comments in a timely fashion.

Please consider extending the deadline by at least 30 days in order to allow more considered review of the application details by those who may have comments.

Thank you -

David Maclennan

From:	Jose Garcia
To:	Gross Reservoir SI-20-0003
Subject:	The Gross Reservoir Expansion
Date:	Monday, October 12, 2020 8:55:59 PM

To whom it may please concern,

I recently moved to Boulder from Florida, originally from Miami. I saw the city i was raised in being raped and stripped of its environment. As Miami's leaders continued to destroy natural land areas, including large areas of the everglades to make more room to allow more people to move into Miami and create an overpopulation problem the will never be fixed, I came to a point where I had to move. I could no longer stay in a city who's main concern was how much money can they bring in so those in the obvious political seats can stuff their pockets and bank accounts.
So I moved to Colorado, specifically Boulder, because of its amazing natural beauty and immense respect for all surrounding wildlife. I found a place that my spirit feels very at home in. And of course I learned of the great importance the city of Boulder places on the environment and the need to stop destroying any more of its natural surroundings and further displacing wildlife. I am under the impression that Boulder wants to preserve what it has, that it knows the difference between sharing a respectful space alongside natural and further destroying nature and disturbing the balance of it all just to make a dam i little bigger, it really doesn't make any rational sense and it's not at all in line with the progressive mentality of the city of Boulder. I am 100% sure that if those involved with The Gross Reservoir Expansion, and all others involved as well, sit and put their heads together that they can come up with an alternative idea. In these modern times with the technology we have now and the knowledge we have gained concerning the damage we've done to our environment and the large number of biological species we have caused to become extinct, we have a great responsibility to put our past ignorance and greed aside and do the right thing. I'm pleading as a newcomer and long time advocate for the protection of the environment, keeping it quiet and peaceful and protecting its wildlife to not proceed with any construction of the Gross Reservoir Expansion in South Boulder and to sit and rethink other viable options that place the protection of that area of land first and foremost.
I'm a Colorado citizen that wants to get involved in anything I can do to protect and better this city in every way it needs. I hope my voice is at least heard, and that many many more like me voice their opposition to this incredibly huge and very sad mistake.
Thank you

Jose Garcia
a human being that has great respect for our home

From:	Zack Coles
To:	Gross Reservoir SI-20-0003
Subject:	Docket #SI-20-0003 - Gross Dam Expansion
Date:	Monday, October 12, 2020 12:59:35 PM

Dear Board of County Commissioners,

I am a resident of Coal Creek Canyon and reside within Boulder County. I have heard of the Gross Dam Expansion and am writing in strong opposition to this proposal. I urge you all to continue to scrutinize and ultimately fight to shut down this expansion. Denver Water has become greedy and is unwilling to make the environmental changes in order to conserve water. There solution to a growing population is to not support conservation efforts, but instead to water lawns and other wasteful issues. What happens 10 years from now when they realize that climate change is happening and dam expansions cannot continue? It is time they look at other efforts to fix their water issues rather than burdening Boulder County, Coal Creek Canyon Residents, and the wildlife and plant life that are home to this area.

I believe this is a fight worth every effort. Why has Denver water not been successful in other dam projects? Because residents in other areas have fought this greedy expansion and won. Boulder County needs to do the same. This is not a long-term solution and 10-15 years down the road they will find themselves in the exact same position.

Say NO to Gross Dam Expansion Project.

Thank you for listening to my concerns,
Zachary Coles
223 Copperdale Ln
Golden CO 80403

--
Zack

From:	Jill Judd
To:	Gross Reservoir SI-20-0003
Date:	Monday, October 12, 2020 11:20:45 AM

In the matter of docket # Si-20-0003
I would like to deny Denver water board the right to expand Gross Reservoir. I moved up here for the wildlife and tranquility of the mountains. This expansion is going to negatively impact the wildlife. It will also have a negative impact on the serenity of our neighborhoods because of all the noise from the traffic of all the big heavy equipment and trucks. Furthermore, highway 72 is not equipped to handle all the extra traffic this will expansion will cause.
Sincerely Jill R Judd, resident of Coal Creek Canyon

From:	April Lew
To:	Gross Reservoir SI-20-0003
Subject:	Comments Gross Dam
Date:	Monday, October 12, 2020 10:32:01 AM

To the BOCO Commissioners:
Re: Gross Dam Expansion

As an 18-year resident of Coal Creek Canyon and Boulder County, I want to thank you for your support of our Canyon. As Denver Water seeks to expand Gross Reservoir, it has one last hoop to jump through—the 1041 review. I've heard from friends involved in CO water politics that BOCO will eventually give into DW's expansion efforts.

As a resident of the Canyon who is worried about the impacts on the safety and quality of life, and as a resident who doesn't want the Colorado River to carry yet another burden, I urge you to do a close review of DW's request in light of the 1041 standards.

The West will always be in need of water. A strong review,

and better yet, a denial of the project,

would send a signal to DW and Colorado that there are many avenues still available to store and conserve water, even as we face a drying climate and exponential growth.

I appreciate all of your efforts to make the best decision not only for Coal Creek and Boulder County residents but also to make a decision that can bring changes to the antiquated ways we manage water in Colorado.

Perhaps your decision will help us all revere and value one of our most precious resources.

Thank you for all you do, April

From:	Tim Hagaman
To:	Gross Reservoir SI-20-0003
Subject:	Docket # SI-20-0003
Date:	Monday, October 12, 2020 10:22:09 AM

Greetings,
Please don't move forward with the Gross Reservoir expansion. EPA studies show that it would affect too many lives both wild and human life in a negative way. The residents of Coal Creek Canyon would also have to face the dangers of giant trucks moving up and down the canyon as well as the destruction of Highway 72. Risking so many lives and so many acres of wildlife is not worth the extra amount of money/water that Denver water would accumulate. The EPA also said that Denver Water does not need the extra water for Arvada. That even with new development there is still plenty of water for Arvada. The expansion of Gross Reservoir will allow Denver Water to Destroy the environment for their own corporate greed! It has nothing to do with supply and demand as they claim. Please consider this argument for not expanding Gross Reservoir. Thanks for your time and consideration.

Sincerely,
Tim Hagaman

--
Tim Hagaman
illustration • retouching
303.621.5546

From:	Tim Hagaman
To:	Gross Reservoir SI-20-0003
Subject:	Stop Gross Res. Expansion
Date:	Monday, October 12, 2020 10:08:00 AM

Greetings,
Please don't move forward with the Gross Reservoir expansion. EPA studies show that it would affect too many lives both wild and human life in a negative way. The residents of Coal Creek Canyon would also have to face the dangers of giant trucks moving up and down the canyon as well as the destruction of Highway 72. Risking so many lives and so many acres of wildlife is not worth the extra amount of money/water that Denver water would accumulate. The EPA also said that Denver Water does not need the extra water for Arvada. That even with new development there is still plenty of water for Arvada. The expansion of Gross Reservoir will allow Denver Water to Destroy the environment for their own corporate greed! It has nothing to do with supply and demand as they claim. Please consider this argument for not expanding Gross Reservoir. Thanks for your time and consideration.

Sincerely,
Tim Hagaman

--
Tim Hagaman
illustration • retouching
303.621.5546

From: ag@la-gordon.org
To: Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Cc: Allen Gordon
Subject: opposition to the moffet tunnel project
Date: Monday, October 12, 2020 5:42:05 AM

Hello,

I am a 27 year resident at 319 Pine Glade Rd about 2 miles from Gross reservoir. I oppose the expansion of the reservoir and urge the commissioners to block it via the 1041 process. Besides being in a drought and that the source of the water to fill the expanded reservoir would come from the over-subscribed Colorado River, the project was not scoped out very well. There will be significant environmental damage through the loss of habitat from county rd 68J to the reservoir. The wildlife here is already stressed from the smoke from the fires, the heat during the summer and the lack of significant precipitation. This has the effect of more interactions between the bears, moose, and elk with the human residents causing property damange, human injuries and the potential euthansia of the offending animals. We have already suffered here from previous fires and evacuations, the Boulder Canyon project, the drought and now the potential of a very invasive project that will severely and negatively impact the people living here as well as property values. The noise generated by the blasting necessary for the construction of the dam, the logging operations and the truck traffic will negate the reasons why many people are living here. This project MUST NOT go through. Even the Army Corps of Engineers is skeptical of the project even though they approved it but with a caveat that they are not responsible if the reservoir does not get filled!

Thank you

Allen Gordon, Ph.D.
319 Pine Glade Rd.
Nederland CO 80466
303 258 0646

From:	John Lodenkamper
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	1041 Application from Denver Water: Docket #SI-20-0003
Date:	Sunday, October 11, 2020 5:28:13 PM
Attachments:	ColoLawyer1041.doc

Dear Boulder Community Planning & Permitting Dept.:

As a former resident of the Gross Reservoir area, and an early opponent of its expansion, I find the requested comment deadline of 10/14/20 on the 354 page 1041 application by Denver Water to be unconscionable. Denver Water has mounted a years-long campaign on this project, and there should be no pressure now to give short shrift to proper analysis of this application, which they even opposed making for a long period of time.

I originally discovered the attached legal precedents for rejecting water projects that did not comply with local 1041 regulations, and expect Boulder County to administer its 1041 regulation responsibly.

Thank you for your consideration.

Yours truly,

John Lodenkamper
3040 Wright CT
Wheat Ridge, CO 80215

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The Colorado Lawyer
December 2005
Vol. 34, No. 12 [Page 79]

Articles
Government and Administrative Law News
Local Government Regulation Using 1041 Powers
by Joseph B. Dischinger

This column provides information to attorneys dealing with various state and federal administrative agencies, as well as attorneys representing public or private clients in the areas of municipal, county, and school or special district law.

Column Editors:

Carolynne C. White, of Brownstein Hyatt & Farber, P.C., (303) 223-1197, cwhite@bhf-law.com; Brad Bailey, Assistant City Attorney, City of Littleton—(303) 795-3725, bbailey@littletongov.org; Tiffanie Bleau, Denver, an attorney with Light, Harrington & Dawes, P.C.—(303)298-1601, tbleau@lhdlaw.com

About The Author:

This month's article was written by Joseph B. Dischinger, Denver, Of Counsel with Fairfield and Woods, P.C.—(303) 894-4404, jdischinger@fwlaw.com. Joe practices water and environmental law.

A state trial court has invalidated Boulder County's 1041 regulations because, through no fault of the county, the state Land Use Commission ("LUC") failed to review the local regulations. The legislature responded by abolishing the LUC. This article provides a historical summary of Colorado planning and zoning laws, and discusses the legal and political implications of the LUC's dissolution.

In 1974, the Colorado General Assembly passed the Areas and Activities of State Interest Act ("AASIA").[1] The AASIA "encourages" local governments to designate certain geographic areas and specified activities as matters of state interest.[2] For example, under the AASIA, a city or county could declare part of its jurisdiction as a wildfire hazard area, or it might declare the activity of selecting a site for mass transit a matter of state interest. If a local government has made such a designation under the AASIA, it must promulgate regulations, commonly called 1041 regulations after the bill number of the state statute. The regulations must control development of land resources within the designated area or that are affected by the designated activity. A permit from the local government is required for development in regulated areas or for regulated activities.[3]

Until recently, courts have been extremely deferential to local government powers under the AASIA. However, there is increasing activity at the local government level to use 1041 regulations to control development. Recent court decisions, and the legislative and executive branch responses to those decisions, demonstrate that local environmental regulations may be the next front for fights over development. If nothing else, they highlight that not all politics is local.

This article provides a concise history of planning and zoning in Colorado. It also explores the case law under the AASIA, which culminated in a recent district court decision that rejected Boulder County's 1041 regulations because the Colorado Land Use Commission ("LUC") had not reviewed the local regulations. The article concludes by describing the responses of the Governor and the legislature to the court decision from Boulder County, and discusses the legal and policy implications of the demise of the LUC.

Colorado Planning and Zoning History

Aside from the regulation of certain "nuisance" land uses such as slaughterhouses, governments in America did not use their police powers extensively to regulate land use before the early 1900s.[4] Growing out of the "City Beautiful" movement at the turn of the last century, the federal government actively encouraged city planning. In 1922, the U.S. Department of Commerce published a Standard State Zoning Enabling Act. The City of Denver, as a home rule city, adopted a comprehensive zoning

als Opinions
Opportunities

ordinance pursuant to a Charter amendment in 1923, based largely on the model act.[5]

Until the U.S. Supreme Court's 1926 decision in *Village of Euclid v. Ambler Realty Co.*,[6] there was great uncertainty about whether zoning laws were valid under the Fourteenth Amendment Due Process Clause.[7] *Village of Euclid* upheld such zoning laws, and three years later, the Colorado General Assembly granted statutory cities and towns the authority to conduct land use planning.[8] Furthermore, Title IV of that 1929 statute provided for the appointment of "regional" planning commissions, which were given authority beyond the boundaries of a single municipality.[9] Title IV was repealed ten years later, with the passage of a state statute in 1939 authorizing planning and zoning by counties of unincorporated territory within their respective boundaries.[10]

In 1970, the legislature passed the Colorado Land Use Act,[11] which created the Colorado LUC, charged with developing a state land use plan. As originally enacted, the Land Use Act called for the adoption of a state land use map, which would classify all lands in the state and designate those uses that would be allowed for lands within each classification.[12] In the next two years, the Land Use Act was amended, and the LUC's role was changed to one of coordinating and unifying policies in planning for growth and development.[13] A few years later, the state passed the Local Government Land Use Control Enabling Act of 1974 ("1974 Enabling Act").[14] The purpose of the 1974 Enabling Act was "to provide for planned and orderly development within Colorado and a balancing of basic human needs of a changing population with legitimate environmental concerns."[15] During the same session, the state enacted the AASIA as Part 1 of the 1970 Land Use Act.

The AASIA is sometimes erroneously referred to as "Colorado's first comprehensive land use law."[16] However, there are at least four different state statutes currently authorizing local government land use planning and zoning (*see* the accompanying table, "Colorado Land Use Planning Statutes"). This may help to explain why it is sometimes difficult to tell whether a local regulation was adopted pursuant to the AASIA.[17]

Areas and Activities of State Interest

House Bill 74-1041 ("H.B. 1041") was loosely based on Article 7 of a Model Land Development Code ("Model Code") prepared by the American Law Institute.[18] The Commentary on Article 7 is enlightening about the nearly revolutionary atmosphere that motivated such legislation in states across the country. Citing specific examples, it illustrates "the problems caused by this failure of the state government to retain any of its power to regulate the use of land within its boundaries."[19] For example, the Commentary notes the competition among communities around San Francisco Bay to encourage new development that caused local governments to allow the rapid filling in of estuarial and shoreline areas. It also cites to the fact that "[i]n Colorado the inability of rural counties to control second home subdivisions created great popular dissatisfaction."[20] The Commentary continues:

-Most of the states are now giving serious study to a variety of proposals to reform land use regulation, and almost all these proposals involve some new powers for state or regional agencies. The long period of unquestioned acceptance of the local prerogative to control land development is clearly over.[21]

However, Colorado's AASIA, which arose from H.B. 1041, was a political compromise in this reallocation of power from local governments to the state. The Model Code suggests giving a state land planning agency the power to designate "areas [and activities] of critical state concern"; to approve or disapprove local government regulation in those areas; to promulgate state regulations for development in designated areas when the local government has not adopted any; and to decide appeals from local land use decisions. H.B. 1041, as originally introduced, included many of these ideas for a more active role by the state in land use decision-making.

Colorado's statute as enacted, however, was considerably more restrained. The AASIA gave local governments the power to designate areas and activities of state concern; gave the LUC the authority to approve or suggest modifications to local rules, but not to disapprove them; and did not give the state commission appellate authority over local decisions, even though the decisions, by definition, related to matters of state interest. As discussed below, even the limited influence of the state through the AASIA has recently been eliminated by statutory amendment.

Under the AASIA, local governments may designate the following as areas of state interest:

• Mineral resource areas

• Natural hazard areas, including floodplains, wildfire hazard areas, and geologic hazard areas

• Areas containing, or having a significant impact upon, historical, natural or archaeological resources of statewide importance

• Areas around airports, rapid or mass transit, highways, and major facilities of a public utility ("key facilities").[22]

Local governments may designate the following as activities of state interest:

• Site selection and construction of major new, or extensions of existing, domestic water and sewage treatment systems

• Site selection and development of solid waste disposal sites (with some exceptions)

• Site selection of key facilities (*see* above)

• Site selection or development of new communities

• Efficient use of municipal and industrial water projects

• The conduct of nuclear detonations.[23]

Colorado Land Use Planning Statutes				
Name	**Bill No.**	**Colo. Sess. Laws**	**Original Codification**	**Current Codification**
City and Regional Planning Act	S.B. 427	1929, Ch. 67, p. 219	unknown	Repealed in 1939
County Planning Act	S.B. 278	1939, Ch. 92, p. 294	unknown	CRS §§ 30-28-101 *et seq.*
Colorado Land Use Act	S.B. 11	1970, Ch. 75, p. 315	CRS § 106-4-1	Repealed in 2005
Local Government Land Use Control Enabling Act of 1974 ("1974 Enabling Act")	H.B. 1034	1974, Ch. 81, p. 353	CRS § 106-8-101	CRS §§ 29-20-101 *et seq.*
Areas and Activities of State Interest Act ("AASIA")	H.B. 1041	1974, Ch. 80, p. 335	CRS § 106-7-101	CRS §§ 24-65.1-101 *et seq.*
Municipal Planning and Zoning Act	H.B. 1089	1975, Ch. 275, p. 1143	CRS § 31-23-101	CRS §§ 31-23-101 *et seq.*

As examples of the types of requirements that local governments may impose pursuant to the AASIA, developments in areas designated as wildfire hazard areas may be required to have firebreaks and roads adequate for service by fire trucks and other safety equipment.[24] Areas containing historical, natural, or archaeological resources must be administered "in a manner that will allow man to function in harmony with, rather than be destructive to, these resources," and "consideration is to be given" to the protection of "areas essential for wildlife habitat."[25] Municipal and industrial water projects shall "emphasize the most efficient use of water, including, to the extent permissible under existing law, the recycling and reuse of water."[26]

According to a survey conducted in 2004 by the Division of Local Government in the Colorado Department of Local Affairs,[27] nearly all Colorado counties reported they have some form of 1041 regulations, although most do not regulate all of the areas and activities of state interest they could regulate. For example, according to the survey: (1) nearly one-half of all Colorado counties regulate mineral resource areas and flood hazard areas; (2) nearly 40 percent regulate wildfire hazard areas and wildlife habitat areas; (3) fewer than 15 percent regulate the efficient use of municipal and industrial water projects; (4) only 2 percent regulate the conduct of nuclear detonations; and (5) only four counties report that they have no 1041 regulations.[28] In addition to counties, a significant number of Colorado municipalities have adopted 1041 regulations, although there is less information available about how many municipalities have them.[29]

Despite this self-reporting by the counties, it appears the counties have widely varying standards about what it means to have 1041 regulations. In a survey of the counties by the author, many more than four have no 1041 permitting process, as such (*see* Appendix). Some incorporate one or more of the ideas for regulated areas and activities suggested by the AASIA into their comprehensive plans or zoning resolutions, but they do not specify a detailed regulatory scheme for such areas and activities. No separate 1041 permit is required; rather, enforcement (if any) is through existing permitting systems, such as building permits, plat or subdivision approval, and zoning enforcement.

A number of counties are currently looking at adopting 1041 regulations for the first time or making substantial revisions to existing regulations. Some of this activity seems to be responsive to proposed projects, such as water pipelines, other water projects, or private toll roads.

The Brief Life of the Colorado LUC

In the early years of its existence, the LUC was quite active. It prepared a 350-page set of Model Land Use Regulations under H.B. 1041, "to provide technical assistance to local governments in devising their own designations and regulations."[30] It intervened in local land use decisions at the request of citizens and of county governments.[31] As discussed below, the LUC also initiated litigation.

Among its most controversial actions, the LUC vacillated over getting involved in the designation of the Pawnee power plant, then under construction by the Public Service Company near Brush, Colorado. In January 1977, the LUC voted not to request Morgan County to designate the plant under the AASIA, but in February voted to reconsider.[32] Under the AASIA as it existed until 2005, the mere request by the LUC would impose a moratorium on further construction until the county could hold a hearing on the request and issue its decision.[33] Finally, in April 1977, the LUC made a formal request to Morgan County to designate the siting of power plants as an activity of state interest, but excluded the Pawnee plant from the request.[34]

Appropriations for the LUC were cut from $202,000 in 1977[35] to $58,000 in 1978.[36] Commentators at the time suggest that this decrease in legislative funding was directly attributable to the LUC's actions on certain controversial land use decisions around the state, especially the Pawnee power plant.[37] The LUC has received no funding since 1983.[38] Notwithstanding the complete lack of funding, the LUC continued to meet, albeit with a gradually diminishing role, into the 1990s. However, at least by January 1998, the LUC had ceased meeting altogether.[39] As a result, the LUC was not reviewing local government 1041 regulations that were being sent to the state, as required by the AASIA.

Judicial Support of Local Control

Until recently, courts have been supportive of local government decisions under the AASIA. In the first reported decision under the AASIA, the LUC sought to prohibit the City of Louisville from rezoning land that was proposed for annexation, and obtained an injunction to that effect in the trial court. In 1975, the Colorado Supreme Court held that the AASIA deals with regulation of development, but that annexation is not development. Until the land was annexed, Louisville had no jurisdiction over the land; and until Louisville permits or attempts to develop the land in question, the AASIA gave no authority for injunctive relief.[40]

In *Tri-State Generation and Transmission Assoc. v. Board of County Commissioners*,[41] the Colorado Court of Appeals announced a more far-reaching decision. In 1973, Tri-State Generation and Transmission Assoc. ("Tri-State") began planning for construction of a power line in a corridor north of Interstate 70 ("I-70") in Lincoln County. It conducted engineering and ecological studies, purchased rights-of-way (in the court's words, at "nominal cost"), and informed the public of its plans by notice and public meetings. Construction started on March 1, 1976, in adjacent Kit Carson County. On March 8, 1976, Lincoln County designated site selection and construction of public utilities as an area or activity of state interest under the AASIA. Tri-State's application for a 1041 permit was denied.

The county commissioners reasoned that the area north of I-70 was primarily wheat fields, and that the area south of I-70 was grassland. Because of the adverse effects of the power line on farming, the county preferred the line to go south of the interstate highway. The trial court reversed, holding that Tri-State had a vested property right by virtue of its expenditures. In 1979, the Court of Appeals reversed the trial court's decision, finding that Tri-State's expenditures amounted to planning, rather than actual use. Only the latter vests a property right.[42] Further, the Court of Appeals found the 1041 regulations to be a proper exercise of the police power, which would be thwarted if any expenditure for planning could block effective land use regulation.[43]

During the same year, the Colorado Supreme Court upheld the AASIA against constitutional challenges in a case involving construction of the Rawhide Energy Project, a waste disposal facility and electrical generating plant in Larimer County.[44] When the county denied the LUC's request to designate the project as a matter of state interest, the LUC sought *de novo* review in the state district court, as provided in CRS § 24-65.1-407(3). The trial court dismissed the complaint, holding that the provision allowing *de novo* review of a county's designation decision was an unconstitutional violation of the doctrine of separation of powers.

The Colorado Supreme Court affirmed the dismissal, but held the AASIA to be constitutional. It ruled that the cited provision of the AASIA provides for limited review of a county's decision. The trial *de novo* is to evaluate the legality of the county's proceedings and to determine whether there has been an abuse of discretion, not to judge the merits of the county's decision.[45]

Similarly, in the 1989 case of *City and County of Denver v. Board of County Commissioners*,[46] the Colorado Supreme Court rejected Denver's argument that the AASIA was an unconstitutional delegation of legislative power to local governments. Denver held certain water rights, the development of which would be subject to 1041 permitting requirements in Eagle and Grand Counties. The Court concluded there are sufficient standards and safeguards to guide and control the local governments in the exercise of their 1041 powers.

The AASIA: (1) establishes procedures the local governments must follow, including the consideration of guidelines issued by the LUC; (2) provides for state input, oversight, and judicial review; (3) provides criteria for the administration of areas and activities of state interest; and (4) provides for certain due process protections, including notice, hearing, preservation of a record, and written findings, conclusions, and reasons for decisions. The Court also rejected numerous other arguments that provisions in the Colorado Constitution, the AASIA, and other state statutes exempt Denver, as a home rule municipality and as a water provider, from operation of the AASIA.

Notwithstanding the defeat of this broad-based attack on local government regulation of extra-territorial water projects, municipal water providers mounted another effort in the 1994 case of *City of Colorado Springs v. Board of County Commissioners*.[47] The cities of Aurora and Colorado Springs own conditional water rights to divert water from what is now the Holy Cross Wilderness Area in Eagle County, sometimes called the Homestake II Project. In fact, the cities had managed to have their water rights expressly protected and excluded from the legislation that created the wilderness area. They had obtained decrees for their water rights, and had successfully and repeatedly met statutory requirements to demonstrate reasonable diligence to preserve the conditional rights. The cities had obtained all of the other necessary permits to construct their water project, including a wetlands permit from the U.S. Army Corps of Engineers. Nevertheless, Eagle County denied the cities' application for a 1041 permit to construct the project.

The Colorado Court of Appeals ruled in favor of Eagle County. The court ruled that the AASIA is not unconstitutionally vague nor an abrogation of the cities' home rule powers. It also ruled that Eagle County's 1041 regulations were consistent with the requirements and authorizations of the AASIA.

Perhaps the most interesting aspect of *City of Colorado Springs* is the cities' attack of the AASIA on essentially policy grounds. In the determination of land use issues, the most important question is "who decides?" If the body deciding whether a project should proceed is elected by people who will bear all the burdens of the project but virtually none of the benefits, it is not difficult to predict what decision the body will reach. In *City of Colorado Springs*, the court rejected the argument that this practical reality should deprive Eagle County of the power to grant or decline 1041 permits. To rule otherwise, the court said, "would eviscerate a fundamental objective of the Land Use Act."[48]

The county's board, acting in its quasi-judicial capacity, is able to balance the potential adverse environmental impact of the project against its potential benefits, and the regulations "do not lend themselves to arbitrary and discriminatory enforcement."[49] The court observed that the county's denial of the permit prevented the Homestake II Project, as presented to the board, from going forward; however, it did not preclude the cities from restructuring the project in some way so that it could proceed in compliance with the environmental requirements of the county's 1041 regulations.

The *County of Boulder* Decision

In the fall of 2004, the Boulder County District Court invalidated Boulder County's 1041 regulations. In *Regents of the University of Colorado v. County of Boulder*,[50] the trial court invalidated Boulder's regulations as an unconstitutional delegation of legislative authority, because there was no review and comment by the LUC.

In 1997, the University of Colorado–Boulder ("University") acquired a 308-acre parcel in unincorporated Boulder County, referred to in the litigation as "CU Boulder–South," on which it intended to expand its campus south of Highway 36. In 1998, Boulder County designated the highway interchange of U.S. 36 and Colorado 157 as a "key facility," and the area around the interchange, including CU Boulder–South, as an area of state interest under the AASIA. In 2001, the county designated the CU Boulder–South property as a "flood hazard initial control area" and an area of state interest for that reason as well. These designations required the University to seek a permit from the county for development of the CU Boulder–South property. Without applying for a permit, the University brought a declaratory judgment action in 2001.

In ruling on cross-motions for summary judgment, the Boulder County District Court found that review of local government 1041 regulations by the LUC was an integral part of the regulatory scheme, even though the local government was free to disregard any suggestions the state may have. It found that the LUC did not, in fact, review Boulder's regulations, noting, "[A] framework [for a LUC] exists in the statutes, but there is, in effect, nobody home."[51]

The test for an unconstitutional delegation of legislative power is "whether there are sufficient statutory standards and safeguards . . . to protect against unnecessary and uncontrolled exercise of discretionary power."[52] The court found that "the role of the LUC in the statutory scheme was a key feature of the standards and safeguards contained in the [Land Use Act and the AASIA]."[53] With the *de facto* nonexistence of the LUC, those standards and safeguards were no longer functional. The court held that Boulder's designations of the CU Boulder–South property as an area of state interest in 1998 and 2001, and the regulations promulgated to regulate development in that area, were enacted pursuant to an unconstitutional delegation of authority. The case is currently on appeal before the Colorado Supreme Court.[54]

The Executive and Legislative Response

To cure Boulder County's problems, Governor Owens appointed a new Land Use Commission,[55] which met on January 11, 2005, and approved Boulder County's 1041 regulations.[56] This was the only action the newly constituted LUC took.[57] The Colorado legislature then abolished the Colorado LUC and removed all reference in the statutes to LUC review of 1041 regulations.[58]

The Boulder court's decision has raised questions about the validity of 1041 regulations adopted by many other counties and municipalities after the LUC ceased to function.[59] After passage of the legislation that abolished the LUC, the Colorado Department of Local Affairs recommended that local governments seek legal advice about whether they need to re-enact their 1041 resolutions and regulations, or whether their previously adopted regulations "are not harmed by lack of commission review or by elimination of the commission."[60]

This may not be an easy decision to make. The burden of re-adopting resolutions and regulations is not great, but re-adoption may be taken as an admission that the enforceability of such regulations prior to re-adoption was questionable. More important, the elimination of the LUC again calls into question the constitutionality of the AASIA. As the court noted in the *County of Boulder* case, the role of the LUC was a "key feature" that kept the AASIA from being an unconstitutional delegation of legislative authority to the local governments.[61] Similarly, in upholding the constitutionality of the AASIA before the 2005 amendment, the Colorado Supreme Court pointed to several mechanisms in the statutory scheme through which the LUC could "check local government abuse of discretion" in designating, or failing to designate, matters of state interest.[62]

The reality is that the LUC's role in Colorado was always limited to being primarily a resource for local governments. Unlike the role envisioned for state planning agencies under the Model Code, the Colorado LUC had no designation, veto, or appellate powers and, at best, could serve as a gadfly to encourage local government action. If the AASIA were not an unconstitutional delegation of legislative authority, the elimination of the LUC's limited role should not dramatically alter the constitutional analysis. The abolition of the state's role in local government regulation of matters of state concern does, however, bring the policy question into sharp relief. It is not always a good idea to leave decisions affecting the entire state, such as the construction of water supply projects, up to local governments, whose interests may conflict with the interests of the state as a whole.

Conclusion

Many local governments have only recently come to recognize the power they have to regulate areas and activities of state interest under the AASIA. The limited role of the state in guiding such regulation has just been eliminated. Many local governments that passed 1041 regulations during the state's *de facto* dissolution of the LUC must now wonder if their regulations are valid. The recent legislative response, to eliminate the LUC officially, may provide slightly more comfort to local governments who adopt 1041 regulations going forward.

NOTES

1. 1974 Colo. Sess. Laws, Ch. 80 at 335, now codified at CRS §§ 24-65.1-101 to -502. The Areas and Activities of State Interest Act ("AASIA") was introduced in the General Assembly as H.B. 1041.

2. *Id.*

3. CRS § 24-65.1-501.

4. *See generally* Rathkopf and Rathkopf, *The Law of Zoning and Planning* (New York, NY: C. Boardman Co., 2005) at §§ 1:1–1:3.

5. Codified as amended at Denver Rev. Mun. Code, Subtitle B, § 3.2.9 (2005); *see also* http://www.denvergov.org/ZoningSimplification/template318641.asp.

6. *Village of Euclid*, 272 U.S. 365 (1926).

7. *Colby v. Board of Adjustment*, 81 Colo. 344, 349, 255 P. 443, 445 (1927). This issue was resolved in Colorado in favor of the constitutionality of zoning regulation in *Averch v. City and County of Denver*, 78 Colo. 246, 248-49, 242 P. 47, 48-49 (1925).

8. Act of May 20, 1929 ("City and Regional Planning Act"), 1929 Colo. Sess. Laws, Ch. 67 at 219. The statutes that now govern municipal planning and zoning are codified at CRS §§ 31-23-101 to -314.

9. *Id.*, Title IV was repealed at 1939 Colo. Sess. Laws, Ch. 92 at 310.

10. Act of March 30, 1939 ("County Planning Act"), 1939 Colo. Sess. Laws, Ch. 92 at 294, now codified as amended at CRS §§ 30-28-101 to -404.

11. 1970 Colo. Sess. Laws, Ch. 75 at 315, formerly codified as amended at CRS §§ 24-65-101 to -106. The Colorado Land Use Act was repealed in 2005.

12. *Id.* at 315, § 106-4-1(2).

13. CRS § 24-65-102(1).

14. 1974 Colo. Sess. Laws, Ch. 81 at 353, now codified as amended at CRS §§ 29-20-101 to -108. The Local Government Land Use Control Enabling Act of 1974 ("1974 Enabling Act") is sometimes referred to as H.B. 1034.

15. CRS § 29-20-102(1).

16. *See, e.g., Bd. of County Comm'rs v. Gartrell*, 33 P.3d 1244, 1247 (Colo.App. 2001); *Droste v. Bd. of County Comm'rs*, 85 P.3d 585, 588 (Colo.App. 2003). Both *Gartrell* and *Droste* cite to *City and County of Denver v. Bd. of County Comm'rs*, 782 P.2d 753, 755 (Colo. 1989) to support this statement. The *City and County of Denver* court, however, was referring to the Land Use Act, which it mistakenly said was adopted in 1974. Even the statement that the Land Use Act was Colorado's first comprehensive land use law is questionable, in light of the 1929 and 1939 statutes cited above.

17. *See also Droste, supra*, note 16 (protection of wildlife habitat authorized by 1974 Enabling Act and AASIA; zoned land exemption in AASIA does not exempt landowner from land use regulation under 1974 Enabling Act).

18. Model Land Dev. Code §§ 7-101 *et seq.* (Proposed Official Draft No. 1, April 15, 1974).

19. *Id.*, Commentary on Article 7 at 282.

20. *Id.*

21. *Id.* at 285.

22. CRS § 24-65.1-201.

23. CRS § 24-65.1-203.

24. CRS § 24-65.1-202(2)(a)(II).

25. CRS § 24-65.1-202(3).

26. CRS § 24-65.1-204(8).

27. Local Land Use and Planning Status survey report, prepared by the Office of Smart Growth and Colorado Counties, Inc. (2004); available from the Colorado Dept. of Local Affairs, Div. of Local Government. *See* website: http://wwdola.state.co.us. Click on "Division of Local Government." For specific questions, contact the help desk at dola.helpdesk@state.co.us.

28. *Id*.

29. *Id.*

30. "Introductory Comments and Instructions for Administrative Guidelines and Regulations," *H.B. 1041 Model Land Use Regulations* at 1-i, Colorado Land Use Commission ("LUC"); available from the Colorado Dept. of Local Affairs, Div. of Local Government. (*See* website, *supra*, note 27.)

31. *See generally* Panos, "A History of the Colorado Land Use Commission's Intervention," 24 *The Colorado Lawyer* 303 (Feb. 1995).

32. Warner, "Of Growth Controls, Wilderness and the Urban Strip," 6 *The Colorado Lawyer* 1730, 1736 (Oct. 1977).

33. CRS § 24-65.1-407(2).

34. Warner, *supra*, note 32 at 1736; White and Petros, "Land Use Legislation: H.B. 1034 and H.B. 1041," 6 *The Colorado Lawyer* 1686, 1706 (Oct. 1977).

35. 1976 Colo. Sess. Laws, Ch. 1 at 13.

36. 1977 Colo. Sess. Laws, Ch. 1 at 12.

37. Warner, *supra*, note 32 at 1736; White and Petros, *supra*, note 34 at 1706-07.

38. Panos, *supra*, note 31 at 303.

39. Memorandum from Charlie Unseld, on Colorado LUC letterhead, to interested parties, dated Feb. 8, 2005, available from the Colorado Dept. of Local Affairs, Div. of Local Government (*see* website, *supra*, note 27); *see also* Panos, *supra*, note 31 at 303 (by early 1995, the LUC "has been reduced to a filing cabinet in the Department of Local Affairs and is now virtually nonexistent").

40. *City of Louisville v. District Court*, 543 P.2d 67 (Colo. 1975).

41. *Tri-State Generation and Transmission Assoc.*, 42 Colo.App. 479, 600 P.2d 103 (1979).

42. *Id*. at 105.

43. *Id*.

44. *Colorado LUC v. Bd. of County Comm'rs*, 199 Colo. 7, 604 P.2d 32 (1979).

45. *Id*. at 35-36.

46. *City and County of Denver, supra*, note 16 at 757-61.

47. *City of Colorado Springs*, 895 P.2d 1105 (Colo.App. 1994).

48. *Id*. at 1113.

49. *Id*. at 1115.

50. *County of Boulder*, No. 01-CV-1896, slip op. (Boulder County Dist. Ct., Oct. 5, 2004).

51. *Id*. at 13.

52. *Cottrell v. City and County of Denver*, 636 P.2d 703, 709-10 (Colo. 1981).

53. *County of Boulder, supra,* note 50, slip op. at 18-19.

54. Colo. Sup.Ct., No. 04-SA-377. At the time this article was published, opening briefs were due in January 2006.

55. *See* press release from the Governor's Office dated Jan. 5, 2005, available at www.colo rado.gov/governor/press/january05/landuse.html.

56. Memorandum from Charlie Unseld, *supra*, note 39.

57. Telephone interview with Charlie Unseld, Director of Local Government Services, Div. of Local Government, Colo. Dept. of Local Affairs (Aug. 24, 2005).

58. H.B. 05-1063, 2005 Colo. Sess. Laws, Ch. 192 at 667 (signed by the Governor on June 1, 2005).

59. Memorandum from Charlie Unseld, *supra*, note 39. The memorandum notes that nearly twenty local governments had sent newly adopted or significantly revised 1041 regulations to the state for review since January 1998, when the LUC ceased review. There may be other jurisdictions that adopted 1041 regulations since 1998 and did not submit them to the state.

60. Memorandum from Colo. Dept. of Local Affairs to Colo. Municipal and County Governments, dated June 13, 2005. (*See* website, *supra*, note 27.)

61. *County of Boulder, supra*, note 50.

62. *City and County of Denver, supra*, note 16.

APPENDIX
Colorado Counties with 1041 Regulations
(*See* author's note below)

KEY

— County does not have 1041 regulations	**?** It is unknown whether county has 1041 regulations	**yes** County has 1041 regulations, but resolution number is unknown	**N/A** Does not apply	***** Link to a general zoning resolution that addresses issues authorized by H.B. 1041

County	1041 Resolution No.	Originally Passed or Effective	Available on the Web (links last checked Nov. 1, 2005)
Adams County	—	N/A	http://www.co.adams.co.us/services/department/planning_development/dev_standards_regs.html *
Alamosa County	—	N/A	N/A
Arapahoe County	040416	06/02/2004	http://www.co.arapahoe.co.us/Departments/PW/Forms/FINALArapahoeCounty1041Regs.pdf
Archuleta County	—	N/A	http://www.archuletacounty.org/Planning/land_use_regulations/land_use_regulations.htm *
Baca County	?	?	no
Bent County	2003-7	04/21/2003	no
Boulder County	94-23 and 94-55	1994	http://www.co.boulder.co.us/lu/lucode/article8.htm
Broomfield (City and County)	—	N/A	http://www.ci.broomfield.co.us/code/index.htm *
Chaffee County	yes	12/10/1991	http://www.chaffeecounty.org/depts/planning/docs/ (see chapters 1-5, 8 and 9)
Cheyenne County	—	N/A	no
Clear Creek County	97-108	01/06/1998	http://www.co.clear-creek.co.us/Depts/Planning/zone_regs.htm#SECTION%2019.%20REGULATIONS (*see* § 19)
Conejos County	?	?	no
Costilla County	93-04 and 93-06	05/07/1993	no
Crowley County	—	N/A	no (but 1041 regs. currently under consideration)
Custer County	?	N/A	http://www.custercountygov.com/Zoning%20Res.pdf * (*see* §§ 6.7 and 8.7)
Delta County	yes	04/04/2005	http://www.deltacounty.com/documents/Planning%20and%20Community%20Development/Specific%20Development%20Regulations_1.pdf
Denver (City and County)	—	N/A	http://www.denvergov.org *
Dolores County	—	N/A	N/A
Douglas County	987-055 000-107	1987 06/22/2000	http://www.douglas.co.us/planning/documents/1041%20regs/default.htm (home page currently under repair); *see* http://www.douglas.co.us/Orgchart_top.htm (click on "Community Development," then "Plans, Regulations and Documents"). Proposed revisions at http://www.douglas.co.us/Planning/MattersReferralDraft.pdf
Eagle County	yes	1980	http://www.eaglecounty.us/uploadedFiles/commDev/Planning/ChapterVI-AmendedUNALTERED(1).pdf and http://www.eaglecounty.us/uploadedFiles/commDev/Planning/1041_READOPTION.pdf
El Paso County	—	N/A	http://adm.elpasoco.com/planning/ldc/default.asp *
Elbert County	yes	unknown	no
Fremont County	—	N/A	N/A
Garfield County	—	N/A	http://www.garfield-county.com/home/index.asp?page=788 *
Gilpin County	—	N/A	http://www.co.gilpin.co.us/CommunityDevelop/ZO%20REGS%202005%20FINAL.doc *
Grand County	1978-5-4	05/16/1978	http://co.grand.co.us/Planning/Reg.%20books/1041%20Regulations.htm
Gunnison County	yes	12/19/1990	no (regulations currently under review by county commissioners)
Hinsdale County	—	N/A	no
Huerfano County	yes	unknown	no
Jackson County	yes	unknown	no
Jefferson County	CC74-95	unknown	http://www.co.jefferson.co.us/ext/policy/chap0501.htm and http://co.jefferson.co.us/ext/dpt/public_works/planning/zoning/zoning.htm
Kiowa County	—	N/A	N/A
Kit Carson County	?	?	no
La Plata County	—	N/A	*But see* http://co.laplata.co.us/plan/code_revision/draft091704/toc.pdf (Sept. 2004 draft—1041 regs. at Chap. 74)
Lake County	yes	unknown	no
Larimer County	—	N/A	http://www.co.larimer.co.us/planning/planning/land_use_code/land_use_code.htm *
Las Animas County	yes	06/30/1976	no
Lincoln County	yes	03/08/1976	no
Logan County	?	?	no
Mesa County	—	N/A	http://www.mesacounty.us/planning/land_dev_code_chapters.aspx *
Mineral County	—	N/A	N/A
Moffat County	—	N/A	N/A
Montezuma County	—	N/A	ftp://206.168.68.47/Out/planning/LUC%20web%209-13-05.pdf *
Montrose County	—	N/A	http://www.co.montrose.co.us/LUD_ZoningResolution.pdf *
Morgan County	yes	06/28/1977	http://www.co.morgan.co.us/Documents/Morgan%20County%20Zoning%20Regs-2004.pdf * (*see* § 2-220)
Otero County	04-15	09/27/2005	no

From:	Michelle Clopton
To:	Gross Reservoir SI-20-0003
Subject:	Stop Gross Dam Expansion
Date:	Sunday, October 11, 2020 2:43:30 PM

Dear Boulder County Community Planning & Permitting Department,

I believe the Gross Dam Expansion is an unnecessary project that will cause grave environmental devastation and relies on outdated data.

I strongly encourage Boulder County Community Planning & Permitting Department members to deny Denver Water's request to expand Gross Dam. Not only will Boulder County resident receive NO benefit from this expansion, the project will cause irreparable harm to Boulder County residents as well. Over a period of at least 5 years, residents will experience dramatically increased traffic through narrow mountain roads and neighborhoods, environmental damage, noise pollution, potential for toxic contamination of natural resources, safety hazards, and reduced property values.

Please, on behalf of Boulder County citizens, vote to deny the Gross Dam expansion project.

Sincerely,

Michelle Clopton
711 Tunnel 19 Rd
Golden, CO 80403

From:	Kathy Peck
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir
Date:	Sunday, October 11, 2020 2:25:06 PM

As you review expansion plans for Gross Reservoir, I hope you will consider all alternative ways to conserve water in the Denver area. The expansion will negatively impact residents in the Coal Creek Canyon area and all those who appreciate this beautiful area.
Thank you,
Kathy Peck

Sent from my iPhone

From:	Rob MacCurdy
To:	Gross Reservoir SI-20-0003
Subject:	Expand Gross use
Date:	Sunday, October 11, 2020 1:11:43 PM

I am writing to suggest that if Denver water wants to move forward with its expansion of Gross Dam, a requirement for expanded use be put in place. Specifically, while numerous reservoirs around the state allow swimming, the Gross dam and reservoir does not. This outdated policy, which is likely a holdover from misplaced fears about Cholera during the last century, should be changed. Boulder county has very few locations for swimming, despite having a large number of lakes and reservoirs, a fact that runs counter to our public messaging about being an outdoor-oriented community. The Gross reservoir occupies a large swath of public land, yet the public is allowed to use it in highly restricted ways. Swimming must be allowed, increased parking areas must be provided, and the boating use restrictions must be eased (boat type and season length) if the dam/reservoir expansion project is allowed to proceed.

Thank you, Rob MacCurdy

Sent from my Verizon, Samsung Galaxy smartphone

From:	Fred Peck
To:	Gross Reservoir SI-20-0003
Subject:	Gross dam construction
Date:	Sunday, October 11, 2020 12:27:32 PM

Hi There

I am writing to voice my concerns about the Gross Reservoir expansion. I am NOT in favor of this project and urge you to not approve Denver Water's 1041 review application. I don't feel this project is necessary nor environmentally sound. I believe Denver Water needs to do way more in the area conservation. For example, allowing the amount of lawn watering they allow is unexceptable and wasteful.

When Denver Water can demonstrate that they ave exhausted all alternatives and brought conservation to its absolute limits, then maybe this project will be warranted.

Thank you for your time.

Fred Peck
Gilpin County

From:	brian whitney
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	I Oppose Proposed Gross Reservoir Expansion
Date:	Sunday, October 11, 2020 12:01:46 PM

I strongly oppose the proposed gross reservoir expansion.

I am a 28 year resident of one of the areas (Magnolia Road/CR68 that would be greatly affected by expansion. This project will have a very large, very long and very real, direct and daily impact on our area and safety. In addition to noise from explosions, one of the largest impacts to Magnolia will be the tree removal that will occur in the expansion area and be removed via FR 359, County Road 68 and Lazy Z. All of these roads are proposed to be improved to accommodate the significant truck and logging truck traffic.

There will be obvious impacts to property values as well. And for what? How will this massive project impact Boulder County residents favorably?

The major fallacy of this project is instead of pushing for long-term solutions that focus on water conservation during this period of climate change, Denver Water wants to ramrod a brute force approach that will negatively impact many people's lives and send the wrong message by encouraging more water usage.

Brian Whitney
881 Pine Glade Road
Nederland, CO

From:	susie gallaudet
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Oppose Gross Reservoir Expansion
Date:	Sunday, October 11, 2020 12:01:36 PM

Gross Reservoir Planning -

I am a resident of western Boulder County and remain in steadfast opposition to proposed application for expanding Gross Reservoir. In addition to impacts on wildlife and natural surroundings in general, I'm especially concerned with the duration of the project, heavy traffic on rural roads from a safety standpoint as well noxious weed invasion. The amount of logging and tree removal would be dramatic and would require road improvements just to do that one step - further changing the character of this part of the county.

Given the scale of the potential impacts and widespread opposition from residents, commissions, non-profit and other groups, I fully oppose the current request for expedited application review and feel strongly that a longer public review period is imperative. We need experts on both sides and elected officials to further review the application and provide a synopsis to the impacted residents before moving any farther forward..

--
~~~~~~~~~~~~~~~~~

Susie Gallaudet
881 Pine Glade Rd.
Nederland, CO 80466
sgallaudet@gmail.com
303-886-7428
~~~~~~~~~~~~~~~~~

From:	JANET
To:	Gross Reservoir SI-20-0003
Subject:	Please do not approvve
Date:	Sunday, October 11, 2020 11:10:09 AM

Hello,
As a resident of Boulder County I am concerned that this project is simply too big, the environmental impact and the impact of this scale of construction on County residents will be extensive.
While the dam needs to be safely maintained, this project ‘its too large. Resources focused on water conservation would be a favorable alternative.
Thanks,
Janet Robinson.

From:	Chris C. Hoffman
To:	Gross Reservoir SI-20-0003
Subject:	Gross Dam Expansion
Date:	Sunday, October 11, 2020 7:35:19 AM

Thank you for extending the review period for the Gross Reservoir and Dam Expansion project.

I strongly urge you to reject the expansion.

The project has numerous harmful impacts on the surrounding environment that others have ably pointed out.

But the primary reason for rejection is that an expansion of a reservoir now, given what we know about climate change and projected continuing aridification of Colorado and other western states, is foolhardy.

It's like a beggar believing that if he held out a bigger hat, he would get more donations.

Chris Hoffman
1280 Fairfield Drive
Boulder, CO 80305 USA
303-513-3621 (mobile)

From:	Charley Haggans
To:	Gross Reservoir SI-20-0003
Subject:	writing in opposition to expansion of Gross reservoir
Date:	Saturday, October 10, 2020 9:38:38 AM

Hello,

I am writing to register my opposition to expanding Gross reservoir. The many reasons for opposing the expansion have been well documented in letters and opinion pieces in the Daily Camera, so I won't repeat them (dramatic environmental/ecosystem disruption (loss of large numbers of trees, habitat, etc..), dramatic disruption due to construction traffic, etc. Not to mention – when sitting in a canoe on the reservoir and looking at the current dam (as we did this summer) – raising the dam by >100 feet is almost unimaginable in scope and visual disruption.

I believe Denver Water's focus should instead be on conservation and for policy change to restrict growth in an unsustainable manner rather than disrupting a significant amount of Boulder County: no matter how many water retention structures we build, there will always be a demand for more unless we learn to conserve and restrict growth.

Thus, I am asking Boulder County Elected and Administrative staff to continue efforts to oppose the reservoir expansion.

Thank you for your consideration,

Charles Haggans
1887 Joliet Way
Boulder, CO 80305

From:	taniabcf@yahoo.com
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Expansion
Date:	Saturday, October 10, 2020 8:06:18 AM

Hello- I have written before and will write again... please oppose and fight this expansion of gross reservoir... so many reasons to oppose it but honestly the times is will not be full will be more than the times it will be full. What is the point of a half full reservoir? The area is a natural gem as it is... yes I understand that at one point the initial construction creates a huge impact to the natural world and it has adjusted but this is a huge project without enough studies actually validating that the reservoir will be full after the expansion.
I will keep it simple- please ask for an extension at the very least to oroperly review the packet... do not allow this to get rushed through... thanks so much.
Tania Corvalan
Board of trustees Nederland Colorado

Sent from my iPhone

From:	jim cowart
To:	Gross Reservoir SI-20-0003
Subject:	Application Documents
Date:	Friday, October 9, 2020 4:46:33 PM

Please assemble all docs in a zip file so citizens don't have to download ~ 20 files and compile.
Thank you.

Jim Cowart
(Home Email)

From:	Alfred McLaren
To:	Gross Reservoir SI-20-0003
Cc:	Avery Russell; Magnolia News
Subject:	IMPORTANT: Proposed Gross Reservoir Expansion
Date:	Friday, October 9, 2020 4:02:31 PM

Dear Madam/Sir:

I am writing, as a resident and a 26-year U.S. Navy/Vietnam veteran who has lived almost 37 years just a couple of miles from Gross Reservoir, to express my strong opposition to the proposed expansion of Gross Reservoir. It makes absolutely no sense to me as a climate change scientist in this time of rapidly accelerating climate change and global warming. The reservoir is in Boulder County, yet the proposed expansion will not benefit its residents in any way, particularly the several hundred who live nearby. It will, in addition, absolutely destroy the surrounding environment and wildlife habitant. Finally, it goes without saying that property values and way of life, for those of us who have chosen to retire here after serving our country for most of our lives will be utterly destroyed as well….

Why must Boulder County now abandon its residents, those who live here and those who come up here every day for recreation and to enjoy its beauty, just to support more golf courses and housing developments that have nothing to do with Boulder County? Where also, is the water going to come from in these times of increasing drought to initially fill, much less sustain such an expanded reservoir?

Please do not allow the proposed expansion of Gross Reservoir to proceed further!

Sincerely,

Alfred Scott McLaren
Captain, USN (Ret.), Ph.D.
and
Avery Battle Russell
73 Aspen Meadows Road
Nederland, Colorado 80466
(303) 447-0608
alfredsmclaren@aol.com

From:	Chris Passarelli
To:	Gross Reservoir SI-20-0003
Subject:	A note in opposition to this project
Date:	Friday, October 9, 2020 1:07:25 PM

Good afternoon Boulder County Community Planning and Permitting staff,

Thank you very much for your close review of the 1041 Gross Dam expansion application. I know it's a huge amount of material and the project promises significant impacts on our county.

I want to be a generous neighbor to those living in the Denver metro, but I oppose the expansion of the reservoir at the cost of our mountain environment and ecosystems downstream. As long as Denver and its suburbs allow ample watering of green lawns throughout our Colorado summers, I can't support this project. Honestly, if Denver Water truly behaved in alignment with our dry Western environment and still needed additional storage, I'd be supportive, but I can't can't get behind trapping more water to fuel the blistering development and aesthetic irrigation.

Also on a personal level, we live on Highway 72 just below Gross Dam Road, and this would have very significant impacts on our quality of life. We're appreciative for CDOT's work over the last 2 years to bolster the canyon against future flooding, but the idea of another several years of construction traffic sounds awful (especially for a project that's not significantly benefiting our county with jobs, water, or environmental protection).

Regardless of the personal impacts, I don't believe this project is in the interest of Boulder County, its residents, or the environment. Please help prevent this construction project from starting.

Thank you very much for your consideration,
Chris Passarelli
31448 Highway 72, 80403

From:	Marca Hagenstad
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Say No to Expediting Review of Gross Dam
Date:	Friday, October 9, 2020 12:34:41 PM

Hello,

The Gross Dam Expansion is the biggest threat to sustainability in Boulder County.

Every decision made from today forward **must** examine 1) carbon emissions, 2) social equity and 3) biodiversity.

We need leaders who are willing to make bold decisions to steer us into the new future. We cannot repeat mistakes of the past and make decisions based on the way previous decisions were made. We are in an absolute mess.

Our forests are burning, our glaciers melting, our animals are dying. At record paces.

I beg of you to do everything in your power to stop this project. The time is NOW to start building a future that works for everyone, including future generations and biodiversity. We need immediate radical change and we are counting on our leaders to have a beautiful vision of the future. We will come together as a society and rise to solve problems of social justice and biodiversity and circular economies. It is a beautiful future socially. I see it and I hope you do too.

Expansion of Gross Reservoir is continuing our destructive ways of the past. It simply is not possible to approve and want a healthy future.

Please do not approve an expedited review. The public needs to be made aware of the horrible impacts this project will have on Boulder County, forever. And let's be honest – its not about 'saving the planet' anymore. The planet will go on whether we are here or not. Its about saving humanity.

Thank you,
Marca Hagenstad

Marca Hagenstad

circle economics
marca@circleconomics.com
Tel: 720-705-2690
www.circleconomics.com

From:	Avery Russell
To:	Gross Reservoir SI-20-0003
Subject:	Proposed Gross Reservoir Expansion
Date:	Friday, October 9, 2020 11:15:40 AM

Dear Sir/Madam: I and my husband, Alfred S. McLaren are strenuously opposed to the expansion of the Gross Reservoir and Dam. We who live on Aspen Meadows Road will be adversely impacted by the traffic to and from the site for years to come. More importantly, the expansion is a case of bureaucratic folly. The Colorado and Frazier Rivers, which are already strained, will not have sufficient water to supply the amount of additional water proposed. Also, it is not at all clear that the water needs of Denver suburbs cannot be met by water conservation. We who live up in the "high country" are ardently protective of the wildlife in our area, which has already suffered greatly from the depredations of the U.S. Forest Service. The Gross Reservoir area is a calving ground for elk. This will now be a thing of the past if the project is allowed to go on. Countless wild animals will no longer have a home and will disappear from this area. Please consider the future more broadly than the Denver Water Board is capable of, which has only its narrow purposes and self-interest at stake. Sincerely, Avery Russell, 73 Aspen Meadows Rd, Nederland, Co 80466.

From:	Deborah Greenfeld
To:	Gross Reservoir SI-20-0003
Subject:	Gross Dam Expansion
Date:	Friday, October 9, 2020 8:43:53 AM

Dear Commissions,
The only benefit of this project is to the water board and the developers. Shouldn't we be focusing on water conservation rather than water grabbing? Boulder County should listen to its residents and block this endeavor. Brings to mind a "David and Goliath" story...
Sincerely,
Deborah Greenfeld
1565 Lazy Z Rd
Nederland, CO 80466

Sent from my iPad

From:	Lucien Heart
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Cc:	Anne Heart
Subject:	Gross Dam Expansion - Please hold a full review process for the 1041 Application
Date:	Thursday, October 8, 2020 10:08:37 PM

Hello,

First off, thank you for your service to the county and the community. You don't have an easy job.

I'm writing to urge you to consider a few very important points around the 1041 application process for the proposed expansion of Gross Dam.

- Please conduct a FULL review process. Denver Water's request to expedite the review is out of integrity
- Please extend the review process at least 90 days... (I don't know about you, but I can't read 30K pages of text in the alloted amount of time.)
- Please consider rejecting Denver Water's application and stopping the Gross Dam expansion project. It will cause lasting damage for the county, the environment, and all of us who live here.

Again, these are not easy issues to preside over and I thank you for your consideration on this critical matter. Do what you know is right in your heart.

Warmly,

Lucien and Anne Heart

Lucien Heart
303-907-7249
Linkedin
[he, him, his]
SaveBoulderCounty.org

From: Giles Goodwin
To: Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject: Gross Dam Expansion
Date: Thursday, October 8, 2020 5:13:29 PM

Hello Boulder County commissioners and staff,

I live very near Gross Reservoir and would like to raise my concerns about the expedition request made by Denver water. As a resident who will be impacted by the expansion I am spending time reviewing all provided material. The process is time consuming due to how the materials are organized and the content is presented in an inconsistent manner. I feel it's reasonable for those of us who stand to be impacted to have some additional weeks to review it properly.

Separately, I would like to say thanks to all of you who make Boulder County such a wonderful and safe place to live. The quality of the open space, infrastructure, and overall environment is outstanding and we appreciate all of the work you do to make this happen.

Giles Goodwin
78 Pika Rd, Boulder, CO 80302

From: Sharon Rouse
To: Gross Reservoir SI-20-0003
Subject: NO expansion of Gross Reservoir, many reasons; conservation FIRST
Date: Thursday, October 8, 2020 12:42:09 PM

Sent from my iPhone

From:	Alex Markevich
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Docket # SI-20-0003 - Gross Reservoir and Dam Expansion 1041 Review
Date:	Wednesday, October 7, 2020 9:42:26 PM

Dear Boulder County Commissioners,

As my representatives in the government of Boulder County, I expect you to fully and seriously exercise Boulder County's 1041 review rights with regard to Denver Water's proposal for the expansion of Gross Reservoir and Dam.

The starting point for such serious review is to allow citizens appropriate time to fully read, understand, and comment on Denver Water's 354 page submission and the tens of thousands of pages of supporting documentation. Given this large amount of submitted material, you as the Boulder County Commission need to allow citizens sufficient time to arrive at informed opinions on the submittal and to formulate their comments.

A deadline of October 14, 2020, coming so soon after Denver Water's submission, allows only a ridiculously short period of time for citizens to formulate informed comments on such a complex, lengthy, and poorly organized submission.

A more appropriate time period for comments would involve at least a two month window after public notice of the existence and availability for review of the submission.

Therefore, I expect you to extend the time period for public comments.

Regards,

Alex Markevich
5570 Magnolia Drive
Nederland, CO 80466
ajmarkevich@gmail.com
(303) 442-4475

From:	George Craft
To:	Gross Reservoir SI-20-0003
Subject:	Stop Gross Dam Expansion! Please!
Date:	Wednesday, October 7, 2020 9:38:42 PM

We think it is wrong to expand Gross Reservoir and urge you to decline the permit. Gross Reservoir is a spot of great beauty and usefulness for many of the wholesome things in our lives like fishing and camping and just looking out over the lake at the cool clear water and the mountains beyond. Expansion would eliminate recreational activities like fishing, hiking, and canoeing for a long time. It will result in the clear cutting of hundreds of thousands of trees. The construction traffic will mean increased noise and disturbances to neighbors and recreation seekers as well as be dangerous unto itself. The construction will bring toxic chemicals. Fresh concrete is an ugly contaminant. To what end? It is said that Denver Water doesn't even need the storage. And the Colorado River flow is so reduced it is debatable if they would even get the water to store.

It's a bad idea! Please turn down the permit.

Thanks,
George & Deb Craft
Boulder
gcrafty@yahoo.com

From:	Lueb Popoff
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir Expansion project
Date:	Wednesday, October 7, 2020 5:35:12 PM

Dear Boulder County,
Please do not allow Denver to push you to fast track their 1041 review application for the Dam Expansion Project. This project is huge and very destructive on many levels. After having many conversations with Denver water board employees around the reservoir over the last 5 years while kayaking, they are very cavalier and aloof about how the project will proceed and the process for extracting 100's of thousands of trees 11.2 linear miles around the reservoir prior to the elevation of the damn. They just want the O.K. so they can do whatever they want without any accountability. Given the remote location of this damn, we feel there won't be a lot of supervision to scrutinize their work ethic and progress.
Regards,
Lueb Popoff and Annie Forester
5915 Flagstaff rd.
Bouder, Co 80302

From: nina judd
To: Gross Reservoir SI-20-0003
Date: Wednesday, October 7, 2020 5:20:14 PM

The plan to expand Gross is just   Way Too Gross!
Please reconsider

From:	Bob Story
To:	Gross Reservoir SI-20-0003
Subject:	Kill it
Date:	Wednesday, October 7, 2020 5:18:56 PM

Stop the expansion of the dam. Period.

Bob Story
Boulder County Resident.

From:	Dana Edwards
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Public Comment regarding Denver Water 1041 Application
Date:	Wednesday, October 7, 2020 4:29:45 PM

Dear commissioners,

Denver Water's recent 1041 application CLEARLY shows how little they care about Boulder County, the impact this project will have on its residents, and the availability of clear, concise information regarding the Gross Dam Expansion. The length, breadth, lack of clarity and consideration is unacceptable. As a citizen, I reject their request for an expedited review, and request of the Boulder County Commissioners that an extended review period be allowed.

Thank you,

Dana C. Edwards
www.linkedin.com/in/danacedwards/

From:	Andrew Currie
To:	Gross Reservoir SI-20-0003
Subject:	re: proposed Gross Dam review
Date:	Wednesday, October 7, 2020 3:15:33 PM

Greetings,
I'm a 30+ year resident of Boulder county. I have been tracking this project and i do not support it. Re: The proposal under review:
This project if approved will have a devastating effect on our Boulder County. Expediting the review is not acceptable. The application and supporting docs are poorly organized and difficult to analyze. It can not be quickly reviewed.
* Therefore please do not rush this important process. Please extend the public comment period for at least an additional 30 days.
Thank you,
Andrew Currie
444 Highland Ave
Boulder CO 80302

From:	Pete Durkin
To:	Gross Reservoir SI-20-0003
Subject:	Gross Dam Comments
Date:	Wednesday, October 7, 2020 3:02:18 PM

A few points of consideration for the County and its residents, including those who are fortunate enough to be able to afford to live near Gross Reservoir:

1) The expansion of Gross Reservoir was a compromise out of the cancellation of the Two Forks project. We should agree that it's the lesser of two evils in comparison. Anyone who has purchased property near Gross Dam in the last 30 years has been made well aware of the compromise and that this expansion was coming.

2) The Gross Dam is already there. It certainly wouldn't be able be built at all from scratch today. This is one of Denver Water's last opportunities to expand capacity and provides valuable redundancy.

3) You really don't want to live 20 miles from Denver while it's in a water crisis, do you? We're all on the Front Range and are all living in a place that wouldn't be habitable to this scale if it weren't for diverting water from the Western side of the Divide. It's hypocritical to rank the needs of one community to another based on this fact.

4) Boulder itself has blocked off some of the most beautiful land in the Indian Peaks to protect its water supply. We should help our neighbors do the same.

5) Denver Water is clearly a better steward of resources than they were when they were trying to force Two Forks in. Everyone on board says as much. They are operating in good faith here.

5) Conservation should be a focus for ALL communities on the Front Range, regardless of what happens to the Gross Dam. I see sidewalks being watered on a daily basis here in Boulder by poorly calibrated sprinkler systems. We should all try to use less water - but that does not take into account the rising population and water security needs of a drier future. There has to be a balance here, and given water's essential nature to life, we do need to ensure that the millions of people on the Front Range have access to it.

I certainly feel for those residents who will have to deal with increased truck traffic or a change in their views of the Dam, but for the rest of the Front Range, we are all complicit in living in an area that does not naturally have abundant water resources. These are the types of projects necessary to provide those resources, and one of the last opportunities to do so for DW.

Thanks,
Peter Durkin
Boulder

From:	Cara Anderson
To:	Gross Reservoir SI-20-0003
Subject:	A very bad idea
Date:	Wednesday, October 7, 2020 2:33:51 PM

Esteemed Commissioners,

As a long-time resident of Boulder, I would like to express my extreme objection to the proposed Gross Reservoir expansion. Before such a huge project is undertaken, large-scale efforts to change water-guzzling habits in the Front Range should be initiated, which has not been the case. This expansion would inflict unimaginable environmental damage on the surrounding area, leading to a loss of hundreds of thousand of trees and destroying the habit of countless species. Colorado is subject to droughts, and with climate change, there’s no way to know if there would even be enough water to fill an expanded Gross Reservoir.

Please use all of your powers of persuasion and legal means to resist this ill-advised project.

Respectfully,
Cara Anderson
2445 Juniper Ave 80304
303-444-6123

Sent from my iPad

From: Anita Carrick
To: Gross Reservoir SI-20-0003
Subject: Gross Dam Road
Date: Wednesday, October 7, 2020 12:57:04 PM

Gross Dam Road is **20 mph road, not 25 as Denver Water states,** they will travel.
Gross Dam Rd is a hard packed dirt road and needs to be maintained by Denver water, since they are using it daily. The homeowners do not want a gravel road. Are they going to put the road back to original way they found it, and replant 90 feet trees they would be removing**? One large truck a day causes many ruts, they would have to maintain it weekly.**
Homeowners are challenged each day walking to their mail boxes, which are not near their home. Many people and dogs have almost been hit by Denver water vehicles.
They are not going the speed limit. If we wanted to live next to a highway, we would of purchased homes elsewhere.
Why would you allow them to remove trees and widen the road on the **widest two corners**, on the road already. They cannot widen the road in many places as houses are only a few feet from the road. So why widen it, when you could not widen the entire road. If a truck is only going 20 mph, they can wait for another truck to pass. No need for two semis to be passing each other on a blind corner! They carry CB radios, they should talk.
Denver water said they would handle dust control, they have not, it is a health issue breathing all the dust they are creating, and they have only just begun the project.
They did not adhere to Boulder county Covid 19 regulations, and when we asked Denver Water about the covi19 situation at the boat launch, they said they will remain open, and never handled the social distancing situation.
Why is Denver Water exempt from health issues **with Covid19, they should have been sited. If they will not follow Covid 19 rules, then they are not likely going to follow any guidelines for the neighbors of Gross Reservoir.**
There are a dozen homes that currently went up for sale, because homeowners are realizing Denver Water is not looking out for the Gross Dam community.
The wildlife has already diminished.
Health and safety of homeowners, should come first. There is a railroad track without safety arms, this could be deadly to neighbors, if semis are allowed to go around a corner two at a time.
If they have to go slower, one truck at a time, then that is what needs to happen.

From:	Ric Rawlins from old mac
To:	Gross Reservoir SI-20-0003
Subject:	Please read this list and stop this Dam Expansion
Date:	Wednesday, October 7, 2020 11:20:36 AM
Attachments:	gross DAM Reasons.pages

A zoom meeting indicated I and my neighbors property will be damaged by the increase flow in South Boulder Creek. To fill the new dam to capacity. Please ! This would be devastating to our town…Stop this now…
Ric Rawlins, Resident for 47 years.

From:	Al Evans
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Gross Dam Review
Date:	Wednesday, October 7, 2020 10:45:42 AM

Boulder County:

1. Please take the appropriate amount of time to review the 354 page application for the Gross Dam expansion project.

2. The idea of providing more water to Suburbia is ridiculous The last thing Colorado needs is more people moving here.

3. FYI   I have lived in the area foothills for about 50 yrs. I don't/ can't have a lawn, outside plants etc. Why to the folks in Suburbia get these things at our expense?

4. Yes the construction will have a huge negative effect on both the Gross Dam area and Coal Creek Canyon.

Thank You

al

From:	Brent Heaviland
To:	Gross Reservoir SI-20-0003
Subject:	Gross expansion
Date:	Wednesday, October 7, 2020 10:42:14 AM

Please do not allow Denver Water to continue to bully Boulder and Jefferson Counties. This project will have a very negative effect on Boulder Co and Jefferson Co residents living in the area let alone the negative environmental impacts. The application and supporting documentation is poorly presented and difficult to analyze. The review can not and should not be expedited. Please don't rush to judgement and demand that public comment time limit needs to be extended for at least an additional 30 days.

Patricia Heaviland
Coal Creek Canyon resident

From:	Uriah Beauchamp
To:	Boulder County Board of Commissioners
Cc:	Gross Reservoir SI-20-0003
Subject:	Gross Dam Expansion
Date:	Wednesday, October 7, 2020 9:42:12 AM

Hello,

I am writing to express some deep concerns I have surrounding the submission of the 1041 application and request to expedite.

First, this project will be extremely detrimental to critical ecosystems, tourism and recreational fishing. The overall effect on Boulder County would be devastating. Expediting this review and circumventing the process and opportunity for thorough review and citizen input is NOT ACCEPTABLE.

The submitted application is purposefully unclear in its wording and a structure. The information presented is poorly organized and difficult to discern, and more time and care must be taken to ensure this application is given its due scrutiny.

I repeat that this process must not be rushed and the public comment period be extended to allow proper forums for analysis, input and rebuttal.

Please heed my words as a concerned citizen of Boulder county and active user of this water.

Uriah Beauchamp

From:	Chris Hansen
To:	Gross Reservoir SI-20-0003
Subject:	Support for Gross Expansion
Date:	Wednesday, October 7, 2020 9:08:49 AM

I wish to submit my support, as a life-long 57 year Boulder native, to the expansion of Gross Reservoir.
Chris Hansen
3100 23rd St, Boulder, CO 80304

From:	Jamie Morin
To:	Gross Reservoir SI-20-0003
Subject:	Comments on Gross Reservoir
Date:	Wednesday, October 7, 2020 8:26:53 AM

Boulder Country,

Two comments here.

First, this project should not be allowed to continue in our county. Too much environment destruction including air, water and land pollution in our mountain parks.

Second, we should not allow any construction access via Flagstaff Mountain road! This would be another environmental disaster and quality of life issue for Boulder. Close the top of the road completely for assess to Gross.

Thank you. Please try to stop this madness.

James Morin
Mapleton
303 817 0866

From:	Mary Karner
To:	Gross Reservoir SI-20-0003
Subject:	Reservoir expansion
Date:	Wednesday, October 7, 2020 7:57:40 AM

As a 68-year-old Colorado native I'm going to straight up say do not approve the expansion. Water is finite and when we expand capacity at one location we are taking it from someplace else. What we really need is a limit on water taps, yes that will make properties more expensive however we live in the arid West and need to find other ways to manage our water resources. Let's figure out every conservation method possible. First look at landscaping, Kentucky blue grass does not belong here nor the sprinkler systems to keep it green. Let's conserve the water we have for agriculture and our food supply.

Regards, Mary Karner

Sent from my iPad

From:	Eliza H Zimmerman
To:	Gross Reservoir SI-20-0003
Subject:	Dockett # SI-20-0003
Date:	Wednesday, October 7, 2020 7:36:59 AM

Dear Boulder County Commissioners,
In regards to the 1041 review for the expansion of Gross Dam and Reservoir, I am oppose to the expansion. If approved, the negative impact to the environment, the neighboring areas, the noise pollution, the added heavy traffic, the wildlife and the quality of life to residents will be devastating and for an expansion that is totally unnecessary. The greater negative impact to the rivers and wildlife/fish has yet to be seen in the future if this expansion is approved and completed. It is impossible to predict or verify what Denver Water had stated in their 'studies' and results in supporting their claims in order to obtains all permits. The 370 page application definitely will need to be looked at and verify as well. This process will need time and real studies to validate. Their studies/claims need to be updated as well. I urge the commissioners to take your time to study and investigate their claims. This expansion doesn't just affect us now, it will haunts us for years while it is being built and the ill effects will continue to haunts us, our children and the environments forever. There will be no turning back to replace the trees that are lost, the animals/birds/fish that will perish from this project. Denver Water should consider conversation of water option for their clients. I grew up in the Bay Area in CA and water conversation has always been a way of living in CA. I have seen in the cities here how wasteful many people are of our water. Sprinklers would be on timers that would come on automatically...even on a rainy day. Broken sprinklers or non maintained ones are shooting waters into the sidewalks. People leaving their hoses with water running. I can also imagine faucet on with water running full stream when brushing teeth...etc. Denver Water has to exercised all options in water conservation. Building a bigger dam to store water that may never be there to fill it will not solve any water need problems in the future.
The Corp of Engineering sure didn't do their job conducting, reviewing or verifying all the studies. Please do not rush the process but to take the time to verify all their documents. We cannot afford to make the mistakes that will affect us for life.
Sincerely,
Eliza Zimmerman

From:	Scott R Fincher
To:	Gross Reservoir SI-20-0003
Subject:	Why?
Date:	Wednesday, October 7, 2020 6:57:44 AM

Hi. I've been following this story fairly closely but still don't understand why Denver Water wants to do this. There does not appear to be an urgent or pervasive problem they need to solve, let alone at Boulder County's expense and the expense of the habitat that will be destroyed. What's the justification beyond a land grab based on rights established MANY years ago and why should those old rights granted under different circumstances apply now?

Scott R Fincher
303.886.0566

From:	Peter Leuenberger
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Date:	Wednesday, October 7, 2020 1:40:36 AM

Hello,

I am writing in regards to Denver Water's attempt to bully us into permitting a project that has no value to our community, is bad for the environment, and with returns on investments that are not sufficient to support such consequences. To summarize :

1) This project will have a devastating effect on Boulder County. Expediting the review is not acceptable.
2) The application and supporting documentation is poorly organized and very difficult to analyze. It can not be quickly reviewed.
3) The county must not rush. DEMAND that the public comment period needs to be extended for at least an additional 30 days.
4) Consideration of traffic issues on flagstaff road have not been addressed and the impact of such a project on local resident would be dramatic. If you must approve this project, Denver Water should be forced to use the road from Golden and not Flagstaff. Between tourists, local residents and the difficult road, it would not be acceptable in my opinion.
5) If you must accept this project, Denver Water should be charged for costs to the environment (hauling so many truckloads everyday, that has a huge pollution cost.

I live in Boulder county, at 679 Cougar drive, up flagstaff.

Thanks for your attention,
Peter Leuenberger.

/720) 675 7255

From:	Cully Little
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Objections to the Gross Dam Expansion Project
Date:	Tuesday, October 6, 2020 5:04:42 PM

Hi,
I am a Boulder County resident and home owner, and as such I am emailing in regards to the gross dam reservoir expansion project. I am very opposed to this project on a number of grounds. 1) The work to build the dam will cut down many trees, and devastated happitates, as well as removing valuable recreation land to the residents of Boulder County. 2) There is no real need for the dam expansion; the choice was to increase reservoir sizes vs. advocating for water conservation, which would be far more effective. 3) This dam project would not benefit Boulder County residents, the water instead intended for Denver to help fuel the expansion of the Denver metroplex.
I demand that the public comment period be extended by an additional 30 days for a proper review of documents.
Sincerely,
Dr. Charles Little
919-536-2295

From: GERARD KELLY
To: Gross Reservoir SI-20-0003
Subject: Need More Time To Comment
Date: Tuesday, October 6, 2020 2:25:22 PM

Hello.

Thank you for supporting the 1041 review of the Gross Dam Expansion. As you know, this project is quite complex with many significant ramifications, including adverse environmental, social and economic impacts within Boulder County and the West Slope watershed. Therefore, I vehemently oppose an expedited review. There is no way County citizens can drop everything and submit comments of any substance and value by October 14. This project is too big and consequential. Assumptions to justify the need and benefits of the project no longer apply. The project no longer presents a cost-effective solution in light of climate change and an extended drought with no end in sight. The environmental costs can no longer be justified when water may not be available to use the increased reservoir capacity. Please seriously consider extending the review until at least the end of the month. This is not too much to ask for such a project. Please consider the review times of similar projects that have comparable impacts. Do not let Denver Water drive the process. The amount of time needed to review the project and make meaningful comments should drive the review schedule.

Sincerely,

Gerard Kelly

Boulder, CO

From:	Wufoo
To:	Boulder County Board of Commissioners; Hackett, Richard
Subject:	Gross Reservoir Land Use 1041 Determination [#52]
Date:	Tuesday, October 6, 2020 2:05:01 PM

Name *	Brooke Carrick
Email *	carrick.brooke@gmail.com

Enter your comments (or attach a comment document below): *

Hello,
I live at 2089 Gross Dam Road right at the corner that is proposed to be widen due to the expansion. We do not have central heat or air (nor do many of the houses up here) and dust from all the trucks is already a problem. If they widen the road it will be unbearabe and we wont be able to open the windows at all. The particular corner is already very wide (we pull a 45ft trailer all the time) and multiple trucks are always passing us there. I can't see a good enough reason to widen that part of the road where other spots aren't able to be widend at all. The dust has gotten so bad I've noticed the trees and grass dying along the road. With all the Denver water traffic it is hard to walk to my mailbox. My mailbox is 1/2 mile down the road from me and the trucks go by so fast and there are blind corners that I've almost been hit twice now just this summer. Gross Dam Road was not built for this much traffic or use. I have lived here for 5 years and no accidents have happened on this road until this summer. Three accidents have happened because the dirt road gets so bummy from the big trucks driving on it and then motorcycles and cars are getting into accidents. The bumps are so bad that it moves your car over!
Thank you,
Brooke

Please check box below *	• I acknowledge receipt of the Open Records Notification

From:	Dave Perkins
To:	Gross Reservoir SI-20-0003
Subject:	Gross reservoir expansion
Date:	Tuesday, October 6, 2020 1:41:03 PM

Hello commissioners of Boulder County, my name is David Perkins and I live on Gross Dam Rd. The proposed dam expansion is not only an environmental disaster from open coal ash pits to silica dust and sediment that will kill everything in the s. Boulder creek and do much harm to humans. I know this because I work in the construction industry and silica dust is one of our major death beds we avoid by wearing PPE. Are you gonna have the entire area within 5 square miles wear PPE during the proposed construction? I am originally from the southeast and it baffles me that y'all water grass in roadways and businesses that never see a foot set upon it. The entire west is under major shortages of water and y'all want to let Denver Water take more water for Greed. Yes I said greed, this has nothing to do with the need for more water but everything for a dollar. On Denver Waters own website you will see water usage has declined dramatically just by citizens taking action. If you and others like yourselves all over the west in the so called leadership roles of our local communities would take just a little bit of common sense action there would be water for all in the west. THERE IS NO NEED TO WATER GRASS BUT ONCE A WEEK AT YOUR HOME, and that is being generous. There are thousands of businesses that waste precious water for looks and appearance. This pretentious attitude is a big reason we have no water. If you want pretty green grass and lots of trees go live in the south or northwest. Coming from the south where environmental regulations aren't a good talking point I was expecting to see them implicated here in Colorado. Although I have come to find out over the last 6 years that the front range is one of the most polluted areas in the country and it's all because of mans ignorant decisions and greed. Well I've said my piece and just hope y'all have the intestinal fortitude to act for the people and for generations to come by saying no to this disastrous proposal of raising the dam at Gross Reservoir.

Thank you for your time, Semper Fi,
David B. Perkins

Sent from Yahoo Mail for iPhone

From:	Hope Prinkey
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir Expansion Project
Date:	Tuesday, October 6, 2020 1:31:01 PM

Hi There,

Recently, we received a notice that Denver Water has submitted their 1041 application and we have until October 14, 2020 for comments. This timeline for review is rushed-especially for a project that will have such a devastating effect on Boulder County. The application and supporting documentation are poorly organized and difficult to understand. So, we urge you to extend the public comment period for at least an additional 30 days and not give Denver Water special treatment.

Thank you for your consideration!

Blessings,
Hope Prinkey

From:	Ginger Riversong
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Reservoir comment
Date:	Tuesday, October 6, 2020 1:16:57 PM

Dear Commissioners:

What a fiasco, what a blatant railroad attempt! Really, public comments cut off on Oct. 14, in a week?

This project will be terrible for Boulder County and it should not proceed. The public - ALL of us in Boulder County, who will all be affected - should have time to comment on this misguided application. You must extend the deadline for comments; the impacts to Boulder County will be too significant to allow a quick push-through by Denver Water. Denver needs to do more conservation; we do not need a Gross Reservoir expansion!

Thank you for taking my comments. Please extend the comment deadline.

--
Ginger Ikeda
Boulder, CO

SHARE THE ROAD :)
Riders: Be Bright and Be Seen; Rules of the Road
Drivers: Put down the @%$ cell phone and Save a Life; 3 Feet Between; Pass <15 mph above bike's speed. THANKS!

“The problem is not to find the answer, it's to face the answer.”
- Terence McKenna

“It takes courage to grow up and become who you really are.”
-ee cummings

From:	Tory Capron
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Gross Reservoir project
Date:	Tuesday, October 6, 2020 12:09:26 PM

To whom it may concern,

This project will have a very large, very long and very real, direct and daily impact on the Magnolia area and all of the safety of its residents. In addition to noise from explosions, one of the largest impacts to Magnolia will be the tree removal that will occur in the expansion area and be removed via FR 359, County Road 68 and Lazy Z. All of these roads are proposed to be improved to accommodate the significant truck and logging truck traffic.

Please do not let this expansion happen. Victoria Capron

From:	Justin Groom
To:	Gross Reservoir SI-20-0003
Subject:	SI-20-0003
Date:	Tuesday, October 6, 2020 11:52:37 AM

To whom it may concern;
I am writing to express my opposition to the expansion of Gross Reservoir. I am a resident of Chute Road which is right off of Gross Dam Road and on the proposed route of the construction vehicles. Chute Road is one mile down Gross Dam Road and in that first mile the elevation changes 500 vertical feet. The road is unpaved and is so steep coming back up from the reservoir to Hwy 72, that large trucks typically can't go more than 5-10mph... in good weather. This road also has blind curves and a nearly 90-degree switchback uphill… and I honestly can't imagine a semi-truck full of trees on this road. I was stuck behind one dump-truck, one time, and eventually had to pass. There are steep drop-offs with no guard rails as well. This issue alone is going to cause numerous accidents.

But my number one issue with the expansion of the reservoir is the environmental impacts it will have. I'm sure you know the stats but hundreds of thousands of trees being removed seems unnecessary and will devastate wildlife in the area for a long time. As a property owner downhill from the reservoir… what impacts will this construction have on my water table? My water source is a natural stream and "there's a big risk heavy metals will leach into our water table including into South Boulder Creek which will affect our health and safety**". How many other property owners are downstream? What impact will raising the spillway 126 feet have on the fish? South Boulder Creek is one of the best fly-fishing spots in the world and raising the spillway could destroy the fish population, along with increased Mercury levels. If this type of construction project can take place in Boulder County, a county that prides itself on being so environmental… then frankly the rest of the country is screwed. Bulldoze it all and put up more box stores. I feel that we, residents of Boulder County, need to stand up and fight the corporations who want to destroy the environment for greener lawns. Thank you for your consideration.

Best,
Justin Groom
justin@justincolorado.com

** Source: https://www.savebouldercounty.org/who-is-affected1

From:	Karen Tourian
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Dam Expansion
Date:	Tuesday, October 6, 2020 11:38:52 AM

Dear Comissioners,

I understand that Denver Water has submitted its 1041 application for the dam expansion, requesting expeditied review. Given the extent and complexity of this project, this application deserves careful and thorough review, which should not be rushed in any way. Denver Water has been developing this project over 20+ years; Boulder County needs to do its due diligance in review of this application.

The project seems doomed to futility, as water in the Colorado River and its tributaries continues to diminsh such that there will rarely be an opportunity for Denver Water to be able to divert sufficient water to fill the enlarged reservoir. The impact of construction and damage to the area involved in enlarging the dam are substantial risks with very little reward. There is no meaningful benefit to Boulder County for this project, and it will provide little long-term benefit even to Denver Water.

As a specific comment on the construction plan, with regards to Gross Dam Road, the connection between Flagstaff Road and highway 72: Denver Water is responsible for the current maintenance of Gross Dam Rd. from Flagstaff Rd. to the rail road crossing. They do an inadequate job- the road is rarely graded (unlike the Boulder County side from the rail road tracks to Highway 72, which is graded regularly), forcing one to drive/ride on extensive rough washboard with pot holes, and in the winter they plow snow much later in the day than Boulder County. It is hard to see that they will be able to keep up with the maintenance of this dirt road with the planned number of large truck trips each day, between materials for the concrete coming in, and felled trees going out- it would need to be graded on almost a daily basis to keep the road surface well maintained. Their current negligence does not bode well for how they would manage these tasks during construction. Travel for those of us who use this road regularly will be impeded not only by the construction traffic, but also by a further deteriorating road surface.

Kind regards,

Karen Tourian
258 Cougar Dr
Boulder, CO 80302

From:	Julie Faerman
To:	Gross Reservoir SI-20-0003
Cc:	Boulder County Board of Commissioners
Subject:	Expediting the Gross Dam Expansion review is not acceptable!
Date:	Tuesday, October 6, 2020 10:48:10 AM
Importance:	High

Dear Boulder County,
We just received the postcard YESTERDAY, Oct. 5...how can you give us residents only 11 days to respond? That is not fair. WE get more time to review new home builds than this. THIS IS RIDICULOUS!!
This project is NOT needed!!! It will devastate so many things in our neighborhood and environment.
This project will have a devastating effect on Boulder County. **Expediting the review is not acceptable.**
The application and supporting documentation is poorly organized and very difficult to analyze. It can**not** be quickly reviewed. It’s 354 pages long and includes references to literally tens of thousands of pages of supporting documentation. It will take weeks for trained specialists to wade through this information - there is no way concerned citizens can be expected to read and understand everything that is being thrown at them.

The county must not rush. **AS A RESIDENT, I DEMAND** that the public comment period be extended for at least an additional 30 days.
Sincerely,
Julie & Jason Faerman

From:	Anna McDermott
To:	Gross Reservoir SI-20-0003
Subject:	Denver Water 1041 application
Date:	Tuesday, October 6, 2020 10:22:47 AM

Dear Boulder County Commissioners and Planners,

I just received the review notification for the Denver Water 1041 application with a deadline for response Oct 14, 2020.

I am deeply concerned about the expedited time frame for individuals to respond to this document. This project will have a devastating effect on Boulder County. Expediting the review is unacceptable! The application is 354 pages long and the supporting documentation is poorly organized and very difficult to analyze. It can not be quickly reviewed. The county must not rush and must demand that the public comment period needs to be extended for at least an additional 30 days! It is critically important that the citizens being affected have an appropriate amount of time to try and sort through all the details contained in this document. If it is anything like what DW has submitted in the past past it is full of issues, incorrect or invalid data, data omissions, lack of necessary details, etc. We need an appropriate amount of time to research all this information and provide you with our questions and concerns. Nine days from notification is a joke!

Please secure an extension for your concerned and highly affected citizens to enable some integrity in this process.

Thank you

Anna McDermott
1 Lakeshore Park Rd
Boulder CO 80302

From: clancyph@aol.com
To: Gross Reservoir SI-20-0003
Subject: Denver Water Gross reservoir 1041 application
Date: Tuesday, October 6, 2020 10:00:28 AM

The schedule for the review of Denver Water's 1041 application is ludicrous! You MUST expand the public review process timeline by a minimum of 30 days so that a competent analysis and review can take place. DO NOT BE COMPLICIT in their efforts to fast-track approval of this project which is fraught with problems, flawed concepts and inane outcomes. DO YOUR JOB and represent the people of Boulder County, not Denver and the surrounding suburbs.

Randall Philipsborn
5316 Pennsylvania Avenue
Boulder

Sent from my iPhone

From:	sarah hallowell
To:	Gross Reservoir SI-20-0003
Subject:	gross res. expansion
Date:	Tuesday, October 6, 2020 9:55:47 AM

To Whom it May Concern,

I am deeply concerned by the push from the Denver Water Board, to expedite the review of their proposed expansion. Let their deadline come and pass.
This a major undertaking , which I believe, will impact Boulder County in countless negative ways. The environmental impact, the increased traffic and road impact of semis running up and down Flagstaff, - a treasured recreational and visitor area, will be massive. I honestly don't think I exaggerate here. And let's also name that dams are not a viable means of water storage for the future. We have to find other ways. I am confident that we will, when it is recognized that dams simply waste too much water through evaporation, etc. Not to mention climate change and drought as the way of the future. I would like to see Denver Water Board, (as well as Denver Chamber of Commerce), take al this into consideration, and instead of stealing more water from the western slope and Colorado River basin, look for creative ways to address a serious problem that we all will deal with in our life times.

The application itself appears to be a hastily gathered, disorganized, complicated document. Ample time and thoughtfulness must be applied and allowed, in order to make the wisest decision for all.
The pubic comment period also feels suspiciously short, given the importance of what is at stake. Extending this public comment period is obvious.

I hold you each personally responsible for the import of what will unfold. Demonstrate thoughtfulness, long term and big picture understanding of what your actions will reap.

Thank you for your consideration.

Sincerely,

Sarah W Hallowell
2435 Topaz Dr
Boulder, CO 80304

From: Paul Katz
To: Gross Reservoir SI-20-0003
Subject: Gross Dam Expansion
Date: Tuesday, October 6, 2020 9:34:32 AM

I am a Boulder resident
Paul Katz
3845 Orange Ct, Boulder, CO 80304
I am against the Gross Dam expansion.

It outrageous that the Denver would be allowed to cut down so many trees in Boulder County.
Please vote against this.
I will be watching what happens.

From:	Neil Rosenthal
To:	Gross Reservoir SI-20-0003
Subject:	Denver water 1041 application
Date:	Tuesday, October 6, 2020 7:34:34 AM

Hi Boulder County,

The application from Denver Water is impossible to understand, and seems purposely absurdly long in order to obscure its contents.

I live up Flagstaff mountain, and I am incensed that Denver Water seems to not understand the corrosive and destructive effect its project will have on Boulder County and its residents, not the least of which will be all my neighbors on Flagstaff.

Please extend the public comment period, do not expedite the review—and please vote "No" regarding expanding Gross Reservoir. Please let Boulder's mountain community live in peace.

Thanks,

Neil Rosenthal
2717 Bison Dr.
Boulder 80302

From:	Keith Harper
To:	Gross Reservoir SI-20-0003
Subject:	Gross Dam Expansion
Date:	Monday, October 5, 2020 10:20:39 PM

Gross Dam Expansion will have a devastating effect on Boulder County.
And there is absolutely no need for expediting the review process.
The application is 354 pages long. It and the supporting documentation is poorly organized and very difficult to analyze. It can not be quickly reviewed by concerned citizens.
It's imperative that the public comment period be extended for at least an additional 30 days.

Thank you.
Keith Harper
2825 La Grange Cir.
Boulder, CO

From:	Kim Huffman
To:	Gross Reservoir SI-20-0003
Subject:	Gross Dam Project
Date:	Monday, October 5, 2020 9:43:30 PM

1. This project will have a devastating effect on Boulder County. **Expediting the review is not acceptable.**
2. The application and supporting documentation is poorly organized and very difficult to analyze. It can not be quickly reviewed.
3. The county must not rush. I **DEMAND** that the public comment period needs to be extended for at least an additional 30 days.

From:	Diane Scott
To:	Gross Reservoir SI-20-0003
Subject:	Gross Reservoir and Denver Waters request to respond by the 14th.
Date:	Monday, October 5, 2020 9:19:23 PM

I insist that the public comment period be extended for at least an additional 30 days, if not longer.

1. This project will have a devastating effect on Boulder County. **Expediting the review is not acceptable.**
2. The application and supporting documentation is poorly organized and very difficult to analyze. It can not be quickly reviewed.
3. The county must not rush. Please do right by Boulder County and review this request and the effects on our community thoughtfully.

I went up to Nederland this past weekend and noticed that the Reservoir there is not near capacity. As my wise mother said "use what you have before asking for more". Seems like if Denver water wanted "more" they should use what they have first before expanding another Reservoir.

Please allow more time for us to review the over 300 page document and supporting materials.

Thank you,
Diane Scott
2823 Whitetail Circle
Lafayette, CO 80026
303 818-9108

From:	Erin Witter
To:	Gross Reservoir SI-20-0003
Subject:	Denver Water 1041 Application re: Gross Dam Expansion
Date:	Monday, October 5, 2020 8:18:50 PM

I recently learned that Denver Water has submitted their 1041 Application, which gives a response date for comments of October 14, 2020. This is ridiculous!

1. This project will have a devastating effect on Boulder County. **Expediting the review is not acceptable.**
2. The application and supporting documentation is poorly organized and very difficult to analyze. It can not be quickly reviewed.
3. Boulder county must not rush. **DEMAND** that the public comment period needs to be extended for at least an additional 30 days.

Thanks for your consideration of this matter.

Erin Witter
720-988-8545

From:	Emel Gomulka
To:	Gross Reservoir SI-20-0003
Subject:	Denver Water"s 1041 Application
Date:	Monday, October 5, 2020 8:03:55 PM

Dear Boulder County Representative,
The public comment period for Denver Water's 1041 application needs to be extended for at least an additional 30 days to be able to understand the vast amount of information in the application.
Thank you for your consideration.
Emel Gomulka

From:	adam
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	NO to Gross Reservoir Expansion
Date:	Monday, October 5, 2020 7:51:46 PM

Honorable members of the board & to those it may concern,

I'm a resident of Boulder and I live at 4656 White Rock Cir, Boulder, CO 80301. I am writing you today to vote NO and deny the 1041 permit for Denver Water to expand the Gross Dam.

There are so many logical reasons to resist this project, from the loss of irreplaceable and valuable headwaters trout fishing, public access to the area around the dam and rivers in and out, loss of waterfalls and popular hiking destinations, insane environmental impact, ridiculous impact on residents, and the overall effect of that many tractor trailers going up and down Flagstaff rd, it just makes no sense to approve this project.

None of this water goes to boulder, we lose our home waters for fly fishing, we risk huge environmental impact, and Denver Water will never provide enough money to pay for all the repairs to the area, to purchase new land for public access or provide new trails and parking... the list goes on and on.

I am horrified by this expansion project, and Denver Water's own website shows our water consumption still going down while people move to the area.

Denver water has other systems that are already extensively dammed, they are working on expanding the system on the South Platte, and have been acting in bad faith during this entier process. I have been to the meetings and will continue to show up.

Please DENY the 1041 permit for Denver Water for the many serious reasons that it should not be approved. Boulder and its residents don't want this project, nor do we want its fallout and damage.

Thank you for your time,
Adam Klagsbrun
Boulder, CO 80301
914-238-0237

From:	kmanteuffel
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Docket # SI-20-003
Date:	Monday, October 5, 2020 6:42:00 PM

My name is Karl Manteuffel, and I own a home at 18 Juniper Heights Road, Golden, CO 80403. Our property is located approximately 3 miles from the propose

d Moffat dam and reservoir project. The proposed construction to enlarge the dam and reservoir would adversely impact our lives and property in so many ways.

I do not support the destruction of the landscape and forest for this project. The environmental implications for a project of this magnitude are vast. I truly believe that water conversation should be promoted and not the idea of capturing more water. Also, this water does not even serve the residents in Boulder County, so it makes no sense to allow Denver water to expand a dam that does not serve the people who live here.

We purchased this home in the hopes of living a quiet, low- key lifestyle in the mountains. We have enjoyed ample time at our mountain home, hiking, sitting on the deck and simply relaxing to the sound of birds. The Gross Dam expansion project will greatly change the way the quiet mountain lifestyle that makes it attractive in the first place and it is supposed to last at least 7 years, which is a lifetime for many of the residents here.

In case we need or want to sell our home, the home will lose value during the Gross Dam build and it will be very difficult to sell, especially for its worth, during the long construction phase of this project. Boulder County residents should not lose value in their homes because of this long-term project that serves Denver.

The traffic on Gross Dam road is already a challenge during the summer months; the roads are dusty and narrow. The truck traffic will cause severe dust and traffic on this delicate mountain road. The people living on these roads will experience great disturbance and pollution due to the high level of truck traffic associated with the dam construction. Our home is directly on Gross Dam Road and we will most certainly be disrupted during this dam construction project.

I urge Boulder County to negotiate with Denver Water to find an alternative plan which includes water conversation and not just this extremely short-sighted idea of enlarging this dam. The environmental impact is enormous. There is so much research that shows that water conservation in Colorado is the best way to secure water for future generations

Thank you,

Karl Manteuffel

kmanteuf@gmail.com
303.847.2830
www.sacredspacesdesignbuild.com

From:	U Kyaw Win
To:	Gross Reservoir SI-20-0003
Subject:	RE: Denver Water''s Application for Gross Dam Expansion
Date:	Monday, October 5, 2020 5:41:27 PM

Boulder County Commissioners:

Denver Water's expansion project of Gross Dam will have a devastating effect on Boulder County.

Its application and supporting documents are poorly organized, extremely unreasonable to analyze in such a short time. Too much is being demanded for a quick review. It should be extended for at least thirty days.

U Kyaw Win
Gandasri A. Win
8566 Flagstaff Road
Boulder, CO 80302-9531
Gawsa1999@gmail.com

From:	Tonya M Williamson
To:	Gross Reservoir SI-20-0003
Subject:	Resident concern
Date:	Monday, October 5, 2020 5:15:24 PM

I live on Flagstaff rd near the reservoir and this is not enough time to understand the impact and have public comments. I have NO IDEA the impact to my neighborhood, home value, etc.

Pls make this go through a thorough review and extend the public comment period.

Tonya Williamson
6722 Flagstaff Rd

Sent from my iPhone

From:	Inge Sengelmann
To:	Gross Reservoir SI-20-0003
Subject:	Denver Water 1041 application
Date:	Monday, October 5, 2020 4:54:48 PM

I'm a resident who will be affected by the Denver Water proposed expansion of Gross Reservoir. We anticipate not only environmental devastation, but a severe disruption of our quality of life for the duration of the years-long expansion project. In addition, we can expect that our property values will be impacted with an economic burden we can't enumerate at this time.

1. This project will have a devastating effect on Boulder County. **Expediting the review is not acceptable.**
2. The application and supporting documentation is poorly organized and very difficult to analyze. It can not be quickly reviewed.
3. The county must not rush. **DEMAND** that the public comment period needs to be extended for at least an additional 30 days.

Inge Sengelmann, LCSW, SEP, RYT (She/Her/Hers)
Cell: 305-788-6857
inge.sengelmann@gmail.com

From:	Cary Paul
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Grosse Resovoir 1041 application
Date:	Monday, October 5, 2020 4:24:47 PM

Dear Commissioners:

The Grosse Reservoir dam project needs to be carefully evaluated. I do not think it is wise or necessary to have an engineering project of this size and scope for Grosse Reservoir. Denver Water's recent 1041 application should NOT receive expedited review. Citizens need time to review the large application and information and 10 days in sorely inadequate. Please extend the review time so interested citizens and groups, and your staff too!, can read and evaluate the application.

Thank you

Cary Paul, Boulder resident
303 888-6784

From: Art Hirsch
To: Gross Reservoir SI-20-0003
Subject: Gross Reservoir 1041 Application by Denver Water
Date: Monday, October 5, 2020 4:01:40 PM

Boulder County Commissioners-

Denver Water has strategically stalled the 1041 process to make it difficult for the citizens to voice their concerns on the largest construction project ever to be constructed in Boulder County history
The Gross Reservoir project will have a devastating effect on Boulder County. SH 72 will be a safety hazard to the citizens living near the project area.
The application and supporting documentation is poorly organized and very difficult to analyze especially in a short amount of time. It cannot be quickly reviewed.
The county must not rush into this application and the public comment period needs to be extended for at least an additional 30 days.

Art Hirsch
Advocate
303-786-9111 home
7820-351-8945 cell

*"Unless someone like you cares a whole awful lot,
Nothing is going to get better. It's not."*

"*I speak for the trees, for the trees have no tongues*."
― Dr. Seuss, The Lorax

From:	Jill
To:	Boulder County Board of Commissioners
Cc:	Gross Reservoir SI-20-0003
Subject:	Gross rez
Date:	Monday, October 5, 2020 3:42:25 PM

Regarding the oer it process, I am a resident up Flagstaff Rd.

1)This project will have a devastating effect on Boulder County. Expediting the review is not acceptable.
2) The application and supporting documentation is poorly organized and very difficult to analyze. It can not be quickly reviewed.
3) The county must not rush. DEMAND that the public comment period needs to be extended for at least an additional 30 days.

Sincerely

Jill Iwaskow

Boulder, CO

From: Fred Peck
To: Gross Reservoir SI-20-0003
Date: Monday, October 5, 2020 3:03:57 PM

Commissioners:

I am writing about the Gross Dam expansion. The latest move by Denver Water expanding the review is, in my opinion, unexceptable. The application and supporting documentation is poorly organized and very difficult to analyze. It can not be quickly reviewed. The county must not rush. **DEMAND** that the public comment period needs to be extended for at least an additional 30 days.

Thank you for your time and effort in this matter.

Fred Peck

From:	Debby Rodgers
To:	Gross Reservoir SI-20-0003
Subject:	1041 Application
Date:	Monday, October 5, 2020 2:33:01 PM

I haven't the time or expertise to read the lengthy Application that DWD has sent. I can only imagine you folks will need quite a bit time to go over it properly. I demand that you not rush this through and extend the comment period at least another 30 days. This is to important not to.

Thank you
Deb Rodgers

From:	Mark Shader
To:	Gross Reservoir SI-20-0003
Subject:	Very short time to properly review
Date:	Monday, October 5, 2020 2:25:10 PM

We are totally against this plan especially with the drought conditions and projections. We should be conserving , not expanding. Watering lawns in Denver without limits of grass should not determine this project.

Thank you

Mark Shader

7245 Flagstaff Road

Boulder

Sent from my iPhone

From: Kathy Gale
To: Gross Reservoir SI-20-0003
Subject: Re: Denver Water Demands
Date: Monday, October 5, 2020 2:20:52 PM

1. This project will have a devastating effect on Boulder County. **Expediting the review is not acceptable.**
2. The application and supporting documentation is poorly organized and very difficult to analyze. It can not be quickly reviewed.
3. The county must not rush. **DEMAND** that the public comment period needs to be extended for at least an additional 30 days.

Kathy and Al Gale
Coal Creek Canyon and Boulder County residents since 1977
May you & I have Happiness,
May you & I have Love,
May you & I have Gratitude,
May you & I have Health and Wellness

From:	david lucas
To:	Gross Reservoir SI-20-0003
Subject:	1041 review
Date:	Monday, October 5, 2020 2:18:58 PM

Please extend the public comment period for AT LEAST 30 days. If this is our chance to weigh in, we should be given a fair chance.
Thank you,
David Lucas

From:	Liz Garfield
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	This is not the Supreme Court
Date:	Monday, October 5, 2020 1:54:07 PM

NO to the Gross Reservoir expansion. This expansion will negatively impact Boulder County. We need another month to review the application at least! Why are you trying to rush it? I mean, it's not like you're the Republican-controlled Senate trying to rush through a nominee to the Supreme Court. Of course, this proposal is about as awful as their nominee, but that's another matter.
I am asking you to extend the deadline for review.
Sincerely,
Elizabeth Garfield

From:	Karl Freund
To:	Gross Reservoir SI-20-0003
Subject:	What?
Date:	Monday, October 5, 2020 1:38:11 PM

1. This project will have a devastating effect on Boulder County. **Expediting the review is not acceptable.**
2. The application and supporting documentation is poorly organized and very difficult to analyze. It can not be quickly reviewed.
3. The county must not rush. **DEMAND** that the public comment period needs to be extended for at least an additional 30 days.

Thanks!
Karl Freund
SR. ANALYST HPC AND DEEP LEARNING
MOOR INSIGHTS & STRATEGY

+1 (512) 632-3634
See my blogs: http://www.moorinsightsstrategy.com/category/ai-and-machine-learning/
Request my time here : https://karlfreund.youcanbook.me/

From:	Mikaela Ruland
To:	Boulder County Board of Commissioners; Gross Reservoir SI-20-0003
Subject:	Gross Reservoir Expansion Public Comment Period
Date:	Monday, October 5, 2020 1:36:24 PM

Hello,

I am writing as a concerned frequent visitor to Boulder County. I live in nearby Broomfield and work in Boulder, along with often recreation here.

The public comment period on the expansion of Gross Reservoir has recently come to my attention. For such a large application review, the length of the comment period is laughably short. I implore you to extend the period for at least 30 days to give the community time to weigh in on this important issue.

The expansion of Gross Reservoir would have a devastating effect on Boulder County. Myself and many residents, recreators and lovers of Boulder do not want this project to continue. Please give proper time for those whose lives will be affected by this project to review and comment on Denver Water's application.

Sincerely,
Mikaela Ruland
mikaelaruland@gmail.com

From:	Stephen Robinson
To:	Boulder County Board of Commissioners
Cc:	Gross Reservoir SI-20-0003
Subject:	Concerned resident
Date:	Monday, October 5, 2020 1:25:11 PM

Hello Boulder Co Commissioners,

After all of the years of back and forth and Denver Water's lawsuit, it's amazing to me that they have the gall to ask for a 2 week turnaround to review their permit. I heartily encourage the commissioners to tell Denver Water that the review process will be at least six months unless they want the entire package summarily rejected.

I feel sure that they expect the pushback and are therefore trying their typical "bully" bowl you over approach. May our Commissioners continue to find the powerful gumption to say NO to this non-Boulder County benefitting and extremely environmentally destructive project.

V/R

Stephen Robinson
County taxpayer and homeowner (721 Cougar Drive)

Stephen Robinson, CEO
www.evenpulse.com
1942 Broadway Suite 314
Boulder, CO 80302
303.444.2912 (o)
303.579.3370 (c)
303.558.4224 (f)
stephen@evenpulse.com

From:	Naomi Rachel
To:	Gross Reservoir SI-20-0003
Subject:	DO NOT RUSH REVIEW
Date:	Monday, October 5, 2020 12:37:29 PM

Dear Commissioners. It is inane to expect all of us who care about the preservation of the land around Gross Rev to review a huge document so quickly. 354 pages of legal lingo?
We have a SPR in our neighborhood that is taking months. And it is actually an acceptable application. Destroying 250+ trees deserves and requires more time. I suggest another 60 days or more. What's the rush? The Denver Water people want us to ignore the details and get you to rush the review. But,luckily, you represent Boulder County and not the Denver Water Board.
Thank you for taking the time this application demands.
Sincerely,

Naomi Rachel
Boulder County

From: Eileen Kintsch
To: Gross Reservoir SI-20-0003
Subject: Denver Water Board expedited review request
Date: Monday, October 5, 2020 12:24:45 PM

Dear County Commissioners,

Denver Water Board's request for expedited review of the Gross Reservoir expansion to the Boulder County Community Planning and Permitting Dept. is outrageous, totally unacceptable: It is impossible to review this long, complicated application within the limited time framework of Oct. 14. The county must demand that the public comment period be extended for at least 30 days.

We urge your continued opposition to this out-of-scale project in view of the environmental damage it will inflict on Boulder County and its residents.

Yours sincerely,

Eileen Kintsch

From:	Kelley McDonald
To:	Gross Reservoir SI-20-0003
Subject:	1041 Application for Gross Reservoir
Date:	Monday, October 5, 2020 12:14:17 PM

Regarding the planned expansion of Gross Reservoir , and public comment BY Oct 14th, 2020

This project will have a devastating effect on Boulder County. **Expediting the review is not acceptable.**

The application and supporting documentation is poorly organized and very difficult to analyze. It cannot be quickly reviewed.

The county must not rush. **DEMAND** that the public comment period needs to be extended for at least an additional 30 days.

Thank You!

Kelley McDonald
Boulder County Resident

From:	David Laswell
To:	Gross Reservoir SI-20-0003
Subject:	Latest mail comm
Date:	Monday, October 5, 2020 12:13:27 PM

1. This project will have a devastating effect on Boulder County. **Expediting the review is not acceptable.**
2. The application and supporting documentation is poorly organized and very difficult to analyze. It can not be quickly reviewed.
3. The county must not rush. **Public** comment period needs to be extended for at least an additional 30 days.

Respectfully,

David Laswell
COAL CREEK AND BOULDER COUNTY RESIDENT
Sent from my iPhone

From:	Liz Morgan
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Cc:	info@savebouldercounty.org
Subject:	Extended review period needed for Gross Reservoir proposal
Date:	Monday, October 5, 2020 12:11:54 PM

Dear Commissioners,

The Denver Water 1041 Application currently requires public comment by October 14th. This is ridiculous!

The application is 354 pages long and includes references to literally tens of thousands of pages of supporting documentation. It will take weeks for trained specialists to wade through this information - there is no way concerned citizens can be expected to read and understand everything that is being thrown at them. Denver Water also included a cover letter requesting an expedited review of the documentation so that they can meet federal permit requirements.

1. This project will have a devastating effect on Boulder County. **Expediting the review is not acceptable.**
2. The application and supporting documentation is poorly organized and very difficult to analyze. It can not be quickly reviewed.
3. The county must not rush. We **DEMAND** that the public comment period needs to be extended for at least an additional 150 days.

Thank you for your continued thoughtful approach to this matter. We are in this together to protect the community and ecosystems. We can not allow Denver water to grab water and use it recklessly as they do.

Best Regards,
Liz

Liz Morgan, MA, FNTP, RWP, JD
Functional Nutritional Therapy Practitioner
www.lizmorgannutrition.com
719-966-9837

From:	Tom Klosowski
To:	Gross Reservoir SI-20-0003; Boulder County Board of Commissioners
Subject:	Gross Res Expansion
Date:	Monday, October 5, 2020 12:11:48 PM

To whom it may concern-

It seems to me that Denver Water is trying to ramrod this decision through.
It will have a major impact on those of us who live in the canyon and certainly those of us who live nearby.

1. This project will have a devastating effect on Boulder County. **Expediting the review is not acceptable.**
2. The application and supporting documentation is poorly organized and very difficult to analyze. It cannot be quickly reviewed.
3. The county must not rush. **DEMAND** that the public comment period needs to be extended for at least an additional 30 days.

Sincerely.
Tom Klosowski & Ann McCampbell
32048 Hwy 72 (coal creek canyon dr.)
Golden, CO 80403

From:	alison harris
To:	Gross Reservoir SI-20-0003
Subject:	New documentation
Date:	Monday, October 5, 2020 12:10:30 PM

I am writing to request That the 1041 application which is poorly organized and extremely difficult to analyze been extended for an additional 30 days.
Please take the time required to carefully analyze the document and possibly stop the expansion
Thank you
Alison Harris Ludlow
Sent from my iPhone

From:	Mary Maxwell
To:	Gross Reservoir SI-20-0003
Subject:	Gross reservoir and dam expansion
Date:	Monday, October 5, 2020 9:02:31 AM

Dear Planning Commision and County Commissioners,

I am writing to express my extreme opposition to any expansion of Gross reservoir and dam for many reasons.

The construction period will cause such environmental damage to both the immediate area and surrounding areas as to create health hazards for residents, visitors, wildlife, and future inhabitants. The dust, noise, vibration, lights, and traffic will impact this entire area for miles around. The mountain roads are already hazardous due to their very nature of winding roads that are at times heavily travelled with poor visibility. Add in increasing pedestrian and aggressive bike travelers, and you realize it is a recipe for increased injury and mortality to many people as well as wildlife. My husband's family farm adjoins the property that 8 North chose as their central gathering facility for Extraction's mammoth oil/gas exploration plans, and I can tell you that the quality of life impacts are many magnitudes worse than were delineated during the community information sessions. Not only are the impacts very real and tangible, but the mechanisms for enforcing health protections are either nonexistent or unenforceable resulting in vastly reduced quality of life for the entire surrounding community. I can easily envision that if this dam expansion is allowed to proceed that the entire valley and ridges in all directions will forever be negatively impacted making future generations wonder how such a debacle could ever be allowed to proceed.

The potential danger to downstream communities cannot be stressed enough. Case in point- who ever thought that deranged terrorists would fly jetliners into the World Trade Center towers?

The negative impacts to the resident wildlife herds alone should prevent this project from proceeding. It has been openly acknowledged that there would be loss of critical habitat for the Winiger Ridge elk herd such that the numbers would dwindle and the herd would suffer. Biological diversity is as important to human survival as it is to our world at large, and habitat loss is the greatest single threat to all wildlife. On a more personal note, our family depends on our hunting ability to fill our freezer with meat every year, and any threat to the ungulate population is a direct threat to the safety of our family.

My understanding of the ownership and title/legal issues is simplistic at best, but my attempts to understand all this have led me to the conclusion that when Denver Water acquired Gross reservoir there was no guarantee of the right to any future expansion. Therefore, for all the reasons I have listed above as well as the fact that they may never even be able to completely fill the expanded reservoir due to climate change and drought I vehemently urge you to deny this application for expansion in toto and outright.

Sincerely,

Mary Maxwell, MD

Resident of Flagstaff Road

Gregory D. Kirkmeyer
Property owner on Flagstaff Road

From:	Sheila Ranegar
To:	Gross Reservoir SI-20-0003
Subject:	Please do not approve!
Date:	Sunday, October 4, 2020 3:46:36 PM

We live at 1508 Lazy Z Rd.
This project is not based on sound principles or science and will only negatively impact all us who live close. Many studies state there will not be future water to fill the expansion. Denver water boards own data shows their water consumption in down.
Please do not let greed destroy thousands of trees and disrupt our lives for years.
Ed and Sheila Ranegar

From: Rhett Mitchell
To: Gross Reservoir SI-20-0003
Subject: Oppose Gross Dam Expansion - Docket number SI-20-0003
Date: Sunday, October 4, 2020 11:30:58 AM

As a resident of Coal Creek Canyon, we oppose the expansion of Gross Dam. The expansion will have irreversible effects on the environment & wildlife.

The expansion will bring harmful pollutants into our habitat & ultimately the waterways. The construction will be terrible for our neighborhood as well as damaging habitat.

Please oppose this project

Rhett Mitchell

From:	Robert Dannenberg
To:	Gross Reservoir SI-20-0003
Subject:	Dam Expansion Project
Date:	Friday, October 2, 2020 10:17:38 AM

I am a Boulder County resident living near Nederland in an area that will be heavily impacted by the proposed project. I strongly object to this completely unnecessary and highly disruptive proposal. The impact on the local environment is certain to be devastating and the construction traffic massively disruptive to our mountain quality of life.
Sincerely,
Robert Dannenberg
189 Aspen Way
Nederland CO

Sent from my iPhone

From:	Arpita Kishen
To:	Gross Reservoir SI-20-0003
Cc:	Karl Mantueffel
Subject:	I strongly stand against the Gross Dam project
Date:	Thursday, October 1, 2020 9:26:21 PM

My name is Arpita Kishen and my husband, Karl Manteuffel, and I own a home at 18 Juniper Heights Road, Golden, CO 80403. Our property is located approximately 3 miles from the proposed Moffat dam and reservoir project. The proposed construction to enlarge the dam and reservoir would adversely impact our lives and property in so many ways.

I do not support the destruction of the landscape and forest for this project. The environmental implications for a project of this magnitude are vast. I truly believe that water conversation should be promoted and not the idea of capturing more water. Also, this water does not even serve the residents in Boulder County, so it makes no sense to allow Denver water to expand a dam that does not serve the people who live here.

We purchased this home in the hopes of living a quiet, low- key lifestyle in the mountains. We have enjoyed ample time at our mountain home, hiking, sitting on the deck and simply relaxing to the sound of birds. The Gross Dam expansion project will greatly change the way the quiet mountain lifestyle that makes it attractive in the first place and it is supposed to last at least 7 years, which is a lifetime for many of the residents here.

In case we need or want to sell our home, the home will lose value during the Gross Dam build and it will be very difficult to sell, especially for its worth, during the long construction phase of this project. Boulder County residents should not lose value in their homes because of this long-term project that serves Denver.

The traffic on Gross Dam road is already a challenge during the summer months; the roads are dusty and narrow. The truck traffic will cause severe dust and traffic on this delicate mountain road. The people living on these roads will experience great disturbance and pollution due to the high level of truck traffic associated with the dam construction. Our home is directly on Gross Dam Road and we will most certainly be disrupted during this dam construction project.

I urge Boulder County to negotiate with Denver Water to find an alternative plan which includes water conversation and not just this extremely short-sighted idea of enlarging this dam. The environmental impact is enormous. There is so much research that shows that water conservation in Colorado is the best way to secure water for future generations

Thank you,

Arpita

Arpita Kishen
410-858-0848
www.arpitakishen.com

From:	Steve Pomerance
To:	Gross Reservoir SI-20-0003
Subject:	Do NOT allow this dam!
Date:	Thursday, October 1, 2020 5:37:48 PM

This is a ridiculous project where Denver Water will try to fill it with its pre-Compact water rights and cost everyone else their water, especially junior rights like the Big Thompson that serves so many Front Range communities.

And for what? It's not like they need it -- it will just fuel more development, which we need like a hole in the head! Denver Water is one of the last remnants of the "grow, baby, grow!" mentality.

When they conceived the dam, many years ago, they hadn't even considered the effects of climate change and global warming on our water supply, and here they are still chasing that chimera. I know this because I went to one of their meetings and talked to their engineers.

And years of truck traffic will destroy our roads and disrupt our rural areas.

Please do NOT allow the damn dam!

Steve Pomerance
335 17th St
Boulder CO 80302