

2014 Riparian Inventory and Assessment of Post-Flood Conditions
Boulder County Parks and Open Space Properties
Boulder, Left Hand, and St. Vrain Creeks
Boulder County, Colorado

Laura Backus and Susan Sherrod
for
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Abstract

Boulder County Parks and Open Space (BCPOS) creeks sustained significant damage in the historic floods of September 2013. This report summarizes surveys in August and September, 2014, of BCPOS properties along Left Hand, Boulder, and St. Vrain Creeks nearly one year following the major disturbance. Our evaluation included (1) changes in and recovery of riparian vegetation, including Boulder County Noxious Weed infestations; (2) Hydrology; and (3) Erosion Potential. Scores for these parameters were compared to similar scores collected in 2008 before the flood. In addition, we took photographs of riparian areas for descriptive purposes as well as to compare to pre-flood photographs of the same areas taken in 2008. Despite considerable variability among reaches and creeks, St. Vrain Creek appeared to sustain the most dramatic damage from the flood, particularly downstream of Lyons as breaching ponds augmented already high water volumes. Weeds listed on the Boulder County Noxious Weed List and/or on the State of Colorado Noxious Weed List were relatively rarely encountered in 2014. However, the potential for larger and more widespread infestations of these species as well as other non-native species is high in coming years. In nearly all reaches, the extent and species richness of non-native colonizers were much greater than for native colonizers. Seedlings of native cottonwood and willow are present in many areas of damp sand and cobble. Exposed and/or deposited cobble is a recurring feature of a majority of these reaches, presenting both an energy-dissipating function as well as opportunities for colonizing plants. Bank cutting and incision was also frequently observed, again, presenting opportunities for colonization and increased vulnerability to additional erosion.

Introduction

In September of 2013, Boulder, Colorado, received over 18 inches of rain, most of which fell in the course of a 36-hour period.^{1,2} This was over ten times the average September precipitation ($1.5'' \pm 1.3$ SD) for the area. The previous record for rainfall in 24 hours, 4.8'' on 7/31/1919, was eclipsed by the 9.08'' that fell from 6 p.m. to 6 p.m. between September 12th and the 13th. Boulder Creek, flowing at an estimated 5000 cfs, crested at 7.78 feet.³ The breadth and duration of these rains resulted in an epic regional disturbance evidenced by severe flooding; tree uprooting and transport; loss of understory shrubs and herbaceous vegetation; channel scouring, avulsion, and displacement; deposition of sediment, cobble, and debris; and extensive streambed downcutting.

Literature reviews show that little if any work has been done to document the post-flood effects of high inundation on Front Range riparian ecosystems. We know from research in other regions that the geomorphological, hydrological, and soil heterogeneity created in stream channels by flooding may be a principal driver of biodiversity in these areas.⁴ The recently flooded stream reaches in Boulder County Parks and Open Space (BCPOS) properties present numerous opportunities for new species establishment, including that of nonnative populations. These opportunities include the denudation effects of extreme flooding, which create unvegetated patches hospitable to plant propagules. Additional opportunities are presented by the recent deposition of soil and organic matter, which can carry plant propagules and also can either increase or decrease seed germination and plant species richness.⁵ Regardless of the mechanism, establishment of previously unobserved species may change the composition of the canopy and/or herbaceous layers. Based on these reports as well as our own personal observations of the flooding and its effects, we expected to find altered riparian plant species composition in areas flooded in September 2013, with a more pronounced response in more severely affected areas.

We conducted a survey of BCPOS properties along Left Hand, Boulder, and St. Vrain Creeks. Our study had three objectives. These objectives were to: (1) alert BCPOS of high-priority Boulder County Noxious Weed infestations; (2) document post-flood changes in and recovery of riparian vegetation, hydrology, and stream geomorphology by comparing to data collected in 2008 by Biohabitats, Inc.⁶ (limited to Left Hand and St. Vrain Creeks only); and (3) provide an

¹ National Oceanographic and Atmospheric Administration. 2013. Boulder Monthly Climate Data: Precipitation. <http://www.esrl.noaa.gov/psd/boulder/Boulder.mm.precip.html>. Accessed January 9, 2014.

² Western Water Assessment. 2013. Severe Flooding on the Colorado Front Range: September 2013. <http://www.colorado.edu/resources/front-range-floods/assessment.pdf>. Accessed January 9, 2014.

³ Henson, Bob. 2013. Inside the Colorado Deluge: How much rain fell on the Front Range, and how historic was it? <http://www2.ucar.edu/atmosnews/opinion/10250/inside-colorado-deluge>. Accessed January 9, 2014.

⁴ Osterkamp, W.R. and C.R. Hupp. 2010. Fluvial processes and vegetation – Glimpses of the past, the present, and perhaps the future. *Geomorphology* 116: 274-85.

⁵ Naiman, R.J. and H. Decamps. 1997. The Ecology of Interfaces: Riparian Zones. *Annu. Rev. Ecol. Syst.* 28:621-58.

⁶ Biohabitats, Inc. 2009. Riparian Inventory and Assessment, Boulder County Parks and Open Space.

electronic summary report to include field data and comparisons of current conditions with those before the 2013 floods.

Methods

Between August 22 and September 5, 2014, we conducted upstream-to-downstream walking surveys of BCPOS properties along Left Hand, Boulder, and St. Vrain Creeks, noting conditions in the context of recovery following the September 2013 floods. We timed the surveys to match the late summer survey season of 2008.⁶ The reaches surveyed varied from ~1000 ft to 1.3 miles in length (Table 1). For each reach, Ms. Backus made observations on vegetation conditions while Ms. Sherrod noted the hydrological and erosion conditions. We supplemented our field notations with information from the Flood Damage Assessment Maps produced by Boulder County Parks and Open Space and from Google Earth aerial imagery dated 10/6/2013, 10/7/2012, and earlier years when appropriate.

We created data forms based on the Proper Functioning Condition method and included sections for hydrology, erosion potential, vegetation, revegetation trends, and flood effects on riparian areas. Species observations included lists of commonly encountered and significant species, including noxious weeds, and whether they occur in areas of deposition and/or erosion.

Hydrology categories were:

- Evidence of floodplain inundation
- Presence and frequency of meanders
- Degree of channel incision
- Potential extent of vegetated riparian area
- Condition of adjacent uplands

Hydrology categories specific for 2013 flood effects were:

- Floodplain connectivity
- Percent of reach with new meanders or advanced incision
- Channel avulsion

Erosion Potential categories were:

- Energy dissipation
- Percent of streambank with sufficient root mass to withstand high flows
- Channel stability as evidenced by bank erosion
- Mid-channel flood deposition

Table 1. Creeks and reaches within creeks surveyed for summer 2014 surveys of BCPOS properties. Boundaries of upper four properties of St. Vrain were uncertain.

Creek	Property	Estimated Length of Reach (miles)
St. Vrain	Custode	1.0
	Hall 2	1.3
	Hall Meadows	0.7
	Triangle*	0.2
	Bullock	0.3
	Wallace	0.2
	Montgomery	1.3
	Western Mobile W	
	Western Mobile E	
	Braly	
	Ramey	0.2
	Sadar	0.1
	Gage	0.4
	Pella West/Marlatt	0.6
	Golden/Fredstrom	0.8
	Keyes/Golden Farm	1.1
	Peschel	0.7
	SVC Total	8.9
Left Hand	Brewbaker/Sorensen	0.5
	IMEL	0.5
	Bielins/Hock Russell/Anderson/Schmidt	0.9
		LHC Total
Boulder	MMS Partnership	0.4
	Dawson W	0.4
	Dawson E	1.1
	Doniphan	0.6
	Bailey Ponds/Kenosha	0.6
		BC Total
Project Total		13.9

*Part of Hall Ranch. Triangle parcel east of Hall Meadows adjacent to South St. Vrain Road.

Vegetation categories were:

- Width of the riparian plant community
- Tree canopy cover by non-native species
- Shrub cover by non-native species
- Herbaceous cover by non-native species
- Woody debris and leaf supply
- Vegetation structure and diversity

Revegetation Trend categories were:

- Presence and prevalence of post-flood native woody seedlings/saplings
- Presence and prevalence of post-flood non-native woody seedlings/saplings
- Abundance of Boulder Co. noxious weeds

Riparian Effects categories were:

- Extent of flood deposition of sand, gravel, cobble
- Percent of riparian area lost to erosion and/or deposition

The data forms were modified from 2008⁶ to better capture the effects of the 2013 flood (see data form in Appendix A). Categories were added to the 2014 survey to measure specific flood effects (“2014 flood effects” in Results). For Hydrology these were floodplain connectivity, new meanders/incision, and avulsion. For Vegetation these were presence and prevalence of post-flood woody seedlings or saplings, percent abundance of Boulder County noxious weeds, and percent of riparian area lost or having experienced deposition. We separated channel morphology and incision into two categories and averaged the scores for comparisons between 2008 and 2014 data. We combined point bars and sediment transport categories due to the high volumes of flood deposition that made these features were largely indistinguishable in 2014, and averaged their 2008 values for the comparison between 2008 and 2014.

Comparisons between 2008 and 2014 were based on our field data, 2008 survey photographs of St. Vrain and Left Hand Creeks, and Google Earth images from multiple years. Boulder Creek was not surveyed in 2008; the data we collected for Boulder Creek in 2014 provides a baseline.

Priority observations for this survey were:

- Locations of large infestations of species on the Boulder County Noxious Weed List. These species are orange hawkweed, spotted knapweed, Japanese knotweed, purple loosestrife, Mediterranean sage, rush skeletonweed, cypress spurge, myrtle spurge, yellow starthistle, dyer’s woad, houndstongue, diffuse knapweed, Russian knapweed, leafy spurge, tamarisk, common teasel, bull thistle, Canada thistle, musk thistle, Scotch thistle, Dalmatian toadflax, and yellow toadflax. We noted whether infestations occurred in areas of deposition/erosion and/or areas of inundation. As practical, we pulled the vegetative weeds of minor infestations and left the plants root side up to desiccate.
- Seedlings and saplings of native and non-native post-flood riparian trees and shrubs.
- Notations of encountered species, nativity, presence in areas of deposition/erosion and/or inundation, and whether commonly or uncommonly encountered.
- Trends influencing woody species recovery such as location relative to the stream channel; areas of sand, gravel, and cobble deposition; any surface indicators of soil wetness such as

standing water, surface wetness, or development of wetland species; and competition from newly developing nonnative species.

The outer extent of survey areas was generally the pre-flood riparian area. Where major channel rerouting will likely remain in place, we also surveyed the new channel and surrounding area. We photographed the channel and riparian area of all reaches from at least four locations and significant conditions or noteworthy features. We recorded photograph locations with Universal Transverse Mercator (UTM) coordinates and/or field notations. Although we had intended to duplicate the locations of selected 2008 photographs, duplication was difficult if not impossible due to changes in stream course and vegetation structure. For this reason, many comparison photographs are at upstream and downstream property boundaries or are taken of the same general area.

Results and Discussion

Below we present a summary of the data collected from our observations of BCPOS reaches of Left Hand, Boulder, and St. Vrain Creeks. Results are separated into subsections by Creek and reach. The final subsection compares all three creeks. The accompanying tables of plant species present those that are common, significant, and/or noxious weeds. A Master List of all species observed throughout the project is in Appendix B, and detailed tables of species observed by creek and reach are in Appendix C.

Appendix D contains site photographs, generally in order from upstream to downstream, that illustrate important observations in the text. Appendix E contains 2008 and 2014 comparison photographs for reaches in the 2008 survey. Appendix F provides aerial photographs marked with important infestations of Boulder County Noxious Weeds. Appendix G is a spreadsheet of all scores based on the data forms (Appendix A).

We use the terms "river right" and "river left" throughout the report and appendices. "River right" is the right side of the river facing downstream, and "river left" is the left side of the river facing downstream.

Scores are presented in Tables 2, 4, and 6. Higher scores indicate better functioning condition. The maximum possible score for each category is indicated at the top of each column. Reaching the maximum possible score for Erosion Potential, for instance, indicates that a reach appeared least vulnerable to ongoing erosion. Scores for 2008 are from Biohabitats, Inc. (2009).⁶ In the score tables, the columns labeled "2014" are a direct comparison of the same parameters observed in 2008.

Scores among categories are intended only for comparison of that category among reaches. For example, if a reach scores 10 in Erosion Potential but a 15 in Vegetation, this does not necessarily mean that vegetative quality is higher than bank stability for a particular reach. The scores are intended only for comparison among reaches within each category.

Note also that in the nearly one-year interval between the floods and our surveys, much repair of infrastructure and grading had been conducted on the three streams especially in areas of important infrastructure. This work included grading of banks and channels, repair of diversion structures and roads, returning flows from flood channels to pre-flood channels, removal of many of the large trees and other washed-in debris.

Left Hand Creek

Table 2 presents scores for Left Hand Creek BCPOS properties. Table 3 presents common and noxious plant species observed along the reaches of Left Hand Creek.

Table 2. Left Hand Creek scores. Reaches are listed in order of upstream to downstream. No data were collected in 2008 for Bielins/Hock or Russell/Anderson/Schmidt.

Reach	Hydrology			Erosion Potential		Vegetation		Reveg Trends	Riparian Effects
	2008 ^a	2014	2013 flood effects	2008 ^a	2014	2008 ^a	2014	2014	2014
<i>Maximum score:</i>	16.0		12.0	16.0		28.0	28.0	15.0	10.0
Brewbaker/Sorenson	13.0	9.5	7.0	12.0	9.0	21.0	22.0	7	2
Imel	10.0	13.0	12.0	12.5	10.0	21.0	21.0	9	6
Bielins/Hock	-	12.0	10.0	-	11.0	-	20.0	8	4
Russell/Anderson/Schmidt	-	10.0	9.0	-	10.0	-	17.0	9	5

^a Biohabitats (2009)

Left Hand Creek 2008 and 2014 Comparison

Only Brewbaker/Sorenson and Imel were surveyed in 2008. Hydrology function did not show a consistent improvement or decline between 2008 and 2014. In 2014, Brewbaker/Sorenson had lower hydrologic function due to its loss of substantial riparian area and less buffer from potential upland degradation. IMEL, in contrast, had better hydrology due to more meandering and less incision. Erosion Potential for both reaches increased from 2008 (*i.e.*, the scores decreased) because of the bank erosion caused by floods. Indeed, most riverbank vegetation was washed out along Left Hand Creek. Vegetation categories showed little change.

Table 3. Common species and noxious weeds, Left Hand Creek (abridged; see Appendix C for complete tables by property). “Dep” ≡ observed in areas of deposition and/or erosion and “inun” ≡ observed in areas of only inundation. Noxious weeds are in a red font and their status indicated with the following codes: BB ≡ Boulder County Noxious Weeds List B; SB and SC ≡ State of Colorado Noxious Weeds Lists B and C, respectively. Species indicated as common in a reach are highlighted in green. RL ≡ river left and RR ≡ river right (facing downstream).

	BREWBAKER/SORENSEN	IMEL	BIELINS/HOCK	RUSSELL/ANDERSON/SCHMIDT
NATIVE TREES				
Peachleaf willow	Uncommon, dep		Common, dep. Large patch.	Uncommon, inun.
Plains cottonwood	Common, dep; Common and dominant, inun.	Uncommon, dep. Common and dominant, inun. In groups, mainly at lower end.	Common, dep.; common and dominant, inun. Most at upstream end.	Uncommon, dep; common, inun. Old riparian area.
NATIVE SHRUBS				
Sandbar willow	Common, dep; uncommon, inun. One lg. patch RL	Uncommon, inun.		
Snowberry		Dominant and common, inun.		
NATIVE FORBS				
Mock cucumber			Common, inun.	
Povertyweed	Uncommon, dep. and inun.		Common and dominant, dep; uncommon, inun.	
Ragweed	Common, dep.		Common, dep.	
NATIVE GRASSES AND GRASS-LIKES				
Cattail	Uncommon, dep.; common, inun. Patch in old pond RR.			Uncommon, inun. Most on RR bank.
NATIVITY UNDETERMINED				
Brassicaceae species			Common, dep. <i>Barbarea?</i>	
NON-NATIVE TREES				
Crack willow	Common, inun. Most at upper or lower boundaries.	Common and dominant, inun. Many mature trees, some saplings.	Uncommon, dep; common and dominant, inun. Most at downstream end / next to cr.	Uncommon, dep; common and dominant, inun. Rooting from flood debris.
Russian olive (SB)			Uncommon, dep and inun.	
NON-NATIVE FORBS				
Alfalfa	Common, dep; uncommon, inun.	Uncommon, dep. Alfalfa field adj. to RL.	Common and dominant, dep; uncommon, inun.	Uncommon, dep

	BREWBAKER/SORENSEN	IMEL	BIELINS/HOCK	RUSSELL/ANDERSON/SCHMIDT
Bindweed (SC)	Uncommon, inun.		Uncommon, dep; common, inun. Many in breach area.	
Bouncing bet (SB)			Uncommon, dep.	
Bull thistle (BB)		Uncommon, inun.		
Burdock (SC)		Uncommon, inun.		
Canada thistle (SB, BB)	Uncommon, inun.	Uncommon, inun.	Uncommon, inun.	Uncommon, inun. Patch RR near Hover Br.
Dalmatian toadflax (SB, BB)	Uncommon, dep. Pulled most.			
Flower-of-an-hour (SB)	Uncommon, dep.			
Great mullein (SC)	Common, dep. and inun. Many rosettes.		Common, dep.	
Horseweed	Common, dep.			
Houndstongue (SB, BB)	Uncommon, inun.	Uncommon, inun.	Uncommon, dep.	
Knapweed rosettes (SB, BB)	Uncommon, dep. and inun.			
Lady's thumb (SB)	Uncommon, dep. and inun.	Uncommon, inun.	Uncommon, dep. and inun.	Uncommon, dep. Upper RL bank.
Musk thistle (SB, BB)	Common, inun.		Uncommon, inun. Many in field to N (breach area).	
Ox-eye daisy (SB)	Uncommon, dep. Pulled.			
Perennial pepperweed (SB)		Uncommon, inun.	Uncommon, inun.	
Puncturevine (SC)	Uncommon, dep.		Uncommon, inun.	
Redstem filaree (SC)	Uncommon, dep. and inun.		Uncommon, dep.	
NON-NATIVE GRASSES AND GRASS-LIKES				
Cheatgrass (SC)	Common, inun.		Uncommon, dep; common, inun.	Common and dominant, inun. Old riparian area.
Quackgrass (SB)		Uncommon, inun.	Common, inun.	Uncommon, inun. Old riparian area.
Smooth brome	Common and dominant, inun.	Common and dominant, inun.	Uncommon, dep; common, inun.	Common, inun. Old riparian area.

Left Hand Creek 2014 Observations

All Left Hand Creek riparian areas in the study area were completely inundated by the 2013 floods and show varying degrees of flood impacts including scour, channel changes, deposition of flood debris, and loss of bank vegetation. Tree canopy cover decreased steadily from Brewbaker/Sorenson to Russell/Anderson, as did structural diversity. Herbaceous non-native cover also decreased progressively along this stretch of properties, particularly in the breach area of Bielens/Hock. However, all of the reaches for Left Hand Creek indicated relatively good overall function.

Cottonwood and willow seedlings were beginning to become established in damper areas of depositing and erosion. Native seedling establishment is lower in areas of post-flood channel regrading. Flood effects were especially pronounced on the Brewbaker-Sorenson and Bielens-Hock properties.

Details on each property are presented below.

Brewbaker- Sorenson

In the upper portion of the Brewbaker-Sorenson property, mature forest dominated by large crack willow (and younger plains cottonwood) survived the floods, although the upper creek channel scoured down to shale bedrock with the resulting loss of all bank vegetation. Downstream of the area of mature forest, floods caused extreme scour and loss of riparian vegetation, including much of the restoration plantings installed in the early 2000s. Floodwaters downcut the primary channel approximately 6 feet and eroded secondary channels on river left. Deposited and exposed cobble and boulders now cover >2 ha of the property. We infer that Brewbaker-Sorenson was particularly vulnerable to erosive disturbance because its soils, likely placed as fill, did not develop *in situ* (note soil profiles in Appendix D), and because most riparian vegetation was not fully mature.

A small portion of restoration area remains on river left, but appears to be now too high and dry for long-term maintenance of wetter riparian species such as sandbar and peachleaf willow.

We observed sandbar willow resprouting from mid-channel flood debris, cottonwoods resprouting from vertical incised banks, and woody seedlings establishing “cottonwood lawns” in damp soils. Narrow wetlands are developing in new side channels on river left.

Boulder County noxious weeds, including Canada thistle, houndstongue, knapweed, and Dalmatian toadflax, as well as ox-eye daisy are scattered in low densities. The only large noxious weed infestation is musk thistle, also present in the 2008 surveys, on the river left berm near the lower boundary.

IMEL

Flooding within the IMEL riparian area removed nearly all low bank vegetation, enlarged a minor flood channel on river left, and deposited sand and cobble. Sand and silt deposition in the river left riparian forest diminished vegetation density. Of all of the Left Hand reaches, IMEL had the best post-flood hydrologic condition (columns labeled “2014” and “2014 flood effects,” Table 2), reflecting high floodplain connectivity, few (if any) new meanders, and minimal channel movement due to the flood. The riparian forest remains a mix of cottonwood and crack willow.

Boulder County noxious weeds bull thistle and Canada thistle have a very minor presence on the property.

Bielens- Hock

Between the access road at the upstream end of the reach and the west side of the forest dominated by crack willow and plains cottonwood, high flows created a new channel approximately 650 feet long with a low terrace approximately 100 feet wide to the north of the pre-flood channel. Vegetation cover, primarily weedy species, is developing on the sand, gravel, and cobble of the new low terrace. In the riparian forest downstream of the avulsion, cottonwood seedlings are developing on sand deposits in the channel, and minor flood debris is present in the forest understory and along the stream banks. The original channel retains a relatively stable streambank in the lower portion of the property.

Boulder County noxious weeds Canada thistle, houndstongue, and musk thistle have a minor presence in the riparian zone. Musk thistle has a high presence in the weedy field to the north of the new channel.

Russell-Anderson-Schmidt

Floods washed out most of the low bank vegetation in this riparian forest property. Native seedling presence is low in the downstream section of the channel, probably due to disturbance from channel regrading during the early part of the growing season.

A small patch of Boulder County noxious weed Canada thistle is present on river left just above the Hover Street bridge. Minor flood debris was deposited in the river left forest.

Boulder Creek

Table 4 presents scores for Boulder Creek BCPOS properties; Table 5 presents common and noxious plant species observed along the reaches of Boulder Creek. In Table 4, because no 2008 data were collected for Boulder Creek, only 2014 scores are shown.

Table 4. Boulder Creek scores. Reaches are listed in order of upstream to downstream. No data were collected from Boulder Creek in 2008. Because Boulder Creek is not within the property boundaries of MMS Partnership, no data were collected on hydrology or erosion potential.

Reach	Hydrology		Erosion Potential	Vegetation	Reveg Trends	Riparian Effects
	2014 ^a	2013 flood effects	2014 ^a	2014 ^a	2014	2014
<i>Maximum score:</i>	<i>16.0</i>	<i>12.0</i>	<i>16.0</i>	<i>28.0</i>	<i>15.0</i>	<i>10.0</i>
MMS Partnership	-	-	-	14.0	9	7
Alexander Dawson west of US 287	13.5	10.5	11.0	23.0	8	2
Alexander Dawson east of US 287	11.5	9.0	8.0	12.0	7	3
Doniphan	11.5	10.0	9.5	18.0	8	4
Bailey/Kenosha Ponds	12.5	10.5	7.5	13.0	7	5

^a Using same categories as 2008

Table 5. Common species and noxious weeds, Boulder Creek (abridged; see Appendix C for complete tables by property). “Dep” ≡ observed in areas of deposition and/erosion; “inun” ≡ observed in areas of only inundation Noxious weeds are in a red font and their status indicated with the following codes: BA, BB ≡ Boulder County Lists A, and B, respectively; SA, SB, and SC ≡ State of Colorado Noxious Weeds Lists A, B, and C, respectively. Species indicated as common in a reach are highlighted in green. RL ≡ river left and RR ≡ river right (facing downstream).

	MMS PARTNERSHIP	DAWSON W OF 287	DAWSON E OF 287	DONIPHAN	BAILEY PONDS/KENOSHA
NATIVE TREES					
Narrowleaf cottonwood		Common, dep and inun; dominant, inun. Seedlings.		Uncommon, inun.	
Peachleaf willow	Uncommon, inun. Oxbow wetland.	Common, dep and inun. Seedlings.	Uncommon, inun.	Uncommon, inun. Some flood debris resprouting.	Uncommon, inun.
Plains cottonwood	Common and dominant, inun. All mature/decadent.	Common, dep and inun.; dominant, inun. Seedlings.	Common and dominant, inun. In groups.	Common and dominant, inun. Many seedlings.	Common, dep and inun.
NATIVE SHRUBS					
Sandbar willow		Common, dep and inun. Seedlings.	Uncommon, dep (new clumps) and inun. Remnant patches, RL.	Common, dep and inun. Dominant, inun. Patches.	Common, inun.
NATIVE FORBS					
Curlycup gumweed			Common, inun.		
Golden aster		Common, inun.			
Licorice		Uncommon, inun.	Common, inun.		
Ragweed	Uncommon, dep.	Uncommon, dep.	Common, inun.	Uncommon, inun.	Common, inun.
NATIVE GRASSES AND GRASS-LIKES					
Bulrush		Uncommon, inun.	Uncommon, inun.		
Cattail		Uncommon, dep and inun.	Uncommon, inun.	Common, inun. Developing in an old meander. Several lg patches.	Uncommon, inun.
Sedge		Common, inun. Common in RL overflow channel.	Uncommon, inun.	Uncommon, dep and inun. Developing in abandoned channel.	
Western wheatgrass	Common and dominant, inun. Provisional ID.				

	MMS PARTNERSHIP	DAWSON W OF 287	DAWSON E OF 287	DONIPHAN	BAILEY PONDS/KENOSHA
NATIVITY UNDETERMINED					
Goosefoot, Lambs' quarters	Uncommon, dep.	Common, dep.	Common, dep.		
NON-NATIVE TREES					
Crack willow		Common, inun.	Uncommon, inun.	Uncommon, inun. Minor, some saplings.	Common and dominant, inun.
Russian olive (SB)	Several near oxbow wetland, also plantings near S fence.	Uncommon, inun.	Uncommon, dep. and inun. Pulled seedlings.	Uncommon, inun.	
NON-NATIVE SHRUBS					
Tamarisk (SB, BB)					Uncommon, inun. Provisional ID. Area inaccessible.
NON-NATIVE FORBS					
Alfalfa	Uncommon, dep. Crop in field to S.	Common, dep; uncommon, inun.	Common, dep (many) and uncommon, inun.	Common, dep; uncommon, inun.	Common, dep.
Bindweed (SC)	Uncommon, dep.	Uncommon, inun.	Uncommon, inun.	Uncommon, dep and inun. Many in field, RR.	Uncommon, dep; common, inun.
Bouncing bet (SB)		Uncommon, dep.			Uncommon, inun.
Burdock (SC)		Uncommon, dep and inun.			
Canada thistle (SB, BB)		Uncommon, inun.	Uncommon, inun.	Uncommon, inun.	
Curly dock	Uncommon, inun. Oxbow wetland.	Uncommon, dep and inun.	Uncommon, dep and inun.	Common, inun. Many in field, RR.	Uncommon, inun.
Great mullein (SC)		Common, dep and inun. V. common in RL meadows.	Common, dep.	Common, dep; uncommon, inun.	
Horseweed			Uncommon, dep.	Uncommon, dep; common, inun. Many in field, RR.	Common, inun.
Hounds tongue (SB, BB)			Uncommon, dep and inun.		
Lady's thumb (SB)	Uncommon, inun. Oxbow wetland.		Common, inun.		
Mediterranean sage (SA, BA)		1 rosette, dep. Provisional ID.			Uncommon, inun. Rosette. Provisional ID.

	MMS PARTNERSHIP	DAWSON W OF 287	DAWSON E OF 287	DONIPHAN	BAILEY PONDS/KENOSHA
Musk thistle (SB, BB)	Uncommon, inun.	Uncommon, dep.	Uncommon, inun.	Uncommon, inun. Berm, RL.	Uncommon, inun.
Perennial pepperweed (SB)	Uncommon, inun. Several dead stalks near oxbow wetland.		Uncommon, inun.	Uncommon, inun. Berm.	
Puncturevine (SC)			Uncommon, dep.		
Redstem filaree (SC)	Uncommon, dep.		Uncommon, dep.	Uncommon, inun.	
Scotch thistle (SB, BB)			Uncommon, dep and inun. Rosettes.	Uncommon, inun.	Uncommon, inun.
Teasel (SB, BB)				Uncommon, inun. Berm.	
Whitetop (SB)			Uncommon, inun. Most in one patch, RR, near upper end.	Uncommon, inun. Patches.	
NON-NATIVE GRASSES AND GRASS-LIKES					
Cheatgrass (SC)	Common and dominant, inun.			Uncommon, inun.	
Reed canarygrass		Uncommon, dep; common, inun.	Common, inun. V. vigorous, beginning regrowth at new edge of bank.	Common, inun.	Common and dominant, inun.
Smooth brome	Uncommon, inun.		Common, inun.	Common, inun.	Uncommon, inun.
Yellow nutsedge (SB)		Uncommon, dep.	Uncommon, dep.		
NON-NATIVE AQUATICS					
Eurasian watermilfoil (SB)		Uncommon, dep.	Uncommon, inun.		Uncommon, inun.

Boulder Creek 2014 Observations

All Boulder Creek riparian areas of BCPOS were completely inundated by the 2013 floods and show varying degrees of flood impacts including scour, deposition of flood debris, and loss of bank vegetation. Based on examination of aerial images from 1993 to 2013, all reaches had been channelized, probably many years prior to the floods. Pre-flood and post-flood riparian areas, including forests, were typically very narrow, wetlands were minimal, and woody debris supply was low. Flood damage compounded these prior changes, as the lack of woody vegetation made these reaches less resistant to flood damage.

Boulder Creek properties generally had higher cover and greater diversity of noxious weeds. Boulder Creek was the only stream where we observed Eurasian watermilfoil. We likely observed tamarisk, also the only project sighting, on the river left bank of the Bailey/Kenosha Ponds property, and have an unconfirmed identification of two Mediterranean sage rosettes, one at Dawson West and one at Bailey/Kenosha Ponds. Fields to the south of the riparian zone that had been inundated were especially weedy.

Except for the MMS Partnership property, cottonwood and willow seedlings were growing in areas of damper deposition and erosion, especially in Alexander Dawson property west of US 287. Flood effects on the riparian area were particularly noticeable at the Alexander Dawson properties and at Doniphan.

We noted trees that appeared to have been recently downed by beaver at the Alexander Dawson property west of US 287 and at the Doniphan property. Details on each property are presented below.

MMS Partnership

Boulder Creek and its low terraces are located off-site to the north of MMS Partnership; the riparian portion of the property, just inside the area of flood inundation, is a sparse cottonwood gallery, comprised primarily of decadent plains cottonwood; no seedling or saplings trees were observed except for planted trees and shrubs along the south fence line. A narrow oxbow wetland is present to the south of the cottonwoods.

Very sparse Boulder County noxious weed musk thistle is present.

Alexander Dawson West of US 287 (“Dawson West”)

Floodwaters inundated stream restoration projects conducted approximately 20 years ago that included cottonwood planting, construction of two meanders, and closing the portion of the channelized reach now bypassed by the new meanders. In the 2013 flooding, main flows reverted to the old channelized reach in the area of the new river left meander, although some

flows continue in the restored meander channel. Despite the floods, some plantings have survived in the channelized reach, and we observed occasional sandbar willows growing through areas of cobble deposits. The large sedge-dominated pre-flood wetland in the channelized reach bypassed by the new river right meander is thriving. Along the current primary channel, cottonwood and willow seedlings are growing in low bank areas, and wetter side channels are developing wetland vegetation. Most of the well-developed cottonwood and crack willow overstory survived the flooding; very sparsely vegetated cobble deposits are present along the post-flood channel and the river right riparian forest. Possibly due to the restoration along Dawson West in the last 20 years, this reach currently appears least vulnerable to erosion and exhibits the highest hydrologic function among all of the Boulder Creek reaches surveyed. Similarly, erosion potential at Alexander Dawson is the lowest among BCPOS Boulder Creek reaches due to good in-stream substrate variability and relatively stable banks.

In addition to Boulder County noxious weed Eurasian watermilfoil, we noted scattered houndstongue, musk thistle, Scotch thistle, teasel, and toadflax. Mediterranean sage (provisional identification) may be present on a mid-property cobble bar. River left Canada thistle and diffuse knapweed have greatly diminished since 1995 vegetation surveys conducted for the City of Boulder Wastewater Treatment Plant.⁷ The field on river right just west of US 287 remains very weedy, with common mullein dominant.

Alexander Dawson East of US 287 (“Dawson East”)

Nearly all sinuosity and riparian forests long had been removed from Dawson East prior to the 2013 floods. Flowing through wetlands, fields, and a large pond, a major side channel breached on river left from just downstream of the US 287 bridge to approximately 1000 feet above the Kenosha Road bridge. Flood waters from the breach washed out the 109th Street bridge that had been replaced by the time of the survey. The prior channelization plus diversion of high flows through the breach channel minimized the alterations to Boulder Creek itself, although long stretches of bank erosion are evident, primarily along river right, especially where banks are higher. Additionally, high flows breached the river right bank approximately 1300 feet above the Kenosha Road Bridge, depositing cobble over a large area. Most trees below the breach survived, and some sandbar willow are growing through the cobble deposition. Wetlands at the low end of the reach are well-vegetated and include a large patch of arrowhead. We noted mattresses dumped in the stream from the east side of the North 109th St. bridge until just upstream of the Kenosha Road bridge.

⁷ McLean, C. and L. Backus. 1995. Weed Survey of Boulder Creek Downstream of the City of Boulder Wastewater Treatment Plant. City of Boulder.

Small infestations of Boulder County noxious weeds Canada thistle, musk thistle, Scotch thistle, and teasel were scattered in the riparian area.

Doniphan

The Doniphan property continues the upstream pattern of historic channelization, although there are bands of riparian areas along most of the reach. High flows overbanked to both sides of the main channel just below the Kenosha Road bridge, leaving some cobble deposition mostly on river right. The “hook” (sharp bend) near the channel split in the center of the property was present before 2013, but the flood enlarged this meander to the south. The northern reach of the channel division just upstream of the hook and an area of river right near the downstream boundary are developing wetlands and good wildlife habitat.

Boulder County noxious weed infestations include scattered Canada thistle, musk thistle, Scotch thistle, and teasel.

Bailey - Kenosha Ponds

As with the Boulder Creek reaches upstream, the Bailey-Kenosha Ponds property historically had been channelized. Riparian vegetation was sparse along this reach except for willow bands and occasional trees along the low banks. Numerous ponds (probably from past gravel mining) are present on both sides of the creek. Just below the upstream end of the property, flood flows breached into a gravel-mining pond on river left and caused a chain reaction of breaches (one possibly intentional) of three more ponds to the east. The easternmost pond breached back into the main channel. Therefore, much of the flow volume spread to the north away from the channel, creating flood flows that were very wide but not particularly erosive.

Bailey - Kenosha Ponds is the one property with the possible presence of Boulder County noxious weed tamarisk that we noted on river left just downstream of the partially washed out center bridge. Mediterranean sage (provisional identification) may be present in the same area. We also noted scattered musk thistle, Scotch thistle and teasel. The erosion potential for this reach seems high, as the channel is relatively homogeneous and its banks are incised.

St. Vrain Creek

Interpretation of St. Vrain Creek flood effects naturally falls into three major sections comprising the four reaches along the South St. Vrain above Lyons, the ten reaches between Lyons and Longmont, and the two reaches east of Longmont where the new flood channel may remain in place (see Tables 7a-c).

Table 6 presents scores for St. Vrain Creek BCPOS properties; Table 7 presents common and noxious plant species observed along the reaches of St. Vrain Creek.

Table 6. St. Vrain Creek scores. Reaches are listed in order of upstream to downstream. No data were collected in 2008 for Custode through “Triangle,” or for Sadar. Custode through “Triangle” are upstream of Lyons, Bullock through Golden/Fredstrom are between Lyons and Longmont, and Keyes/Golden Farm and Peschel are east of Longmont.

Reach	Hydrology			Erosion Potential		Vegetation		Reveg effects	Riparian Effects
	2008 ^a	2014	2013 flood effects	2008 ^a	2014	2008 ^a	2014	2014	2014
<i>Maximum score:</i>	16.0		12.0	16.0		24-28	28.0	15.0	10.0
Custode	-	10.5	9.5	-	13.5	-	15.0	10	2
Hall Ranch II	-	11.0	7.5	-	12.0	-	11.0	9	2
Hall Meadows	-	11.5	8.5	-	12.0	-	18.0	10	2
“Triangle”	-	9.5	5.0	-	13.0	-	16.0	8	2
Bullock	9.0	11.0	5.0	10.5	10.5	21.5	19.0	8	2
Wallace	9.0	10.5	9.0	11.0	9.0	22.0	20.0	8	3
Montgomery	10.0	11.5	8.5	12.5	10.0	21.0	21.0	8	5
Western Mobile	10.0	11.5	11.5	12.5	12.0	21.5	23.0	8	5
Braly	12.0	14.0	10.5	12.5	12.5	22.0	21.0	9	4
Ramey	11.5	9.0	4.5	13.0	9.0	22.0	17.0	8	5
Sadar	-	9.5	4.5	-	11.0	-	14.0	8	2
Gage	10.5	12.0	7.0	12.5	13.0	21.0	22.0	9	4
Pella West/Marlatt	10.5	12.0	10.5	13.0	10.5	21.0	21.0	8	4
Golden/Fredstrom	9.5	11.5	10.0	11.5	7.5	21.5	22.0	8	4
Keyes/Golden Farm	8.5	13.0	9.0	12.5	10.0	18.0	17.5	7	4
Peschel	8.5	11.5	5.0	10.5	9.5	20.0	15.0	11	3

^a Biohabitats (2009)

St. Vrain Creek 2008 and 2014 Comparison

Eleven of the St. Vrain Creek sites have comparison information from the 2008 survey (Table 6). Between 2008 and 2014, hydrology function increased for all reaches except for that of Ramey (note that all reaches exhibited evidence of the 2013 flooding and this improved their scores on the data forms). About two-thirds of the reaches surveyed along St. Vrain also exhibited increased meandering and less incision after the flood. Braly and Keyes/Golden Farm had better upland condition as well following the flood.

With the exception of Gage, less resistant bank structure for all reaches increased erosion potential. Vegetative quality remained relatively constant except for Ramey where augmented flood flows rejoined the main channel and degraded plant community structure.

Table 7. Common species and noxious weeds, St. Vrain Creek (abridged; see Appendix C for complete tables by property). “Dep” ≡ observed in areas of deposition and/or erosion; “inun” ≡ observed in areas of only inundation. Noxious weeds are in a red font and their status indicated with the following codes: BA, BB, and BC ≡ Boulder County Lists A, B, and C, respectively; SA, SB, and SC ≡ State of Colorado Noxious Weeds Lists A, B, and C, respectively. Species indicated as common in a reach are highlighted in green. RL ≡ river left and RR ≡ river right (facing downstream).

Table 7a. St. Vrain Creek above Lyons.

	CUSTODE	HALL RANCH II	HALL MEADOWS	TRIANGLE
NATIVE TREES				
Narrowleaf cottonwood	Common, dep/eros, upper bank	Common, dep/eros & inun. Sprouts from upper bank root stock + saplings.	Uncommon, dep; common and dom, inun. Remnant forest, saplings.	Common and dominant, inun. Remnant forest.
Peachleaf willow	Upper bank			Uncommon, inun. Remnant forest.
Plains cottonwood	Common, dep/eros			Common, dep/eros and inun. Remnant forest.
Ponderosa pine	Uncommon, inun, upper bank	Uncommon, inun	Uncommon, inun. Remnant forest.	Common, inun. Remnant forest.
NATIVE FORBS				
Blazingstar			Uncommon, sandy banks	
Sunflower			Common, dep	
NATIVITY UNDETERMINED				
Goosefoot	Common, eros			
NON-NATIVE FORBS				
Alfalfa	Common, dep/eros	Common, dep/eros; uncommon, inun	Common and dominant, dep	Common & dominant, dep/eros
Bindweed (SC)		Uncommon, inun	Uncommon, dep	
Bouncing bet (SB)				Uncommon, dep/eros
Burdock (SC)		Uncommon, inun. RR meadow.		
Canada thistle (SB, BB)	Upper bank	Uncommon, dep/eros	Uncommon, dep	Uncommon, dep/eros
Chicory (SC)				
Diffuse knapweed	Uncommon, inun	Common, dep/eros & inun. Several		

	CUSTODE	HALL RANCH II	HALL MEADOWS	TRIANGLE
(SB, BB)		patches.		
Knapweed		Common, dep/eros. Rosette, several patches.	Uncommon, dep. Rosette (pulled).	Uncommon, dep/eros. Scattered.
Kochia	Uncommon, dep	Uncommon, dep/eros & common, inun.	Uncommon, dep. Common, inun. Remnant forest.	
Mullein (SC)	Common, eros & inun	Uncommon, dep/eros	Uncommon, inun	
Musk thistle (SB, BB)		Uncommon, dep/eros & inun. RR meadows.		
Redstem filaree (SC)			Uncommon, dep	Uncommon, dep/eros & inun.
Dalmatian toadflax (SB, BB)		Uncommon, inun. Scattered along flood channel deposits.		
Yellow toadflax (SB, BB)	Uncommon, inun	Uncommon, dep/eros & inun		Uncommon, dep/eros. Few.
NON-NATIVE GRASSES AND GRASS-LIKES				
Cheatgrass (SC)		Uncommon, dep/eros & inun		Uncommon, dep/eros
Foxtail (SB)		Uncommon, dep/eros	Uncommon, dep	
Smooth brome	Uncommon, inun	Uncommon, inun	Common, inun. Remnant forest, meadow.	Uncommon, inun
Tall wheatgrass		Common, inun		

Observations of Custode through “Triangle”

Commonalities in this higher-gradient section of the South St. Vrain Canyon include deep, rapidly moving floodwaters that inundated all of the riparian area and caused major scour of banks, breaches and avulsions primarily to the south, and remnant areas of intact riparian forest that can provide seeds for natural revegetation. Cottonwood and willow seedlings were beginning to become established in damper areas of deposition and erosion. Extensive earthwork was conducted particularly in areas of road wash-out, which likely will slow natural revegetation. Due to extensive areas of bare soil, sand, and cobble, plus survivor weeds growing in areas away from scouring flows, these four upstream properties will be especially vulnerable to weed infestations. Boulders are a common feature of these reaches and lend considerable stability to the streambed and banks. Additionally, the close proximity of Highway 7 compromises the “upland” condition of these reaches and has resulted in highly channelized features.

Note that upstream and downstream boundaries were uncertain for these four reaches.

Custode

The riverbanks at Custode are now long reaches of sparsely vegetated cobble. Woody flood debris is wound tightly to a height of 1 meter around the stems of trees adjacent to the narrow upper channel. Some coniferous trees did not survive the prolonged soil saturation.

There are minor infestations of Boulder County noxious weeds diffuse knapweed and Canada thistle as well as a small patch of State noxious weed sulfur cinquefoil on the road berm.

Hall Ranch II

Hall Ranch II is characterized by extensive areas of sand and cobble deposited by the flood and/or exposed by flows, and is the site of a sparsely vegetated former quarry near the upstream boundary. This quarry, an upland feature, is presumed to have compromised the general hydrologic condition of Hall Ranch II through its constriction of the riparian area and the general weediness of the remnant forests. Flood flows formed new meanders throughout Hall Ranch II, and at the time of the 2014 survey, the channel appeared to retain much of its post-flood configuration. The streambanks along the length of Hall Ranch II are generally unconsolidated materials. Some large snags remain in cobble areas and forests.

Although several large stands of the riparian forest remain, nearly all stream banks are bare. The height of spring runoff is likely indicated by several areas with lines of woody seedlings now about 1 meter or more from the edge of water. Wetlands are developing around side channels and pools, as are strands of algae.

Many Boulder County noxious weeds including diffuse knapweed, musk thistle, as unlisted kochia are present in the remnant forest and/or meadows and can be expected to move into unvegetated areas. Small infestations of toadflax and bull thistle are growing in areas of cobble deposition.

Hall Meadows

At Hall Meadows, the pre-flood vegetation was riparian bands, mainly narrow, and large meadows. Floodwaters breached to the south, creating several major side channels. Most of these altered flows had been returned to the pre-flood channel prior to our field studies; however, minor flows remained in the avulsed channel and support cottonwood and willow seedlings as well as rushes along the low banks as well as large native sunflowers. Although most stream banks retain little vegetation, we observed several areas where cottonwoods and sandbar willows were regenerating from roots along the main channel. Among the four upstream reaches of St. Vrain, Hall Meadows was least incised and had the most favorable riparian and upstream condition.

In areas of deposition, we observed scattered Boulder County noxious weeds Canada thistle and diffuse knapweed.

“Triangle” portion of Hall Meadows

At the very small “Triangle” portion of Hall Meadows, flooding created several new meanders that appeared to be still in place at the time of the survey. Some mature trees remain, including ponderosa pine, cottonwood, and apple. Very little shrub understory remains; however, sandbar willow and grape appear to be growing through the deposits of sand and cobble. Highway 7, adjacent to this portion of the St. Vrain, confines the channel.

Boulder County noxious weeds were widely scattered Canada thistle, knapweed rosettes, and yellow toadflax.

Table 7b. St. Vrain Creek between Lyons and Longmont.

	BULLOCK	WALLACE	MONTGOMERY⁸	WESTERN MOBILE	BRALY	RAMEY	SADAR	GAGE	PELLA W/MARLATT	GOLDEN/FREDSTROM
NATIVE TREES										
Box elder	Uncommon, inun	Uncommon, inun	Common, inun	Uncommon, inun	Common, inun		Uncommon, inun. Upper bank.		Uncommon, inun	Uncommon, inun
Narrowleaf cottonwood	Common, inun	Common, inun	Common, inun. Some saplings.	Common, inun. Saplings.	Common & dominant, inun + saplings	Common, inun	Uncommon, dep. Flood debris.	Common & dominant, inun	Common, dep/eros & inun. Saplings too.	Uncommon, dep; common & dominant, inun
Plains cottonwood	Common, inun	Common, inun	Common, inun	Common, inun	Uncommon, erosion; common & dominant, inun + saplings	Common & dominant, inun	Common & dominant, inun. Remnant RL forest.	Common & dominant, inun	Common, dep/eros & inun	Common, dep & inun
NATIVE SHRUBS										
Alder		Uncommon, inun. One sm. grove.	Uncommon, inun	Common, inun.	Uncommon, inun				Uncommon, inun	
Poison ivy		Uncommon, inun	Uncommon, inun	Common, inun	Uncommon, inun					
Sandbar willow	Uncommon, inun	Uncommon, inun	Common and dominant, inun	Common and dominant, inun. Some lg patches.	Common, inun	Uncommon, inun. V. few survived flood.	Uncommon, dep & inun. Remnant RL forest.		Common, dep/eros; uncommon, inun	Uncommon, dep
Snowberry	Uncommon, inun		Common, inun		Uncommon, inun		Uncommon, inun. Upper bank.		Common, inun	
NATIVE FORBS										
Dogbane									Uncommon,	

⁸ Noxious weeds of RL wetland just west of Montgomery are burdock, Canada thistle, houndstongue, myrtle spurge, and teasel.

	BULLOCK	WALLACE	MONTGOMERY⁸	WESTERN MOBILE	BRALY	RAMEY	SADAR	GAGE	PELLA W/ MARLATT	GOLDEN/ FREDSTROM
									inun	
Golden aster			Uncommon, inun	Uncommon, inun		Common, inun				Common, inun
Golden banner					Uncommon, inun				Uncommon, inun	
Heath aster	Uncomon, inun						Uncommon, inun. Upper bank.		Uncommon, inun	Common, inun
Ragweed		Uncommon, inun	Common, inun		Uncommon, dep & inun	Uncommon, inun	Uncommon, inun. Upper bank.		Uncommon, inun	
Sunflower	Uncommon, dep & inun	Uncommon, inun; common, inun		Uncommon, inun	Uncommon, inun	Uncommon, dep			Uncommon, inun	
NATIVE GRASSES AND GRASS-LIKES										
Cattail			Common, inun			Uncommon, dep			Uncommon, inun	
NATIVITY UNDETERMINED										
Lambs' quarters					Uncommon, inun	Common, dep			Uncommon, dep/eros	
NON-NATIVE TREES										
Crack willow	Uncommon, inun	Common, inun. Some regenerating from roots.	Common, inun	Common, inun. Pulled sapling.	Common, inun	Common, inun		Common, inun	Common, inun. Saplings. Some growing from root stocks along bank.	
Locust	Uncommon, inun	Common, dom	Common, inun	Common, inun. Also in old cobble dep.	Common & dominant, inun + saplings	Uncommon, dep & inun	Uncommon, dep & inun. Remnant RL forest.	Common, inun	Uncommon, dep/eros; common, inun. Saplings.	
Russian olive			Uncommon, inun				Uncommon,		Uncommon,	

	BULLOCK	WALLACE	MONTGOMERY ⁸	WESTERN MOBILE	BRALY	RAMEY	SADAR	GAGE	PELLA W/ MARLATT	GOLDEN/ FREDSTROM
(SB)							inun. Remnant RL forest.		inun	
NON-NATIVE FORBS										
Alfalfa	Common and dominant, dep	Common, dep	Uncommon, dep	Uncommon, inun. Old cobble dep.	Uncommon, dep & inun	Common, dep	Uncommon, dep		Common, dep/eros	Common, dep
Bindweed (SC)	Uncommon, dep	Uncommon, dep							Uncommon, inun	
Bouncing bet (SB)				Uncommon, inun	Uncommon, inun	Uncommon, dep & inun			Uncommon, dep/eros; common, inun	
Bull thistle (SB, BB)	Uncommon, dep	Uncommon, inun. Pulled.								
Burdock (SC)			Uncommon, dep & inun						Uncommon, inun	
Canada thistle (SB, BB)				Uncommon, inun	Uncommon, inun	Uncommon, inun	Uncommon, inun. Upper bank.			
Chicory (SC)					Uncommon, inun					
Dalmatian toadflax (SB, BB)				Uncommon, inun	Uncommon, inun					
Diffuse knapweed (SB, BB)						Uncommon, inun				
Flower-of-an-hour (SB)	Uncommon, dep								Uncommon, dep/eros	
Houndstongue (SB, BB)	Uncommon, dep	Uncommon, dep & inun		Uncommon, inun. Also old cobble dep.					Uncommon, dep/eros & inun	
Kochia		Uncommon, dep		Uncommon, inun. Old cobble dep.			Common, dep			

	BULLOCK	WALLACE	MONTGOMERY ⁸	WESTERN MOBILE	BRALY	RAMEY	SADAR	GAGE	PELLA W/ MARLATT	GOLDEN/ FREDSTROM
Lady's thumb							Uncommon, dep		Uncommon, dep/eros	
Mediterranean sage (SA, BA)						Uncommon, inun. Rosette. Provisional ID.				
Mullein (SC)	Uncommon, dep			Uncommon, inun. Also old cobble deposit.	Uncommon, inun	Common, dep	Uncommon, eros. Slump.		Uncommon, dep/eros	
Musk thistle (SB, BB)			Uncommon, inun	Uncommon, inun		Uncommon, dep			Uncommon, inun	
Myrtle spurge (SA, BA)			Wetland adjacent to property							
Puncture vine (SC)	Uncommon, dep			Uncommon, inun	Uncommon, inun					
Purple loose-strife (SA, BA)			Wetland adjacent to property							
Redstem filaree (SC)		Uncommon, dep								
Yellow toadflax (SB, BB)	Uncommon, dep. Pulled.			Uncommon, inun. Near bridge.						
NON-NATIVE GRASSES AND GRASS-LIKES										
Canada bluegrass					Uncomon, inun	Common, inun				
Cheatgrass (SC)	Common & dominant, inun. Very tall		Uncommon, inun	Uncommon, inun						Uncommon, inun
Crabgrass	Uncommon, dep									
Crested wheatgrass				Uncommon, inun					Uncommon, inun	
Foxtail (SB)	Uncommon,					Uncommon,			Uncommon,	

	BULLOCK	WALLACE	MONTGOMERY⁸	WESTERN MOBILE	BRALY	RAMEY	SADAR	GAGE	PELLA W/ MARLATT	GOLDEN/ FREDSTROM
	dep					dep			dep/eros	
Quackgrass							Common, inun. Upper bank.		Uncommon, inun	
Reed canarygrass	Uncommon, inun		Common and dominant, inun	Common, inun. Some areas of resprouting.	Common, inun. Clumps revegetating in deposition.		Uncommon, inun. Upper bank.		Uncommon, dep/eros; common, inun	
Smooth brome	Uncommon, dep/common, inun	Common and dominant, inun	Common and dominant, inun	Common, inun	Common, inun	Common & dominant, inun	Common, inun. Upper bank.		Common, inun	Common & dominant, inun
Tall wheatgrass	Common, inun									

Observations of Bullock through Golden/Fredstrom

In the section between Lyons and Longmont, flood impacts to one reach directly impacted the next reach downstream. The first major breach of the St. Vrain below Lyons occurred at the Bullock upper boundary, cutting a channel through the floodplain to south. Floodwaters flowed through a series of gravel mining ponds that ultimately breached. This breaching of high flows into a new channel to some degree protected the riparian areas of Bullock, Wallace, Montgomery, Western Mobile and Braly. Downstream where the flows from the new and old channels rejoined near the downstream boundary of Ramey, major channel and vegetation alterations occurred. Cottonwood and willow seedlings were beginning to become established in damper areas of deposition and erosion. In areas of infrastructure repair these reaches were reworked by heavy machinery, a secondary disturbance that will delay vegetation regrowth. We observed recent wetland plantings on low banks at several properties that appear to be establishing well. Flood effects on riparian areas were especially pronounced at the Bullock, Wallace, and Sadar properties.

Bullock

At the Bullock property, which sustained the first major breach below Lyons, high flows, channel changes, and cobble deposition removed sandbar willow and reed canarygrass from the banks as well as much of the forest overstory and understory vegetation. The trajectory of post-flood forest revegetation is unclear, as both native and non-native species are colonizing disturbed areas.

Boulder County noxious weeds include scattered bull thistle, Canada thistle, musk thistle, houndstongue, and diffuse knapweed.

Wallace

Channel changes were minor at the Wallace property, as much of the high-flow volume had been diverted to the south upstream within the Bullock property. However, many washed-in trees and smaller woody debris, especially on river left, remain as evidence of powerful flows. Wide cobble banks are present along the channel as well as in the lower river right forest.

Boulder County noxious weeds include scattered bull thistle and houndstongue.

Montgomery

No channel changes occurred on the Montgomery property, but evidence of high flows includes many areas of eroded banks, continuing erosion into the shale bedrock near the railroad track

on river left, and large piles of woody flood debris as well as sand and silt deposition in the riparian forest especially on river right. The stream banks retained much of their pre-flood sandbar willow and reed canarygrass. Non-native trees, particularly locust, provide numerous seed sources. The only area of cobble deposition is a minor cobble dump on river left at the site of the rebuilt irrigation head gate.

Boulder County noxious weeds include scattered Canada thistle, houndstongue, and musk thistle. Note that State of Colorado and Boulder County Noxious Weeds are present in and adjacent to a small wetland on river left just west of the property's upstream boundary. In addition to teasel, Canada thistle, burdock, diffuse knapweed, and houndstongue, this wetland area property contains the only project sightings of purple loosestrife and myrtle spurge.

Western Mobile

Western Mobile, a property with former gravel mines adjacent, rated "High Functioning" in 2008 (Biohabitats, 2009⁶). Complex flood action resulted in the loss of low bank vegetation and widening of the stream. While the first major breach of the St. Vrain was at Bullock, the second major breach occurred at the upstream end of Western Mobile, directing most if not all of the floodwaters into the Lake 2 gravel pit. A secondary breach at the south end of Lake 2 flowed over a large area of river right. The flows from this breach left deposits of silt and sand in the river right riparian area as well as gravel and cobble deposits in the original channel and river left bank.

Boulder County noxious weeds include scattered Canada thistle, houndstongue, Dalmatian toadflax, and musk thistle. The riparian area is weediest near the bridge to the west of the old mining facility where there are knapweed and yellow toadflax.

Braly

Much of high flow volume had been diverted upstream of Braly into the new flood channel to south, allowing the channel and riparian area to remain in relatively good and stable condition. Some of the early flood flows went into a side channel on river right near the upstream boundary. Flooding left cobble deposits on point bars.

Boulder County noxious weeds include scattered Canada thistle, houndstongue, musk thistle and Dalmatian toadflax.

Ramey

The Ramey property marks the beginning of major impacts from augmented flood flows. Our initial commentary of the site was that it looked like a "blowout." Ramey is a shorter reach (the

upstream end can be seen from the downstream end) that dramatically lost riparian area and function. After bursting through the gravel mining ponds upstream, the floodwaters cut a new channel across N 61st St., through the field at river right, and converged with the pre-flood channel just below the downstream boundary of Ramey. Below this confluence the eroded and scoured-out channel is greatly widened, the riparian area is narrowed, and the cobble banks are sparsely vegetated. The overland scouring flows through the river right fields created major erosion gullies as well as major erosion and channel scour in the downstream portion of Ramey and in off-site properties further downstream. Minor flow remains in the two major new channels in the river right fields, allowing some development of wetland bands. Cobble deposits block convergence points between the new channels and the original channel; flows are seeping through cobble and creating small side channels adjacent to the main channel.

Boulder County noxious weeds include scattered Canada thistle and musk thistle. A patch of diffuse knapweed is present on river left near 63rd Street. Mediterranean sage (provisional identification) may be present on a river right cobble bar.

Sadar

At the Sadar property, the rejoined floodwaters and flows from the breached gravel pits ripped out the original channel which is now approximately 6 feet lower than the remnant upper riparian forests and fields on river right. The main flood path followed the pre-flood channel. River right has several areas of side channels eroded from very wide overland flows that also breached a small pond near the downstream boundary. The pre-flood channel, now over 150 feet wide, is a sparsely vegetated cobble expanse adjacent to the new low channel on river left. Small areas of woody seedlings are growing in these cobble areas and damp sand. The new channel collected washed-in tree snags, some of which are resprouting and could become islands of revegetation. The eroded river-right banks harbor some areas of resprouting cottonwood rootstocks. The riparian area to river left retains one remnant area of surviving trees above an eroded bank.

Boulder County noxious weeds include widely scattered Canada thistle (upper bank) and musk thistle (slump from upper bank).

Gage

Flood flows between Sadar and Gage were complex. Floodwaters entered the Gage property in the main stream channel and via a trench that was cut through Hygiene Road to drain ponds to the north. Because trench flows probably carried less sediment and discharged into the

irrigation ditch to the north of the main channel, they appear to have had a relatively minor effect on the riparian area at Gage. As a result, erosion potential along this reach is low.

Cobble deposits line much of the primary creek channel. We also noted mid-channel cobble bars and a cobbly secondary flood channel along river right that is now dry. The cobble areas are very sparsely vegetated except for low, damp, sandy areas that support native cottonwood and willow seedlings and occasional wetland areas with pools. Big jumbles of piled up trees and other flood debris are present in the riparian forest.

Boulder County noxious weeds include scattered bull thistle, Canada thistle, musk thistle, houndstongue, and diffuse knapweed.

Pella West/Marlatt

Flood flows over 3000 feet wide surrounded the Pella West/Marlatt property. Although this width moderated erosive forces of the floodwaters, high waters downcut the pre-flood channel and exposed shale bedrock, especially near the downstream end. In this area, streambank wetlands now appear too far above base flows to sustain wetland hydrology. Little flood debris is present in the forest, but large trees remain in the channel, which has both very sinuous and very straight sections. We observed some areas of cobble deposition and tree snags in the channel and along the banks. Native woody seedlings are present in many areas of bank cobble.

Boulder County noxious weeds include scattered Canada thistle, houndstongue, musk thistle and toadflax.

Golden/Fredstrom

The Golden/Fredstrom property is at the south boundary of the inundation zone, as the gravel mining ponds to the north, which breached, provided the path for most of the flood. An extensive, well-developed riparian area in very good condition is present on the upstream portion of river left. This area encompasses mature cottonwoods, a pond, wetlands, and meadows. Further downstream, the riparian area is concentrated adjacent to the channel. Floodwaters eroded long areas of the upstream portion of the bank down to shale bedrock; native woody seedlings are present in areas where the surface shale bedrock is overlain with cobble. In an area of very narrow riparian vegetation on river right, high water cut an approximately 300-meter-long new channel in the off-site field to the south. The well-developed, very wide riparian forest on river left near the upstream boundary is in excellent condition and encompasses a cottonwood gallery, wetlands, meadow, and pond. The creek is

highly channelized in the upstream portion. Substantial cobble deposition remains mid-reach, while further downstream are an impoundment, drop structure, and cattle crossing.

Boulder County noxious weeds include scattered Canada thistle, musk thistle, houndstongue, and teasel. Patches of diffuse knapweed are present on the dam of the mid-site ponded area and on river right approximately 650 feet downstream.

Table 7c. St. Vrain Creek east of Longmont.

	KEYES/ GOLDEN FARM	PESCHEL
NATIVE TREES		
Peachleaf willow	Uncommon, dep/eros & inun	Common, dep
Plains cottonwood	Common, dep/eros & inun. Some resprouting from root stocks along bank & edge of RR flood channel, some samplings in forest.	V. common, dep; common & dominant, inun
NATIVE SHRUBS		
Snowberry	Common, inun	
NATIVE FORBS		
Dogbane	Uncommon, dep/eros; common, inun	
Waterwort	Uncommon, dep/eros	Uncommon, dep/eros
NON-NATIVE TREES		
Chinese elm	Common, inun	Common, inun. Old riparian area.
Crack willow		
NON-NATIVE FORBS		
Alfalfa	Common, dep/eros; uncommon, inun	Common, dep
Bindweed (SC)	Uncommon, dep/eros	
Bouncing bet (SB)	Uncommon, inun	
Buffalo-bur	Uncommon, dep/eros; common, inun	Uncommon, dep
Canada thistle (SB, BB)	Uncommon, inun. In some slump areas.	Uncommon, eros & inun. Pre-flood channel.
Diffuse knapweed (SB, BB)	Uncommon, dep/eros & inun	
Houndstongue (SB, BB)	Uncommon, dep/eros	
Kochia	Common, inun	Uncommon, dep & eros; very common, inun. Old meadow area, berm.
Mullein (SC)	Uncommon, dep/eros	Uncommon, dep
Musk thistle (SB, BB)	Uncommon, dep/eros & inun	
Perennial pepperweed (SB)	Uncommon, inun	
Poison hemlock (SC)		
Puncture vine (SC)	Uncommon, dep/eros & inun	
Redstem filaree (SC)		

	KEYES/ GOLDEN FARM	PESCHEL
Scotch thistle (SB, BB)	Uncommon, inun	
Teasel (SB, BB)	Uncomon, dep/eros. Rosettes.	
Yellow toadflax (SB, BB)	Uncommon, dep/eros	
White top (SB)	Common, dep/eros & inun	Uncommon, inun. Old riparian area.
NON-NATIVE GRASSES AND GRASS-LIKES		
Cheatgrass (SC)	Uncommon, inun	Common, inun. Old riparian area.
Quackgrass (SB)	Uncommon, inun	
Reed canarygrass	Common, inun	Pre-flood N-S channel
Smooth brome		Old riparian area

Observations of Keyes/Golden Farm through Peschel

Flooding downstream of Longmont caused massive alterations at the Keyes/Golden Farm and Peschel properties that we discuss in detail below. St. Vrain Creek remained in its post-flood channel at the time of the survey and may remain in its post-flood configuration. Cottonwood and willow seedlings were beginning to become established in damper areas of deposition and erosion.

Keyes/Golden Farm

At the Keyes/Golden Farm property, floodwaters washed out most of the berms near the upper and lower property boundaries, removed a section of County Line Road bridge, and cut a new channel across the road to the south. The main flood flows went south of the pre-flood channel and, near the downstream end of the property, cut two deep channels to the south. These channels are now mostly dry and lined with unvegetated cobble. At the time of the 2008 survey (Biohabitats, 2009⁶), the fields south of the pre-flood channel had been primarily vegetated with kochia, an annual weed with little capacity to hold soils. The northern (upstream) of the two channels eroded a path in between mature cottonwoods, creating patchy wetlands and areas of cottonwood regeneration that have the potential to create a mosaic of good habitat. The southern (downstream) channel remains sparsely vegetated, although some cottonwood seedlings are present in areas of longer-lasting flows. Kochia is a major component of the post-flood channel vegetation in both channels. The cottonwood gallery, which has a snowberry understory, remains, although with deposits of silty sediment.

Boulder County noxious weeds of the riparian area include small, intermittent patches of toadflax, diffuse knapweed and thistles. A Scotch thistle patch is present mid-property at the outer edge of the riparian area. White top, a State noxious weed, infests the riparian area.

Peschel

Flood waters massively altered the Peschel property, with the primary channel shifting significantly to the south. Deposition blocked the east-west-flowing pre-flood channel, resulting in a reversal of flow direction. Flows are much diminished and the mid-portion is developing wetland vegetation. East of the wetlands, the channel became dry sand and gravel. The north-to-south reach of the pre-flood channel continues to flow to the south, although flows are much reduced and algae are present in the lower portion of the reach. The source of these flows is unclear. Just south of the property, cobble deposition has dammed the north-to-south reach, and below the dam the channel is dry.

Much of the riparian forest remains, although the water table is probably deeper. New cottonwood plantings are present in the western portion of the pre-flood channel.

The flood channel that cut through ponds and wetlands to the south of the pre-flood main channel remains in place, although it is longer and more sinuous than the original. Much of the very extensive cobble deposition in this area is unvegetated; however, sand and cobble are developing wetland vegetation or dense stands of cottonwood and willow seedlings where the water table is shallow.

The pre-flood riparian area has scattered Boulder County noxious weed Canada thistle as well as infestations of white top.

Comparison of Three Creeks and Overall Impressions

Comparing the three creeks is complicated by the huge amount of variability within each creek and among reaches, and the limitations of the data form. However, based on our field surveys supplemented by aerial imagery, we conclude that St. Vrain Creek sustained more flood impacts along a greater distance than did Boulder or Left Hand Creeks and that Boulder Creek was more impacted than Left Hand Creek, the stream with the smallest watershed. All properties were affected to some degree by deposition or exposure of sand, gravel and cobble substrate, and all lost portions of their riparian areas. The average scores for the three creeks are in Table 8.

Table 8. Average scores for the three creeks.

Creek	Hydrology			Erosion Potential		Vegetation		
	2008 ^a	2014	2013 flood effects	2008	2014	2008	2014	2013 flood effects
Left Hand	11.5	11.1	9.5	12.25	10.0	21.0	20.0	12.5
Boulder	-	12.25	10.0	-	8.75	-	16.0	11.6
St. Vrain	9.9	11.2	7.3	12.0	10.9	21.0	18.3	12.2

^a Biohabitats (2009)

Averaged Hydrology scores for each creek (Table 8) indicate that overall hydrology between the two survey years was considerably improved for St. Vrain compared to Left Hand Creek (Boulder Creek was not surveyed in 2008). The average Boulder Creek scores for 2013 flood effects on hydrology, however, suggest that it was less impacted by the 2013 floods than were the other two creeks. Overall, St. Vrain Creek sustained the most damage, likely due to its pre-flood channelization that made it less accommodating to high flows, and the breaching of

numerous gravel pits east of Lyons that augmented floodwaters and placed even more hydrologic demand on downstream reaches.

None of the three creeks stood out in comparisons of Erosion Potential between years, but Boulder Creek scored the lowest averages among the three in 2014. This score reflects the absence of energy-dissipating structures, such as boulders, cobble, and woody features, in the channels as well as susceptibility of banks to erosion. The lowest score for Boulder Creek indicates that, on the whole, it showed less mid-channel structural variation and more erosion of its banks than the other two creeks.

The largest disparity among Vegetation scores was among the creeks for 2014 (non-flood effects). Boulder Creek has the lowest average score, reflecting narrow riparian zones, generally greater presence of non-native trees, high presence of non-native herbaceous species including noxious weeds, and relatively low vegetative structure and diversity. Left Hand Creek had the highest average Vegetation score due to relatively wide riparian zones, no non-native shrubs, and good cover by mature woody species.

Overall, revegetation trends show that native woody seedlings were establishing wherever the groundwater was close to the surface and post-flood regrading had been minimal. Although all sites did have at least a few observations of Boulder County Noxious Weeds, most were scattered individual plants or in small patches.

Aside from reaches with extensive scour, most areas had increased habitat diversity in 2014 compared to 2008. Where channels were incised, once-riparian and wetland areas no longer have riparian hydrology and we expect them to trend toward a drier community composition.

The principal observations from our field surveys are listed below:

Erosion and Hydrology

- The first Hydrology parameter on our data forms (Appendix A) is Floodplain Inundation. Every reach surveyed received the highest score of 4 for evidence of flooding.
- The entrenchment ratio, a feature of Floodplain Connectivity (Appendix A) was used to evaluate flood effects for Hydrology. The entrenchment ratio was high for all reaches, probably due to the relatively shallow depth of the creeks.
- Cobble deposition and/or exposure characterize a majority of the reaches. This substrate could have mixed effects: the energy-dissipating properties of significant cobble deposition afford a creek greater resistance to high flows and lower erosion potential, but also provide habitat for weed colonizers.

- Areas of bank cutting were significant and render these spots vulnerable to ongoing erosion and/or colonization by weedy species. Where non-natives, *e.g.*, reed canarygrass, are currently established upslope, they could expand onto the bare soils below.

Estimates of the Extent of New Cobble Areas and Riparian Area Loss

- Of the Left Hand Creek properties, Brewbaker/Sorensen received the most flood impacts, with approximately half of the riparian area lost and more than a third of the riparian area now exposed cobble or cobble deposits.
- Along Boulder Creek, the two Dawson properties also received large cobble deposits and lost more than 25% of their riparian area.
- Many of the St. Vrain Creek properties had extensive cobble exposure or deposition as well as high loss of riparian area, especially those properties along the South St. Vrain, between Lyons and the major breaches to the south, and at the confluence of the flood waters augmented by breached gravel mining ponds with the pre-flood channel. The pre-flood riparian zone of Golden Farm and Peschel is relatively intact. However where flood flows washed out County Line Road Bridge and created a new channel to the south, extensive post-flood changes are present, including extremely large areas of cobble exposure and deposition. Many cottonwoods and willow are developing along the new Peschel channel, especially near the lower property boundary.
- Fields outside of the riparian zone were also heavily impacted by erosion and deposition.

Vegetation

- Nearly all reaches sustained loss of trees and bank vegetation and that in some reaches these losses were extensive. Additionally, the forest understories appeared less densely vegetated in 2014. In most sites where 2008 comparison information is available, percentage of cover by non-native trees, shrubs, and herbaceous species was very similar, as was the vegetation structure and diversity. At some properties, the addition of many woody seedlings increased the number of tree age classes. We do note that
- Due to flood wash-out of vegetation, riparian areas became significantly more narrow in some sites. In areas of very erosive flows, few or no trees remain close enough to the channel to provide woody and leaf debris that is important to aquatic habitat. Loss of bank shrubs and trees has exposed the streams to much more sunlight that can result in higher water temperatures and algal blooms.

Post-flood vegetation recovery:

Typical Post-Flood Conditions

- The first flood flows typically scoured banks and side channels, removing all or nearly all vegetation. As the flooding continued, high waters inundated the riparian area and beyond, resulting in deposition of woody and rock materials.
- Extensive areas of the floodplain are now exposed cobble subsoils or covered by sand, gravel, or cobble deposition. In many inundation areas, riparian forests received a thin layer of silt and sand.
- Mature trees were lost in areas of high, scouring flows, in particular in the upper properties of the St. Vrain Creek adjacent to SH 7, sites immediately downstream of the confluence of flood flows from breached gravel mining ponds, and sites east of Longmont.
- Streambanks, particularly along the St. Vrain, have lost long stretches of bank vegetation and are now eroded, often with wide areas of very sparsely vegetated cobble. Post-flood channels are generally wider with shallower flows.
- Erosive flows exposed shale bedrock at the edge of the flow channel on several plains properties in the western portion of the study area. The exposed bedrock is anticipated to be very slow to revegetate.
- Due to channel downcutting, we noted some areas of former riparian forest and former bank wetland that will probably be too far above the water table to maintain their current vegetation community.
- Overall, flooding increased the potential for plant and animal diversity by creating new land forms including new meanders and main channels, abandoned channels, side channels, point bars, and pools. Habitat for wetland plants in particular increased.
- Woody flood debris, often in large jumbles, is present through the riparian forests and could provide habitat for small mammals.

Natural Regeneration of Native Species

- Nearly all woody seedlings observed in our field studies were native cottonwoods and willow. Many mature individual cottonwoods and willows survived the flood in and near the stream reaches, providing a 2014 seed source. Seedlings of plains cottonwood and lanceleaf cottonwood were indistinguishable in the early growth stage. The seedlings are most prevalent and vigorous in low, damp areas with both sand and cobble substrates, *e.g.*, near the edge of flows and in scoured areas of secondary flood channels.

- The dominance by native woody species is likely due to the unusual timing of the flood in September that appears to have washed out the 2013 seed crop for common non-native woody species such as locust, Chinese elm, Russian-olive, and probably tamarisk (tamarisk can produce seeds from April to August⁹). Consequently, the early spring seeds produced by native cottonwood and willow species had the opportunity to establish with almost no competition in 2014. Their seedlings are highly adapted to establish in post-flood conditions.
- Willows and cottonwoods are occasionally resprouting from flood debris or from rootstock exposed by bank erosion. At several sites we noticed dense revegetation at the toe of eroded slopes where seedlings may receive seepage water.
- In some areas, we observed sandbar willow and other shrub species growing through cobble deposition.
- No seedlings of crack willow were observed, but if present these will be easier to spot and remove as they develop in coming years. Few saplings of crack willow were observed; possibly at least some of these were present pre-flood.
- Bank areas reworked by heavy machinery had fewer colonizing species.
- In sand deposition at Keyes/Golden Farm and in cobble deposition at Peschel, we observed widely scattered waterwort, an infrequent species according to Weber and Wittman¹⁰, but one that appears to be well suited for post-flood colonization of damper sites.
- We encountered very few native grasses, although native sedges and rushes were colonizing new wetlands.

Colonization by Non-Native Species

- We anticipate that following a productive 2014 growing season, beginning in 2015 seedlings of non-native woody species will start to colonize areas exposed by erosion or covered by deposition.
- Weeds listed on the Boulder County Noxious Weed List and/or on the State of Colorado Noxious Weed List were relatively rarely encountered in 2014. However, the potential for larger and more widespread infestations of these species is high in the coming years due to vast areas of flood debris and exposed subsoils. Many of these species were present in areas of cobble and did not appear to be limited to the damper soils.
- Although noxious weeds were a small component of the vegetation communities, we noted in nearly all reaches that extent and species richness of non-native colonizers

⁹ Colorado State Parks. 2005. Best Management Practices Profile: Salt Cedar (Tamarisk). Factsheet, April 1, 2005.

¹⁰ Weber, W.A. and R.C. Wittmann. 2012. Colorado Flora Eastern Slope: A Field Guide to the Vascular Plants. University Press of Colorado.

were much greater than for native colonizers. Without a very large restoration and weed control program, the plant species composition of post-flood riparian communities is likely to favor non-native and difficult-to-control species.

- Most of the still very sparse cover on areas of deposition and erosion is provided by non-native species. Many non-native species, such as kochia, alfalfa, horseweed, red-root pigweed, and sweetclover, are not on the Boulder County or State of Colorado Noxious Weed lists, but have the potential to extensively colonize the large post-flood bare areas. In 2015 and beyond, non-native herbaceous species that we anticipate to increase in abundance in cobble areas include alfalfa, bindweed, burdock, houndstongue, knapweeds, kochia, mullein, myrtle spurge, reed canarygrass, and weedy thistles, especially musk and Scotch. In 2015 and beyond, non-native woody species that we anticipate to increase in abundance in cobble areas include Chinese elm, green ash, locust, Russian-olive, and tamarisk.
- The wetland just outside of the Montgomery property river left upstream boundary is infested with the only field work sightings of purple loosestrife and myrtle spurge as well as other noxious weeds.
- Areas that colonize with vigorous weeds will be very slow to acquire trees and shrubs, especially native species.
- We observed very few seedlings of non-native trees and no seedlings of non-native shrubs.

The Future - Restoration

- Extensive planting efforts accompanied by removal of non-native species will be necessary to promote development of riparian areas composed of pre-flood native species.
- Deep planting techniques and other innovative techniques will be necessary for plant survival in many sites.
- Additional restoration activities to help raise the water table and store water could include re-introduction of beaver.
- Based on observation of native species volunteers in dry and/or cobbly areas as well as those that are prevalent in the remnant riparian forests, we compiled a short list of species that could be considered for revegetation (Table 9).

Table 9. Candidate species for revegetation based on observations of native species volunteers, post-flood in BCPOS riparian areas. Note that many of the herbaceous species are classified as “ruderal.” See Appendix B for scientific names and comments.

Trees	Shrubs, Vine	Forbs	Grasses, Grass-likes
Lanceleaf cottonwood	Chokecherry	Blazing star	Big bluestem (observed on an old cobble bar)
Narrowleaf cottonwood	Golden currant	Blue vervain	Bulrush
Peachleaf willow	Grape	Clammy weed	Canada wildrye
Plains cottonwood	Lead plant	Curlycup gumweed	Foxtail barley
	Plum	Dogbane	Prairie cordgrass
	Sandbar willow	Golden aster	Rush
	Snowberry	Golden smoke	Saltgrass
		Heath aster	Scratchgrass muhly
		Licorice	Sedge
		Milkweed	Spike rush
		Mock cucumber	Switchgrass
		Native lamb's quarters	Three square
		Scorpion weed	Witchgrass
		Silver sage	
		Speedwell	
		Sunflower	
		Willowherb	

SUMMARY OF FINDINGS

Flood effects and post-flood natural revegetation along St. Vrain, Boulder, and Left Hand Creeks varied with the type of inundation. In reaches of scouring flows, such as South St. Vrain Creek canyon and areas immediately downstream of dam breaches, fast-moving flood waters removed all or nearly all riparian vegetation, caused major channel changes, and, over very large areas of the floodplain, both deposited cobble and exposed the cobble substrate. In Boulder Creek's eastern channelized reaches and in St. Vrain Creek reaches which were bypassed when high flows avulsed into new channels, slower moving inundation flows submerged the riparian zone, leaving most mature trees intact, but covering the understory with sand and silt as well as jumbles of woody debris.

Where available comparison to 2008 pre-flood conditions, 2014 observations of the channel generally included increased evidence of and potential for erosion as well as improved hydrology. The width, structure, and diversity of riparian communities generally decreased, as did the supply to the channel of woody debris and leaves. In some sites, the presence of woody seedlings increased the number of age classes.

Relatively few plants have begun to colonize cobble areas. Native cottonwood and willow seedlings are concentrated where sand and are cobble just above the water table. Vegetation in the drier cobble areas is very sparse; most colonizing species are non-natives, including State of Colorado Noxious Weeds.

Woody species that are late summer seed producers were rarely encountered in the post-flood seedling assemblages. We infer that due to the September timing of the floods, most of these seeds had washed out of the riparian zone. Beginning in 2015, late summer seed producers, mainly non-native locust, Chinese elm, Russian-olive, and possibly tamarisk, likely will begin to dominate the woody revegetation. Restorationists have a narrow window of opportunity to develop techniques for massive plantings of native species into cobble and to remove non-native species before weed infestations become very difficult and expensive to control.

Appendices

Appendix A: Data Form

Appendix B: Master Species List

Appendix C: Plant Species Tables by Creek and Reach

Appendix D: 2014 Photographs

Appendix E: 2008 and 2014 Comparison Photographs

Appendix F: Weed Infestations on Aerial Photographs

Appendix G: Master Score Table

APPENDIX A

Stream _____ Property _____

Master Species List (I – present in inundation areas, D - present in deposition areas, Dom – dominant)

NATIVE							
TREES		SHRUBS		FORBS		GRASSES, GRASS-LIKES	
	Negundo aceroides		Alnus tenuifolia		Aster ericoides		Carex spp.
	Populus angustifolia		Amorpha fruticosa		Ambrosia spp.		Chondrosium gracile
	P. deltoides		Atemisia frigida		Apocynum cannabinum		Distichlis spicata
	P. x acuminata		Chrysothamnus spp.		Asclepias speciosa		Eleocharis palustris
			Clematis ligustifolia		Asclepias incarnata		Elymus canadensis
			Crataegus spp.		Bidens spp.		Hordeum jubatum
			Padus virginiana				
			Parthenocissus spp.		Conyza canadensis		Juncus spp.
			Physocarpus spp.		Equisetum arvense		Muhlenbergia asperifol.
			Prunus americana		Glycyrrhiza lepidota		Panicum virgatum
			Rhus trilobata				Pascopyrum smithii
			Rhus glabra				Poa palustris
			Ribes aureum		Grindelia squarosa		Schoenoplectus spp.
			Rosa woodsii		Helianthus annuus		Typha spp.
			Sabina scopulorum		Heterotheca villosa		
			Salix amygdaloides		Hippochaete spp.		
			Salix exigua				
			Salix irrorata		Lobelia siphilitica		AQUATIC
			Salix spp.		Opuntia spp.		Lemna minor
			Symphoricarpos occidentalis		Perscaria pensylvanica		
			Toxicodendron rydbergii		Solidago canadensis		
			Robinia neomexicana				
					Thermopsis spp.		
			Vines				
			Parthenocissus vitacea		Verbena hastata		
			Vitus riparia		Veronica spp.		

NON-NATIVE - Bold denotes State Noxious Weed List

TREES		FORBS		FORBS		GRASSES, GRASS-LIKES	
	Eleaegnus angustifolia		Alliaria petiolata		Lotus tenuis		Aegilops cylindrica
	Fraxinus pensylvanica		Amaranthus retroflexus		Lythrum salicaria		Agropyron cristatum
	Morus alba		Ambrosia trifida		Medicago lupulina		Agrostis stolonifera
	Robinea pseudoacacia		Arctium minus		Medicago sativa		Bromopsis inermis
	Salix fragilis		Asparagus officinalis		Melilotus spp.		Bromus tectorum
	Ulmus pumila		Barbarea vulgaris		Myosotis scorpioides		Convolvulus arvensis
			Bassia hyssopifolia		Nepeta cataria		Cyperus esculentus
			Bassia scoparia				Dactylis glomerata
	SHRUBS						
	Rhamnus cathartica		Cardaria draba				
			Chenopodium album		Perscaria maculata		Echinochloa crus-galli
	Rosa multiflora		Conium maculatum		Potentilla recta		Elytrigia repens
	Salix purpurea		Convolvulus arvensis		Rumex crispus		Festuca arundinacea
			Epilobium heirsutum				Phalaroides arundinacea
			Erodium cicutarium		Saponaria officinalis		Phragmites australis
			Hesperis matronalis		Sonchus arvensis		Poa canadensis
					Taraxacum officinale		Poa pratensis
					Tribulus terrestris		Polypogon monspeliensis
			Lactuca serriola		Verbascum thapsus		
			Lathyrus latifolius				AQUATIC
			Lepidium latifolium				
			Solanum rostratum				Nasturtium officinale
			Solanum triflorum				

Stream _____ Property _____

AQUATIC PROBLEM SPECIES

	Algae
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	Didymosphenia geminata
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BOULDER COUNTY NOXIOUS WEEDS		
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A LIST - ERADICATE	B LIST - CONTAIN AND SUPPRESS	ADDITIONAL SPECIES
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	Acosta maculosa	
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	Acosta diffusa	
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		Iris pseudacorus
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	Centaurea solstitialis	
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	Acroptilon repens	
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		Myriophyllum spicatum
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	Chondrilla juncea	
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	Carduus nutans	
--	----------------	--

		Epilobium hirsutum
--	--	--------------------

	Euphorbia cyparissias	
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	Cirsium arvense	
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		Alliaria petiolata
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	Euphorbia myrsinites	
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	Cirsium vulgare	
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		Polygonum x bohemicum
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	Hieracium aurantiacum	
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	Cynoglossum officinale	
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	Isatis tinctoria	
--	------------------	--

	Dipacus laciniatus	
--	--------------------	--

	Lythrum salicaria	
--	-------------------	--

	Dipsacus fullonum	
--	-------------------	--

	Polygonum cuspidatum	
--	----------------------	--

	Euphorbia esula	
--	-----------------	--

	Salvia aethiopsis	
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	Linaria genistifolia var. dalmatica	
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	Linaria vulgaris	
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	Onopordum acanthium	
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	Tamarix ramosissima, T. parviflora	
--	------------------------------------	--

Stream _____ Property _____

Rating:	4	3	2	1	Score
VEGETATION					
Width of riparian plant community (both sides of stream)					
>200'	100-200'	50-100'	<50'		
Tree age class and vigor					
3 age classes, healthy w/ new growth	2 age classes, most healthy w/ new growth	1 age class, most healthy w/ new growth OR 2 age classes w/ signs of decadence	1 age class and exhibiting decadence OR no trees present		
Tree canopy cover by nonnative spp.					
<10%	10-25%	25-50%	>50%		
Shrub cover by nonnative spp.					
<10%	10-25%	25-50%	>50%		
Herbaceous cover by nonnative spp.					
<10%	10-25%	25-50%	>50%		
Woody debris & leaf supply					
Mature, overhanging trees & shrubs provide abundant coarse and/or large woody and leaf material	Mature trees & shrubs close enough to provide abundant coarse and/or large woody and leaf material	Trees & shrubs provide some coarse and/or large woody and leaf material	No on-site source of coarse and/or large woody or leaf material		
Vegetation structure & diversity					
3 structure classes, high diversity	2 structure classes, high diversity	2 structure classes, moderate diversity	1 structure class, low diversity		
Subtotal					

Comments:

Stream _____ Property _____

Rating:	4	3	2	1	Score
HYDROLOGY					
Floodplain inundation based on documentation, debris, water marks, etc.	Evidence of relatively frequent inundation (1-3 yrs) and/or 2013 flood	Evidence of inundation, but time frame indefinite or >3 yrs	Inundation severity uncertain based on water availability	No evidence of flooding outside of historic norm	
Channel morphology*	Meanders present	Meanders present but areas of straightening	Few meanders, most of channel straightened	Stream is channelized	
Channel incision*	No incision	Slightly incised	Moderately incised	Channelized or deeply incised	
Potential extent of vegetated riparian area based on current water supply	Riparian area has achieved potential extent	Riparian area could become up to 25% wider	Riparian area could become up to 50% wider	Very narrow or no riparian area	
Adjacent upland area condition (erosion, ag, infrastructure, etc.)	No contribution to riparian degradation	Minor contribution to riparian degradation	Moderate contribution to riparian degradation	Significant contribution to riparian degradation	
Subtotal					

*Channel morphology and incision were a combined category in 2008.

Comments:

Rating:	4	3	2	1	Score
HYDROLOGY - 2014 additions					
Floodplain connectivity	Low gradient (est. ___%) from OHWM to upper riparian vegetation; little resistant material on banks; wetland plants dominant in streambank zone	Moderate gradient (est. ___%) from OHWM to upper riparian vegetation; possible presence of large, resistant material; wetland plants and/or woody riparian species not dominant	Considerable gradient (est. ___%) from OHWM to upper riparian vegetation and/or large, resistant material on banks; few wetland plants and/or woody riparian species.	High gradient (est. ___%) from OHWM to upper riparian vegetation; banks characterized by large, resistant material; no wetland plants and/or no woody riparian species.	
% New Meanders created by 2013 flood	_____ % (Will estimate percent and assign rating post-field work.)				
Channel Movement after 2013 flood	67-100% reach avulsed	34-66% avulsed	1-33% reach avulsed	Pre-flood channel is same; no signs of avulsion	
Subtotal					

Comments:

Stream _____ Property _____

Rating:	4	3	2	1	Score
EROSION POTENTIAL					
Energy dissipation	Well-developed riffles and deep pools. Large woody debris in channel.	Moderate number of small riffles/shallow pools, but good meander pattern. Some woody debris in channel.	Minor number of small riffles/shallow pools. Few meanders. No woody debris in channel.	No riffles/pools, meanders, or woody debris in channel.	
% of streambank w/sufficient root mass to withstand high flows	>90%	50-90%	25-50%	<25%	
Bank erosion (channel stability)	No evidence of bank erosion.	Minor bank erosion and/or slightly incised, small headcuts.	Bank erosion noticeable but no slumping and/or large headcuts.	Severe bank erosion with vertical slumping banks	
Sediment transport	No mid-channel bars	1-2 small mid-channel bars	Numerous unvegetated mid-channel bars	Vegetated mid-channel bars throughout	
Point Bars	Well-developed point bars.	Well-developed point bars.	Small depositional features	No depositional features	
Subtotal					

Comments:

Photo Notes

Scoring notes for Post-Flood Vegetation Recovery, p.1

Native woody seedlings/saplings

- 4 - widespread in sand, gravel, cobble
- 3 - present in many areas
- 2 - present in some areas
- 1 - few observed

Non-native woody seedlings/saplings

- 4 - none observed
- 3 - few observed
- 2 - many observed
- 1 - extensive presence, will easily crowd out natives

Abundance of Bldr Co noxious weeds

- 4 - none observed
- 3 - some observed but less than 1% of area
- 2 - many observed, but less than 25% of area
- 1 - extensive presence, greater than 25% of area. Note: species NOT listed as noxious can prevent noxious species from colonizing, but prevent native species as well.

Extent of flood deposition

- 4 - no flood deposition
- 3 - < 5 % covered
- 2 - 5 to 25% covered
- 1 - >25 % covered

% of riparian area lost to erosion and/or deposition

- 4 - no riparian area lost
- 3 - <5% of riparian area lost
- 2 - 5 to 25% of riparian area lost
- 1 - > 25% of riparian area lost

APPENDIX B

MASTER List of Significant Species

C= Common, U = Uncommon

Note that because areas of deposition and erosion are sparsely vegetated while areas of inundation are densely vegetated, common and uncommon designations are relative to each type of area.

Green highlight = important as a native revegetation source / high value

Orange highlight = high potential to become barrier to native revegetation / State, County listed species

Common Name	Scientific Name	Deposition / Erosion	Inundation	Noxious Weed Lists
Native Trees				
Box elder	<i>Negundo aceroides</i>		U	
Douglas fir	<i>Pseudotsuga menziesii</i>		U	
Juniper	<i>Sabina scopulorum</i>		U	
Lanceleaf cottonwood	<i>Populus x acuminata</i>	?	U	
Mountain maple	<i>Acer glabrum</i>		U	
Narrowleaf cottonwood	<i>Populus angustifolia</i>	C	C	
Peachleaf willow	<i>Salix amygdaloides</i>	C	C	
Plains cottonwood	<i>Populus deltoides</i> subsp. <i>monilifera</i>	C	C	
Ponderosa pine	<i>Pinus ponderosa</i>		U	
Native Shrubs				
Alder	<i>Alnus incana</i> subsp. <i>tenuifolia</i>		U	
Chokecherry	<i>Padus virginiana</i> subsp. <i>melanocarpa</i>		C	
Golden current	<i>Ribes aureum</i>		U	
Lead-plant	<i>Amorpha fruticosa</i>		U	
Ninebark	<i>Physocarpus</i> spp.		U	
Plum	<i>Prunus americana</i>		U	
Poison ivy	<i>Toxicodendron rydbergii</i>		C	
Rabbitbrush	<i>Chrysothamnus</i> spp.		U	
Red-osier dogwood	<i>Swida sericea</i>		U	
Sandbar willow	<i>Salix exigua</i>	C	C	
Skunkbrush	<i>Rhus aromatica</i> subsp. <i>trilobata</i>		U	
Snowberry	<i>Symphoricarpos occidentalis</i>		C	
Wood's rose	<i>Rosa woodsii</i>		U	
Native Vines				
Grape	<i>Vitis riparia</i>		U	
Virgin's bower	<i>Clematis ligusticifolia</i>		U	
Native Forbs				
Arrowhead	<i>Sagittaria</i> spp.		U	
Beggar's tick	<i>Bidens</i> spp.		U	
Black nightshade	<i>Solanum americanum</i>	U	U	
Blue vervain	<i>Verbena hastata</i>	U	U	
Cactus	<i>Cactus</i> spp.		U	
Clammyweed	<i>Polanisia decandra</i>	U		
Curlycup gumweed	<i>Grindelia squarosa</i>		U	
Dogbane	<i>Apocynum cannabinum</i>		U	
Evening primrose	<i>Oenothera elata</i> subsp. <i>hirsutissima</i>		U	
Fleabane	<i>Erigeron</i> spp.		U	
Golden aster	<i>Heterotheca</i> spp.		C	
Licorice	<i>Glycyrrhiza lepidota</i>		U	

Common Name	Scientific Name	Deposition / Erosion	Inundation	Noxious Weed Lists
Golden banner	<i>Thermopsis</i> spp.		U	
Golden smoke	<i>Corydalis aurea</i>	C		
Goldenrod	<i>Solidago canadensis</i>		U	
Great blue lobelia	<i>Lobelia siphilitica</i>		U	
Heath aster	<i>Virgulus</i> spp.		C	
Jewel weed	<i>Impatiens capensis</i>		U	
Licorice	<i>Glycyrrhiza lepidota</i>		U	
Milkweed	<i>Asclepias speciosa</i>		U	
Mock cucumber	<i>Echinocystis lobata</i>		U	
Nettle	<i>Urtica gracilis</i>	U	U	
Nuttall's sunflower	<i>Helianthus nuttallii</i>		U	
Poppy	<i>Argemone</i> spp.	U		
Povertyweed	<i>Iva xanthifolia</i>	U	U	
Prickly pear cactus	<i>Opuntia</i> spp.		U	
Ragweed	<i>Ambrosia</i> spp.	U	U	
Scorpion weed	<i>Phacelia heterophylla</i>	U		
Silver sage	<i>Atemisia frigida</i>		U	
Snow on the mountain	<i>Agaloma marginata</i>		U	
Speedwell	<i>Veronica americana</i>	U		
Sunflower	<i>Helianthus annuus</i>	C		
Waterwort	<i>Elatine triandra</i>	U		
Willowherb	<i>Epilobium</i> spp.		U	
Native Grasses, Grass-Likes				
Big bluestem	<i>Andropogon gerardii</i>		U	
Blue grama	<i>Chondrosum gracile</i>		U	
Bulrush	<i>Schoenoplectus lacustris</i> spp.	U	U	
Canada wildrye	<i>Elymus canadensis</i>		U	
Cattail	<i>Typha</i> spp.	U	U	
Foxtail barley	<i>Critesion jubatum</i>		U	
Horsetail	<i>Equisetum arvense</i>		U	
Muhley	<i>Muhlenbergia</i> spp.	U		
Prairie cordgrass	<i>Spartina pectinata</i>		U	
Prairie Junegrass	<i>Koeleria macrantha</i>		U	
Rush	<i>Juncus</i> spp.	U	U	
Saltgrass	<i>Distichlis spicata</i>		U	
Scouring-rush	<i>Hippochaete</i> spp.	U		
Sedge	<i>Carex</i> spp.	U	U	
Spike rush	<i>Eleocharis palustris</i>	U		
Switchgrass	<i>Panicum virgatum</i>		U	
Three square	<i>Schoenoplectus pungens</i>		U	
Toad rush	<i>Juncus bufonius</i>	U		
Western wheatgrass	<i>Pascopyrum smithii</i>		U	
Witchgrass	<i>Panicum capillare</i>	U		
Native Aquatics				
Duck weed	<i>Lemna</i> spp.		U	
Non-Native Trees				
Common Name	Scientific Name			
Apple	<i>Malus domestica</i>		U	
Chinese elm	<i>Ulmus pumila</i>		C	
Crack willow	<i>Salix fragilis</i>	U	C	
Green ash	<i>Fraxinus pennsylvanica</i>		U	
Locust	<i>Robinea pseudoacacia</i>	U	C	
Russian-olive	<i>Eleaagnus angustifolia</i>	U	C	State B

Common Name	Scientific Name	Deposition / Erosion	Inundation	Noxious Weed Lists
Non-Native Shrubs				
Sweetbriar	<i>Rosa rubiginosa</i>		U	
Tamarisk	<i>Tamarix ramosissima, T. parviflora</i>		U	State B, Boulder B
Non-Native Forbs				
Alfalfa	<i>Medicago sativa</i>	C	U	
Bigbract verbena	<i>Verbena bracteata</i>	U		
Bindweed	<i>Convolvulus arvensis</i>	U		State C
Black medic	<i>Medicago lupulina</i>	U		
Bouncing bet	<i>Saponaria officinalis</i>	U	C	State B
Buffalo-bur	<i>Solanum rostratum</i>	U		
Bull thistle	<i>Cirsium vulgare</i>		U	State B, Boulder B
Burdock	<i>Arctium minus</i>			State C
Canada thistle	<i>Cirsium arvense</i>		U	State B, Boulder B
Catchfly	<i>Silene vulgaris</i>	U		
Chicory	<i>Cichorium intybus</i>	U	U	
Cocklebur	<i>Xanthium strumarium</i>	U	U	
Curly dock	<i>Rumex crispus</i>		U	
Devil's shoestring	<i>Polygonum aviculare</i>	C		
Eurasian watermilfoil	<i>Myriophyllum spicatum</i>			State B, occasional along Boulder Cr
Forget-me-not	<i>Myosotis scorpioides</i>	U	U	
Garden orache	<i>Atriplex hortensis</i>	U		
Giant ragweed	<i>Ambrosia trifida</i>		U	
Great Mullein	<i>Verbascum thapsus</i>	U	C	State C
Horseweed	<i>Conyza canadensis</i>	U	C	
Hound's tongue	<i>Cynoglossum officinale</i>		U	State B, Boulder B
Knapweed	Rosette	U	U	State B, Boulder B
Knapweed, diffuse	<i>Acosta diffusa</i>	U	C	State B, Boulder B
Kochia	<i>Bassia</i> spp.	U	C	
Lady's thumb	<i>Perscaria maculata</i>	C	C	
Lettuce / sow-thistle	<i>Lactuca / Sonchus</i>	U	U	
Lotus	<i>Lotus tenuis</i>		U	
Mallow, common	<i>Malva neglecta</i>		U	
Mediterranean Sage	<i>Salvia aethiopsis</i>	U	U	State A, County A Rosette, provisional ID
Musk thistle	<i>Carduus nutans</i>	U	C	State B, Boulder B
Myrtle spurge	<i>Euphorbia myrsinites</i>		U	State A, Boulder A, outside Co.
Nasturtium	<i>Nasturtium officinale</i>		U	
Ox-eye daisy	<i>Chrysanthemum</i>	U		State B
Pepperweed, perennial	<i>Lepidium latifolium</i>		U	State B
Plantain, common	<i>Plantago major</i>	U		
Plantain, narrowleaf	<i>Plantago lanceolata</i>	U		Slump from upland meadow
Poison hemlock	<i>Conium maculatum</i>		U	State C
Puncture vine	<i>Tribulus terrestris</i>	U		State C
Purple loosestrife	<i>Lythrum salicaria</i>		U	State A, Boulder A, outside Co. property
Purslane	<i>Portulaca oleracea</i>	U		
Red clover	<i>Trifolium pratense</i>	U	U	
Red-root pigweed	<i>Amaranthus retroflexus</i>	U		
Redstem filaree	<i>Erodium cicutarium</i>	U		State C
Russian thistle	<i>Salsolsa iberica</i>	U		
Scotch thistle	<i>Onopordum acanthium</i>		U	State B, Boulder B
Sulfur cinquefoil	<i>Potentilla recta</i>		U	State B
Sweet clover	<i>Melilotus</i> spp.		U	
Teasel	<i>Dipsacus</i> spp. rosettes		C	State B, Boulder B,

Common Name	Scientific Name	Deposition / Erosion	Inundation	Noxious Weed Lists
Teasel, common	<i>Dipsacus fullonum</i>		U	State B, Boulder B
Toadflax, Dalmation	<i>Linaria genistifolia</i> var. <i>dalmatica</i>		U	State B, Boulder B
Toadflax, yellow	<i>Linaria vulgaris</i>		U	State B, Boulder B
Toothed spurge	<i>Poinsettia dentata</i>		U	
Velvetweed	<i>Gaura mollis</i>		U	
White top	<i>Cardaria draba</i>		U	State B
Non-Native Grasses, Grass-likes				
Barnyard grass	<i>Echinochloa crus-galli</i>	U	U	
Canada bluegrass	<i>Poa compressa</i>		U	
Cheatgrass	<i>Bromus tectorum</i>		U	State C
Crabgrass	<i>Digitaria</i> spp.	U		
Crested wheatgrass	<i>Agropyron cristatum</i>		U	
Foxtail	<i>Setaria</i> spp.	U		
Orchardgrass	<i>Dactylis glomerata</i>	U		
Quackgrass	<i>Elyrygia repens</i>		U	State B
Rabbitfoot grass	<i>Polypogon</i> spp.	U		
Redtop	<i>Agrostis stolonifera</i>	U		
Reed canarygrass	<i>Phalaroides arundinacea</i>	C	C	
Smooth brome	<i>Bromopsis inermis</i>		C	
Stinkgrass	<i>Eragrostis cilianensis</i>	U		
Tall wheatgrass	<i>Elytrigia elongata</i>		U	
Timothy	<i>Phleum pratense</i>		U	
Yellow nutsedge	<i>Cyperus esculentus</i>	U		State B
Nativity Not Determined				
Lamb's quarters / Goosefoot	<i>Chenopodium</i> spp.	U	U	
Mint	<i>Lamiaceae</i> spp.	U	U	
Mustard	<i>Brassicaceae</i> spp.	U		Possibly <i>Barbarea vulgaris</i>
Mustard	<i>Brassicaceae</i> spp.	U	U	
Nightshade	<i>Solanaceae</i> spp.	U	U	
Smartweed	<i>Perscaria</i> spp.	U	U	
Virginia creeper	<i>Parthenocissus</i> spp.	U	U	

APPENDIX C

C1. Significant species, Left Hand Creek. “Dep” ≡ observed in areas of deposition and/or erosion; “inun” ≡ observed in areas of inundation that were not eroded nor experienced deposition. No significant species were observed in areas of erosion. Noxious weeds are in a red font and their status indicated with the following codes: BB ≡ Boulder County Noxious Weeds List B; SB and SC ≡ State of Colorado Noxious Weeds Lists B and C, respectively. Species indicated as common in a reach are highlighted. RL ≡ river left and RR ≡ river right (facing downstream).

	BREWBAKER-SORENSEN	IMEL	BIELINS/HOCK	RUSSELL/ANDERSON/SCHMIDT
NATIVE TREES				
Lanceleaf cottonwood	Uncommon, inun.			
Narrowleaf cottonwood	Uncommon, inun. (planted)			
Peachleaf willow	Uncommon, dep		Common, dep. Large patch.	Uncommon, inun.
Plains cottonwood	Common, dep; Common and dominant, inun.	Uncommon, dep. Common and dominant, inun. In groups, mainly at lower end.	Common, dep.; common and dominant, inun. Most at upstream end.	Uncommon, dep; common, inun. Old riparian area.
NATIVE SHRUBS				
Chokecherry	Uncommon, dep	Uncommon, inun.	Uncommon riparian forest.	
Golden currant			Uncommon, riparian forest.	
Leadplant	Uncommon, inun		Uncommon, riparian forest.	
Poison ivy		Uncommon, inun.	Uncommon, riparian forest.	Uncommon, inun.
Sandbar willow	Common, dep; uncommon, inun. One lg. patch RL	Uncommon, inun.		
Snowberry		Dominant and common, inun.		
NATIVE FORBS				
Beggar’s tick	Uncommon, dep.			
Clammyweed			Uncommon, dep and inun.	
Blue vervain	Uncommon, dep.	Uncommon, dep.	Uncommon, dep.	
Dogbane				Uncommon, inun.
Golden aster				Uncommon, inun. Old riparian area.
Heath aster (<i>Virgulus</i> sp.)	Uncommon, inun.			
Mock cucumber			Common, inun.	
Nightshade			Uncommon, dep.	
Poppy	Uncommon, dep.		Uncommon, dep.	
Povertyweed	Uncommon, dep. and inun.		Common and dominant, dep; uncommon, inun.	
Ragweed	Common, dep.		Common, dep.	
Scorpionweed	Uncommon, dep.			
Snow on the mountain			Uncommon, dep.	
Speedwell			Uncommon, dep.	
Sunflower	Uncommon, dep.		Uncommon, dep.	

	BREWBAKER-SORENSEN	IMEL	BIELINS/HOCK	RUSSELL/ANDERSON/SCHMIDT
NATIVE GRASSES AND GRASS-LIKES				
Bulrush	Uncommon, dep.		Uncommon, dep.	
Cattail	Uncommon, dep., inun. Patch in old pond RR.			Uncommon, inun. Most on RR bank.
Horsetail	Uncommon, dep.		Uncommon, dep.	
Rush	Uncommon, dep.			
Sedge				Uncommon, inun. Most on RR bank.
Three-square				Uncommon, inun. Most on RR bank.
NATIVITY UNDETERMINED				
Asteraceae spp.	Uncommon, dep.			
Brassicaceae species			Common, dep. <i>Barbarea?</i>	
Goosefoot	Uncommon, dep.	Uncommon, dep.	Uncommon, inun.	
Smartweed				Uncommon, dep.
Virginia creeper			Uncommon, inun.	
NON-NATIVE TREES				
Crack willow	Common, inun. Most at upper or lower boundaries.	Common and dominant, inun. Many mature trees, some saplings.	Uncommon, dep; common and dominant, inun. Most at downstream end / next to cr.	Uncommon, dep; common and dominant, inun. Rooting from flood debris.
Green ash		Uncommon, inun.	Uncommon, inun. Existing riparian forest.	
Locust	Uncommon, dep. and inun.	Uncommon, inun. Some saplings.	Uncommon, dep.	
Russian-olive (SB)			Uncommon, dep and inun.	
NON-NATIVE FORBS				
Alfalfa	Common, dep; uncommon, inun.	Uncommon, dep. Alfalfa field adj. to RL.	Common and dominant, dep; uncommon, inun.	Uncommon, dep
Bindweed (SC)	Uncommon, inun.		Uncommon, dep; common, inun. Many in breach area.	
Black medic	Uncommon, dep.			
Bouncing bet (SB)			Uncommon, dep.	
Buffalo-bur	Uncommon, dep.			
Bull thistle (BB)		Uncommon, inun.		
Burdock (SC)		Uncommon, inun.		
Canada thistle (SB, BB)	Uncommon, inun.	Uncommon, inun.	Uncommon, inun.	Uncommon, inun. Patch RR near Hover Br.
Catchfly			Uncommon, inun.	
Catnip	Uncommon, inun.		Uncommon, dep.	
Chicory	Uncommon, dep.			
Common mallow			Uncommon, inun.	
Common mullein	Common dep., inun. Many rosettes			

	BREWBAKER-SORENSEN	IMEL	BIELINS/HOCK	RUSSELL/ANDERSON/SCHMIDT
Common plantain	Uncommon, dep.			
Curly dock	Uncommon, dep.	Uncommon, inun.		
Dalmatian toadflax (SB, BB)	Uncommon, dep. Pulled most.			
Dandelion		Uncommon, inun.		
Devil's shoestring	Uncommon, dep.			
Flower-of-an-hour (SB)	Uncommon, dep.			
Garden orache			Uncommon, dep.	
Giant ragweed		Uncomon, inun.		
Great mullein (SC)	Common, dep. and inun. Many rosettes.		Common, dep.	
Horseweed	Common, dep.			
Houndstongue (SB, BB)	Uncommon, inun.	Uncommon, inun.	Uncommon, dep.	
Knapweed	Uncommon, dep., rosette			
Kochia		Uncommon, inun.	Common and dominant, dep.	
Lady's thumb (SB)	Uncommon, dep. and inun.	Uncommon, inun.	Uncommon, dep. and inun.	Uncommon, dep. Upper RL bank.
Musk thistle (SB, BB)	Common, inun.		Uncommon, inun. Many in field to N (breach area).	
Ox-eye daisy (SB)	Uncommon, dep. Pulled.			
Perennial pepperweed (SB)		Uncommon, inun.	Uncommon, inun.	
Puncturevine (SC)	Uncommon, dep.		Uncommon, inun.	
Red-footed pigweed			Uncommon, dep.	
Redstem filaree (SC)	Uncommon, dep. and inun.		Uncommon, dep.	
Russian thistle			Uncommon, dep.	
Sow thistle or lettuce (<i>e.g.</i> , prickly)	Uncommon, inun.	Uncommon, inun.	Uncommon, dep; common, inun. Many in field to N (breach area).	
Sweet clover			Uncommon, dep. Upper riparian.	
Toothed spurge				Uncommon, inun.
NON-NATIVE GRASSES AND GRASS-LIKES				
Barnyard grass		Uncommon, dep.	Uncommon, dep.	
Brome	Uncommon, inun. <i>B.</i> <i>japonicus?</i>			
Canada bluegrass				Uncommon, inun. Old riparian area.

	BREWBAKER-SORENSEN	IMEL	BIELINS/HOCK	RUSSELL/ANDERSON/SCHMIDT
Cheatgrass (SC)	Common, inun.		Uncommon, dep; common, inun.	Common and dominant, inun. Old riparian area.
Crabgrass			Uncommon, dep.	
Quackgrass (SB)		Uncommon, inun.	Common, inun.	Uncommon, inun. Old riparian area.
Rabbitfoot grass			Uncommon, dep.	
Redtop	Uncommon, inun.		Uncommon, inun.	
Reed canarygrass		Uncommon, inun.	Uncommon, inun.	Uncommon, inun.
Smooth brome	Common and dominant, inun.	Common and dominant, inun.	Uncommon, dep; common, inun.	Common, inun. Old riparian area.
Stinkgrass	Uncommon, dep.			

C2. Significant species, Boulder Creek. “Dep” ≡ observed in areas of deposition and/or erosion; “inun” ≡ observed in areas of inundation that were not eroded nor experienced deposition. No significant species were observed in areas of erosion. Noxious weeds are in a red font and their status indicated with the following codes: BA, and BB ≡ Boulder County Lists A and B, respectively; SA, SB, and SC ≡ State of Colorado Noxious Weeds Lists A, B, and C, respectively. Species indicated as common in a reach are highlighted. RL ≡ river left and RR ≡ river right (facing downstream).

	MMS PARTNERSHIP	DAWSON W OF 287	DAWSON E OF 287	DONIPHAN	BAILEY PONDS/KENOSHA
NATIVE TREES					
Box elder		Uncommon, inun.			
Juniper	Uncommon, inun. Planted				
Lanceleaf cottonwood			Uncommon, inun. Saplings.	Uncommon, inun.	
Narrowleaf cottonwood		Common, dep and inun; dominant, inun. Seedlings.		Uncommon, inun.	
Peachleaf willow	Uncommon, inun. Oxbow wetland.	Common, dep and inun. Seedlings.	Uncommon, inun.	Uncommon, inun. Some flood debris resprouting.	Uncommon, inun.
Plains cottonwood	Common and dominant, inun. All mature/decadent.	Common, dep and inun.; dominant, inun. Seedlings.	Common and dominant, inun. In groups.	Common and dominant, inun. Many seedlings.	Common, dep and inun.
NATIVE SHRUBS					
Golden currant		Uncommon, inun.		Uncommon, inun.	
Plum		Uncommon, inun.			Uncommon, inun.
Sandbar willow		Common, dep and inun. Seedlings.	Uncommon, dep (new clumps) and inun. Remnant patches, RL.	Common, dep and inun. Dominant, inun. Patches.	Common, inun.
Snowberry		Uncommon, inun.	Uncommon, inun.		Uncommon, dep and inun.
Wood’s rose	Uncommon, inun.				
NATIVE FORBS					
Arrowhead		Uncommon, inun.	Uncommon, inun.		
Beggar’s tick		Uncommon, dep.			
Blue vervain		Uncommon, dep.	Uncommon, dep.		
Cactus	Uncommon, inun.				
Clammyweed			Uncommon, dep.	Uncommon, dep.	Uncommon, dep.
Curlycup gumweed			Common, inun.		
Evening primrose			Uncommon, dep.	Uncommon, dep.	
Fleabane	Uncommon, inun.				
Golden aster		Common, inun.			
Goldenrod		Uncommon, inun.			
Heath aster		Uncommon, inun.			Uncommon, inun.
Jewelweed		Uncommon, inun.		Uncommon, inun.	

	MMS PARTNERSHIP	DAWSON W OF 287	DAWSON E OF 287	DONIPHAN	BAILEY PONDS/KENOSHA
Lambs' quarters			Uncommon, dep.		
Licorice		Uncommon, inun.	Common, inun.		
Milkweed		Uncommon, inun.	Uncommon, inun.	Uncommon, inun.	
Mock cucumber		Uncommon, inun.		Uncommon, inun.	Common, inun.
Poppy			Uncommon, dep.		
Povertyweed			Uncommon, dep.	Uncommon, dep.	
Ragweed	Uncommon, dep.	Uncommon, dep.	Common, inun.	Uncommon, inun.	Common, inun.
Silver sage		Uncommon, inun.		Uncommon, inun.	
Speedwell		Uncommon, inun.	Uncommon, dep.		
Sunflower				Uncommon, inun.	
Velvetweed			Uncommon, dep.		Uncommon, inun.
NATIVE GRASSES AND GRASS-LIKES					
Bulrush		Uncommon, inun.	Uncommon, inun.		
Cattail		Uncommon, dep and inun.	Uncommon, inun.	Common, inun. Developing in an old meander. Several lg patches.	Uncommon, inun.
Muhly				Uncommon, dep.	
Prairie junegrass				Uncommon, dep.	
Prairie cordgrass	Uncommon, inun. Oxbow wetland.				
Rush	Uncommon, inun. Oxbow wetland.	Uncommon, dep and inun. Undeveloped, maybe <i>Eleocharis</i> .	Uncommon, inun.		
Saltgrass			Uncommon, inun.		
Sedge		Common, inun. Common in RL overflow channel.	Uncommon, inun.	Uncommon, dep and inun. Developing in abandoned channel.	
Three-square	Uncommon, inun. Oxbow wetland.		Uncommon, inun.		
Western wheatgrass	Common and dominant, inun. Provisional ID.				
Witchgrass				Uncommon, dep.	
NATIVE AQUATICS					
Duckweed		Uncommon, inun.	Uncommon, inun.		
NATIVITY UNDETERMINED					
Asteraceae sp.			Uncommon, inun. Probably <i>Bidens</i> .		
Asteraceae sp.		<i>Helianthus nuttallii?</i>			
Brassicaceae species		Uncommon, dep. <i>Barbarea?</i>	Uncommon, dep.	Uncommon, dep.	
Goosefoot	Uncommon, dep.	Common, dep.	Common, dep.		
Smartweed				Uncommon, dep.	Uncommon, inun.

	MMS PARTNERSHIP	DAWSON W OF 287	DAWSON E OF 287	DONIPHAN	BAILEY PONDS/KENOSHA
NON-NATIVE TREES					
Chinese elm		Uncommon, inun.	Uncommon, inun.	Uncommon, inun.	
Crack willow		Common, inun.	Uncommon, inun.	Uncommon, inun. Minor, some saplings.	Common and dominant, inun.
Green ash	Uncommon, inun.		Uncommon, inun. Minor.		
Locust	Uncommon, inun. Some saplings.			Uncommon, inun.	
Russian olive (SB)	Several near oxbow wetland, also plantings near S fence.	Uncommon, inun.	Uncommon, dep. and inun. Pulled seedlings.	Uncommon, inun.	
NON-NATIVE SHRUBS					
Sweetbriar			Uncommon, inun.		
Tamarisk (SB, BB)					Uncommon, inun. Provisional ID. Area inaccessible.
NON-NATIVE FORBS					
Alfalfa	Uncommon, dep. Crop in field to S.	Common, dep; uncommon, inun.	Common, dep (many) and uncommon, inun.	Common, dep; uncommon, inun.	Common, dep.
Bigbract verbena			Uncommon, dep.		
Bindweed (SC)	Uncommon, dep.	Uncommon, inun.	Uncommon, inun.	Uncommon, dep and inun. Many in field, RR.	Uncommon, dep; common, inun.
Black medic			Uncommon, dep.		
Bouncing bet (SB)		Uncommon, dep.			Uncommon, inun.
Buffalo-bur		Uncommon, dep.	Uncommon, dep.		
Burdock (SC)		Uncommon, dep and inun.			
Canada thistle (SB, BB)		Uncommon, inun.	Uncommon, inun.	Uncommon, inun.	
Catnip		Uncommon, inun.			
Cocklebur			Uncommon, dep.	Uncommon, dep.	
Curly dock	Uncommon, inun. Oxbow wetland.	Uncommon, dep and inun.	Uncommon, dep and inun.	Common, inun. Many in field, RR.	Uncommon, inun.
Devil's shoestring			Uncommon, dep.		
Garden orache	Uncommon, dep.		Uncommon, dep.		
Great mullein (SC)		Common, dep and inun. V. common in RL meadows.	Common, dep.	Common, dep; uncommon, inun.	
Horseweed			Uncommon, dep.	Uncommon, dep; common, inun. Many in field, RR.	Common, inun.
Houndstongue (SB, BB)			Uncommon, dep and inun.		

	MMS PARTNERSHIP	DAWSON W OF 287	DAWSON E OF 287	DONIPHAN	BAILEY PONDS/KENOSHA
Kochia			Uncommon, dep.		Uncommon, inun.
Lady's thumb (SB)	Uncommon, inun. Oxbow wetland.		Common, inun.		
Mediterranean sage (SA, BA)		1 rosette, dep. Provisional ID.			Uncommon, inun. Rosette. Provisional ID.
Musk thistle (SB, BB)	Uncommon, inun.	Uncommon, dep.	Uncommon, inun.	Uncommon, inun. Berm, RL.	Uncommon, inun.
Perennial pepperweed (SB)	Uncommon, inun. Several dead stalks near oxbow wetland.		Uncommon, inun.	Uncommon, inun. Berm.	
Puncturevine (SC)			Uncommon, dep.		
Purslane			Uncommon, dep.		
Red-footed pigweed			Uncommon, dep.		
Redstem filaree (SC)	Uncommon, dep.		Uncommon, dep.	Uncommon, inun.	
Russian thistle			Uncommon, dep.		Uncommon, dep and inun.
Scotch thistle (SB, BB)			Uncommon, dep and inun. Rosettes.	Uncommon, inun.	Uncommon, inun.
Sow thistle or lettuce (<i>e.g.</i> , prickly)		Uncommon, dep.	Uncommon, dep.		Uncommon, inun.
Sweet clover	Uncommon, inun.				Uncommon, inun.
Teasel (SB, BB)				Uncommon, inun. Berm.	
Teasel (species-unspecific)			Rosettes.	Uncommon, inun. Rosettes. Berm.	Uncommon, inun. Rosettes.
Toothed spurge			Uncommon, dep.		
Whitetop (SB)			Uncommon, inun. Most in one patch, RR, near upper end.	Uncommon, inun. Patches.	
NON-NATIVE GRASSES AND GRASS-LIKES					
Barnyard grass		Uncommon, dep.	Uncommon, dep.	Uncommon, dep.	
Cheatgrass (SC)	Common and dominant, inun.			Uncommon, inun.	
Rabbitfoot grass		Uncommon, dep.		Uncommon, dep.	
Reed canarygrass		Uncommon, dep; common, inun.	Common, inun. V. vigorous, beginning regrowth at new edge of bank.	Common, inun.	Common and dominant, inun.
Smooth brome	Uncommon, inun.		Common, inun.	Common, inun.	Uncommon, inun.
Stinkgrass				Uncommon, dep.	

	MMS PARTNERSHIP	DAWSON W OF 287	DAWSON E OF 287	DONIPHAN	BAILEY PONDS/KENOSHA
Tall wheatgrass				Uncommon, inun. Berm.	
Yellow nutsedge (SB)		Uncommon, dep.	Uncommon, dep.		
NON-NATIVE AQUATICS					
Eurasian watermilfoil		Uncommon, dep.	Common, inun.		Uncommon, inun.

C3. Significant species, St. Vrain Creek. “Dep” ≡ observed in areas of deposition; “eros” ≡ observed in areas of erosion; “inun” ≡ observed in areas of inundation that were not eroded nor experienced deposition. Noxious weeds are in a red font and their status indicated with the following codes: BA, BB, and BC ≡ Boulder County Lists A, B, and C, respectively; SA, SB, and SC ≡ State of Colorado Noxious Weeds Lists A, B, and C, respectively. Species indicated as common in a reach are highlighted. RL ≡ river left and RR ≡ river right (facing downstream).

C3a. St. Vrain Creek above Lyons.

	CUSTODE	HALL RANCH II	HALL MEADOWS	TRIANGLE
NATIVE TREES				
Box elder		Uncommon, inun		
Douglas fir	Upper bank			
Juniper	Dead/uncommon, upper bank.	Uncommon, inun	Uncommon, inun. Remnant forest.	Uncommon, inun. Remnant forest.
Lanceleaf cottonwood	Uncommon, inun	Uncommon, dep/eros & inun		
Mountain maple	Upper bank			
Narrowleaf cottonwood	Common, dep/eros, upper bank	Common, dep/eros & inun. Sprouts from upper bank root stock + saplings.	Uncommon, dep; common and dom, inun. Remnant forest, saplings.	Common and dominant, inun. Remnant forest.
Peachleaf willow	Upper bank			Uncommon, inun. Remnant forest.
Plains cottonwood	Common, dep/eros			Common, dep/eros and inun. Remnant forest.
Ponderosa pine	Uncommon, inun, upper bank	Uncommon, inun	Uncommon, inun. Remnant forest.	Common, inun. Remnant forest.
NATIVE SHRUBS				
Alder	Upper bank	Uncommon, inun	Uncommon, inun. Remnant forest.	Uncommon, inun. Remnant forest.
Chokecherry				
Currant				
Plum				Uncommon, inun
Poison ivy				Uncommon, dep and inun. Remnant forest.
Rabbitbrush			Uncommon, inun. Remnant forest.	Uncommon, inun. Remnant forest.
Red-osier dogwood	Upper bank	Uncommon, dep/eros & inun		
Sandbar willow	Uncommon, inun. Upper bank.	Uncommon, dep/eros & inun. Some resprouts from flood debris.	Uncommon, inun. Also growing out from forest edge.	Uncommon, dep/eros. Resprouting from roots.
Snowberry		Uncommon, inun	Uncommon, inun.	
Wood’s rose	Upper bank		Uncommon, dep and inun.	

	CUSTODE	HALL RANCH II	HALL MEADOWS	TRIANGLE
			Remnant forest.	
NATIVE VINES				
Grape	Upper bank	Uncommon, inun	Uncommon, inun. Remnant forest.	Common, inun
Virgin's bower				
NATIVE FORBS				
Blazingstar			Uncommon, sandy depos.	
Clammyweed	Uncommon, inun	Uncommon, dep/eros		
Curlycup gumweed		Uncommon, inun		
Dogbane				Uncommon, dep/eros. Possibly resprouting from roots.
Golden smoke	Uncommon, inun	Uncommon, dep/eros		
Heath aster		Uncommon, inun		Uncommon, inun
Licorice			Uncommon, inun	
Nettle	Uncommon, inun			
Poppy			Uncommon, dep & inun	
Povertyweed		Uncommon, dep/eros	Uncommon, inun. Remnant forest.	
Prickly pear cactus			Uncommon, inun	
Ragweed	Uncommon, inun	Uncommon, inun	Uncommon, dep & inun	Uncommon, dep/eros
Scorpionweed		Uncommon, dep/eros		
Silver sage		Uncommon, inun		
Sunflower			Common, dep	
NATIVE GRASSES AND GRASS-LIKES				
Foxtail barley		Uncommon, dep/eros		
Horsetail	Upper bank			
Rush	Uncommon, inun; upper bank	Uncommon, dep/eros		
Scouring-rush			Uncommon, dep	Uncommon, dep/eros
Sedge	Uncommon, inun	Uncommon, dep/eros		
Toad rush			Uncommon, dep	
Witchgrass		Uncommon, dep/eros		
NATIVITY UNDETERMINED				
Asteraceae		Uncommon, dep/eros		
Goosefoot	Common, eros			
Mustard		Uncommon, dep/eros	Uncommon, dep.	
Rose				Uncommon, inun
Smartweed		Uncommon, dep/eros		
Virginia creeper				Uncommon, dep/eros & inun. Remnant forest, probably resprouting from roots.
NON-NATIVE TREES				
Apple	Uncommon, inun	Uncommon, inun		Uncommon, inun

	CUSTODE	HALL RANCH II	HALL MEADOWS	TRIANGLE
Chinese elm			Uncommon, remnant forest	Uncommon, inun. Fallen tree resprouting.
Crack willow				Uncommon, inun
Locust		Uncommon, inun		
NON-NATIVE FORBS				
Alfalfa	Common, dep/eros	Common, dep/eros; uncommon, inun	Common and dominant, dep	Common & dominant, dep/eros
Bigbract verbena	Uncommon, inun			
Bindweed (SC)		Uncommon, inun	Uncommon, dep	
Black medic				
Bouncing bet (SB)				Uncommon, dep/eros
Buffalo bur				Uncommon, inun
Bull thistle		Uncommon, dep/eros		
Burdock (SC)		Uncommon, inun. RR meadow.		
Canada thistle (SB, BB)	Upper bank	Uncommon, dep/eros	Uncommon, dep	Uncommon, dep/eros
Catchfly	Uncommon, inun			
Chicory (SC)				
Cocklebur	Uncommon, inun			
Devil's shoestring	Uncommon, dep			Uncommon, dep/eros
Diffuse knapweed (SB, BB)	Uncommon, inun	Common, dep/eros & inun. Several patches.		
Garden orache			Uncommon, dep	Uncommon, dep/eros
Knapweed		Common, dep/eros. Rosette, several patches.	Uncommon, dep. Rosette (pulled).	Uncommon, dep/eros. Scattered.
Kochia	Uncommon, dep	Uncommon, dep/eros & common, inun.	Uncommon, dep. Common, inun. Remnant forest.	
Lady's thumb		Uncommon, dep/eros		
Lettuce/sow-thistle			Uncommon, dep	
Mullein (SC)	Common, eros & inun		Uncommon, inun	
Musk thistle (SB, BB)		Uncommon, dep/eros & inun. RR meadows.		
Red clover			Uncommon, dep	Uncommon, dep/eros & inun.
Redstem filaree (SC)				
Russian thistle	Uncommon, dep	Uncommon, dep/eros & inun		
Sulphur cinquefoil	Uncommon, inun			
Sweet clover			Uncommon, dep	
Dalmatian toadflax (SB, BB)		Uncommon, inun. Scattered along flood channel deposits.		
Yellow toadflax (SB, BB)	Uncommon, inun	Uncommon, dep/eros & inun		Uncommon, dep/eros. Few.
NON-NATIVE GRASSES AND GRASS-LIKES				

	CUSTODE	HALL RANCH II	HALL MEADOWS	TRIANGLE
Barnyard grass	Uncommon, inun	Uncommon, dep/eros		
Brome species, probably <i>B. japonicus</i>	Uncommon, dep			
Canada bluegrass	Upper bank	Uncommon, inun		
Cheatgrass (SC)		Uncommon, dep/eros & inun		Uncommon, dep/eros
Crested wheatgrass		Uncommon, inun		
Foxtail (SB)		Uncommon, dep/eros	Uncommon, dep	
Orchardgrass	Upper bank			
Quackgrass			Uncommon, inun	
Redtop	Uncommon, eros	Uncommon, dep/eros		
Russian wildrye	Uncommon, inun			
Smooth brome	Uncommon, inun	Uncommon, inun	Common, inun. Remnant forest, meadow.	Uncommon, inun
Stinkgrass		Uncommon, dep/eros		
Tall wheatgrass		Common, inun		
Timothy		Uncommon, dep/eros		

C3b. St. Vrain Creek between Lyons and Longmont.

	BULLOCK	WALLACE	MONTGOMERY ¹	WESTERN MOBILE	BRALY	RAMEY	SADAR	GAGE	PELLA W/MARLATT	GOLDEN/FREDSTROM
NATIVE TREES										
Box elder	Uncommon, inun	Uncommon, inun	Common, inun	Uncommon, inun	Common, inun		Uncommon, inun. Upper bank.		Uncommon, inun	Uncommon, inun
Juniper					Uncommon, inun					
Lanceleaf cottonwood	Uncommon, inun	Uncommon, inun			Uncommon, inun	Uncommon, inun			Uncommon, inun	Uncommon, dep & inun
Mountain maple										
Narrowleaf cottonwood	Common, inun	Common, inun	Common, inun. Some saplings.	Common, inun. Saplings.	Common & dominant, inun + saplings	Common, inun	Uncommon, dep. Flood debris.	Common & dominant, inun	Common, dep/eros & inun. Saplings too.	Uncommon, dep; common & dominant, inun
Peachleaf willow		Uncommon, inun								Uncommon, dep & inun
Plains cottonwood	Common, inun	Common, inun	Common, inun	Common, inun	Uncommon, erosion;	Common & dominant,	Common & dominant,	Common &	Common, dep/eros &	Common, dep & inun

¹ Noxious weeds of RL wetland just west of Montgomery are burdock, Canada thistle, hound's tongue, myrtle spurge, and teasel.

	BULLOCK	WALLACE	MONTGOMERY ¹	WESTERN MOBILE	BRALY	RAMEY	SADAR	GAGE	PELLA W/MARLATT	GOLDEN/FREDSTROM
					common & dominant, inun + saplings	inun	inun. Remnant RL forest.	dominant, inun	inun	
Ponderosa pine	Uncommon, inun									
NATIVE SHRUBS										
Alder		Uncommon, inun. One sm. grove.	Uncommon, inun	Common, inun.	Uncommon, inun				Uncommon, inun	
Chokecherry		Uncommon, inun		Uncommon, inun						
Currant										
Ninebark			Uncommon, inun							
Plum		RL					Uncommon, inun. Upper bank.		Uncommon, inun	
Poison ivy		Uncommon, inun	Uncommon, inun	Common, inun	Uncommon, inun					
Rabbitbrush				Uncommon, inun						
Red-osier dogwood										
Sandbar willow	Uncommon, inun	Uncommon, inun	Common and dominant, inun	Common and dominant, inun. Some lg patches.	Common, inun	Uncommon, inun. V. few survived flood.	Uncommon, dep & inun. Remnant RL forest.		Common, dep/eros; uncommon, inun	Uncommon, dep
Skunkbrush				Uncommon, inun					Uncommon, inun	
Snowberry	Uncommon, inun		Common, inun		Uncommon, inun			Uncommon, inun. Upper bank.		Common, inun
Wood's rose									Uncommon, inun	
NATIVE VINES										
Grape	Uncommon, inun	Uncommon, inun	Uncommon, inun	Uncommon, inun	Uncommon, inun				Uncommon, inun	
Virgin's bower										
NATIVE FORBS										
Black nightshade		Uncommon, dep		Uncommon, inun.						
Blue vervain			Uncommon, inun			Uncommon, dep			Uncommon, dep/eros	Uncommon, dep

	BULLOCK	WALLACE	MONTGOMERY ¹	WESTERN MOBILE	BRALY	RAMEY	SADAR	GAGE	PELLA W/ MARLATT	GOLDEN/ FREDSTROM	
Cactus		Uncommon, inun			Uncommon, inun	Uncommon, inun			Uncommon, inun		
Clammyweed	Uncommon, inun					Uncommon, dep			Uncommon, dep/eros	Uncommon, dep	
Curlycup gumweed											
Dogbane									Uncommon, inun		
Golden aster			Uncommon, inun	Uncommon, inun		Common, inun				Common, inun	
Golden banner					Uncommon, inun						
Goldenrod			Uncommon, inun	Uncommon, inun	Uncommon, inun				Uncommon, inun		
Great blue lobelia											
Heath aster	Uncomon, inun							Uncommon, inun. Upper bank.			
Licorice											Uncommon, inun
Milkweed				Uncommon, inun	Uncommon, inun	Uncommon, inun	Uncommon, inun. Upper bank.				
Mock cucumber											
Nettle				Uncommon, inun					Uncommon, dep/eros & inun		
Nuttall's sunflower			Uncommon, inun								
Poppy											
Povertyweed	Uncommon, inun		Uncommon, inun								
Prickly pear cactus				Uncommon, inun							
Ragweed		Uncommon, inun	Common, inun		Uncommon, dep & inun	Uncommon, inun	Uncommon, inun. Upper bank.		Uncommon, inun		
Silver sage				Uncommon, inun	Uncommon, inun						
Speedwell				Uncommon,	Uncommon,	Uncommon,	Uncommon,		Uncommon,		

	BULLOCK	WALLACE	MONTGOMERY¹	WESTERN MOBILE	BRALY	RAMEY	SADAR	GAGE	PELLA W/MARLATT	GOLDEN/FREDSTROM
				dep	dep	dep	dep		dep/eros	
Sunflower	Uncommon, dep & inun	Uncommon, inun; common, inun		Uncommon, inun	Uncommon, inun	Uncommon, dep			Uncommon, inun	
NATIVE GRASSES AND GRASS-LIKES										
Bulrush									Uncommon, inun	
Cattail			Common, inun			Uncommon, dep				
Horsetail			Uncommon, inun	Uncommon, inun	Uncommon, inun				Uncommon, dep/eros	
Rush									Uncommon, inun	
Scouring-rush					Uncommon, inun					
Sedge			Uncommon, inun	Uncommon, inun	Uncommon, inun. Some plantings.				Uncommon, inun	
Spike rush									Uncommon, dep/eros	
Witchgrass						Uncomon, dep				
NATIVE AQUATICS										
Duckweed			Uncommon, inun							
NATIVITY UNDETERMINED										
Aster		Uncommon, inun								
Goosefoot			Uncommon, dep & inun							
Lambs' quarters					Uncommon, inun	Common, dep			Uncommon, dep/eros	
Mint									Uncommon, inun	
Mustard			Uncommon, inun	Uncommon, inun		Uncommon, dep			Uncommon, dep/eros	
NON-NATIVE TREES										
Apple										
Chinese elm	Uncommon, inun	Uncommon, inun	Uncommon, inun	Uncommon, inun	Uncommon, inun + saplings		Uncommon, inun. Remnant RL forest.		Uncommon, inun	
Crack willow		Common, inun. Some	Common, inun	Common, inun.	Common, inun	Common, inun			Common, inun	Common, inun.

	BULLOCK	WALLACE	MONTGOMERY ¹	WESTERN MOBILE	BRALY	RAMEY	SADAR	GAGE	PELLA W/MARLATT	GOLDEN/FREDSTROM
		regenerating from roots.		Pulled sapling.					Saplings. Some growing from root stocks along bank.	
Green ash		Uncommon, inun	Uncommon, inun	Uncommon, inun + saplings						
Locust	Uncommon, inun	Common, dom	Common, inun	Common, inun. Also in old cobble dep.	Common & dominant, inun + saplings	Uncommon, dep & inun	Uncommon, dep & inun. Remnant RL forest.	Common, inun	Uncommon, dep/eros; common, inun. Saplings.	
Russian olive (SB)			Uncommon, inun				Uncommon, inun. Remnant RL forest.		Uncommon, inun	
NON-NATIVE SHRUBS										
Sweetbriar				Uncommon, inun						Uncommon, inun
NON-NATIVE FORBS										
Alfalfa	Common and dominant, dep	Common, dep	Uncommon, dep	Uncommon, inun. Old cobble dep.	Uncommon, dep & inun	Common, dep	Uncommon, dep		Common, dep/eros	Common, dep
Bindweed (SC)	Uncommon, dep	Uncommon, dep							Uncommon, inun	
Black medic										
Bouncing bet (SB)				Uncommon, inun	Uncommon, inun	Uncommon, inun	Uncommon, dep & inun			Uncommon, dep/eros; common, inun
Buffalo-bur							Uncommon, eros. Slump.		Uncommon, dep/eros	
Bull thistle (SB, BB)	Uncommon, dep	Uncommon, inun. Pulled.								
Burdock (SC)			Uncommon, dep & inun						Uncommon, inun	
Canada thistle (SB, BB)				Uncommon, inun	Uncommon, inun	Uncommon, inun	Uncommon, inun. Upper bank.			
Catchfly			Uncommon, inun	Uncommon, inun. Old						

	BULLOCK	WALLACE	MONTGOMERY¹	WESTERN MOBILE	BRALY	RAMEY	SADAR	GAGE	PELLA W/MARLATT	GOLDEN/FREDSTROM
				cobble dep.						
Chicory (SC)					Uncommon, inun					
Cocklebur		Uncommon, inun								
Dalmatian toadflax (SB, BB)				Uncommon, inun	Uncommon, inun					
Devil's shoestring	Uncommon, dep								Uncommon, dep/eros	
Diffuse knapweed (SB, BB)						Uncommon, inun				
Flower-of-an-hour (SB)	Uncommon, dep								Uncommon, dep/eros	
Forget-me-not				Uncommon, inun			Uncommon, dep			
Giant ragweed									Uncommon, inun	
Horseweed									Uncommon, dep/eros	
Hound's tongue (SB, BB)	Uncommon, dep	Uncommon, dep & inun	Uncommon, inun	Uncommon, inun. Also old cobble dep.	Uncommon, inun				Uncommon, dep/eros & inun	
Knapweed				Uncommon, inun. Near bridge.					Uncommon, inun	
Kochia		Uncommon, dep		Uncommon, inun. Old cobble dep.		Common, dep				
Lady's thumb							Uncommon, dep		Uncommon, dep/eros	
Lettuce/sow-thistle		Uncommon, dep		Uncommon, inun						
Lotus			Uncommon, inun							
Mediterranean sage (SA, BA)						Uncommon, inun. Rosette. Provisional ID.				
Mullein (SC)	Uncommon, dep			Uncommon, inun. Also	Uncommon, inun	Common, dep	Uncommon, eros.		Uncommon, dep/eros	

	BULLOCK	WALLACE	MONTGOMERY¹	WESTERN MOBILE	BRALY	RAMEY	SADAR	GAGE	PELLA W/MARLATT	GOLDEN/FREDSTROM
				old cobble deposit.			Slump.			
Musk thistle (SB, BB)			Uncommon, inun	Uncommon, inun		Uncommon, dep			Uncommon, inun	
Mustard										
Pennycress										
Plantain							Uncommon, eros. Slump.			
Puncture vine (SC)	Uncommon, dep			Uncommon, inun	Uncommon, inun					
Red clover						Uncommon, inun	Uncommon, inun		Uncommon, inun	
Red-root pigweed	Uncommon, dep									
Redstem filaree (SC)		Uncommon, dep								
Russian thistle	Uncommon, dep			Uncommon, inun			Uncommon, eros. Slump.			
Sweet clover	Uncommon, inun	Uncommon, inun			Uncommon, inun	Uncommon, dep			Uncommon, dep/eros	
Sweet pea		Uncommon inun. Patch on berm.								
Teasel				Uncommon, dep. Rosettes.					Uncommon, inun. Rosettes.	
Toothed spurge		Uncommon, dep							Uncommon, inun.	
Yellow toadflax (SB, BB)	Uncommon, dep. Pulled.			Uncommon, inun. Near bridge.						
NON-NATIVE GRASSES AND GRASS-LIKES										
Barnyard grass	Uncommon, dep	Uncommon, inun							Uncommon, dep/eros	
Canada bluegrass						Common, inun				
Cheatgrass (SC)	Common & dominant, inun. Very tall		Uncommon, inun	Uncommon, inun	Uncomon, inun				Uncommon, inun	
Crabgrass	Uncommon, dep									
Crested				Uncommon,					Uncommon,	

	BULLOCK	WALLACE	MONTGOMERY¹	WESTERN MOBILE	BRALY	RAMEY	SADAR	GAGE	PELLA W/MARLATT	GOLDEN/FREDSTROM
wheatgrass				inun					inun	
Foxtail (SB)	Uncommon, dep					Uncommon, dep			Uncommon, dep/eros	
Quackgrass							Common, inun. Upper bank.		Uncommon, inun	
Redtop		Uncommon, inun	Uncommon, inun	Uncommon, inun					Uncommon, dep/eros	
Reed canarygrass	Uncommon, inun		Common and dominant, inun	Common, inun. Some areas of resprouting.	Common, inun. Clumps revegetating in deposition.		Uncommon, inun. Upper bank.		Uncommon, dep/eros; common, inun	
Russian wildrye					Uncommon, inun					
Smooth brome	Uncommon, dep/common, inun	Common and dominant, inun	Common and dominant, inun	Common, inun	Common, inun	Common & dominant, inun	Common, inun. Upper bank.		Common, inun	Common & dominant, inun
Stinkgrass	Uncommon, dep	Uncommon, dep		Uncommon, inun						
Tall wheatgrass	Common, inun									
NON-NATIVE AQUATICS										
Nasturtium									Uncommon, inun	

C3c. St. Vrain Creek east of Longmont.

GOLDEN FARM		
NATIVE TREES		
Box elder	Uncommon, inun	
Lanceleaf cottonwood	Uncommon, dep/eros & inun	
Narrowleaf cottonwood		
Peachleaf willow		Common, dep
Plains cottonwood	Common, dep/eros & inun. Some resprouting from root stocks along bank & edge of RR flood channel, some samplings in forest.	V. common, dep; common & dominant, inun
NATIVE SHRUBS		
Sandbar willow	Uncommon, dep/eros & inun. Some regrowing from root stock, some lg patches near E end.	Uncommon, inun.
Snowberry	Common, inun	
NATIVE VINES		
Grape	Uncommon, inun	
NATIVE FORBS		
Beggar's tick	Uncommon, inundation	
Black nightshade		Uncommon, dep
Blue vervain	Undommon, dep/eros	
Clammyweed		
Dogbane	Uncommon, dep/eros; common, inun	
Fleabane	Uncommon, dep/eros	
Goldenrod	Uncommon, inun	
Mock cucumber		
Povertyweed	Uncommon, dep/eros, inun	Uncommon, dep
Ragweed		
Speedwell	Uncommon, inun	
Sunflower		
Waterwort	Uncommon, inun. Rarely collected. Provisional ID.	
NATIVE GRASSES AND GRASS-LIKES		
Bulrush	Uncommon, inun	Uncommon, dep
Cattail	Uncommon, dep/eros	
Three-square		Uncommon, dep
Witchgrass	Uncommon, dep/eros	
NATIVE AQUATICS		
Duckweed		Uncommon, dep
NATIVITY NOT DETERMINED		
Goosefoot	Uncommon, dep/eros, inun	Uncommon, dep
Mint	Uncommon, dep/eros	
Mustard		Uncommon, dep
Virginia creeper	Uncommon, inun	
NON-NATIVE TREES		
Chinese elm	Common, inun	Common, inun. Old riparian area.
Crack willow		
NON-NATIVE FORBS		
Alfalfa	Common, dep/eros; uncommon, inun	Common, dep

Bigbract verbena		Uncommon, dep
Bindweed (SC)	Uncommon, dep/eros	
Black medic		
Bouncing bet (SB)	Uncommon, inun	
Buffalo-bur	Uncommon, dep/eros; common, inun	Uncommon, dep
Canada thistle (SB, BB)	Uncommon, inun. In some slump areas.	Uncommon, eros & inun. Pre-flood channel.
Curly dock	Uncommon, dep/eros & inun	
Diffuse knapweed (SB, BB)	Uncommon, dep/eros & inun	
Flower-of-an-hour	Uncommon, dep/eros	Uncommon, dep
Forget-me-not		
Garden orache		
Horseweed	Uncommon, dep/eros & inun	
Hound's tongue (SB, BB)	Uncommon, dep/eros	
Knapweed	Uncommon, dep/eros. Rosette.	
Kochia	Common, inun	Uncommon, dep & eros; very common, inun. Old meadow area, berm.
Lady's thumb	Uncommon, dep/eros	Uncommon, dep
Lettuce/sow-thistle	Uncommon, inun	
Mallow, common		Uncommon, inun. Old riparian area.
Mullein (SC)	Uncommon, dep/eros	Uncommon, dep
Musk thistle (SB, BB)	Uncommon, dep/eros & inun	
Perennial pepperweed (SB)	Uncommon, inun	
Poison hemlock (SC)		
Puncture vine (SC)	Uncommon, dep/eros & inun	
Purslane		
Red-rooted pigweed		
Redstem filaree (SC)	Uncommon, dep/eros	Uncommon, dep
Russian thistle		Uncommon, dep
Scotch thistle (SB, BB)	Uncommon, inun	
Sweet clover	Uncommon, dep/eros	Uncommon, dep
Teasel (SB, BB)	Uncomon, dep/eros. Rosettes.	
Toothed spurge	Uncommon, inun	
Yellow toadflax (SB, BB)	Uncommon, dep/eros	
White top (SB)	Common, dep/eros & inun	Uncommon, inun. Old riparian area.
NON-NATIVE GRASSES AND GRASS-LIKES		
Barnyard grass	Uncommon, dep/eros	Uncommon, dep
Cheatgrass (SC)	Uncommon, inun	Common, inun. Old riparian area.
Crabgrass	Uncommon, dep/eros	
Quackgrass (SB)	Uncommon, inun	

Rabbitfoot grass	Uncommon, dep/eros	
Reed canarygrass	Common, inun	Pre-flood N-S channel
Smooth brome		Old riparian area
Yellow nutsedge		Uncommon, inun

APPENDIX D

Left Hand Creek

Brewbaker-Sorenson



View downstream of upper forested area. Note both banks were scoured to shale bedrock and the presence of boulders.



View to NW of side channels cut into river left by overland flows. Flows were approximately from photo right to photo left. Note layer of trash in center of photograph.



View to east southeast approximately midway through reach. Note almost horizontal tree on eroded bank river right.



View to east of restoration planting area, now well above stream flows. Flood debris covers the lower meter of the stems.



View to upstream of restoration plantings in background on right side of photograph. Note seedlings in foreground are densest in damp soils in the channel.



View upstream of lower property. Note sandbar willow resprouting from flood debris.

IMEL



View downstream from Nimbus Road bridge. Note absence of low bank vegetation and presence of flood debris on banks.



View downstream to beginning of secondary flood channel through river left forest. Note cobble deposition and woody flood debris.



View downstream of secondary flood channel with sand deposition on river left.



View downstream from approximately $\frac{1}{4}$ way downstream from Nimbus Road.



View downstream of mid-reach forest on river left.



View upstream from lower boundary. Note downed fence in foreground and unvegetated banks.

Bielins/Hock



View downstream of new channel to north of pre-flood main channel. Note eroded banks on river left and extensive sand deposition on river right.



View downstream of new channel with western end of the riparian forest in background. Note numerous woody seedlings on river right low banks and alfalfa, redroot pigweed, barnyard grass and cottonwood seedlings in foreground.



View upstream of cottonwood seedlings in channel sand deposit, foreground.



View downstream of riparian forest. Note crack willow in middle ground and eroded bank on river right.

Russell/Anderson



View downstream from upper end. Note large flood debris on river left and sandy channel bottom in foreground.



View downstream of area of minor avulsion on river right.



View downstream of river left bank erosion and large sand deposit in foreground.



View upstream of vegetation developing on sand deposit and along the low bank.



View downstream of sand deposition, river left, and debris pileup against woody vegetation, center.



View upstream from Hover Street bridge. Note wide, shallow flows and sandy channel bottom.

Boulder Creek Photographs

MMS Partnership



View to east of minor cobble deposition near south side of property.



View to northeast into site center from along northern boundary fence. Note that cottonwoods are sparse and decadent.



View to west from near northeast corner of property. Note that much of property is meadow.



View to west of wetland in old oxbow. Note Russian-olive in center background.

Alexander Dawson West of 287



View to upstream of side channel on river left near the upper boundary. Note development of wetland vegetation.



View to downstream of sandbar willow likely revegetating from roots up through cobble deposits. Note broad expanse of cobble deposition.



View to upstream of river left cobble bar with many cottonwood seedlings. Note side channel on left appears to be a developing wetland.



View to east of cobble deposits covering a portion of river right riparian area.



View to downstream of a formerly channelized reach which carried primary flows during flooding. Note regrowth of some bank willows as waters go down.



View to downstream toward US 285 bridge in background. Note teasel in foreground, flood debris on branches at left, and areas of bank willows.



View to upstream from downstream boundary at US 287 bridge. Note secondary flood channel at left of photograph.

Alexander Dawson East of 287



View to downstream from US 287 bridge. Note new bank vegetation developing on river right.



View to downstream of cottonwoods sprouting in strip at toe of river right bank and established reedcanary grass above, probably at former edge of channel.



View to downstream of undulating microtopography resulting from high flows in a secondary flood channel, river right. Note cottonwood seedlings in low areas, remnant bindweed.



View to upstream at 109th Street. Note intermittent and very narrow riparian area at left side of photograph.



View to downstream of developing river right vegetation at toe of bank erosion. Note alfalfa in foreground and sandbar willow in background. Note intact willows on river left and remnant willow patch on river right in background.



View to downstream of extensive cobble deposits at breach on river right. Note dead tree in center with small sandbar willow patch behind, probably resprouts.



View to east northeast of wetland adjacent to a ditch on river right near downstream end of property with Kenosha Road bridge in center background. Note good condition of wetland vegetation.

Doniphan



View to downstream from Kenosha Road. Note gravel/cobble deposit developing vegetation in left foreground, and secondary flood channel with cobbles through the riparian forest in right background.



View down channel of river right flood flow channel, now cobble deposits on river right. Note bindweed colonizing cobble deposits.



View to southeast of weedy meadow on river right. Note curly dock, Scotch thistle, and bindweed.



View to north of river right weed patch with teasel, musk thistle, bindweed, horseweed. Note cottonwoods in background which are at edge of channel.



View down channel of developing wetland in former main channel. Note vegetation developing in the cobble bar which now blocks flows into the channel.



View to downstream of tree stumps left from post-flood beaver activity near lower end of property. Note bank tree, now fallen into the creek.

Bailey/Kenosha



View to north of breached river left berm which diverted flood flows into a series of gravel mining ponds which also breached. Mid-channel bar is remnant of former low bank.



View to upstream at confluence pre-flood channel on left with post-flood secondary channel on right. Note wide cobble deposits, sparse riparian vegetation.



View to downstream of river right bank incision, river right. Note absence of riparian trees on river right, bank willow present on river left, and development of cobble point bars.



View to downstream of weedy bank above long reach with river right bank erosion.



View to upstream of Scotch thistle on river right (left side of photograph). Note areas of intact willows in foreground and bank of river left.



View to upstream with washed-out bridge. Note weedy foreground, intact bank willows on river left and possible tamarisk on river right.



View to northwest of breach from lowest pond. Note that minor out flows continue and cottonwoods plus wetland vegetation are developing on river left upper bank.



View to downstream of cobble deposition from breach of lowest pond (to left out of photo view). Note intact river right willow band.

St. Vrain Creek

Custode



View downstream from upper boundary. Note confined canyon and scour of low bank riparian area.



View downstream in area of river right cliffs. Note high water mark evident with debris deposition, scouring of opposite bank, and foreground poison ivy.



View downstream of remnant riparian area on river right bank. Note flood flow area to right of remnant riparian area.



View downstream of remnant ponderosa pine, some dying.



View to south of flood flow channel in middle ground. Note former quarry in background.



View downstream of river in graded channel of former flows. Note proximity of road to creek.

Hall Ranch II



View downstream with quarry on river right. Note wide, shallow flows and absence of bank vegetation.



View upstream of flood path with small channel of left at toe of eroded quarry tailings. Note preferential colonization of damp areas by native woody species and presence of many weedy species in the drier areas.



View downstream of woody flood deposition north of the quarry. Note abundance of alfalfa.



View upstream of confluence of pre-flood channel in center below cliff and post-flood channel coming in on left.



View downstream of area of where a widened meander washed out the Old St. Vrain Road which accessed the quarry. Note the road surface barely visible below the trees in left background.



View downstream of line of seedling cottonwoods on river right, probably at the edge of spring flows. Note flood debris in foreground, remnant forest on river right background.

Hall Meadows



View downstream of cottonwoods revegetating from root stock along an eroded bank, river left. Note exposed roots to the right of the saplings.



View downstream of flood debris in forest, river right. Note weedy species colonizing sandy area in foreground.



View downstream of bank area now cobbles on river left. Based on aerial photographs, the cobble area was possibly meadow prior to the flood.



View upstream of very sparsely vegetated flood channel.



View downstream at channel split. Secondary channel goes to river right and feeds a wetland where plants are beginning to establish.



View downstream of flood channel through a former meadow. Sand and gravel deposition above bank, river left.



View downstream of native sunflower at edge of flood channel.



View downstream of reach where the channel has been moved back to the pre-flood location. SH 7 is between the cliff and the trees on river left.

“Triangle” east portion of Hall Meadows



View downstream of river right inundation area from near upstream boundary. Note cobble and boulders, surviving sandbar willow, and developing alfalfa.



View downstream of boulders and drifted tree snag on river right. Note vegetation developing around snag.



View upstream of pre-flood channel at right of photograph. Note bank is scoured to bedrock.



View downstream from upper boundary. Note river left bank scour and SH 7 above.



View toward SH 7 from river right (detail of previous photograph). Note potentially hazardous eroded area below highway.



View upstream from Old St. Vrain Road. Note unvegetated cobble banks.

Bullock



View downstream from mid-channel bar at upper boundary. Note flood debris and on bar and riprap blockage of flood avulsion on river right.



View down stream of channelized reach indicating post-flood earthwork. Note absence of bank vegetation.



View to north of pre-flood riparian area. Note some intact shrubs, extensive deposition of sand, and developing weedy community.



View to south east of river right cobble deposition and surviving forest.



View to downstream of many cottonwood seedlings in river right sand deposition.



View upstream near lower boundary. Note very wide cobble bank at left of photograph.

Wallace



View downstream from upstream end of reach. Note proximity of railroad, river left and large, unvegetated cobble bank on river right.



Weed infestations, river right near southern property boundary. Note sand and cobble deposits, prevalence of alfalfa.



View to south from river left of woody flood debris with stream in background. Note possible resprouting of fallen tree at left of photograph.



View upstream from downstream boundary. Note lack of bank vegetation.

Montgomery



View of river left forest near the upper end of the property. Note tall grasses in foreground and sandbar willow in left background.



View of water outlet in river left riparian forest. Note undercut bank at left of photograph and exposed cobble on bank at right of photograph.



View downstream approximately 1/3 way down the reach. Note root wad and bole in foreground and severely incised bank in center background.



View to northwest of flood debris on upstream side of trees. Note sedimentation in foreground.



Detail view of typical area of silt deposits in river right forest.



View downstream of shale exposed by stream erosion, river left.

Western Mobile



View downstream of cobbly, weedy meadow on river left. Note sandbar willow in right middle ground.



View downstream of strip of reed canarygrass, probably remnants of pre-flood bank vegetation, on cobble bank.



View downstream of exposed bedrock adjacent to river left railroad tracks.



View downstream of an old channel on river right blocked off by boulders in foreground.



View upstream of the old channel on river right. Note restoration bank plantings.



View downstream from access bridge of cobble bar with remnant reed canarygrass. Note quarry conveyor overhead.



View downstream of cobble deposition at inlet into secondary channel on river right. The river bends to the left of the photograph. Note flood debris at base of trees in background.



View upstream through trunks of crack willow at downstream end of reach. Note well-vegetated banks at the left side of the photograph.

Braly



View to northeast of river left riparian forest , near upper boundary.



View down stream of river right sand and cobble deposition just upstream of bend.
Note intact willows in left middle ground and herbaceous plantings in sand at the right of the photograph.



View to downstream of sand, gravel, and cobble deposition in river right flood path. Note line of cottonwoods developing at left of photograph.



View downstream of strip of reed canarygrass regrowth probably at edge of the pre-flood bank.



View downstream of woody debris and cobble deposition.



View downstream of fallen trees; sand deposition, left; and cobble deposition, background.



View downstream at the lower boundary. Note flood debris piled against river right crack willow.

Ramey



View downstream from 63rd St. bridge. Floodwaters re-entered the main channel at the long area of cobble deposition on river right in the center background of the photograph. Note short stretch of relatively intact bank vegetation on river left just upstream of the confluence.



View to southwest of northern channels eroded by flood flows from breached gravel mining ponds. Note actively slumping banks in right middle ground, flows in farther channel.



View to west up the southern channel eroded by flood flows. Note large areas of very sparsely vegetated cobble and wetlands developing adjacent to the flows.



View upstream from downstream boundary. Note very wide, shallow channel and cobble banks.

Sadar



View downstream from upper boundary. Remnant riparian forest is in river left background. Note wide, shallow flows; very wide mid-channel bar, lack of bank vegetation, actively slumping banks.



View upstream of eroded bank. Note cottonwoods resprouting from root stock in the upper soils of the bank which overlies a lower layer of very cobbly soil.



View to north of flood-eroded channel, river right. Note colonization by weedy vegetation.



View upstream of remnant forest on river left. Note eroded banks and fallen trees.



View upstream of extensive areas of exposed cobbles and cobble deposition. Note very sparse vegetation and large flood debris.

Gage



View downstream from Hygiene Road of repaired irrigation diversion structure. Note eroded banks, loss of riparian forest on river right.



View to southeast of resprouting narrowleaf cottonwood on river left. Note cobbles and piled up debris.



View downstream of river left sandy deposits overflow channel with woody seedlings and wetland plants.



View across the creek of channel side channel, still with flows. Note debris caught up in dead stems in center of photograph.



View downstream of dead sandbar willow and small trees in area of cobble deposition.



View downstream of scoured-out pool in a cobble-lined overflow channel, river right. Note woody debris and beginning development of cottonwoods.



View downstream of river-left overflow channel. Note wetland plantings.



View downstream of woody debris on both sides of channel. Note that tree trunk on left has been sawed off.



View downstream, from reach mid-point. Note wide channel with cobble deposits with willow above on left bank; large woody flood debris on right bank.



View upstream from Crane Hollow Road bridge. Note cobble deposits on banks and river left willow resprouts. Secondary river right flood channel is visible at the left of the photograph.

Pella West/Marlatt



View downstream from near the upper boundary. Note river left bank erosion below the fence.



View of river left tree snag. Note cobble secondary flood channel in center of photograph.



View across the channel to the north of downed tree in channel.



View across the channel of river left bank eroded to shale bedrock. Note wetland plants growing above the shale exposed by downcutting.



View downstream of resprouting flood debris at the left of the photograph. Note that the snag in foreground creates a sharp meander.



View of same meander from just downstream of previous photo. Note that this is a very sinuous stretch.



View across the channel of river left exposed shale bedrock overlain with cobble deposits. Note colonizing plants in the cobble.



Detail of the cottonwood and willow mix colonizing cobble.

Golden/Fredstrom



View to downstream of river left channel. Note very low presence of bank trees, shape of river right slope and cobble deposition.



View downstream of channel work at the breach to the south.



View upstream of impoundment behind irrigation structure. Note cottonwoods developing in riprap, possible crack willow at left.



View into the well-developed riparian cottonwood forest in the riparian area near the north side of the property.

Keyes/Golden Farm



View to southeast from 119th Street bridge on February 28, 2014. Note loss of trees; area of deposition and scour on river right.



View downstream of river right "cottonwood lawn" just downstream of 119th Street bridge. Photo taken August 1, 2014.



View downstream to east-northeast of enlarged meander on river right.



View to downstream of cobbles wave pattern in river right flood channel.



View to downstream the river right flood channel just to the south of the main channel. Note wetland developing in damp area, weeds in drier areas.



View upstream of river right northern flood flow channel entering the post-flood main channel. Note sparse vegetation and salt-coating of incised banks.



View downstream of the south-most of flood channel to confluence with post-flood . Note salt coatings on eroded banks and weedy vegetation.



View upstream from County Line Road. Note woody seedlings on river right cobble bar, salt coatings on eroded river bank in background left.

Peschel



View upstream toward the damaged County Line Road bridge. Note vegetation development in foreground cobbles, new riprap bank downstream of the bridge at the right of the photograph.



Waterwort, an uncommon species, colonizing riverbank cobble area.



View to west of the west to east reach of the pre-flood channel. Flows now move west. Wetlands are developing in the channel upstream of this photograph .



View to north of the north to south reach of the pre-flood channel. Flows continue moving to the south. Note that flows have narrowed as indicated by the sandbar willow at the right of the photograph which are no longer at the edge of water.



View to the south east from the former river right berm to the post-flood channel. Note large flood debris in the channel and large areas of cobble.



View to west of developing wetland back channel along river right of the post-flood main channel.



View to east-northeast of post-flood channel. Note that the main flows go to the left of the photograph while minor flows continue to the east-northeast. Wetlands are developing in the area between the two flows.



View to the west from the river bend near the lower portion of the property. Note cottonwood development in damp areas of sand and cobble.

APPENDIX E

Left Hand Creek - Brewbaker-Sorenson



2008: view to east of upper riparian area. Note many cobbles and boulders, well-vegetated banks.



2014: view to east of upper riparian area. Note banks eroded to shale bedrock, loss of bank vegetation, reduced connectivity to riparian area.



2008: View to west of well-vegetated riparian restoration area with species diversity. Note grassy and forested foothills in left back ground and barn roof in center background



2014: View to west of site of riparian restoration area, now an area of cobble, gravel and sand deposition, but good floodplain connectivity. Note eroded bank at the right side of the photo. Due to downcutting, the barn is no longer visible from this perspective.

Left Hand Creek - IMEL



2008: View downstream from Nimbus Road. Note dense bank vegetation.



2014: View downstream from Nimbus Road. Note removal of most bank vegetation, cobble deposits on river right.



2008: View to downstream of river left forest. Note abundant understory vegetation.



2014: View to downstream of river left forest. Note that riparian vegetation is little changed.

St. Vrain Creek - Bullock



2008: View of typical riparian forest with dense understory vegetation.



2014: View of typical post-flood riparian forest. Note long expanse of cobble deposits, jumbles of woody debris in background.



2008: View upstream from downstream boundary



2014: View upstream from downstream boundary

St. Vrain Creek - Wallace



2008: View downstream from upstream boundary. Note well-vegetated banks.



2014: View downstream from upstream boundary. Note very enlarged channel, loss of bank vegetation, wide expanse of cobble.



2008: View upstream from downstream boundary. Note dense bank willows, shading of stream.



2014: View upstream from downstream boundary. Note loss of bank willows, exposure of stream to sun, sparse understorey.

St. Vrain Creek: Montgomery



2008: View of river right forest. Note dense understory vegetation



2014: View to east of river right forest. Note sand and silt deposition.



2008: View upstream from mid-site. Note well-vegetated banks.



2014: View down from mid-site. Note reduction in bank vegetation and river right bank erosion and woody deposition.



2008: View upstream from lower boundary. Note dense bank vegetation.



2014: View upstream from lower boundary. Note wide cobble bank with remnant bank grasses at left of photograph and bank erosion at right of photograph.

St. Vrain Creek: Western Mobile



2008: View downstream from upper boundary. Note presence of low bank vegetation, woody debris pile on river right below crack willow.



2014: View downstream from upper boundary. Note loss of branches on river right crack willow, rip rap on river right below crack willow at repair of major breach to south.



2008: View to southeast from boulder dam blocking off a portion of an old channel. Note woody debris on dam boulders, well-developed low bank vegetation, minor cobble bank deposits.



2008: View upstream from bridge east of former processing structures. Note well-vegetated low banks.



2014: View to southeast from repaired boulder dam blocking off a portion of an old channel. Note cobbly and sparsely vegetated low banks, very narrow flows.



2014: View upstream from bridge east of former processing structures. Note unvegetated cobble deposits, loss of riparian trees, narrower flows.

St. Vrain Creek - Braly



2008: Mid-site view of well-vegetated banks



2014: Near mid-site view to upstream of banks. Note stretch of eroded bank on far side of stream and wide cobble low terrace with remaining reed canarygrass clumps in foreground.



2008: View to upstream from downstream boundary



2014: View to upstream from downstream boundary. Note cobble banks.

St. Vrain Creek - Ramey



2008: View downstream from 63rd St. Bridge. Note well vegetated banks.



2014: view downstream from 63rd St. Bridge. Note loss of bank vegetation, wide cobble banks on river right in background.



2008: View downstream from downstream end of property. Note that lower end of property had been ponded.



2014: View downstream from near downstream end of property. Note cobble deposition where overland flows joined main channel, loss of bank vegetation



2008: View upstream from river right downstream boundary. Note ponded area in center of photograph, well-vegetated banks



2014: View upstream from river right downstream boundary. Note wide, shallow flows, wide cobble banks with large flood debris.

St. Vrain Creek: Gage



2008: View downstream from irrigation diversion at Hygiene Rd. Note well-vegetated banks.



2014: View downstream from reconstructed irrigation diversion at Hygiene Rd. Note long bank erosion on river right, widening of channel.



2008: Mid-site view to upstream. Note densely vegetated banks.



2014: Mid-site view to downstream. Note dead willow stems, wide cobble banks.



2008: View to north of riparian forest. Note dense understory.



2014: View to east of riparian forest. Note cobble deposits, especially in secondary flood channel, sparse understory vegetation.



2008: View upstream from Crane Hollow Road Bridge. Note well-vegetated banks.



2014: View upstream from Crane Hollow Road Bridge. Note cobble deposits, some willow survival.

St. Vrain Creek - Pella West/Marlatt



2008: View downstream from irrigation diversion. Note weedy berm on river right.



2014: View downstream from irrigation diversion. Note berm removal, foreground flood debris, eroded river left bank.



2008: View mid-site to downstream below irrigation diversion.



2014: View mid-site downstream below irrigation diversion. Note wide cobble banks.



2008: View upstream from N 75th St. bridge, Note well-vegetated banks, wide flows.



2014: View upstream from N 75th St. bridge. Note exposed bedrock bank at left of photograph, flood debris at right of photograph, concentrated flows.

St. Vrain Creek - Golden Fredstrom



2008: View downstream from N 75th St bridge. Note well-vegetated banks.



2008: View of river right berm and riparian forest.



2014: View downstream from just below N 75th St bridge. Note river left low bank eroded to cobbly, shale bedrock and steep, unvegetated river right bank just upstream of breach area.



2014: View to river right riparian forest (different location). Note debris from channel and bank grading.

St. Vrain Creek - Golden Farm / Keyes



2008: View downstream from 119th St. bridge. Note ducks in riffle with herbaceous river left bank wetland beyond.



2014 (February): View downstream from 119th St. bridge. Note loss of many bank willows and trees, bank erosion, flood path on river right.



2008: View to east of river right berm with common mullein and bouncing bet near lower boundary. Note sandbar patch to left of berm.



2014: View to east northeast of river right near lower boundary. River right berm of 2008 is now in center background of photo, and stream flows are through the former field to the south of the 2008 photo.

St. Vrain Creek - Peschel



2008: View downstream from County Line Rd. Note densely vegetated banks. This photo location is at the extreme right of the 2014 photo.



2008: View to east from mid-way on east-west reach of channel. Note stream is flowing east, and flows are wide.



2014: View to southwest across upper channel from County Line Road. Note post-flood channel is relocated the south and pre-flood channel is barely visible to the right of the track hoe on river left.



2014: View to east from mid-way on east-west reach of pre-flood channel. Note stream is flowing west, and flows are narrow.



2008: View to south of dry field from channel berm.



2014: View to SW of former dry field, now the new channel, from pre-flood channel berm.



2014: View to southeast toward downstream boundary of north-south portion of channel. Note banks are well-vegetated with willows and grasses.



2014: View to southeast toward downstream boundary of north-south portion of pre-flood channel. Note that flows continue to south, loss of much bank vegetation, re-establishment of bank grasses, algae in stream. Stream ends in pool in the center of the photograph; flows are dammed by cobble deposition. Beyond the cobble dam, the channel is dry.

APPENDIX F

Brewbaker-Sorenson



1999

Imagery Date: 10/6/2013 40°06'51.42" N 105°15'12.81" W elev 5379 ft eye alt 8090 ft

Bielens-Hock and Russel-Anderson-Schmidt



Dawson West of US 287



Dawson East of US 287, western portion



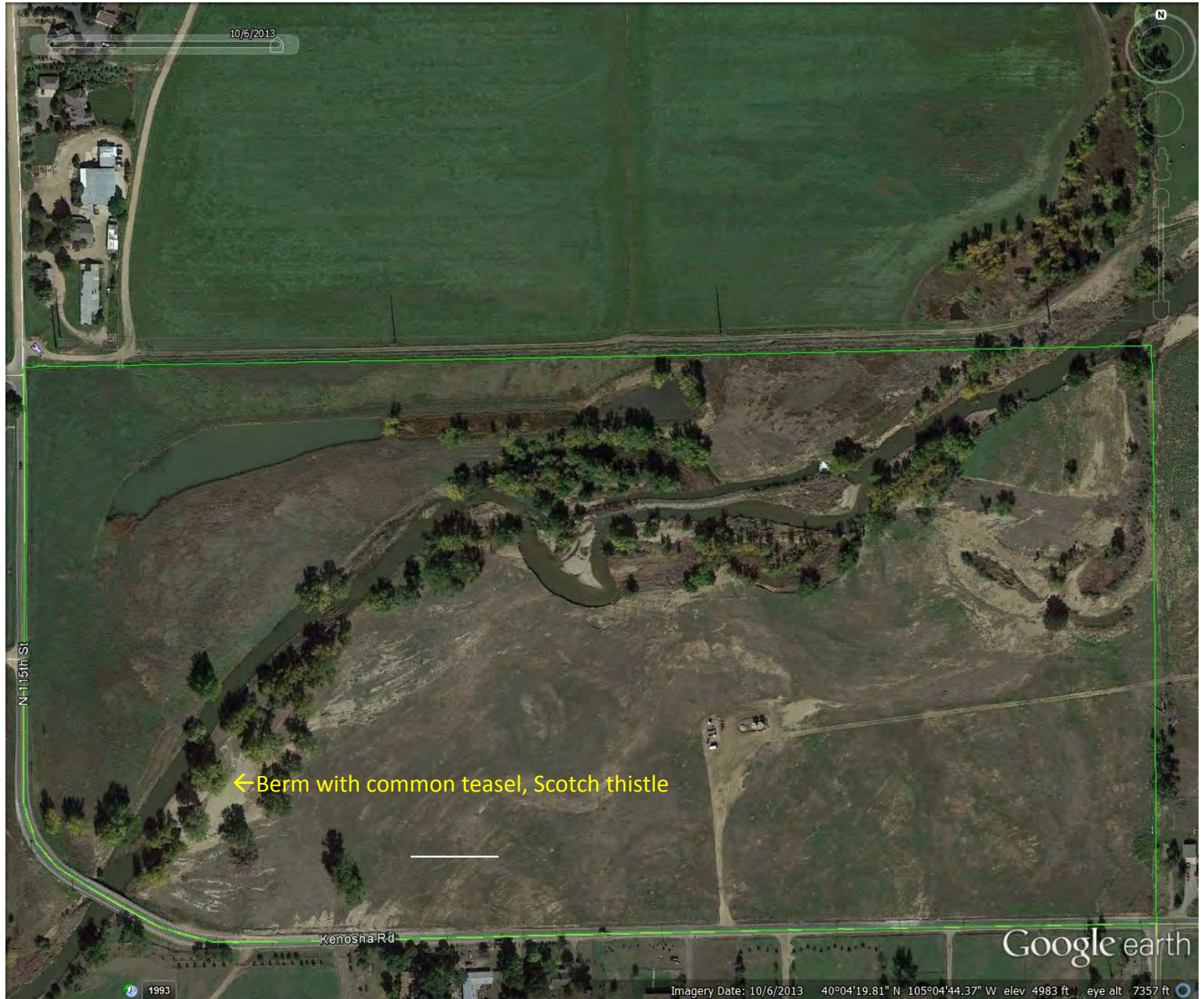
← Eurasian water milfoil

Google earth

Imagery Date: 10/6/2013 40°03'36.43" N 105°05'49.20" W elev 5013 ft eye alt 7872 ft

1993

Doniphan



Bailey – Kenosha Ponds



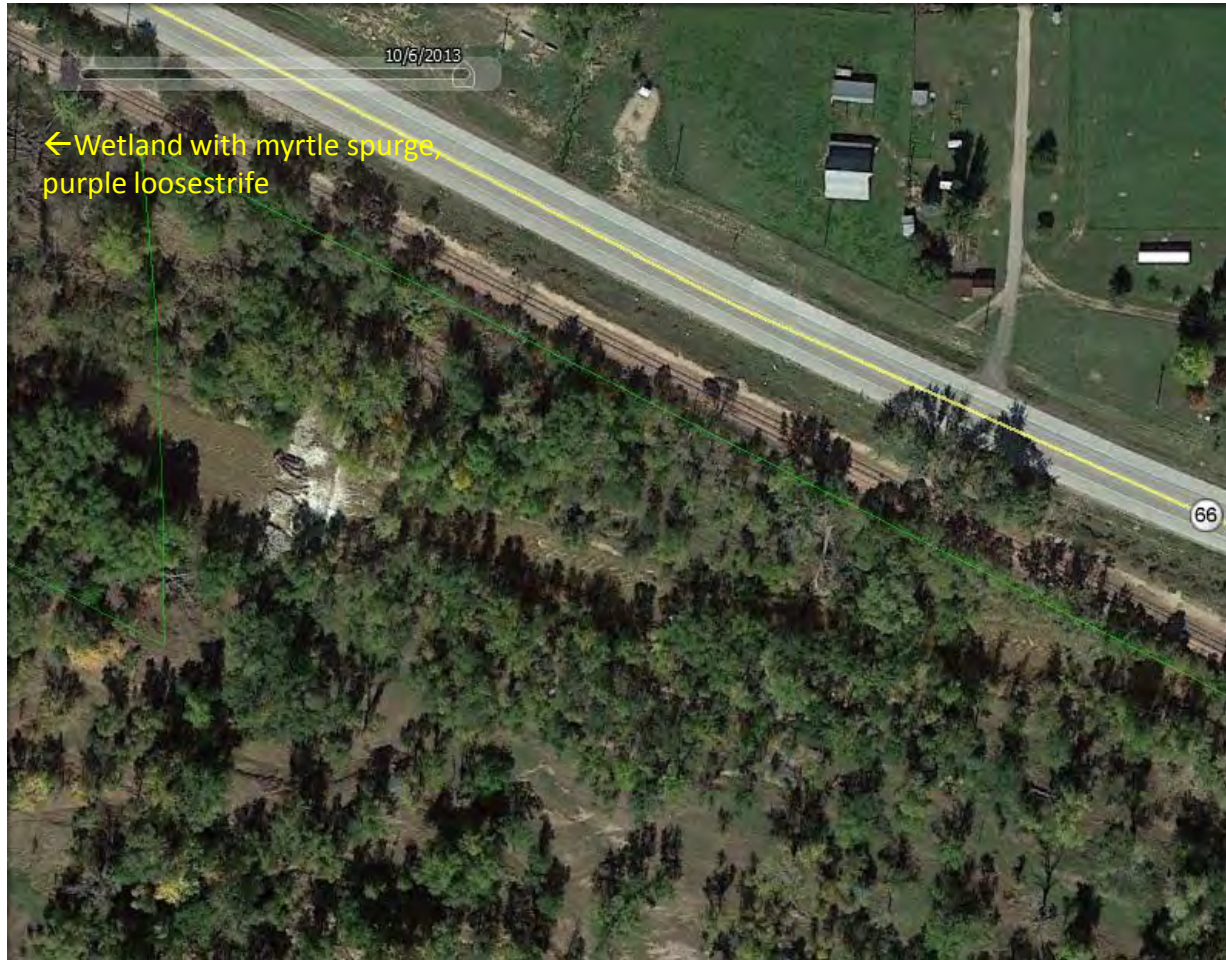
Hall Ranch II



Lots 15-18, 21-24, Lot26 Tumbleson – “Triangle”



River Left upstream of Montgomery



Western Mobile



Ramey



Pella West, Marlatt



Golden-Fredstrom



Keys – Golden Farms





← Scotch thistle

Google earth

Imagery Date: 10/6/2013 40°09'07.21" N 105°03'47.65" W elev. 4908 ft eye alt. 6662 ft

APPENDIX G

