Lower Boulder Creek and Coal Creek Open Space Master Plan

Boulder County Parks and Open Space Department

Boulder County, Colorado

Anderson & Company
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and

Queen of the River Fish Co., Inc. ▪ Don D'Amico
Plantae Consulting ▪ Carron Meaney, Ph.D
Stephen R. Jones ▪ Native Cultural Services
Boyle Engineering Corporation

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Dedicated to the memory of Carolyn Holmberg

Visionary,
Steward,
Extraordinary public servant,
Whose unceasing devotion
To open space and the community
Will live on
In all she inspired

April 1944 - September 1998

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Boulder County Commissioners
Ronald K. Stewart, Chairman
Jana L. Mendez
Paul Danish

Parks and Open Space Advisory Board Members
Chris Colelli
John Ellis
Jim Holitza
Steven Jeffers
Claire Levy
Frederick Matlenthal
Richard McKee
Sharon Purvis Rosall
David Robertson
Robert Smith, Jr.
Emery Tracy
Tony Umile
Eric Vogelsberg
Dan Wolford

Boulder County Parks and Open Space Staff
Carolyn Holmberg, Director
Rich Koopmann, Project Manager
Don Wojcik, Planner
Jeff Moline, Planner
Resource Management Staff

The Consulting Team:

Peggy 'Kaia' Anderson, Project Manager, *Anderson & Company, ecoplanning*

Mike Mitchell, *Queen of the River Fish Co., Inc.*

Maureen O'Shea Stone, *Plantae Consulting*

Don D'Amico, *Wetlands Ecologist*

Carron A. Meaney, Ph.D., *Mammologist*

Stephen R. Jones, *Environmental Consultant, Avian Specialist*

Pete Gleichman, Tracey Sweely and staff, *Native Cultural Services*

Walter Pennington, P.E. and Meg Frantz, P.E., *Boyle Engineering Corporation, Inc.*

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Lower Boulder Creek and Coal Creek
Open Space Master Plan

Executive Summary

INTRODUCTION

Sweeping views of the front range mountains from the lower Boulder Creek and Coal Creek open space are unsurpassed. Lands still cultivated and grazed are a welcome contradiction to the visible passing of the rich agricultural legacy and unique beauty of the region. Central to these lands is Boulder Creek, a precious water resource in the semi-arid west and the hub of human settlement in Boulder Valley. With a wealth of both water and mineral resources, this open space landscape is an intricately woven fabric of human history and natural resources (see Figures 1 & 2, Figures section).

In 1997, the Boulder County Parks and Open Space Department contracted with the Anderson & Company, Ecoplanning, consulting team to undertake an interdisciplinary, multi-objective approach to environmental planning of these lands. The planning process consisted of a thorough inventory of natural and cultural resources by consulting team specialists (see Figure 3- Resource Inventory), assessment of site features, identification of planning opportunities, and development of management recommendations (see Figure 4 - Site Opportunities), development of three Master Plan alternatives, and finally refinement of a comprehensive Master Plan (Figure 5).

The planning project area extends along Boulder Creek from the Alexander Dawson School parcel west of US 287, approximately 3.5 miles east to the Boulder-Weld County line. The site also incorporates approximately a 0.7 mile segment of Coal Creek through the permitted Kenosha mine parcel, owned by Boulder County. In total, the project area encompasses approximately 1,110 acres of agricultural land, much of it previously gravel mined and reclaimed.

PROJECT OBJECTIVES

The foundation of this planning effort was the identification of specific project objectives which guided development of the Master Plan throughout. They are:

- Re-establish successional river processes and restore self-sustaining riparian ecosystems
- Restore historic floodplain and associated features
- Preserve, restore, and create diverse, functional wetland communities
- Preserve, restore, and create a diversity of native plant communities and wildlife habitats throughout the stream corridor
- Enhance pond and stream water quality through natural processes
- Enhance aquatic habitat in surface waters
- Restore upland habitat
- Preserve and enhance viewsheds and open space in perpetuity
- Provide for a diversity of post-gravel mining land uses that complement the rural character of the region and promote a healthy stream corridor ecosystem
- Provide for recreational opportunities while preserving the integrity of the ecosystem
- Preserve and enhance cultural and agricultural resources
- Demonstrate the legacy of and promote a sustainable future for the Boulder and Coal Creek systems

To sustain the function and value of native ecosystems in a landscape so affected by human activity both in and beyond the project boundaries requires that a delicate balance be maintained: a balance which is just beginning to be understood. Therefore, the visible effects of past human activity on this property are, in fact, extensive.

Restoration is emphasized as a primary objective of this Master Plan, however restoration does not infer that the landscape be restored to a pristine state, nor that human activity be precluded. It is generally agreed that preserving and enhancing biodiversity, and restoration of functional natural systems is of primary importance for a sustainable future. It is the conscious, careful synthesis of people and environment which creates sustainable community. This Master Plan addresses ecosystem function in the regional context. It also emphasizes restoring healthy, natural systems, and preserving and enhancing biodiversity while accommodating compatible land uses such as agriculture, mineral extraction, interpretation, and recreation within the project area. The principle goal of this planning effort is to preserve, restore, and enhance both ecosystem functions and cultural values.

BASELINE INVENTORY & MASTER PLAN DEVELOPMENT

Context

The study area is located approximately 2 miles east of the White Rocks Natural Landmark and state designated Natural Area most noted for its raptor habitat. It is also approximately 1/3 mile east of a state registered Heron Rookery Natural Area. The portion of the study area west of US 287 at Boulder Creek constitutes the eastern portion of a Boulder County Comprehensive Plan (BCCP) designated Critical Wildlife Habitat, described as a Cottonwood Grove and Heron Rookery (+ wetlands). All of these significant areas are linked by Boulder Creek and its associated habitat features. As the project area is situated immediately downstream of these resources, ecological restoration onsite has the potential to greatly benefit and expand this stream valley's capability as a significant habitat corridor.

Cultural and Natural Resources

The attached figures depict the primary site features. Although the cultural resources identified lack national significance, they do reflect the history of the study area, and so are important amenities for interpretation of the site. The farm structures and ditches, in particular, are valuable expressions of the Boulder Creek valley's agricultural heritage. These features are designated for preservation, relocation, and/or access in the Master Plan, as appropriate.

Most of the natural resources in the project area would benefit greatly from restoration efforts. Some high quality plant communities and wildlife habitats do exist, however. At the west end of the project site is a mature riparian woodland which provides high quality bird habitat. Rock squirrels and marmots inhabit a riprapped area at 109th St., the site of an old stage road bridge. Marshlands with high quality bird habitat and a beaver lodge occur north of Boulder Creek, east of 109th St. Two other large seep-fed wetlands occur along the Boulder-Weld Canal, south of Boulder Creek. A highly diverse wetland marks the surface water collection point for the mined valley extending upslope. Several remnant oxbow sloughs occur upstream of Kenosha Road.

A large prairie dog colony, valuable feeding grounds for raptors in the area, is situated east of the bend in Kenosha Road. A smaller prairie dog colony also occurs in the Kenosha parcel. And downstream of the existing pedestrian bridge, high quality nesting bird habitat occurs in shrub communities situated on point bars within Boulder Creek. In the abandoned Coal Creek channel, diverse riparian woodlands and unique high quality nesting bird habitat exists. All of these important natural features are earmarked for preservation and, in some cases, enhancement in the Master Plan.

General land management recommendations are provided in the Master Plan. Of primary importance are implementation of weed management and prescriptive grazing practices, and fencing riparian corridors and primary wetlands to halt degradation.

Trails, Recreation, and Interpretation

Recreational features such as a regional trail, internal trails, fishing opportunities, and interpretive facilities are also recommended. These are located to minimize adverse environmental impacts and maximize the diversity, education, and enjoyment of the park user.

While preservation, ecological enhancement, and restoration are emphasized for much of the project area, the Master Plan recognizes that providing appropriate public access and recreation opportunities in open lands is essential to instilling a conservation ethic. It is recommended that a trailhead, and passive recreational/interpretive area be developed at the Kenosha parcel, herein referred to as Kenosha Ponds Park, situated near the Erie town limits. Numerous features of interest exist and are proposed for this site. Also, the Lower Boulder Creek and Coal Creek Master Plan is aimed at demonstrating ecosystem restoration and beneficial land management practices. Kenosha Ponds Park, therefore, has the potential to be an invaluable educational center at the eastern gateway to Boulder County: one which demonstrates the County's philosophy and commitment to its environmental and cultural heritage.

STREAM RESTORATION

Of all the site features, the most prominant are lower Boulder Creek and Coal Creek. These streams are essentially the lifeblood of most other landscape features. However, both streams are severely degraded, and ecosystem functions greatly impacted within the project area. Restoring health, function, and beauty to these streams is the cornerstone of this Master Plan.

Channel Morphology

The Boulder and Coal Creek channels in the study area are in states of disequilibrium within their watersheds. In other words, the channels are currently unstable. Managing unstable channels is one of the foremost challenges facing communities on manipulated and urbanized stream systems today. Channel instability comes with great cost to both the ecosystem and the community. Native riparian vegetation and habitat are lost, and water quality and aquatic habitat are degraded. As a result of loss of habitat, biodiversity in the stream corridor is significantly reduced. Financial costs include the continual need for channel improvements, and maintenance of structures such as diversions, and bridge abutments. Common treatments for unstable channels include riprapped banks, grade control structures, channelization, and even concrete lined channels. The vitality of streams is severely impacted by both channel instability and typical management techniques.

Channel Stability

In order to understand the ramifications of stream instability in the study area, it is necessary to have a basic understanding of the nature and function of a stable stream system. In its natural, stable state, a stream channel is in equilibrium with its environment. It is adapted to all of the influences which affect its morphology, or shape. These influences include flow regimes, flood events, vegetation, soils, and landform. A stable channel exhibits a consistent dimension, meander pattern, and profile, so that over time channel features are maintained, without aggrading or degrading. Channel features include the active channel, the active floodplain, and the floodplain terrace. The active, or bank-full channel contains the annual high flow and is an aquatic dominated environment. The active floodplain or floodprone area (to be distinguished from the regulatory 100-year floodplain) is contiguous to the bank-full channel, and is typically dominated by herbaceous and woody riparian vegetation. The terrace which occurs above the active floodplain is an abandoned floodplain, isolated from all but the most extreme floods. This zone is also typically occupied by riparian vegetation. In a state of dynamic equilibrium, all of these channel forms work cohesively to maintain the most efficient conveyance of sediment and variable flows.

Studies indicate that a natural, stable stream does not measurably migrate or shift course in its floodplain unless any of the environmental factors influencing its form are altered. Within the active channel, erosion, deposition and scour occur. Point bars erode and are replaced annually, yet meanders migrate very slowly. The dramatic shifts we commonly see in streams today are due to channel alterations often caused human activities such as channelization, channel realignment, and flood control efforts. It is interesting to note that, contrary to popular belief, studies have shown that a sinuous stream with the appropriate width/depth ratios conveys sediment and flood flows more efficiently than a broad, straight reach (Rosgen, 1996).

Channel stability is also affected by alterations in flow regimes caused by urban and agricultural runoff, irrigation diversions, and use of the channel to convey irrigation and wastewater flows. Overgrazing and loss of riparian vegetation also greatly affect channel stability. Field data collected on some sites has shown that when vegetation composition has changed due to over grazing, lateral migration of the stream can be affected by as much as a 3.5 order of magnitude (Rosgen, 1998).

Human activities which affect streams often accelerate natural processes, causing the stream to adapt by altering its form. It is important to realize, however, that without human intervention, stream adaptation may take ages to reach a point of equilibrium and recover historic ecological functions. In cases like lower Boulder Creek or Coal Creek, where the channel is confined and cannot alter its lateral configuration, the stream may never reach a stable state.

Riparian and wetland communities are also vital to maintaining stream stability. Conversely, the ecological function of riparian areas is dependent on a functional, active floodplain. In fact, native woody riparian vegetation requires flood events to regenerate. When the active channel and floodplain are maintained, flood flows are allowed to dissipate on the floodplain and the riparian system is not adversely impacted. Where the floodplain is limited by channelization or confinement, flood flow energies cause bank and bed erosion. The stream begins to downcut, or incise. Once the stream has downcut to the point where frequent flood flows no longer reach the floodplain, no active floodplain exists. Remnant riparian vegetation is eventually lost due to the drop in ground water levels, and regeneration does not occur. Variations in streambed structure vital for aquatic life are also lost. As demonstrated in the project area natural resource inventory, with entrenchment, a cycle of degradation is established which affects every aspect of the stream ecosystem, not only in the immediate stream reach, but extending upstream. When a stream downcuts, every tributary within the watershed will downcut until a sustainable equilibrium is reached.

Lower Boulder Creek and Coal Creek Channel Conditions

Examination of historic and recent aerial photographs illustrates that the Boulder Creek and Coal Creek channels have been dramatically altered within the study area. The historic channel belt width, or active flood prone area, utilized approximately 1000'-1200' of the valley floor. Today, long reaches of Boulder Creek have been channelized, stream diversions have reduced the intensity of flood flow events and the energy they provide to maintain the channel and floodplain. Dikes have been erected over decades to contain flood flows. The stream has been straightened to reduce land area dominated by the creek, thus reducing the channel sinuosity or meander factor (see Site Opportunities - Reaches 1,2,3, and 5). As a result of this type of manipulation, the stream is no longer able to dissipate the high flow energy across its floodplain or into meanders, and this energy is spent eroding the stream bed. Significant down cutting, or entrenchment, is apparent on Boulder Creek throughout the project area. Down cutting has increased the bed load of material in this stream and caused deposition in flatter areas of the channel, creating braided channel sections (see Site Opportunities - Reach 4). In essence, Boulder Creek no longer has an active floodplain.

Coal Creek, once an upland, intermittent gulch with a clay and silt substrate, now carries perennial flows. As a result of the increased annual and periodic high flow events Coal Creek exhibits extreme entrenchment, exceeding 25 foot depths in some sections. Erosion in Coal Creek also significantly increases suspended sediments entering Boulder Creek at the confluence immediately downstream.

Overall, down cutting and the loss of active floodplains on both streams has caused the loss of aquatic habitat, and riparian and wetland vegetation. It threatens those remnant communities remaining, and has virtually eliminated regeneration of these plant communities and their associated habitats.

General Planning and Management Recommendations
One of the primary objectives identified for this project is the re-establishment of successional river processes and self-sustaining riparian ecosystems. In order to achieve this objective, it is essential that natural, stable channels be restored. The term 'stable' refers to a channel that is in a state of dynamic equilibrium. A stable stream's configuration is adapted to current influences, and because all channel components are functional, it has the ability to adapt to changes in the flow regime.

Typically, stream improvement involves a 'patch-in-place' method of placing structures in the channel or on banks to mitigate the most immediate problems. Often, the ability to address stream function is limited by the length of stream involved. These improvements are also typically designed to address one concern only, such as severe bank erosion or fish habitat improvement. In an unstable channel, however, these are generally short-lived improvements. They are aimed at armoring a stream feature rather than allowing the flexibility necessary for the stream to reconfigure its form and re-establish a state of equilibrium.

Boulder County has acquired an extensive reach of Boulder Creek, thereby affording a rare opportunity to restore a functional stream system in these open space lands. The most appropriate, multi-objective, and long-term approach is to realign the channel in a more natural and stable form based on current hydrologic and geomorphic data. In other words, nature is mimicked to the best of our ability in order to re-establish a functioning system. This geomorphic approach addresses the function and values of the river system as a whole, considering both physical and ecological processes. Construction involves re-establishment of the appropriately configured active channel, attendant floodplain, meander pattern, and stream gradient. The channel is typically reconfigured at the current invert elevation. Riparian areas are revegetated to enhance bank stability and ecological function. Stream banks and instream habitat structures are stabilized using such materials as boulders, tree root wads, and tree and shrub cuttings. Wherever possible the stream is not armored extensively, thereby allowing the channel to adapt morphologically to future changes in physical influences.

However, due to the need to maintain structures such as bridge crossings and irrigation diversions, and to avoid adversely affect neighboring properties, some segments are armored with natural materials to restrict lateral movement.

A geomorphic approach to stream restoration is emphasized as the key component of overall ecological restoration in the lower Boulder Creek corridor (see subsection 3.3.6 for Coal Creek recommendations). Just as channel degradation initiates a cycle of degradation that impacts the entire riverine ecosystem, so restoration of a functional channel will provide for the rehabilitation and regenerative capability of a healthy, diverse ecosystem.

Water Quality

Concerns regarding water quality in lower Boulder Creek have been voiced by the community for some time. Data characterizing water quality in Boulder Creek in 1986 indicated that water quality changed significantly below the City of Boulder's 75th Street wastewater treatment plant. Recent data indicates continued ammonia loading of Boulder Creek. During low flow periods Boulder Creek flows are comprised primarily of wastewater return flows, impeding the development and maintenance of aquatic communities.

Coal Creek flows are also dominated by greywater return flows from upstream wastwater facilities at Erie, Superior, Lafayette, and Louisville Water quality requirements incorporated into recently drafted discharge permits for dischargers on Coal Creek will require upgrades and establishment of new treatment facilities that will improve water quality, however opportunities to improve Coal Creek water quality remains an important consideration of this planning effort.

Boulder County Parks and Open Space, as the primary manager of lower Boulder Creek area, faces involvement in a number of federally madated programs if water quality issues in these two creeks are not addressed. The lower Boulder Creek and Coal Creek riverine systems are not confined by political and property boundaries, however. Both streams inextricably link this open space parcel to lands throughout the basin. Likewise, in order to restore the health and function of these streams, it is essential that a basin-wide cooperative effort be established.

General Planning and Management Recommendations

Water quality functions of a stable channel include decreased width/depth ratios, solar heating abatement, increased oxygenation, dissipation of high flow energies, reduction of erosion, filtering of sediment, improved sediment transport, and flood-water retention. Re-establishing natural, stable channels on Boulder Creek and Coal Creek as proposed is an important component of water quality enhancement long-term.

Historically Boulder Creek occupied a broad floodplain and supported numerous wetlands. Aerial photographs from 1937 in the vicinity of the study area show prairie marshes, wet meadow wetlands and extensive riparian woodlands. Wetlands are among the most biologically diverse and productive ecosystems on earth (Mitsch and Gosselink 1993). In the semi-arid west, wetlands comprise a small portion of the landscape while supporting a disproportionately large number of species. They also provide a variety of other benefits including flood conveyance, shoreline stability, food chain support, fish and wildlife habitat, recreational values, and water quality improvement (Adamus 1983). Marsh wetlands are particularly beneficial for filtering and cleansing water prior to discharge into streams and percolation into groundwater. Despite their values, regionally wetland losses due to activities such as filling, draining, stream dewatering, and channelization, have been extensive.

The Lower Boulder Creek and Coal Creek Master Plan preserves existing wetlands and proposes utilizing some wetlands for water quality enhancement via diversion of partial stream flows, gradient allowing. In addition, some wetland creation is proposed. Reclamation of the Kenosha gravel mine provides a significant opportunity to create a constructed wetland water quality treatment and energy dissipation basin. It is proposed that Coal Creek perennial flows in excess of historic intermittent flows, be diverted from the current severely degraded channel, and filtered through this wetland basin prior to its outfall near the project limits.

It is emphasized that stream restoration and wetlands enhancement are proposed on this site in order to benefit many ecological functions and values. One of those values is enhancement of water quality. However, it is not suggested that these features alone will solve the current water quality issues on Boulder Creek or Coal Creek.

IMPLEMENTATION

Partnering and Funding

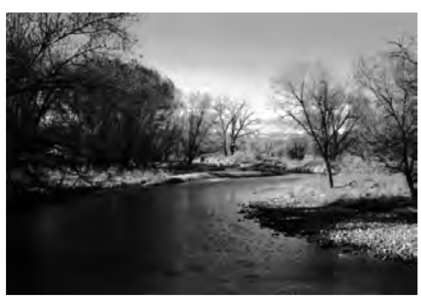
Stream restoration, water quality improvements, and wetlands are currently national environmental priorities, and multiple funding sources and partnering opportunities exist at the federal, state and local levels. Therefore, although stream restoration is costly, it is emphasized that cost-sharing opportunities with multiple agencies renders the plan achievable (see Appendix B).

It is recommended that the Boulder County Parks and Open Space Department begin partnering discussions with funding sources and involved stakeholders during the final analysis and design development phase of the project. Key stakeholders include, but are not limited to the City of Boulder Wastewater Utilities Department, and the towns of Erie, Superior, Lafayette, and Louisville.

CONCLUSION

Boulder County has made a substantial commitment to the preservation of its natural resources by acquiring and planning the lower Boulder Creek/Coal Creek corridor open space lands. In so doing, it has also created unprecedented opportunities for progressing toward a sustainable community. A workable environmental ethic requires a perception of community and environment as one integral system. In order for this system to be sustained, it is essential that the inherent integrity of natural systems be recognized, and their ability to function restored. By definition, restoration means simply giving back what was once taken away.

Water, more than any other resource, reminds us of the interconnectedness of communities and all life. By maintaining its commitment to this precious natural resource and summoning the cooperation of involved and interested parties, Boulder County can restore the life, health, function, and beauty of lower Boulder Creek and Coal Creek on these open space lands, and set a precedent regionally. Incrementally, our waterways systems can be restored. And, restored, they will continue to sustain us for generations to come.



Section 1
Background

1.1 PROJECT PURPOSE

Boulder County has long been committed to responsible stewardship of open space lands within its jurisdiction. The Boulder County Comprehensive Plan (BCCP) states that the County's environmental heritage, which includes natural areas and cultural resources, are "irreplaceable resources that warrant preservation from destruction or harmful alteration" (p. 1-23). The Boulder County Parks and Open Space Department oversees the acquisition, preservation, conservation, and management of these resources.

In an effort to understand community values of County open space, and manage these lands accordingly, a public opinion survey was conducted in May of 1997 (Public Information Corporation, 1997). A representative sample of voting age citizens of Boulder County were polled with regard to issues facing the County open space program and other topics. When asked to what degree they approved or disapproved of the Boulder County open space program, 77% showed some degree of approval. Of those, 50% registered strong approval. When asked how important each of 11 activities and values attendant to Boulder County open space areas were to them personally, protecting habitat for wildlife emerged as the most important open space value or activity in the collective judgement of respondents. Of the 96% that felt protecting wildlife habitat was "important", 75% said it is "very important." Other "important" values, in order of preference included hiking, preserving agricultural lands, nature study, assisting with growth management, and providing buffers between communities, followed by other recreational activities. This citizen survey provided valuable information for the planning and management of County open space lands, and supported the County's emphasis on protection of its environmental heritage.

The Boulder County Parks and Open Space Department (BCPOS) recently acquired a number of individual parcels in order to assemble a substantial amount of contiguous land in the lower Boulder Creek corridor. Collectively, these are referred to as the lower Boulder Creek and Coal Creek open space property. Initial assessments of these lands indicated that ecosystem health and function, particularly in the riverine systems, were less than desirable. Recognizing that the citizens of Boulder County not only supported the acquisition of open space for preservation of rural lands, but attributed such high values to protection of natural resources, and desired some recreational access to open space, the Boulder County Commissioners and the BCPOS initiated a comprehensive study and master planning effort. In June of 1997, the BCPOS contracted with the Anderson & Company, Ecoplanning, consulting team to undertake this interdisciplinary, multi-objective approach to environmental planning of the Lower Boulder Creek and Coal Creek open space lands.

1.2 PLANNING PROCESS

The environmental planning process implemented consisted of:

- A baseline inventory and assessment of natural and cultural resources by consulting team specialists
- Development of general land management recommendations
- Identification of planning opportunities
- Development of three preliminary Master Plan alternatives
- Refinement of a final, comprehensive Master Plan
- Documentation of findings and recommendations in this advisory report

In the course of the project, three alternative master plans were developed based on the inventory and evaluations completed. These alternatives ranged from minimum to maximum modification of the open space lands. The modifications proposed include varying degrees of stream and riparian restoration, wetland creation and enhancement, upland prairie restoration, and recreation. The Master Plan alternatives, including an evaluation of planning criteria met and preliminary estimates of costs of construction, were presented to BCPOS staff. Staff's review comments were relied upon to provide direction for development of the final Master Plan described in this report. This phase of the process concluded with presention of the final Master Plan in a public forum held before the Board of County Commissioners and the Parks and Open Space Advisory Board in May of 1998.

1.3 PROJECT AREA

The planning project area extends along Boulder Creek from the Alexander Dawson School parcel west of US 287, approximately 3.5 miles east to the Boulder-Weld County line (see Figure 1 - Vicinity Map, Figures section). The site also incorporates approximately a 0.7 mile segment of Coal Creek through the Kenosha mine parcel, owned by Boulder County. This mine is permitted through the Division of Minerals & Geology (DMG) and Boulder County for gravel mining, though mining has not yet begun. In total, the project area encompasses approximately 1,110 acres of land. Elevations range from 5060 feet to 4970 feet above sea level.

Agricultural operations, including grazing and cultivation, continue throughout the open space property today. As is common on these rural lands, the natural resources have been utilized extensively. Natural gas and oil pipelines and tank facilities are scattered throughout, and gravel mining has occurred in much of the area. With a wealth of both water and mineral resources, this open space landscape is an intricately woven fabric of human history and natural resources (see Figure 2-Aerial View).

1.4 PROJECT OBJECTIVES

The foundation of this planning effort was establishing concensus on specific project objectives which guided development of the Master Plan throughout. The project objectives are:

- Re-establish successional river processes and restore self-sustaining riparian ecosystems
- Restore historic floodplain and associated features
- Preserve, restore, and create diverse, functional wetland communities
- Preserve, restore, and create a diversity of native plant communities and wildlife habitats throughout the stream corridor
- Enhance pond and stream water quality through natural processes
- Enhance aquatic habitat in surface waters
- Restore upland habitat
- Preserve and enhance viewsheds and open space in perpetuity
- Provide for a diversity of post-gravel mining land uses that complement the rural character of the region and promote a healthy stream corridor ecosystem
- Provide for recreational opportunities while preserving the integrity of the ecosystem
- Preserve and enhance cultural and agricultural resources
- Demonstrate the legacy of and promote a sustainable future for the Boulder and Coal Creek systems

This planning effort is primarily aimed at preserving, enhancing, and restoring both ecosystem functions and cultural values on this open space property. Ecosystem restoration is emphasized, however restoration does not infer that the landscape be restored to a pristine state, nor that human activity be precluded. It is generally agreed that restoration of functional natural systems, and preservation and enhancement of biodiversity are of primary importance for sustainability. The BCCP recognizes the importance of perpetuating and encouraging a diversity of species in the County. As stated, "...loss of environmental diversity weakens the system as a whole, since diversity is an indication of the health of our environment." Stated environmental management goals include recognizing "...the importance of an ecosystem approach in protecting all species and habitat types currently found in Boulder County in order to balance natural systems and human use."

In keeping with this philosophy, this plan emphasizes an ecosystem approach to restoring the health and function of natural systems while accommodating compatible land uses such as agriculture, mineral extraction, interpretation, and recreation. It also emphasizes sound land management practices vital to maintaining this compatibility.

Section 2
Baseline Inventory And Analysis

2.1 SETTING

Sweeping views of the front range mountains from the lower Boulder Creek corridor open space area are unsurpassed. Lands still cultivated and grazed are a welcome contradiction to the visible passing of the rich agricultural legacy and unique beauty of the region. Central to these lands is Boulder Creek, a precious water resource in the semi-arid west and the hub of human settlement in Boulder Valley.

From the time settlement first occurred in the Boulder Creek basin, in the mid-1800's, the river valley was a changed landscape. As is typical in front range river valleys, settlement brought about the conversion of these lands to agricultural uses, primarily due to the availability of irrigation water. Riverbank dikes were frequently constructed for flood protection in agricultural or mined lands. Native grasslands were converted to pasture and croplands. Established wetlands were often drained for cultivation and grazing while new wetland communities developed in irrigated lands. As urbanization in the vicinity followed, the quantity and quality of water in the streams, and flow regimes continued to be altered. Gravel mines also became common features as the demand for gravel, used in construction and infrastructure maintenance, increased.

While some of these changes have certainly compromised ecosystem function, others have likely benefitted it. As testament to the potential compatibility of human activity and functional natural systems, it is widely recognized that alterations in stream flow regimes due to the introduction of agriculture have developed more abundant native riparian woodlands than occurred in the pre-settlement landscape. These ecosystems provide extremely valuable habitat and habitat value is greatly dependent on the contiguity of vegetative cover to accommodate wildlife movement. Among other functions, riparian vegetation shades the stream, and stabilizes stream banks. These functions, in turn, benefit water quality and stream stability, both of which are commonly degraded by agricultural and urban return flows. This is just one example which clearly demonstrates the interconnectedness of natural systems and human use.

Again, it is emphasized that the project setting is an altered landscape. This Master Plan emphasizes opportunities to enhance and restore the health, function and vitality of natural systems in the settled landscape, not to restore the area to a pristine state.

2.2 CONTEXT

Today rural, agricultural lands surround the project area. Land development is occurring rapidly in eastern Boulder County and neighboring Weld County, however. The town of Erie has recently annexed lands for residential development immediately south of Kenosha Road and east of the Boulder-Weld County line, adjacent to this parcel. Long-term the project area will remain an oasis of open lands in the region, and provide for the protection of an extensive reach of the Boulder Creek corridor.

The study area is located approximately 2 miles east of the White Rocks Natural Landmark and state designated Natural Area, most noted for its raptor habitat. It is also approximately 1/3 mile east of a state registered Heron Rookery Natural Area. The Dawson School portion of the study area, west of US Highway 287 at Boulder Creek, constitutes the eastern limit of an area designated as Critical Wildlife Habitat: Cottonwood Grove and Heron Rookery (+ wetlands) in the BCCP. All of these significant natural features are linked by Boulder Creek, a BCCP designated stream connector between the East County and the White Rocks/Gunbarrel Hill Core Environmental Conservation Areas. Ecological enhancement and restoration on the project site has the potential to greatly benefit and expand this stream valley's capability as a significant habitat corridor.

2.3 RESOURCE INVENTORY & ANALYSIS

An extensive inventory of flora and fauna, cultural resources, stream systems, and site features, including scenic vistas was performed by the consulting team at the project outset. Site features and wildlife sightings were recorded on field inventory maps. Reports, including planning and management recommendations, were prepared for each component studied. These detailed reports are presented in Appendix A. The majority of the inventory information is mapped in Figure 3 - Resource Inventory.

The data collected on existing conditions was used to identify important areas for preservation and enhancement, to guide restoration activities, to identify appropriate trail locations and recreation levels, and to formulate management recommendations. This baseline data is also intended to facilitate monitoring following implementation of the Master Plan recommendations. The following subsection contains an overview of the significant findings of the data collection phase.

2.3.1 Cultural Resources

2.3.1a Inventory

A cultural resource inventory was performed in the study area to locate, record and evaluate historic and prehistoric cultural resources for planning and land management purposes. An intensive (100%) cultural resource inventory was conducted on approximately 212 acres, and a visual reconnaissance survey of approximately 300 acres was made. Wetlands and areas which were previously mined and reclaimed were not inventoried.

Four previously unrecorded sites and two isolated finds were located. The previously unrecorded sites are:

- Duffy Pigeon Barn
- Remnants of an historic bridge, which was likely part of the Denver-Cheyenne Stage Road (known as Boone Station in early 1860's, and later as Buford Station toll bridge)
- Howell-Robinson Farm
- Howell Ditch

Isolated finds include:

- Concrete stave silo
- Portable cattle chute

Two historic ditch sites also occur:

- Liggett Ditch
- Boulder and Weld County Ditch

Prehistoric sites in this region of the plains are generally limited to small scatters of lithic debris and tools left by groups following a hunter-gatherer adaptation. Bone beds from kill/butcher sites, stone circles, firepits, and other ephemeral camps and campsites with layers of culturally deposited material are present in eastern Boulder County. Any of these types of prehistoric cultural properties could potentially occur in the study area, particularly since prehistoric sites tend to be in areas near water sources or other critical natural resources. The study area does, however, occur in the Boulder Creek floodplain. The preferred habitation areas were terraces and bluffs above the floodplain. Also, any prehistoric sites which were present would have been subjected to floods, and probably either washed away or buried. Additionally, the study area has been cultivated for generations, gravel mining has occurred in several areas, and Boulder Creek has been channelized in some reaches.

The first irrigation ditch in the area was constructed by approximately 1859. By 1880, open range cattle grazing occurred. Farming and ranching were the primary economic pursuits in the study area, although coal mining occurred in Erie and lands south of the study area.

Significance

None of the cultural properties are eligible for the National Register of Historic Places (NRHP) due to a lack of significance or due to loss of integrity from post-use changes and modifications. Building no. 2 at the Howell-Robinson Farm is a braced frame pinned mortis-and-tenon granary constructed about 1875, later converted to a barn. It may be eligible for local landmarking as an example of this type of construction. It should be noted that this barn occurs in the permitted Kenosha gravel mine site. Under that permit, the barn is approved for demolition. When mining occurs at Kenosha, it is recommended that the barn be relocated onsite. The Kenosha Ponds Park trailhead may be an ideal location (see subsection 3.3.5).

2.3.1b General Planning and Management Recommendations

Although the cultural features identified onsite lack national significance, they do reflect the history of the study area, and so are important amenities for interpretation of the site. Throughout history, stream corridors such as Boulder Creek and Coal Creek were the cornerstone of human activity, whether as a transportation corridor, a source of food and water for Native Americans, or the center of settlement. The farm structures and ditches are valuable expressions of the Boulder and Coal Creek corridor's agricultural heritage. Whatever level of recreation and access occurs onsite, these features are important planning components and are designated for preservation in the Master Plan. In addition, continuing agrarian land uses in conjuction with the land management practices identified herein is also recommended.

2.3.2 Wooded Riparian Communities

In the semi-arid west, wooded riparian plant communities which flank our waterways provide a multitude of environmental benefits including: food, cover, perches, and nest sites for wildlife, corridors for wildlife movement, streambank stability, and enhancement of water quality by virtue of the shade they provide. In the plains environment, they effectively function as ribbons of habitat, rich in biodiversity. The better the vertical and horizontal structure, the more valuable the habitat. Vertical structure refers to an overstory tree canopy, an understory shrub layer, and/or a herbaceous wetland or upland layer on the forest floor. Horizontal structure refers to the connectivityy of vegetation. An unbroken ribbon of vegetation maximizes wildlife movement capability.

Riparian woodlands are adapted to a specific hydrological regime. They occur near the waterway and rely on flood events within the frequent floodplain for regeneration, therefore channel morphology is a key component of riparian ecosystem function (see subsection 2.3.9a).

Riparian areas onsite vary greatly in terms of habitat structure, function and value, reflecting the degree the stream has historically been altered. The healthiest riparian community on Boulder Creek occurs west of US 287. East of US 287, healthy riparian vegetation and regeneration is distinctly lacking. Those stands that still exist both at Boulder Creek and Coal Creek are generally threatened by drops in the ground water table associated with vertical streambed erosion. Restoration of healthy riparian communities and the stream morphology which sustains them is essential for protection of the natural resources in the project area, and for fulfillment of many of the project objectives. Stream restoration is further described in subsection 2.3.8.

Riparian plant associations are at times classified as upland, and at times wetland, depending on the dominant species, soils, and hydrologic regime. Therefore, riparian areas are further discussed in both the upland and wetland plant community subsections which follow.

2.3.3 Upland Plant Communities

2.3.3a Inventory

A field investigation was performed to characterize upland plant communities onsite. Six plant community types were identified:

- Cottonwood groves
- Cottonwood / shrubs
- Cobble bars
- Reclaimed fields / pastures
- Weedy fields
- Cultivated fields

Cottonwood groves occur in upland areas contiguous to Boulder Creek in the western portion of the site. These are dominated by plains cottonwood with narrow-leaf cottonwood, crack willow, boxelder and russian olive. Undisturbed natural communities of this type typically contain a thick, diverse shrub component. In the study area, the understory is instead dominated by a weedy forb community.

Cultivated fields of corn, oats, wheat, and hay occur at the west and east ends of the study area. Reclaimed fields and pastures dominated by grasses (primarily introduced species) occupy the largest portion of the upland plant community. These exhibit a notable lack of forb and shrub diversity. The species mix reflects the land use history of each area. Several prominantly weedy areas are severely degraded due to intensive grazing by domestic livestock.

One of the most notable aspects of the entire study area is the large diversity and frequency of weedy plant species in the upland areas. Some areas contain a solid cover of weeds. Twenty-two of the 108 identified upland plant species are listed as noxious weeds under the Colorado Weed Law. Five of the 10 species listed as the highest priority for control occur onsite.

Species of Special Concern

Although the study area is in the proximity of, or contains suitable habitat for four species of sensitive, rare, or threatened and endangered upland plants, none were observed onsite.

2.3.3b General Planning and Management Recommendations

The primary objective of the following recommendations is restoration and enhancement of upland habitat throughout the site. Recommended techniques for implementation are provided in the 'Upland Vegetation Inventory and Management Recommendations' report, Appendix A. The management recommendations provided are as follows:

- Control existing weed populations (high priority)
- Implement prescriptive livestock grazing practices to emulate natural processes
- Protect and enhance cottonwood groves, ie. protect mature trees and shrubs, encourage and plant native saplings, shrubs, and herbacous plants to diversify the canopy and age structure
- Seed weedy fields with native grasses and forbs, as appropriate for soils and land use
- Interseed reclaimed fields and pastures with native grasses and forbs to increase diversity and ecological function (lower priority)

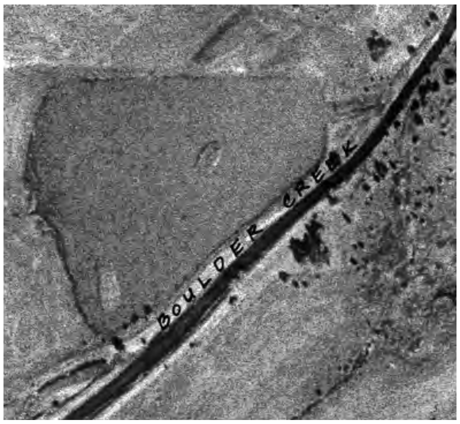
2.3.4 Wetland Plant Communities

2.3.4a Inventory

Methods implemented for the wetland inventory include a review of previous studies, analysis of recent aerial photographs for wetland signatures, and a field investigation of the study area. The baseline data gathered includes mapped locations of wetlands, an ecological characterization, and a qualitative evaluation of the functions currently being performed by these wetlands (see wetlands report, Appendix A). The study was not intended to map specific wetland boundaries.

Fifty-one wetland areas were mapped in the study area (see Figure 3). Nearly half (25 of 51) of the wetlands identified are natural landscape features. The majority of these are riparian wetlands which occur in the frequent floodplain of Boulder Creek. The historic configuration of Boulder Creek was a broadly meandering channel. Altered flow regimes, channelization and land development have straightened and shortened the channel and reduced or eliminated the active floodplain. As a result, these riparian wetlands have been reduced extensively. In addition, while historically these wetlands were likely dominated by woody species such as cottonwoods and willows, they are now typified by

herbaceous plants such as the introduced species, *Phalaroides arundinaceae*. The remainder of the natural wetlands, in order of occurrence, are off-channel sloughs, riparian forests, and emergent marshes. The highest species diversity of wetlands in the study area occurred predominantly in off-channel sloughs and marshes.



Fifteen wetlands were apparently created as a result of gravel mining which has occurred throughout the study area. Most of these wetlands are ponds or lakes and contain mostly aquatic plant communities. The shorelines are often angular and steeply sloped with narrow linear zones of emergent vegetation such as cattails or bulrush.

Agricultural wetlands are typically supported by seepage from irrigation ditches and the accumulation of return flows. Soils in these wetlands are often only seasonally saturated, and plant communities are adapted to these fluctuating water tables. Four wetlands in the study area are naturally occurring wetlands augmented by irrigation water.

Spiranthes diluvialis Habitat Evaluation

Several wetlands in the study area exhibited commonly associated plant species and physical conditions suitable for the federally listed threatened and endangered species, *Spiranthes diluvialis*, Ute Ladies' Tresses Orchid. None of these were ideal habitat due to non-native weed infestation and past human disturbances such as gravel mining. No individual orchids were observed, although the plant is difficult to recognize unless flowering or fruiting, and may only bloom during years when environmental conditions are suitable. *Spiranthes diluvialis* populations are known to occur upstream on Boulder Creek and it is possible that they occur in wetlands in the study area. Further investigation is, therefore, recommended.

2.3.4b General Planning and Management Recommendations

Wetlands are among the most biologically diverse and productive ecosystems on earth (Mitsch and Gosselink 1993). In their natural state, they provide a variety of benefits including flood conveyance, shoreline stability, water quality improvement, food chain support, fish and wildlife habitat and recreational values (Adamus 1983). In the semi-arid west, wetlands comprise a small portion of the landscape while supporting a disproportionately large number of species. Despite their values, wetland losses due to activities such as filling, draining, stream dewatering, and channelization, have been extensive throughout the region. At one time, Boulder Creek occupied a broad floodplain and supported numerous wetlands. Aerial photographs from 1937 in the vicinity of the study area show prairie marshes, wet meadow wetlands and extensive riparian woodlands. Preservation, enhancement, and restoration of existing wetlands in the project area, as appropriate, is recommended. This plan also calls for creation of some wetlands, where beneficial.

Wetland Preservation

Priority wetland preservation areas were determined based on several factors. Relative rarity or uniqueness was evaluated. For example, cattail marshes, lakes and ponds are relatively common wetland types in Boulder Valley while riparian forests, salt marshes and sedge meadows are not as common. Second, plant species diversity and the number of wetland plant communities in each wetland were considered since these reflect overall biological diversity. Third, wetlands that perform a number of wetland functions to a high degree were deemed more valuable than those that performed fewer functions to a lesser degree.

Those wetlands determined most critical to preserve were wetland 5 (emergent salt marsh and salt marsh/salt meadow), wetland 16 (salt marsh, freshwater marsh, riparian forest and aquatic), wetland 30 (oxbow slough with high species diversity and good structural diversity), and wetlands 49 & 50 (large, mature riparian forests) (see Figure 3).

Wetland Enhancement and Restoration

In addition to preservation, maximizing opportunities for enhancement and restoration of wetlands is recommended. Developing and maintaining conditions that promote diverse wetlands and enhancing the performance of ecological functions is emphasized. For instance, due to downcutting in Boulder Creek and the subsequent drop in the ground water table, some oxbow slough wetlands are no longer saturated. Where surface elevations allow, it is recommended that the hydrologic connection to Boulder Creek be re-established. In other marginal wetland areas, maximizing opportunities to enhance the hydrologic regime is recommended. For further information on specific wetland areas and proposed treatment, refer to Section 3 - Master Plan.

Wetland Creation

Wetland construction is proposed in some areas. These wetlands provide opportunities for off-channel treatment of water quality in Boulder Creek and Coal Creek. Marsh wetlands are particularly beneficial for filtering and cleansing water prior to discharge into streams and percolation into ground water. Treatment of Coal Creek flows is discussed in detail in subsection 3.3.6. Boulder Creek water quality is lowest during low flow periods, when pollutants are most concentrated (see subsection 2.3.8), therefore diversion structures on Boulder Creek should be designed to capture partial low flows without depleting stream flows beyond acceptable levels. The design should also prevent diversion of high flows into the wetland. Partial flows may be diverted through some existing wetlands as well, gradient allowing.

General wetland management recommendations provided include:

- Restore meandering channel and active floodplain for the regeneration of wooded riparian plant communities (see subsection 2.3.9)
- Utilize grazing as a management tool to control undesireable weeds and promote healthy native plant communities without wetland and riparian degradation
- Control undesirable non-native plants such as russian olive and peppergrass, *Lepidium virginicum* in wetland areas
- Establish wetland nurseries in some areas, maintaining agrarian land use
- Consider wetland mitigation banking of constructed wetlands

2.3.5 Mammals

2.3.5a Inventory

The mammalian survey relied on direct sitings, indirect indicators such as discovery of skeletal remains, tracks, or dens, and inferences from published distributions and the presence of suitable habitat (see 'Evaluation of Wildlife Habitat', Appendix A). Sightings and evidence of the following mammals occurred:

- Bear, Black (atypical - trapped and relocated)
- Beaver (wetland #5)
- Coyote
- Deer, White-tailed
- Gopher
- Marmot, Yellow-bellied
- Raccoon
- Prairie Dogs, Black Tail
- Rabbit, Cottontail
- Squirrel, Rock
- Vole

Species of Special Concern

None of the mammalian species observed onsite represent species of special concern nor any other special status either locally, statewide, federally, or globally.

Preble's Meadow Jumping Mouse Habitat

The Preble's Meadow Jumping Mouse, *Zapus hudsonius preblei,* is a recent federally listed threatened species. These mice are restricted to well-developed riparian vegetation along creeks and ditches in this region. Boulder Creek, Coal Creek, and the Boulder-Weld Canal all provide potential habitat for the mouse, although density of riparian vegetation on this site varies significantly. In accordance with the Endangered Species Act (ESA), a survey for the jumping mouse is required for all potential habitat areas disturbed by proposed construction. If the mouse was found, federal regulations would require consultation with the U.S. Fish and Wildlife Service (FWS) and the Colorado Division of Wildlife (CDOW), and development of agency-approved mitigation plans. Generally, jumping mouse habitat would be greatly enhanced by the revegetation efforts proposed in the project area.

2.3.5b General Planning and Management Recommendations

Overall, much of the lower Boulder Creek project area would benefit greatly from habitat improvement, in terms of structure and diversity. As mentioned previously, connectivity of well-vegetated riparian areas is extremely important. It is also important to divert trails at some segments of streams and ditches to provide preserved, undisturbed areas for small mammals.

In addition to habitat improvement, a few areas which currently provide valuable mammalian habitat are worthy of preservation. The degree to which public access in these areas is desirable varies, and has been considered in the Master Plan. Recommendations provided for habitat improvement and management of the site for mammalian habitat include:

- Remove grazing from riparian corridor (ie. 30 meter setback), manage weeds, and revegetate
- Restore willow communities for small mammal habitat
- Provide a buffer between the edge of cultivation and Coal Creek (ie. 30 meters) (not applicable if mined)
- Implement prescriptive grazing practices in upland areas, allowing plants to reach full height
- Preserve large prairie dog colony at Kenosha & limit access. Utilize barrier fencing and other prairie dog population control measures as needed to contain colonies on County property.
- Preserve or re-establish squirrel family and beaver habitat in place
- Perform Preble's Meadow Jumping Mouse and other small mammal survey
- Perform bat surveys
- Monitor squirrel species
- Monitor beaver population and impacts to revegetation efforts

2.3.6 Birds

2.3.6a Inventory

An inventory of the site was performed to collect baseline information on avian species, and to assess habitat use by breeding bird populations and nesting locations of Boulder County avian species of special concern. Locations of specific sightings are provided in the report entitled, 'Habitat Use by Breeding Birds in Lower Boulder Creek Drainage', Appendix A.

A total of 58 species of birds were observed within the study area. Twenty-four species nested onsite, and 11 species were migrants which nest in other regions of Boulder County.

Species of Special Concern

Eleven Boulder County species of special concern were sighted, including:

- Double-crested Cormorant
- Great Blue Heron
- Great Egret
- Black-crowned Night Heron
- Wood Duck
- Peregrine Falcon
- Gray Catbird
- Yellow Warbler
- Ovenbird
- Blue Grosbeak
- Yellow-headed Blackbird

Red-tailed hawks and great horned owls nested within the study area. Herons and cormorants are known to nest in protected rookeries nearby, between 95th St and US 287, and at Panama Reservoir. They fly and fish eastward across the study area.

Wood ducks nest within tree cavities along prairie streams and around lakes and reservoirs. Peregrine falcons frequently hunt in prairie wetlands. The gray catbird historically nested on the plains in mesic shrublands and the riparian understory on the South Platte. There are no recent records of nesting, however, they were sighted in remnant shrubs along Coal Creek.

The yellow warbler is adversely affected by brood parasitism and loss of riparian woodland habitat through its range. Highest densities onsite occurred in riparian areas that contained mature cottonwoods and a willow understory.

One ovenbird, which relies on shrub growth and mature deciduous trees, was observed onsite. The study area is probably peripheral to its normal breeding range. The blue grosbeak appears to be breeding in dense willow and chokecherry shrublands along Coal Creek and Boulder Creek east of Kenosha Road. Yellow-headed blackbirds nested in cattail marshes onsite.

Other species of special interest in the study area are the Marsh Wren, which occurs in cattail marshes, and the Orchard Oriole, which frequents lowland riparian woodlands.

2.3.6b General Planning and Management Recommendations

Maximizing species diversity and breeding bird population density on the property while protecting habitat for species of special concern is emphasized. The following recommendations are provided:

- Preserve mature riparian trees
- Encourage shrub growth along riparian corridors
- Preserve cattail marshes and exclude cattle from marsh (wetland #5) north of Boulder Creek
- Retain all standing dead trees along Boulder Creek and Coal Creek for cavity-nesting birds such as wood ducks
- Divert trails away from red-tailed hawk nest sites
- Divert trails away from Boulder Creek and some wetlands between the western study area boundary and Kenosha Road
- Generally locate future trails west of Kenosha Road a minimum of 100 meters from the creek and provide visual buffer from the creek bed for the protection of herons and cormorants
- Maintain a minimum 50m buffer between trails and Coal Creek

2.3.7 Fisheries

2.3.7a Inventory

Identification and distribution studies of fish species in Boulder Creek and Coal Creek have been underway since the early part of this century (see 'Fisheries and Channel Existing Conditions and Recommendations' report, Appendix A). Although the specific reaches in which these species were found is not identified, fish identified in these drainages in three studies conducted between 1968 and 1987 include:

- Creek Chub
- Longnose Dace †
- Common Shiner
- Red Shiner
- Bigmouth Shiner
- Sand Shiner †
- Brassy Minnow *
- Fathead Minnow †
- Central (Common) Stoneroller †
- Longnose Sucker
- Western White Sucker †
- Plains Killifish
- RioGrande Killifish (now accepted as Plains Killifish)
- Plains Topminnow **
- Johnny Darter
- Common Carp
- Gizzard Shad
- Largemouth Bass (possibly lentic habitat) †
- Green Sunfish

† Species observed in 1987
* State Threatened (Natural Heritage Status)
** State Species of Special Concern (Natural Heritage Status)

A 1947 study of fishes in Boulder County found that 31 species occurred below 6,500 mean sea level. It is useful to compare the numbers of species found in Boulder Creek/Coal Creek in 1968 (15 spp), 1982 (16 spp, 1 from lentic habitat), and 1987 (7 spp.). This information indicates that the number of species found in the Boulder Creek and Coal Creek drainages has diminished over time. Species such as longnose dace, sand shiners, fathead minnows, stonerollers, and white suckers appear to be surviving in this system while other native species have not. Environmentally sensitive species which were common in the main stem of the St. Vrain made up only 2% of the fish sampled in subdrainages such as Boulder and Coal Creeks. Nessler, et al (1997) states that if the limiting factors which have precluded the colonization of Boulder and Coal Creeks by rare or sensitive species can be identified and mitigated, these two subdrainages may provide valuable habitat for these species.

The limitations causing the reductions in fish species diversity in the study area have been identified by researchers as far back as 1947. Water quality deterioration, habitat degradation and alteration, and exotic species introduction have been identified as pertinent factors causing the demise of fish species in the St. Vrain and, particularly, its tributaries.

A baseline study of fish habitat rating was performed for this planning effort. Five stations were established in the project area. The habitat assessed scored poor with the exception of one station where stream improvements have been completed. Factors identified as potential problems include lack of instream and stream side cover, poor pool quantity and quality, poor bank stability, and only fair channel stability and food abundance. These conditions are typical of streams that have been channelized, and exhibit poor and lacking riparian habitat conditions, water quality deteriorization, flow depletions, and poor instream habitat conditions.

2.3.7b General Planning and Management Recommendations

The CDOW has speculated that a significant amount of it's effort in the St. Vrain drainage will be to maintain and enhance the abundance of native fish species. Boulder Creek and Coal Creek are valuable flowing water resources for the enhancement and maintenance of the fish species native to this foothill stream transitional area. Stream restoration as recommended for the study area will compliment and contribute to this regional commitment. Fish habitat enhancement recommendations provided include:

- Develop cooperative agreements with the CDOW, water users, point source dischargers, and adjacent landowners to address limiting factors for target species
- Develop in-stream habitat in conjunction with stream restoration activities
- Enhance off-channel fish habitat in ponds
- Develop brood stock populations of sensitive fish which could be periodically harvested and transferred to new habitat sites. The Kenosha Ponds Park area is ideal for development of a native fish hatchery (see subsection 3.3.6)

Prior to disturbance of fish habitat for stream restoration construction, a survey of federally listed threatened and endangered species must be performed in accordance with the ESA. State listed threatened or species of concern should also be identified. If any of these species are found, consultation with the FWS and/or the CDOW would be required, and agency-approved mitigation plans must be developed. The stream restoration activities proposed in this Master Plan will improve habitat for native fish significantly.

2.3.8 Water Quality

2.3.8a Inventory

Concerns regarding water quality in lower Boulder Creek have been voiced by the community for some time. Data characterizing water quality in Boulder Creek at the 95th Street bridge was completed in 1986. This data indicated that water quality changed significantly below the City of Boulder's 75th Street wastewater treatment plant. Reports on recent data indicate continued ammonia loading of Boulder Creek. The primary concern voiced by professional water quality managers is the elevated levels of nitrogen and the interaction of conditions in Boulder Creek which sometimes increase the toxic free ammonia radical part of the nitrogen constituents. The specific conditions of concern include: aquatic photosynthetic activity and temperature increases (which increase pH and are correlated to season and flow reductions/balance), and decreases in dissolved oxygen concentration (correlated to temperature increases, oxygen demand increases, and elevation decreases). During low flow periods Boulder Creek flows are comprised primarily of wastewater return flows, impeding the development and maintenance of aquatic communities.

Coal Creek flows are dominated by greywater return flows from wastewater facilities managed by the upstream communities of Superior, Erie, Lafayette, and Louisville. Water quality requirements incorporated into recently drafted discharge permits for these dischargers on Coal Creek will require upgrades that will improve water quality, however opportunities to improve water quality remains an important consideration of this planning effort.

2.3.8b General Planning and Management Recommendations

The recommendations presented in this study for re-establishing natural, stable channels (see subsection 2.3.9) on both Boulder and Coal Creeks are essential for optimizing the streams' water quality capabilities long-term. Restoration of channel dimension, pattern and profile and a healthy riparian ecosystem will re-establish important riverine-riparian functions. These functions include: decreased width/depth ratios, solar heating abatement, increased oxygenation, dissipation of high flow energies, reduction of erosion, filtering of sediment, improved flood-water retention and ground water recharge. Maximizing options for the use of wetlands for water treatment, as previously mentioned, will also provide water quality benefits.

Although implementation of these recommendations will benefit water quality, it is not suggested that this effort alone will solve the current water quality issues on Boulder Creek or Coal Creek. The issues and solutions must be addressed basin-wide, and will require basin-wide cooperation for successful water quality improvement. It is noted that Boulder County, as primary manager of lower Boulder Creek, faces involvement in a number of federally mandated programs if water quality issues are not addressed in these two creeks.

2.3.9 Channel Morphology

2.3.9a Inventory

The Boulder and Coal Creek channels in the study area are in states of disequilibrium within their watersheds. In other words, the channels are currently unstable.   Managing unstable channels is one of the greatest challenges facing communities on manipulated and urbanized stream systems today.

Channel instability comes with great cost to both the ecosystem and the community. As demonstrated in the project area, native riparian vegetation and habitat are lost, and water quality and aquatic habitat are degraded. As a result of loss of habitat, biodiversity in the stream corridor is significantly reduced. Financial costs include the continual need for channel improvements, and increased maintenance of structures such as diversions, and bridge abutments. Common treatments for unstable channels include riprapped banks, grade control structures, channelization, and even concrete lined channels. The beauty, life and function of streams are severely impacted by both channel instability and common management techniques.

Channel Stability

In order to understand the ramifications of stream instability in the study area, it is important to have a basic understanding of the nature and function of a stable stream system. In its natural, stable state, a stream channel is in equilibrium with its environment. It is adapted to all of the influences which affect its morphology, or shape. These influences include flow regimes, flood events, vegetation, soils, and landform. A stable channel exhibits a consistent dimension, pattern, and profile, so that over time channel features are maintained, without aggrading or degrading.

Channel features include the active channel, the active floodplain, and the floodplain terrace. The active, or bank-full, channel contains the annual high flow and is an aquatic dominated environment. The active floodplain, or floodprone area, (as distinguished from the regulatory 100-year floodplain) is contiguous to the active channel, and is typically dominated by riparian vegetation. The terrace which occurs above the active floodplain is an abandoned floodplain, isolated from all but the most extreme floods. This zone is also typically occupied by riparian vegetation. In a state of dynamic equilibrium, all of these channel forms work cohesively to maintain the most efficient conveyance of sediment and flows. It is interesting to note that, contrary to popular belief, studies have shown that a sinuous stream with the appropriate width/depth ratios conveys sediment and flood flows more efficiently than a broad, straight reach (Rosgen, 1996).

Studies indicate that a natural, stable stream does not measurably migrate or shift course in its floodplain unless any of the environmental factors influencing its shape are altered. Within the active channel, erosion, deposition and scour occur. Point bars erode and are replaced annually, yet meanders migrate very slowly. The dramatic shifts we commonly see today are due to channel alterations often caused human activities such as channelization, channel realignment, and flood control efforts.

Channel stability is also affected by alterations in flow regimes such as the addition of urban and agricultural runoff, irrigation diversions, and use of the channel to convey irrigation and wastewater flows. Changes in vegetation resulting from overgrazing and loss of riparian vegetation also greatly affect channel stability. Field data collected on some sites has shown that when vegetation composition has changed due to over grazing, lateral migration of the stream can be affected by as much as a 3.5 order of magnitude (Rosgen, 1998).

Human activities which affect streams often accelerate natural processes, causing the stream to adapt by altering its form. It is important to realize, however, that without human intervention, stream adaptation may take ages to reach a point of equilibrium and recover historic ecological functions. In cases like lower Boulder Creek and Coal Creek, where the channel is confined and cannot alter its lateral configuration, the stream may never reach a stable state.

Riparian and wetland plant communities are also vital to maintaining stream stability. Conversely, the health of riparian communities is dependent on a functional, active floodplain. In fact, native woody riparian vegetation requires flood events to regenerate. When the active channel and floodplain are maintained, increased flows and flood flows are allowed to dissipate on the floodplain and the riparian system is not adversely impacted. Where the floodplain is limited due to channelization or confinement, flood flow energies cause bank and bed erosion. The stream begins to downcut, or incise. Once the stream has downcut to the point where frequent flood flows no longer reach the floodplain, it becomes an historic terrace, and no active floodplain exists. Remnant riparian vegetation is eventually lost due to the drop in ground water levels, and regeneration does not occur. Variations in streambed structure vital for aquatic life are also lost. As the project area inventory demonstrates, with entrenchment, a cycle of degradation is established which affects every aspect of the riverine ecosystem. Whatsmore, the effects are not limited to the immediate stream reach, but extend upstream. When a stream downcuts, every tributary within the watershed will downcut until a sustainable equilibrium is reached.

Lower Boulder Creek and Coal Creek Channel Conditions

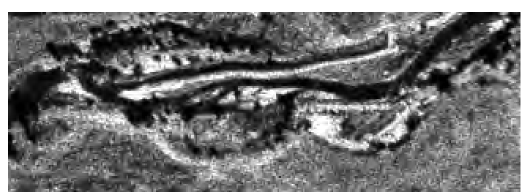
The method used to evaluate both the historic stream forms and current stream conditions in the project reach involves identification of the channel type and stream conditions at several cross-sections in the study reach and in a reference reach of stream (Rosgen, 1996). Identifying a reference reach which depicts the natural, stable channel form within the watershed is a vital component for interpretation of the baseline data and defining design parameters for restoration. The reference reach selected which most closely depicts the historic lower Boulder Creek channel occurs upstream of the study area at Boulder Valley Farms (see 'Fisheries and Channel Conditions and Recommendations', Appendix A).

Restoring functioning channels and floodplain/riparian areas on both Boulder Creek and Coal Creek that are representative of the natural systems also requires an understanding of the flow events that occur with some regularity. Available flow data was acquired for the study reach, and predictions made regarding normal, typical high, and typical low water yield years. It is noted that large gaps occur in the database, however. Additional flow data should be collected in the design development phase.

Historic lower Boulder Creek is characterized as a C3 channel, a "slightly entrenched, meandering, riffle pool, cobble dominated channel in a well developed floodplain." (Rosgen, 1996). The historic channel belt width, or active flood prone area, utilized approximately 1000'-1200' of the valley floor.

Examination of historic and recent aerial photographs illustrates that the Boulder Creek and Coal Creek channels have been dramatically altered within the study area. Long reaches of Boulder Creek have been channelized, eliminating the active floodplain and its associated vegetation. Stream diversions have reduced the intensity of flood flow events and the energy they provide to maintain the channel and floodplain. Dikes have been erected over decades to contain flood flows. The stream has been straightened to reduce land area dominated by the creek, reducing the channel sinuosity or meander factor. As a result of this type of manipulation, the stream is no longer able to dissipate the high flow energy across its floodplain or into meanders, and this energy is spent eroding the stream bed. Significant down cutting, or entrenchment, is apparent on Boulder Creek from Boulder Valley Farms upstream of the project area to the downstream project area boundary. Down cutting has increased the bed load of material in this stream and caused deposition in flatter areas of the channel, creating braided channel sections as well. In essence, Boulder Creek has abandoned its floodplain due to horizontal restriction, vertical down cutting, placement of graded stream side structures to an elevation of the historic terrace, and a combination of these factors.

Coal Creek, once an upland, intermittent gulch, now carries perennial flows from several upstream municipal wastewater treatment plants, and runoff. The associated increase in annual and periodic high flow events in Coal Creek in conjunction with the clay and silt substrate, have caused extreme instability, entrenchment, and abandonment of historic alignments.



As a result, diverse vegetation and habitat in the perched, remnant channels are threatened. Entrenchment in Coal Creek currently exceeds 25 foot depths in some areas. Massive erosion in Coal Creek also significantly increases suspended sediments entering Boulder Creek at the confluence immediately downstream.

Overall, degradation and the loss of active floodplains on both streams has caused the loss of aquatic habitat, and riparian and wetland vegetation. Those remnant communities remaining are threatened, and regeneration of these plant communities and their associated habitats is minimal

2.3.9b General Planning and Management Recommendations

One of the primary objectives identified for this project is the re-establishment of successional river processes and self-sustaining riparian ecosystems. In order to achieve this objective, it is essential that natural, stable channels be restored. The term 'stable' refers to a channel that exists in a state of dynamic equilibrium. The generally accepted definition of stream or river restoration is to restore the physical and biological functions of the river valley, not to restore the river to a pristine state. Rehabilitation of both Boulder and Coal Creeks must re-establish a state of equilibrium relative to current flow regimes and sediment loads in order to achieve this project objective and minimize maintenance of the channel and attendant structures.

Most often, stream improvement involves a 'patch-in-place' method of placing structures in the channel or on banks to mitigate the most immediate problems. Often, the ability to address stream function is limited by the length of stream involved. These improvements are also typically designed to address one concern only, such as severe bank erosion or fish habitat improvement. In an unstable channel, however, these are generally short-lived improvements.

Boulder County has acquired an extensive reach of Boulder Creek, thereby affording a rare opportunity to restore a functional stream system in these open space lands. The most appropriate, multi-objective, and long-term approach is to realign the channel in a more natural and stable form based on current hydrologic and geomorphic data. This geomorphic approach to stream restoration addresses the function of the river system as a whole, considering both fluvial geomorphological (water, earth, shape), and ecological processes. In other words, we mimic nature to the best of our ability.

A Geomorphic Approach to Stream Restoration

The geomorphic approach to restoration relies upon the reference reach to understand the dimensions, patterns, and profile of a stable stream reach in order to define the design parameters for restoration. Construction involves re-establishment of the appropriately configured active channel, attendant floodplain, meander pattern, and stream gradient. The channel is typically reconfigured at the current invert elevation. Riparian areas are revegetated to enhance bank stability and ecological function. Stream banks and instream habitat structures are stabilized using such materials as boulders, tree root wads, and tree and shrub cuttings. These structures are most susceptible to damage during spring runoff or seasonal high flows the first few years of plant establishment following construction, and some may require maintenance during that period. Wherever possible the stream is not armored extensively, thereby allowing the channel to adapt morphologically to future changes in physical influences. However, due to the need to maintain structures such as bridge crossings and irrigation diversions, and to avoid adversely affect neighboring properties, some segments are armored with natural materials to restrict lateral movement.

A geomorphic approach to stream restoration is emphasized as the cornerstone of ecological restoration in the lower Boulder Creek corridor (see subsection 3.3.6 for Coal Creek recommendations). Just as channel degradation initiates a cycle of degradation that impacts the entire riverine ecosystem, so restoration of a functional channel will provide for the rehabilitation and regenerative capability of a healthy, diverse ecosystem.


Section 3
Master Plan

General descriptions of existing conditions and recommendations for each reach of the project area are depicted in the attached Site Opportunities plan (see Figure 4). Conceptual design of the site is provided in the Master Plan (see Figure 5). The following information supplements that provided in these illustrations.

3.1 GENERAL LAND MANAGEMENT RECOMMENDATIONS

Based on the inventory data compiled and recommendations developed by each member of the consulting team, the following land management practices are recommended for implementation throughout the project area. These include:

- Implement prescriptive grazing practices, including fencing for the protection of the riparian corridor and significant wetlands
- Develop and implement a weed management plan
- Remove russian olive trees
- Revegetate as needed and diversify with native species
- Assess the creek corridors for potential dump sites
- Survey for threatened and endangered species
- Monitor beaver activity impacts to stream restoration efforts
- Monitor stream restoration and overall ecological vitality, diversity, and succession
- Maintain agricultural land use as feasible
- Restrict public access at existing oil & gas facility access roads, except as noted

Over grazing has greatly contributed to weed infestation and the degradation of Boulder Creek in the project area. It has also limited the habitat function of the pasture areas. Therefore, balancing domestic grazing and ecosystem function through prescriptive grazing is a primary recommendation for land management. Implementing management practices such as these on public lands also provides a setting for public education: a model for ecologically sound agricultural practices.

Weed management is also a high priority for these lands. Weeds not only degrade the ecosystem in the project area, but spread rapidly throughout the region. Where weeds dominate, eradication and reseeding will be required. In less weedy pastures, interseeding may be necessary. It is recommended that where soil conditions allow, native grasses and forbs be planted for ecosystem enhancement.

3.2 TRAILS

The Boulder County Comprehensive Plan (BCCP) designates a conceptual regional trail corridor along Boulder Creek from west of N. 95th St. to the eastern end of this study area, at the Boulder County line. Although an exact alignment has not been determined for the linkage from this site west, a recommended trail alignment through the project area is proposed in this plan.

While access to streams and ditches provides an interesting park user experience, these waterways also provide the most diverse and valuable habitat zones onsite, and provide the critical function of wildlife movement corridors. It was determined, therefore, that the proposed trail should not follow the length of any waterway, but access them only intermittently. Other historic or natural points of interest are linked by trail to direct public use away from environmentally sensitive areas, including those scheduled for restoration.

A regional trail spur is proposed to access the Wise Museum south of this parcel (photo, left). The lands east of 119th Street and south of Kenosha Road have recently been annexed to the town of Erie, and residential development is scheduled to occur. In addition, an Erie neighborhood park is slated for construction here, accessed by an internal trail. Linkage to this privately developed trail system will provide valuable opportunities for the residents to access the open space lands, and will allow a regional trail connection to the eastern portion of the open space lands known as Kenosha without traversing the Boulder Creek corridor. An internal loop trail system and passive recreation / interpretive area is proposed at Kenosha Ponds Park (see subsection 3.3.5).

Several equestrian facilities occur in the vicinity of the lower Boulder Creek/Coal Creek open space. It is recommended that the County consider allowing equestrian use on the regional trail, and provide hitching posts at trailheads. The internal trails proposed are best suited to pedestrian use only.

3.3 SITE OPPORTUNITIES

Upon synthesis of the baseline inventory, site opportunities (see Figure 4) which provided a framework for master planning (see Figure 5) became apparent. The project area is divided into six reaches represented by varying degrees of preservation, ecological enhancement, restoration, and recreation recommended. Specific stream restoration techniques recommended for each reach are described in detail as Alternative C in the 'Fisheries and Channel Existing Conditions Recommendations' report, Appendix A.

3.3.1 Boulder Creek, Reach 1 - West of Highway 287

Mature cottonwood groves, designated wetlands 49 & 50 (see Figure 3), occur in the riparian zone of this reach. This forest is dominated by plains cottonwood with narrow-leaf cottonwood, crack willow, boxelder and russian-olive. Undisturbed natural communities of this type typically contain a thick, diverse shrub component. In the study area, the understory is instead dominated by a weedy forb community. This relatively well-vegetated area, nevertheless supports relatively high densities of nesting birds, and serves as a foraging area for herons and egrets that nest in the rookery west of the study area. It is also suitable habitat for the preble's mouse and many other mammalian species. It provides bedding areas for deer, good cover for small mammals, and denning sites for raccoons, coyotes, and foxes.

Recently the City of Boulder constructed stream improvements in this reach. Grade control structures were established which divert partial flows through the historic meanders. It is proposed that stream restoration as described previously (see subsection 2.3.8) begin in this upstream reach. Generally, stream restoration in the project area should be phased sequentially from upstream down. Among other benefits, realignment of the stream into its historic meander pattern will reduce the stress on the bridge abutments at US 287, and begin dissipating energy upstream, benefitting restoration activities proposed downstream. Cobble bars likely created during the previous stream improvements project currently support a diverse weedy plant community adapted to xeric conditions. Re-grading during restoration will allow for removal of these islands. It will also allow for reconstruction of the Boulder-Weld irrigation diversion in a maintainable location, and reconstruction of a siphon which captures free water, when available, via the Liggett Ditch diversion. This siphon historically supplied irrigation water to the lands south of Boulder Creek in the project area.

Enhancement of the riparian vegetation with the introduction of saplings, shrubs, and native herbaceous species is also recommended. Overall, management of this area emphasizes preservation, restoration, and enhancement. No public access is recommended in this reach. The existing RTD Park-n-Ride lot south of this area provides an opportunity for use as a regional trailhead.

3.3.2 Boulder Creek, Reach 2 - US 287 to 109th Street

Several interpretive opportunities occur in the vicinity of 109th Street at Boulder Creek. The bridge provides a setting for interpretation of the historic stage road in this location. Although few historic bridge remnants remain, interpretive signage or pamphlets would render the area a point of historic interest. Currently, both rock squirrels and yellow-bellied marmot(s) reside in the riprap at the 109th Street bridge. Rock squirrels are opportunistic and do adapt to more urban settings. As marmots are typically found in the foothills and mountains, this site likely represents the easternmost limits of marmot habitat. Marmots currently exist at the White Rocks Ranch, about 4 miles west of this site, and it is likely that the marmot(s) onsite have dispersed from that population. A small prairie dog colony also occurs north of Boulder Creek in this vicinity. Because all of these members of the squirrel family are relatively large and visible, wildlife viewing opportunities exist. These populations will likely tolerate some level of public access. The 109th Street bridge also affords high views of the creek and stream restoration activities. Public access to the stream is proposed, therefore, at the 109th St. bridge.

Marginal wetlands occur on the mined lands both north and south of Boulder Creek in this reach. The abundance of wetlands north of the creek through most of the project reach suggests the area, situated below a bluff, is spring fed. Mine reclamation north of the creek in this reach included a slurry seal at the north boundary to preserve the hydrology of the neighboring wetlands.

As a result, although the surface elevation of these mined lands is lower than the surrounding landscape, the wetland is marginal and weedy. It is recommended that existing drainage flows beneath US 287 which daylight in the project area be diverted through the wetland to augment the hydrologic regime and enhance the wetland plant community.

The marginal wetland south of the creek is currently pumped by the neighboring private property owner as a requirement of gravel reclamation. Long-term, it is recommended that the County consider eliminating the pumping requirement, and allow establishment of a wetland and pool. This area may provide good habitat for shorebirds particularly. Any open water resulting from this alteration will likely require augmentation of evaporative losses of ground water. However, due to the mined, depressed surface elevation, this wetland may provide a water quality treatment diversion for a small quantity of Boulder Creek low flows. It is suggested that Boulder County negotiate with the City of Boulder for use of water rights to benefit water quality where opportunities such as this arise. It is also recommended that the County research the potential to file for water rights on naturally occurring springs in the project area where beneficial to implementation of the Master Plan.

Due to the limited length of stream between US 287 and the 109th St. bridge, and the high cost-benefit ratio, construction of a broadly meandering stream in this reach is not proposed. Selectively regrading for establishment of limited active floodplain function, channel stabilization to reduce incising, instream habitat enhancement, and riparian revegetation are recommended. If the 109th street bridge will be replaced in the near future, creation of meanders, re-alignment of the channel appropriate to the bridge crossing, and design of the bridge to maintain bank full channel flows and active floodplain flows separately is recommended. It is further recommended that architectural detailing of a new bridge either be reminiscent of the historic stage road, or reflect the value and beauty of Boulder Creek. A below grade path crossing would also be beneficial. Replacement of marmot and squirrel habitat at this location is also recommended if the bridge is rebuilt.

The regional trail alignment depicted in this reach allows for future enhancement of the south wetlands, and provides for access and views on the elevated unmined fringe. Restoration in this reach should include removal of the existing streamside road to discourage public access.

3.3.3 Boulder Creek, Reach 3 - 109th Street to Kenosha Road

Reach 3 of Boulder Creek is the most altered stream reach in the project area. Channelization and construction of streamside dikes have contributed to incising and elimination of the active floodplain. Little riparian vegetation remains on the south side of the stream, particularly. Due to the length of stream unconfined by road crossings, this reach exhibits great potential for the geomorphic stream restoration approach proposed. Excavation of broad meanders and removal of dikes in this channelized stream reach will generate material in excess of that needed for reclamation of the current channel. It is recommended that some of the excess material be used to reclaim the existing Coal Creek channel (see subsection 3.3.6) onsite, and to diversify shorelines on some lakes. The remainder may have some commercial value as construction fill or aggregate. Sale of this material may be used to help offset some stream restoration costs. If aggregate is sold, a mine permit, or revision or amendment to existing permits will likely be required.

Much of the project area has been gravel mined and reclaimed. Wetland 16, which occurs south of the stream at the northeast corner of this reach is a complex of salt marsh, freshwater marsh, riparian forest and aquatic communities. It is interpolated that this wetland was created by mining activities in this valley. The wetland basin captures ground water and surface water runoff from the long mined valley upslope, prior to discharge into Boulder Creek. This wetland ranks high in biodiversity, and is earmarked for preservation. Two other large wetlands, sustained by ditch seep, occur south of the creek and are also scheduled for preservation.

Wetland 5, north of Boulder Creek and east of 109th Street, is an emergent salt marsh and salt marsh/salt meadow complex. A beaver den was sighted in this area. These mammals may be a detriment to revegetation efforts onsite, therefore it is recommended that they be monitored and managed carefully during re-establishment of riparian woodlands. The mosaic of riparian woodland, marsh, and grasslands in this area also supports several nesting bird species of special concern in this reach. While, at a minimum, these habitats should be protected from public access and free-ranging cattle, the area would also benefit greatly from habitat enhancement. Enhancement activities recommended overall, such as revegetation of riparian woodlands overstory and understory, implementing prescriptive grazing to allow grasslands to grow to seed, and improving stream water quality and aquatic habitat for fish and other aquatic invertabrates, will also enhance the avian and mammalian habitat in this area. As with all wildlife, diversification of habitat will exponentially increase the value and richness of the ecosystem.

Wetland 2 occurs in the mined lands north of the creek, and is scheduled for preservation. The north lake wetland 3 also provides some wildlife benefit, however the shorelines and islands lack diversity and habitat structure. It is suggested that the County consider construction of a slurry seal at this lake to reduce ground water exposure and provide for water storage at this lake.

Conversion of this lake to a reservoir is a good example of the potential to create mutual benefits cost effectively by working cooperatively with other stakeholders. The City of Boulder (City) has previously expressed an interest in sealing at least one of the Wittemeyer ponds downstream of this lake. The intention is to store City water rights for dilution of Boulder Creek stream flows as needed to mitigate water quality problems. Negotiations between the BCPOS and the City may include sealing the north lake onsite for City water storage, allowing for dilution higher upstream than the Wittemeyer property. To the County's benefit, although this lake does not have an augmentation liability due to the age of mine reclamation, upon sealing the lake it may be possible to credit the reduction of evaporative losses to creation of open water and wetlands proposed in the mined lands south of the stream in this reach, thereby offsetting any augmentation requirement of these wetlands. If the two areas occur within the same gravel mine permit area, the State Engineer's Office will consider such an exchange, even if the lake was constructed before 1981 and does not require augmentation (ref: Colorado Senate Bill 89-120). Additionally, some of the wetland creation and enhancement proposed throughout the project area may provide off-channel Boulder Creek water quality treatment, thereby benefitting the City of Boulder. It is reasonable, therefore, to also discuss the possibility of utilizing some City water for any augmentation which may be required by these wetlands. Further, this water may be stored in the north lake. This scenario is just one example of the creativity and cooperation called for when addressing water rights throughout the project area in the final design phase. Certainly, the greatest benefits will be realized if the water rights and site planning are designed for the entire project area comprehensively.

Public access is restricted north of the creek in the Master Plan to preserve two large wetlands and prevent stream crossing through the restoration area. Locating the trail through the pasture lands south of the creek, instead, provides a rural experience through broad open space for the user. Scenic vistas characteristic of the eastern plains also unfold here. Removal of the existing interior roads is proposed. The trail shown is diverted away from the stream restoration area, accessing the Boulder-

Weld Canal, a point of historic interest. This elevated canal provides panoramic views of the front range and overlook views of the proposed creek restoration area. An internal trail which follows a short length of the canal and accesses the west shore of the south lake is also suggested for consideration. This lake provides some waterfowl viewing, yet lacks habitat structure on the western shore. Susceptibility to recreational impacts is, therefore, low. The regional trail proposed continues eastward along the south site boundary, and provides connections to both the Wise Museum and the proposed privately developed neighboring trail to the east.

A historic cattle chute, reminiscent of the agricultural heritage of the site, is situated north of the creek at the northeast corner of Reach 3. As this feature is portable, it is recommended that the chute be relocated to another area within public view on the site. An historic concrete stave silo also exists at the eastern access road from 119th Street in this reach. Public access to this area is not recommended. Due to its size, however, the silo remains a visible aesthetic feature of the rural landscape when viewed from the trail and neighboring roadways.

3.3.4 Boulder Creek, Reach 4 - Kenosha Road to 119th Street Alignment

The stream character in Reach 4 is indicative of the effects of upstream channelization and erosion. Streambed materials transported from Reach 3 have been deposited below the Kenosha Road bridge, creating a braided stream section. Riprap has been placed repeatedly to maintain a stream connection to the Howell Ditch diversion. Stream restoration as proposed in Reach 3, and the appropriate placement of the Howell Ditch diversion are recommended.

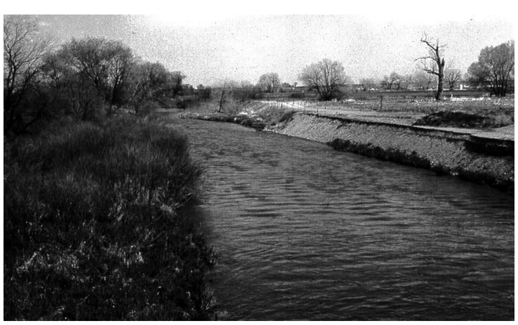
Several remnant oxbow sloughs (wetland 30) with high species diversity and good structural diversity occur in this reach. Over time, the hydrology needed to sustain them has been compromised. Reconnection of high stream flows to these areas is recommended.

Beasley Slough is situated north of the creek. Water rights from this naturally occurring spring are held by Boulder County, however without storage capability, the water rights provide little benefit. The County may consider sealing and perhaps expanding the small lake which captures this water to provide another option for replacement obligation or water rights exchanges on the property.

Weedy fields occur in much of the area east of Kenosha Road. These fields are dominated by weedy forbs, or weedy forbs with grasses. Some areas contain a solid cover of weeds. Therefore, weed management, interseeding with native species for biodiversity enhancement, and careful management of grazing and the prairie dog populations in this area is recommended.

Several populations of prairie dogs occur in this reach and are considered one large, interconnected colony. These animals are a significant resource for the predators they attract, particularly raptors. Prairie dog colonies also provide wildlife watching opportunities, and good habitat or habitat elements for some sixty-four species of vertebrates (Campbell and Clark 1981). Due to the colony's significant size and value to predators, it is proposed that public access be limited to wildlife viewing from the proposed loop trail at Kenosha Ponds Park, Reach 5. Views of the oxbow sloughs and the Duffey Pigeon Barn historic feature can also be enjoyed from this trail, depicted immediately east. It should be noted that the current deterioration of the Duffey barn could pose a public safety hazard. Fencing to restrict public access, and renovation of the structural integrity is recommended if the barn is preserved.

3.3.5 Boulder Creek, Reach 5 - Kenosha Ponds Park



Reach 5 of Boulder Creek lends itself to some stream restoration activities, including: selectively regrading to enhance floodplain function, instream habitat enhancement, bank stabilization, amplifying meanders, and revegetation. A narrow meander pattern and active floodplain with attendant riparian vegetation has naturally re-established in the channel, however. The lakes north of the creek limit meander establishment northward, a powerline easement limits regrading of the stream at the west end of the reach, and east of the pedestrian bridge a buried natural gas pipeline traverses the south bank of Boulder Creek. Also east of the bridge, a relatively well developed shrub understory occurs on instream point bars, providing habitat for several bird species of interest. To reduce the cost of stream restoration overall, to preserve the existing riparian vegetation, and due to the presence of these physical barriers, the proposed plan limits meander excavation in this reach.

The Kenosha parcel adjoins the town of Erie to the south and east. Residential development is scheduled to occur in the area. Providing a passive recreational area in this vicinity to serve the citizens of Erie was, therefore, an important consideration of the Master Plan. Because the potential for stream restoration is limited in this reach, and a variety of interesting amenities exists, west Kenosha, herein referred to as Kenosha Ponds Park, is a prime location for passive recreation, interpretation, and trailhead facilities at the eastern limit of the Boulder Creek regional trail corridor. Passive recreational activities recommended include hiking, fishing, wildlife viewing, and picnicking. Programmed educational activities would also be appropriate. Phasing of park development in this area does not rely on sequential stream restoration phasing, and can occur at any time according to Boulder County's priorities and budget.

A small prairie dog colony occurs in this reach. Preservation and restriction of public access at the larger colony in Reach 4 allows the opportunity to provide public access nearer this colony. Stream restoration activities in Reach 4 will generate excess excavated material. It is recommended that some of this material be used to fill and diversify the shorelines of the solitary small gravel pond south of the creek. Shoreline enhancement, including revegetation, will benefit both wildlife habitat and the aesthetic quality of the pond in this public area.

A small drainage channel in the center of the area provides access to shallow water with aquatic and amphibious life. Areas such as this are valuable exploratory areas for children. Access to these amenities, Boulder Creek, and several visual amenities at the eastern limit of Reach 4 are accommodated by the suggested internal loop trail.

A series of rectangular gravel ponds occurs south of Boulder Creek. Due to their sizes and angular configuration in both plan and profile, these ponds present a unique opportunity for a native fish hatchery, or refugia. Alternatively, they may be used as a stocked fishing concession. The Colorado Division of Wildlife (CDOW) has expressed an interest in managing a native fish hatchery in this area. Negotiations with CDOW would determine the details of an agreement, but management considerations may include such things as public education, and stocking Boulder Creek in the project reach with a percentage of each harvest. If a hatchery is developed south of the creek, public sportfishing is recommended at the north lakes. Public fishing at the north lakes will require fish habitat enhancement, some shoreline re-contouring, and revegetation for bank stability. The existing pedestrian bridge at Boulder Creek is deteriorated and will require replacement or repair if public access is provided north of the creek. If public fishing occurs in the rectangular gravel ponds, preservation of the open space lands north of the creek is recommended, with no public access.

Given the restoration efforts, land uses, and land management practices proposed throughout the project area, an interpretive facility or educational center would also be a very beneficial use at Kenosha Ponds Park. The buildings remaining at the Howell-Robinson Farm complex are scheduled for removal upon commencement of mining at east Kenosha (see subsection 3.3.6). Because of its architectural interest, it is recommended that building no. 2 be considered for rehabilitation and relocation at the Kenosha trailhead. This building could potentially house interpretive information for the area.

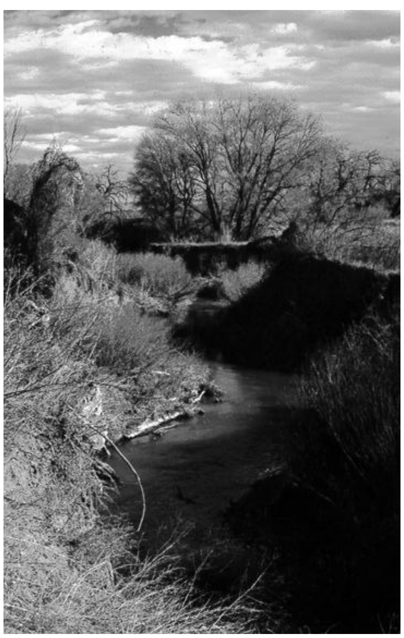
The existing oil and gas facility access road easily accommodates entry to Kenosha Ponds Park from Kenosha Road. It is also recommended that a regional trail linkage be provided to the neighboring privately developed trail proposed in the vicinity of the Boulder-Weld Canal (see section 3.2). The existing small reservoir near the entry road lends itself to shoreline planting and entry signage as a gateway feature to the park area.

3.3.6 Coal Creek, Reach 6 - Kenosha Mine

The portion of the Kenosha parcel east of the entry road constitutes the permitted Kenosha mine, an aggregate resource owned by Boulder County. Mining or leasing the mineral rights on Kenosha would generate revenues to help offset some stream restoration costs in the project area.

The permitted reclamation plan consists of a lake south of the Public Service Company easement, and a cottonwood grove / marsh wetland to the north.

This reclamation plan presents several opportunities beneficial to the Lower Boulder Creek and Coal Creek Open Space Master Plan. It is recommended that the County consider sealing the south lake via compacted backfill, or slurry trench if needed. Under Colorado water law, evaporative losses from all gravel pits that expose water after December 31, 1980, must be augmented. In this region, the net annual evaporative loss is approximately 2.34 acre-feet per acre of exposed groundwater surface area. An equivalent quantity of water must be reserved in order to augment the pit. The County owns water rights in this area which could be used to partially augment the pit, although purchase of additional water rights may required. If the lake is sealed however, these rights could be stored and dedicated to other beneficial uses, such as augmenting wetlands created or enhanced, if required. Again, sealing the south Kenosha Mine lake will minimize ground water depletions, eliminate the ground water replacement obligation on an unsealed lake, provide for water storage capability, and maintain flexibility regarding use of the County's water rights currently used for cultivation of this area. Furthermore, sealing is generally a relatively low cost activity when done prior to reclamation, while the pit is dewatered. The town of Erie has also expressed an interest in water storage at this lake. Discussions with Erie regarding cost-sharing, therefore, would also be approriate.



Extreme degradation of Coal Creek in this reach suggests that the most desirable alternative for reclamation of the stream is to establish a new channel designed to convey current and future flows in excess of the historic intermittent flows. Diversion of these flows along a shallow gradient roughly in the vicinity of the Boulder-Weld canal and the entry road is proposed. It is recommended that these flows be diverted through the constructed wetlands at Kenosha mine prior to outfall at the existing Coal Creek channel near the northern property boundary. The marsh wetlands planned will provide water quality benefits to Coal Creek flows. Islands of woody vegetation placed to distribute flows throughout the wetland, will increase the length and time of treatment. Water quality treatment basins such as these are becoming more common features for tertiary treatment of wastewater below treatment plants and in developments which rely on septic systems for wastewater management. It is highly recommended that the County consider a proposal to the U.S. Army Corps of Engineers for mitigation banking of these and other wetlands created in the project area. Like other features of the Master Plan which emphasize restoration, ecological enhancement, and sustainability, this water quality treatment option also provides a prime opportunity for interpretation and education. The wetlands planned will also provide a wildlife sanctuary rich in biodiversity. Access to the western wetland boundary via an accessible, interpretive boardwalk is a recommended element of the proposed loop trail system at Kenosha Ponds Park.

Abandoned oxbow channels occur above the west bank of Coal Creek. These remnants of the historic Coal Creek channel contain a very diverse cottonwood / shrub community. Currently, the stream invert occurs some 20-25 feet below this historic channel due to severe down cutting. As a result, this complex of native trees, shrubs and vines is threatened by the associated drop in the water table. Several options for restoring the hydrology in these areas exist, however. Seep from the wetlands created by mine reclamation may be sufficient to sustain this plant community in the northern portion of the site. If the south mined lake is sealed, however, the contiguous woody riparian community may be further impacted by the downslope cone of ground water depression. A small outfall channel from the lake into the rehabilitated channel through the oxbows may offset those impacts. Alternatively, with reconstruction of degraded segments of the oxbows, this historic channel could convey the historic intermittent flows once again.

It is recommended that the existing Coal Creek channel be backfilled as possible, and reclaimed as a drainage swale for agricultural runoff. Overburden excavated from mining at Kenosha, and/or material generated from meander excavation and dike removal at Boulder Creek may be used to fill the degraded Coal Creek channel. If cost and a lack of sufficient fill material are major concerns, the historic intermittent flows may continue to flow through the existing channel, or be piped through this segment of Coal Creek to eliminate further degradation.

Dense shrub growth in the perched, remnant channel supports a suite of shrub-nesting birds once common, but now mostly absent from the plains of Boulder County. Due to the potential for these now uncommon species to nest, no trail access is scheduled at Coal Creek, and it is suggested that the existing access road be removed upon mine reclamation. Access to the northern oil and gas facilities can be accommodated by the entry road and connecting access road which skirts the north property boundary.

3.4 IMPLEMENTATION

3.4.1 Design Development

Development of the Lower Boulder Creek and Coal Creek Open Space Master Plan and this advisory report concludes the master planning phase of this project. Implementation will involve a design development phase wherein a final design of each stream reach, individually or collectively, will be completed prior to construction documentation. Anticipated tasks of design development include, but are not limited to: obtaining a detailed topographical survey, infrastructure location and mapping, gathering additional channel morphology and stream flow data, definition of stream restoration parameters, ground water monitoring as-needed, and additional water rights data collection. Water rights issues and opportunities should be addressed strategically and comprehensively for the project area to determine potential uses of water rights owned by BCPOS and other stakeholders, where mutually beneficial options exist. Some detailed inventories must also be completed, such as wetland delineations in or near affected areas, threatened and endangered species surveys, and investigation of possible dump sites in the stream corridors which would affect stream restoration. Although the project team consulting engineers do not foresee any adverse impacts of this Master Plan on the regulatory floodplain, floodplain effects should also be analyzed in the final design stage. A determination as to whether revisions to the Kenosha mining and reclamation plans are required will also be made. If revised, a technical revision or amendment to the DMG permit would be submitted and processed at this time as well.

Once the additional data collected has been analyzed, and a budget determined, final design, construction documentation, and permitting begins. It is anticipated that construction will occur in phases. As indicated on the Master Plan, stream restoration should be phased upstream to down, at least through Reach 4. The Kenosha parcel may be mined and the park area developed at any time, according to the County's priorities and availability of funds. A plausible time frame for completion of stream restoration for the entire project reach may range from 3 to 10 years, though the schedule is flexible.

3.4.2 Preliminary Estimate of Probable Construction Costs

The attached estimate of probable construction costs (see Table 3-1) is based on 1998 cost figures. It includes stream corridor restoration, wetland enhancement and creation, and development of the native fish hatchery and north sportfishing ponds. It is anticipated that trails and other recreational/ interpretive features such as trailhead amenities, picnic areas, signage, or a boardwalk will be

Table 3-1: Preliminary Estimate of Probable Construction Costs

Item	Unit	Qty	Cost	Subtotal
Stream Corridor Restoration				
Data Acquisition/Final Design				
Boulder Creek	lf	20,000	$22	$440,000
Coal Creek	lf	4,000	$22	$88,000
Materials Acquisition (delivered and staged)				
Rootwads	ea	225	$100	$22,500
Rock	tons	50,000	$15	$750,000
Preliminary Excavation/grading (spoils distributed 35 min. from excavation)				
Channels	cy	700,000	$4	$2,800,000
Wetlands	cy	105,000	$4	$420,000
Final Grading (channel/riparian/floodplain)				
Boulder Creek	lf	19,640	$92	$1,806,880
Coal Creek				
Channel	lf	3,965	$78	$309,270
Wetlands	ac	26	$3,120	$81,120
Revegetation				
Willow (harvested)	sf	91,500	$3	$274,500
Floodplain Seeding	ac	163	$2,500	$407,500
Wetland Planting	ac	30	$6,700	$201,000
			Subtotal	$7,600,770
Native Fish Species Hatchery				
Final Design	ls	1	$7,500	$7,500
Lake dredging	cy	19,360	$5	$96,800
Shoreline regrading	lf	3,500	$2	$7,000
Access road construction	lf	2,300	$26	$59,800
Habitat development	ac	3	$1,500	$4,500
Fish population reclamation	acft	100	$88	$8,800
Electrical service	lf	1,000	$13	$13,000
Pond aeration	ac	18	$1,944	$34,992
Revegetation	ac	2	$7,000	$14,000
			Subtotal	$239,892
North Ponds Sportfishing Development				
Data Acquisition/Final Design	ls	1	$10,000	$10,000
Shoreline regrading (4800'x30'x3.5')	cy	21,500	$4	$86,000
Fisheries reclamation	acft	165	$88	$14,520
Habitat development	ac	4	$1,500	$6,000
Fish Stocking	ac	22	$330	$7,260
Revegetation	ac	5	$7,000	$35,000
			Subtotal	$158,780
			Project Sub.	$7,999,442
			Contingency	$1,199,916
			TOTAL	$9,199,358

designed by BCPOS staff and phased in under the County's annual park and open space improvements budget. The estimate of probable construction costs also does not include repair or replacement of the small bridge at Kenosha, weed management, revegetation of upland areas, monitoring, nor maintenance of proposed channel restoration features.

Activities which will offset some construction costs are also not included in the cost estimate. For example, revenues generated by the sale of gravel resources at the Kenosha mine, or the sale of excess excavated material can be applied to the costs.

3.4.3 Partnering and Funding

The Lower Boulder Creek and Coal Creek Open Space Master Plan fulfills many varied objectives and is, by design, a good candidate for funding assistance from multiple sources. Stream restoration, wetland creation, and water quality improvements are currently national environmental priorities, and multiple funding sources occur at the federal, state and local levels (see Appendix B). For example, the Clean Water Act Initiative has designated extensive funding for stream restoration and water quality improvements projects, particularly in the next five to six years. Section 319 of the Clean Water Act has established grants funded by the EPA and administered by the Colorado Department of Health, Water Quality Division. These funds are earmarked for the protection of water quality, emphasizing projects which address non-point source pollution.

A partial compilation of other potential funding partners is provided in Appendix B. Even an internet search on the topic of funding sources for stream restoration and wetland creation and enhancement projects today is staggering. Therefore, although the preliminary estimate of probable construction costs is high, it is emphasized that cost sharing opportunities with multiple agencies renders the plan achievable.

It is recommended that BCPOS begin partnering discussions with potential funding sources and involved stakeholders during the final analysis and design development phase. Key stakeholders include the City of Boulder, and the communities of Erie, Superior, Lafayette, and Louisville. As mentioned previously for example, construction of wetlands which will benefit Boulder Creek water quality may require that additional water rights be appropriated to offset evaporative losses of ground water. As this would benefit the City of Boulder's efforts to address water quality concerns, discussions with the City for some use of City water rights is appropriate. It is emphasized that conversion of some lakes to reservoirs, restoration of a functional stream reach, riparian revegetation, and construction of wetlands as proposed throughout the project area will provide mutual benefits for all stakeholders. Negotiation with these agencies is highly recommended in order to fully realize the enhancement and restoration potential of the project cost-effectively.

The project area also occurs within the Urban Drainage and Flood Control District's (UDFCD) jurisdiction. UDFCD, a regional district, provides funding assistance to municipalities within its jurisdiction for design, maintenance, and construction of stream improvement and flood control projects. It is recommended that the County approach UDFCD as a funding partner for the stream restoration proposed. Typically, UDFCD design criteria requires construction of a road adjacent to the stream to provide access for maintenance. Since the geomorphological approach to stream restoration planned will significantly reduce, the need for regular channel maintenance long-term, it is suggested that the County negotiate waiving this requirement.

3.4.4 Monitoring

For the benefit of both long-term management of this property and for future similar projects, it is strongly recommended that a long-term monitoring plan be developed and adhered to. Monitoring the stream restoration efforts in established permanent plots is crucial to the success of the project. A comparison of baseline and post-restoration data will determine both the successes and failures, and contribute to design of subsequent phases of the project. Monitoring will also contribute information critical to the science and art of stream restoration. This field of applied science is rapidly growing as environmental priorities nationwide are shifting to water resources. The Master Plan proposed for this property employs stream restoration and water quality treatment techniques which are at the forefront of the profession. One of the great benefits of this effort will be the information it offers for the advancement of the science.

Monitoring the development of habitat in terms of plant and animal species diversity, voluntary plant establishment, ecological succession, the appearance of species of special concern or threatened and endangered species, etc. will also provide much needed data for the profession.

Monitoring should begin prior to project construction to establish permanent plots and determine baseline data. Monitoring may be undertaken by BCPOS staff, consultants, and/or high level university students. Publication of this information, and presentation in professional venues is highly recommended.

3.5 CONCLUSION

Boulder County has made a substantial commitment to the preservation of its natural resources by acquiring and planning the lower Boulder Creek corridor open space lands. In so doing, it has also created unprecedented opportunities for progressing toward a sustainable community. A workable environmental ethic requires a perception of community and environment as one integral system. For this system to be sustained, it is essential that the inherent integrity of natural systems be recognized, and their ability to function restored. By definition, restoration means simply giving back what was once taken away.

Water, more than any other resource, reminds us of the interconnectedness of communities and all life. By maintaining its commitment to this precious natural resource and summoning the cooperation of involved and interested parties, Boulder County can restore the life, health, function, and beauty of lower Boulder Creek and Coal Creek on these open space lands, and set a precedent for other communities. Incrementally, our waterway systems can be restored. And, restored, they will continue to sustain us for generations to come.

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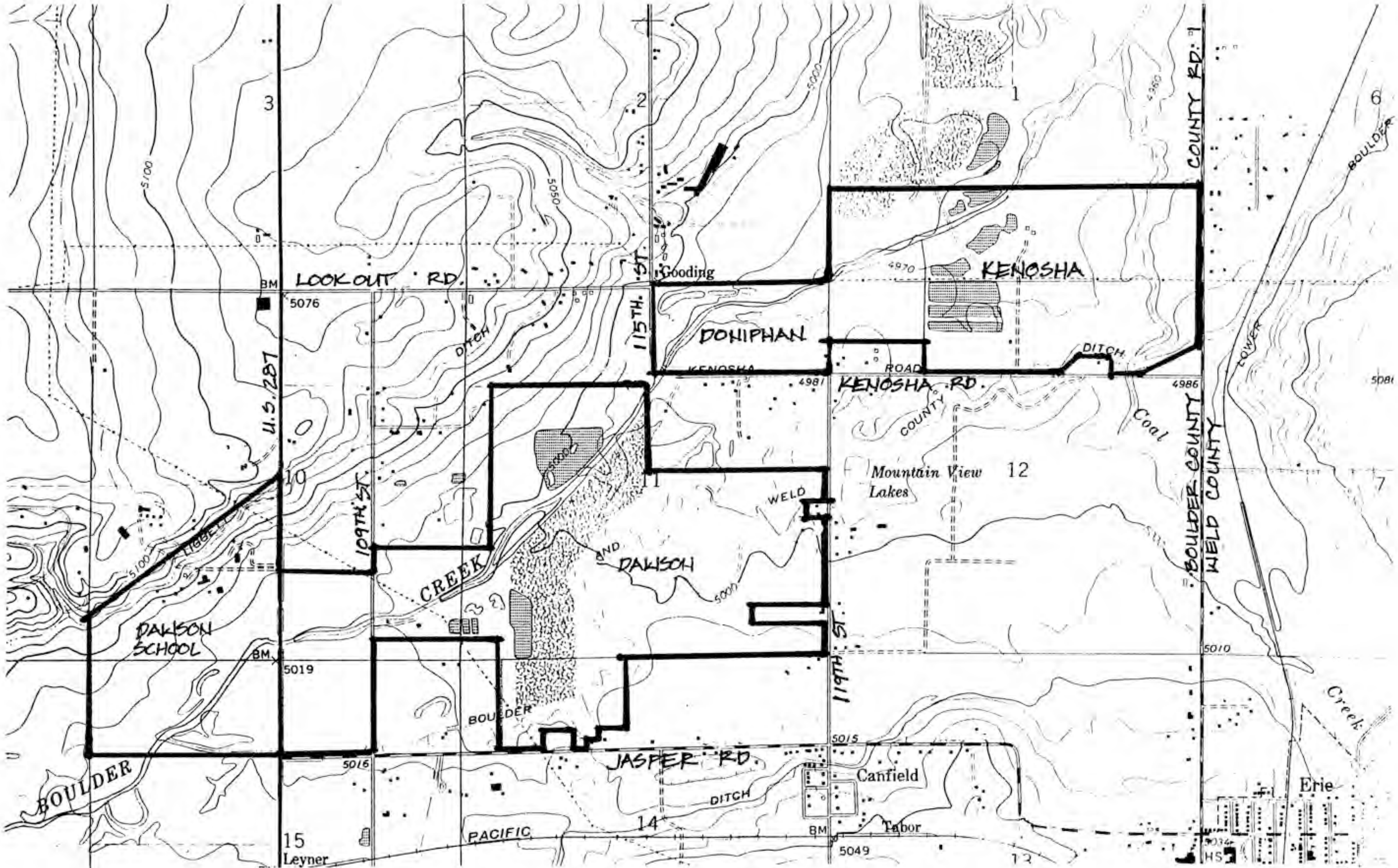

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Figure 1

Lower Boulder Creek and Coal Creek

VICINITY MAP

Boulder County Parks and Open Space Department

Boulder County, Colorado

Anderson & Company and Queen of the River Fish Co., Inc. • Don D'Amico

eco plan ning

Plantae Consulting • Carron Meaney, PhD

Stephen R. Jones • Native Cultural Services

Boyle Engineering Corporation

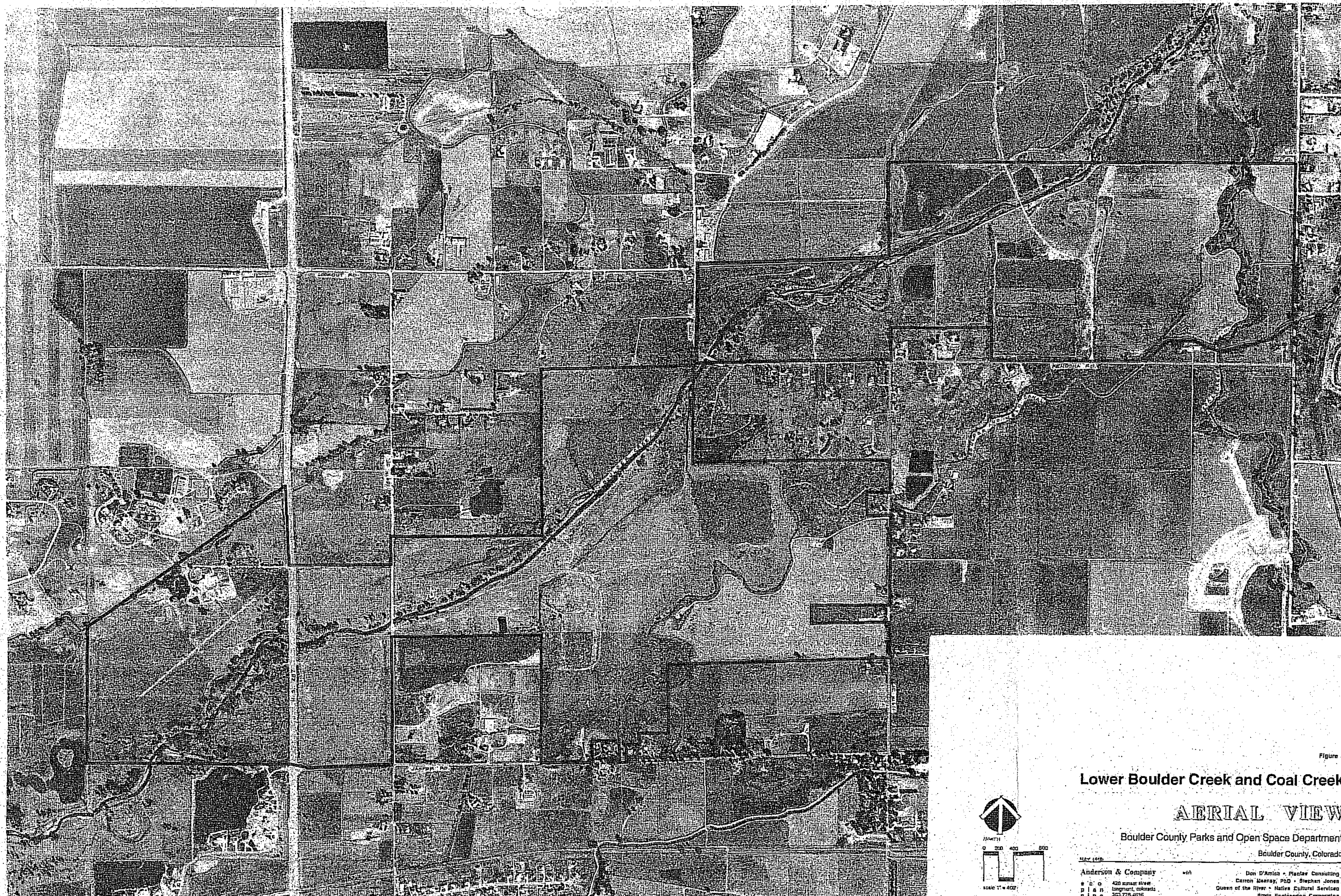

Figure 2

Lower Boulder Creek and Coal Creek

AERIAL VIEW

Boulder County Parks and Open Space Department

Boulder County, Colorado

Anderson & Company with

eco plan ning
420 sunset street
longmont, colorado
303.776.4036

Don D'Amico • Planter Consulting
Carron Meaney, PhD • Stephen Jones
Queen of the River • Native Cultural Services
Boyle Engineering Corporation

Stream Conditions

BOULDER CREEK

Assessment

- HISTORIC C-3 CHANNEL TYPE TRANSITIONING TO F-3
- STREAM SUBSTRATES ARE COBBLE, SANDS AND GRAVEL
- WASTEWATER DISCHARGES AND IRRIGATION RETURN FLOWS UPSTREAM CONTRIBUTE TO POOR WATER QUALITY
- STREAM FLOWS ALTERED -
  - Winter base flows elevated due to municipal water return
  - Peak spring runoff flows reduced due to irrigation and municipal diversion
- IMPACTS OF ALTERED FLOWS -
  - Active floodplain belt width reduced, riparian regeneration capability reduced
  - Meander pattern reduced
  - Channel entrenched, historic oxbows perched above channel invert
  - Incising causes headcutting for unknown distances upstream until equilibrium established
  - Frequent flood event reduced, limiting meander creation & maintenance of stable morphology
- IMPACTS OF CHANNELIZATION -
  - Limited ability to maintain natural channel dimensions
  - Flows spread on broad, uniform bottom increases water temperature due to solar exposure, increasing ammonia conversion & lowering water quality
  - Increased hydraulic pressure on unstable banks
  - Increased sediment loading to stream with concurrent reduction in sediment transport capability, resulting in braided channel section downstream
  - Aggradation causing increased channel gradient & increased channel entrenchment below braided section
- INCREASED STREAMBANK EROSION DUE TO DOMESTIC LIVESTOCK ACCESS
- CURRENT STREAM MORPHOLOGY IS UNSTABLE

Recommendation

- RE-ESTABLISH A NATURAL, STABLE CHANNEL TO RESTORE FUNCTIONAL INSTREAM AND RIPARIAN ECOSYSTEMS, AND TO RESTORE BOULDER CREEK'S NATURAL BEAUTY, AND ENHANCE WATER QUALITY

COAL CREEK

Assessment

- CURRENTLY G-4 CHANNEL TYPE
- STREAM SUBSTRATES ARE SILTS AND CLAYS, SUSCEPTIBLE TO EROSION
- STREAM FLOWS ALTERED
  - Historically an intermittent gulch
  - Presently flow is perennial, consisting of wastewater discharge
- IMPACTS OF ALTERED STREAM FLOWS
  - Extensive channel degradation
  - Increased sediment loading into Boulder Creek at confluence downstream
  - Remnant riparian vegetation threatened
  - Riparian regeneration eliminated
  - Poor water quality
- CURRENT STREAM MORPHOLOGY IS EXTREMELY UNSTABLE

Recommendation

- UTILIZE MINE RECLAMATION TO CONSTRUCT LARGE WETLAND BASIN
- DIVERT PERENNIAL FLOWS TO CONSTRUCTED WETLANDS FOR WATER QUALITY TREATMENT AND ENERGY DISSIPATION
- RESTORE REMNANT CHANNEL TO CONVEY HISTORIC FLOWS
- RECLAIM CURRENT CHANNEL AS DRAINAGE SWALE

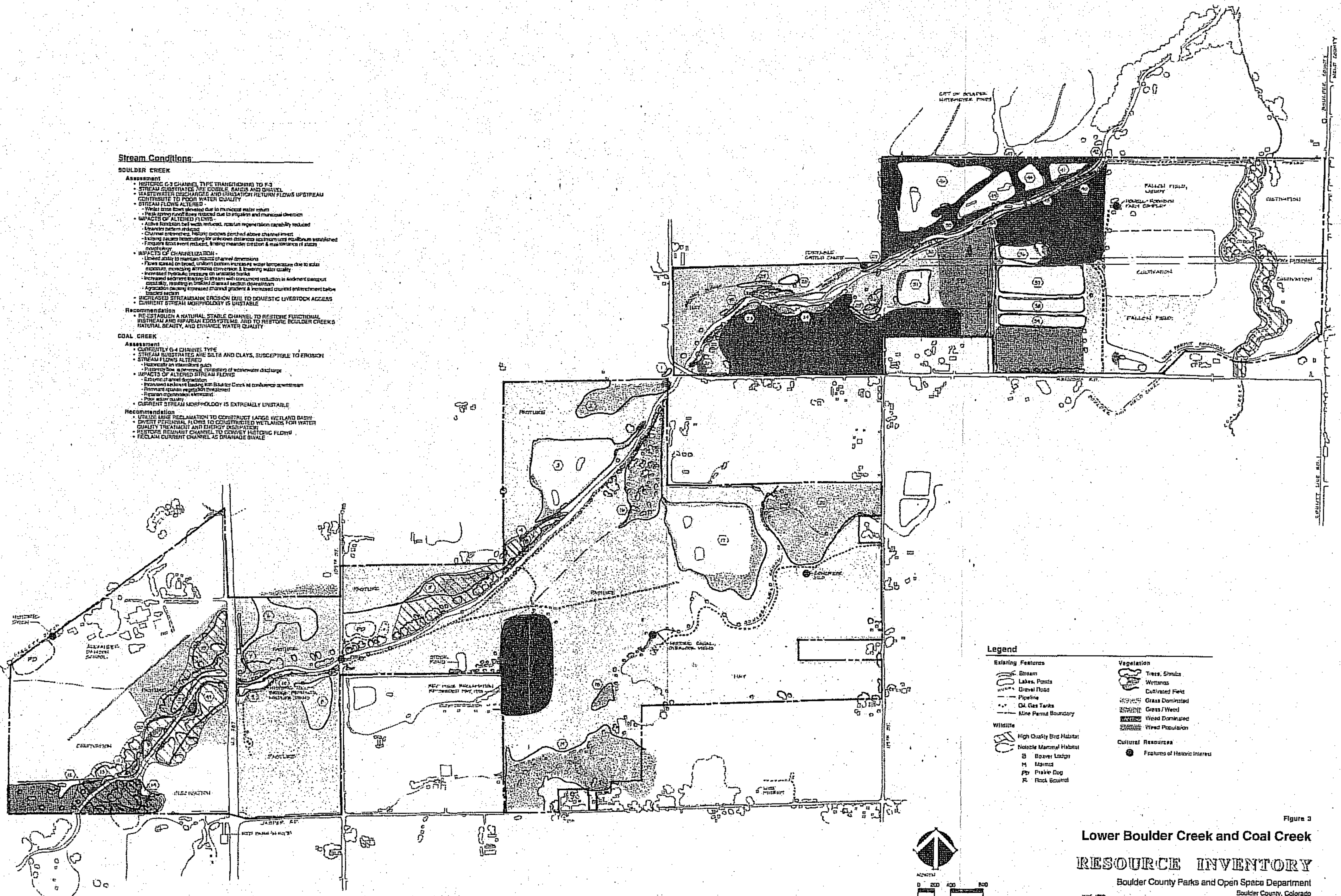

Figure 3

Lower Boulder Creek and Coal Creek

RESOURCE INVENTORY

Boulder County Parks and Open Space Department

Boulder County, Colorado

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Stephen E. Jones • Native Cultural Services
Boyle Engineering Corporation

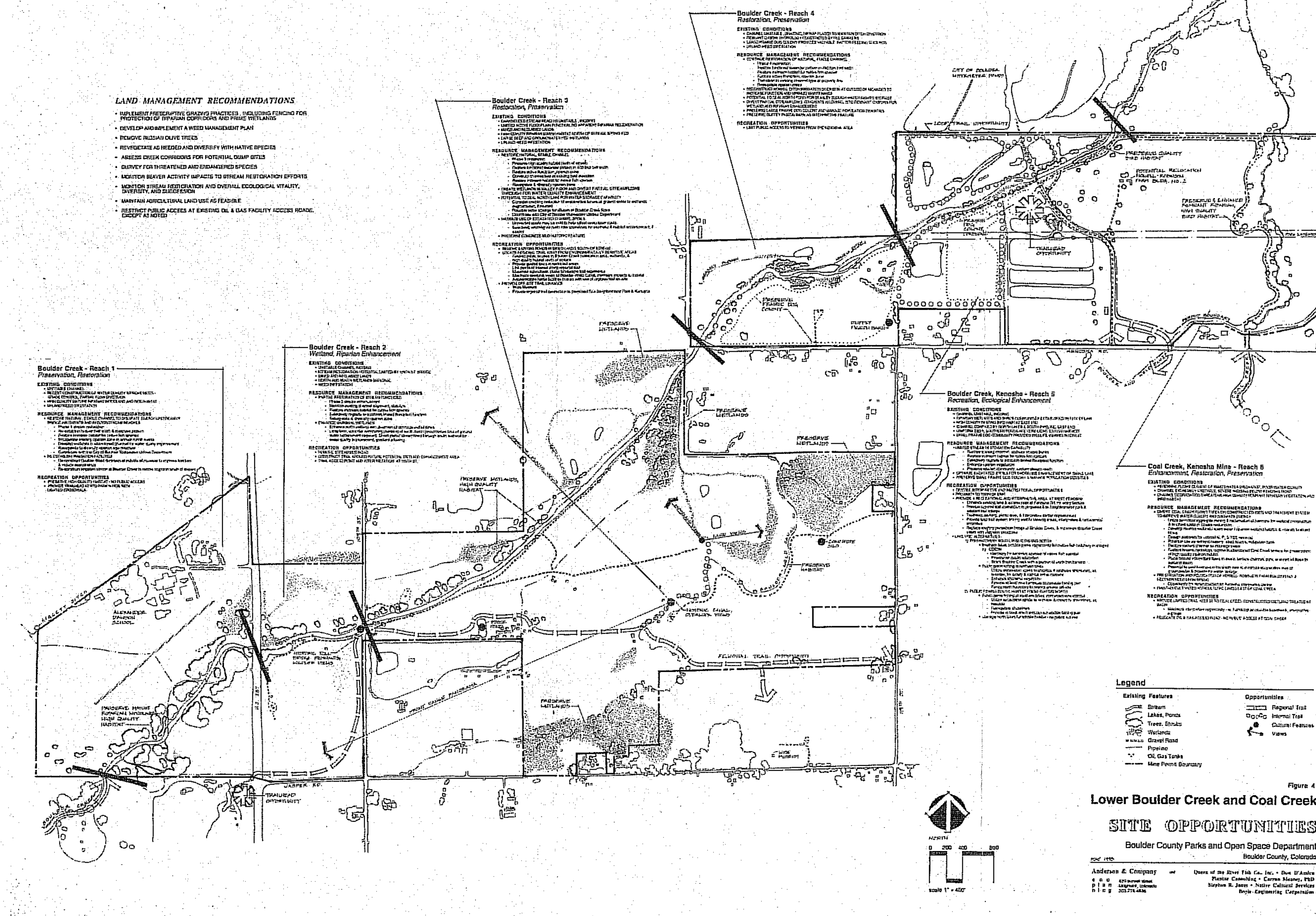

Figure 4

Lower Boulder Creek and Coal Creek

SITE OPPORTUNITIES

Boulder County Parks and Open Space Department

Boulder County, Colorado

Anderson & Company and Queen of the River Fish Co. Inc. • Don D'Amico
Planter Consulting • Carron Meaney, PhD
Stephen R. Jones • Native Cultural Services
Boyle Engineering Corporation

LAND MANAGEMENT RECOMMENDATIONS

- IMPLEMENT PRESCRIPTIVE GRAZING PRACTICES, INCLUDING FENCING FOR PROTECTION OF RIPARIAN CORRIDORS AND PRIME WETLANDS
- DEVELOP AND IMPLEMENT A WEED MANAGEMENT PLAN
- REMOVE RUSSIAN OLIVE TREES
- REVEGETATE AS NEEDED AND DIVERSIFY WITH NATIVE SPECIES
- ASSESS CREEK CORRIDORS FOR POTENTIAL DUMP SITES
- SURVEY FOR THREATENED AND ENDANGERED SPECIES
- MONITOR BEAVER ACTIVITY IMPACTS TO STREAM RESTORATION EFFORTS
- MONITOR STREAM RESTORATION AND OVERALL ECOLOGICAL VITALITY, DIVERSITY, AND SUCCESSION
- MAINTAIN AGRICULTURAL LAND USE AS FEASIBLE
- RESTRICT PUBLIC ACCESS AT EXISTING OIL & GAS FACILITY ACCESS ROADS, EXCEPT AS NOTED

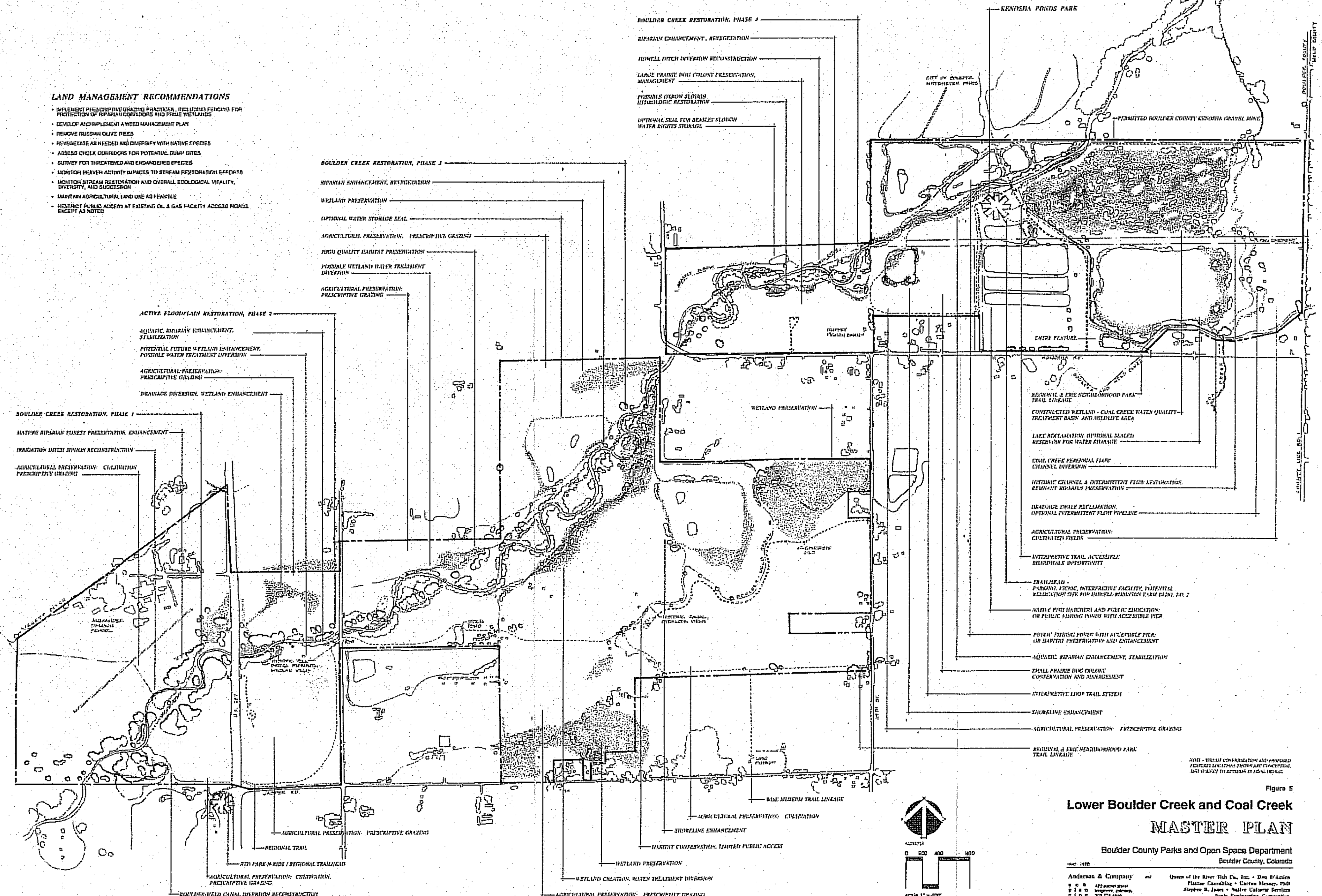

Figure 5

Lower Boulder Creek and Coal Creek

MASTER PLAN

Boulder County Parks and Open Space Department
Boulder County, Colorado

Anderson & Company and Queen of the River Fish Co., Inc. • Dan D'Amico
Planning Consulting • Carron Meaney, PhD
Stephen R. Jones • Native Cultural Services
Boyle Engineering Corporation

Appendix B

Potential Project Funding Sources, Partial List

American Zoo and Aquarium Association

Beldon Fund

Colorado Division of Wildlife Wetlands Program

Educational Foundation of America

FishAmerica Foundation

General Service Foundation

Homeland Foundation

Izaak Walton League of America, Save Our Streams

Kenney, William C., Watershed Protection Foundation

Levinson, Max and Anna, Foundation

National Environmental Education & Training Foundation

National Fish and Wildlife Foundation

Natural Resources Conservation (NRC) Matching Grants Program

North American Wetlands Conservation Act, U.S. Fish and Wildlife

Noyes, Jessie Smith, Foundation, Inc.

Outdoor Industry Conservation Alliance

Patagonia, Inc.

Recreational Equipment, Inc.

Strong Foundation for Environmental Values

Tides Foundation

Trout Unlimited

Turner Foundation, Inc.

US EPA, Catalog of Federal Funding Sources for Watershed Protection

US EPA, EPA/NSF/NASA Joint Program on Water and Watersheds

US EPA, Office of Wastewater Management

Weeden Foundation

Wildlife Forever

NATIVE CULTURAL SERVICES

CULTURAL RESOURCE SURVEY

OF

LOWER BOULDER CREEK

Boulder County, Colorado

By

Peter J. Gleichman
and
Tracy L. Sweely

Prepared For:

Boulder County Parks and Open Space

Submitted To:

Anderson & Company
420 Sunset Street
Longmont, CO 80501

Submitted By:

Peter J. Gleichman
Principal Investigator
Native Cultural Services
Boulder, Colorado

December 10, 1997

MANAGEMENT SUMMARY

Native Cultural Services performed a cultural resource survey of the Lower Boulder Creek Corridor. The study area is Open Space, managed by the Boulder County Parks and Open Space Department. The cultural resource study was conducted as part of a comprehensive environmental master plan for the Lower Boulder Creek Corridor.

The study area encompasses portions of Boulder Creek and Coal Creek, from ½ mile west of Highway 287, extending east to the county line. The parcels are in Sections 1, 10, 11, 12, 14, and 15, T1N, R69W, 6th PM, comprising approximately 1110 acres. An intensive (100%) cultural resource inventory was conducted on approximately 212 acres, and a visual reconnaissance survey of approximately 300 acres was made. The remaining acres were not inventoried, due primarily to their being disturbed by gravel quarrying, or because they were wetlands or marshlike.

The purpose of this inventory was to locate, record and evaluate the historic and prehistoric cultural resources within the study area, so that appropriate management decisions may be made regarding their protection or interpretation.

Four previously unrecorded sites and two isolated finds were located. The sites are the Duffy Pigeon Barn (**5BL7098**); the remnants of an historic bridge (**5BL7099**), probably part of the Denver-Cheyenne Stage Road; the Howell-Robinson Farm (**5BL7100**); and the Howell Ditch (**5BL7103**). The isolated finds consist of a concrete stave silo (**5BL7101**), and a portable cattle chute (**5BL7102**).

Two historic ditch sites, the Liggett Ditch (**5BL860**) and the Boulder and Weld County Ditch (**5BL861**), previously recorded outside of the study area had segments located within the current study area which were documented.

None of the cultural properties are eligible to the National Register of Historic Places, due to a lack of significance or due to loss of integrity from post-use changes and modifications. Building 2 at the Howell-Robinson Farm is a braced frame pinned mortis-and-tenon granary constructed about 1875, later converted to a barn. It may be eligible for local Landmarking as an example of this type of construction.

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INTRODUCTION

Native Cultural Services performed a cultural resource survey of the Lower Boulder Creek Corridor. The study area is Open Space, managed by the Boulder County Parks and Open Space Department. The cultural resource study was conducted at the request of Anderson and Company, as part of a larger environmental study, with the purpose of developing a comprehensive environmental master plan for the Lower Boulder Creek Corridor.

The study area consists of approximately 1110 acres. An intensive (100%) cultural resource inventory was conducted on approximately 212 acres, and a visual reconnaissance survey of approximately 300 acres was made. The remaining acres were not inventoried, due primarily to their being disturbed by gravel quarrying, or because they were wetlands or marshlike.

The study area includes parcels of Boulder County Open Space encompassing Boulder Creek and a portion of Coal Creek, from ½ mile west of Highway 287, extending east to the county line. The parcels are in Sections 1, 10, 11, 12, 14, and 15, T1N, R69W, 6th PM. The study area is depicted in Figure 1, which also shows the inventory and reconnaissance areas.

The intent of the survey was to locate and document historic and prehistoric cultural resources within the study area, and to evaluate their significance and eligibility for the National Register of Historic Places (NRHP) and for local Landmarking, so that appropriate management decisions may be made regarding their protection or interpretation.

Peter J. Gleichman served as principal investigator for the study. The field work was performed in August and September, 1997, under the direction of Pete Gleichman and Tracy Sweely (crew chief), with the assistance of Frances Black, Cara Gulley, Dock Teegarden, and Michael Whalen. Historic research was conducted by Scott Phillips and Pete Gleichman. Tracy Sweely and Michael Whalen assisted with report preparation. Field notes are curated at the office of Native Cultural Services in Boulder.

Our thanks to Emma Snyder, Sarah Wise, Ralph Newman, Richard Koopmann, Richard Savino, Craig Anderson, and Jack Wheeler for sharing their knowledge of the history of the area with us.

ENVIRONMENT

The study area parcels are within the Great Plains physiographic provence, in the Boulder Creek and Coal Creek floodplains. Boulder Creek is a permanently flowing stream, and is the natural permanent

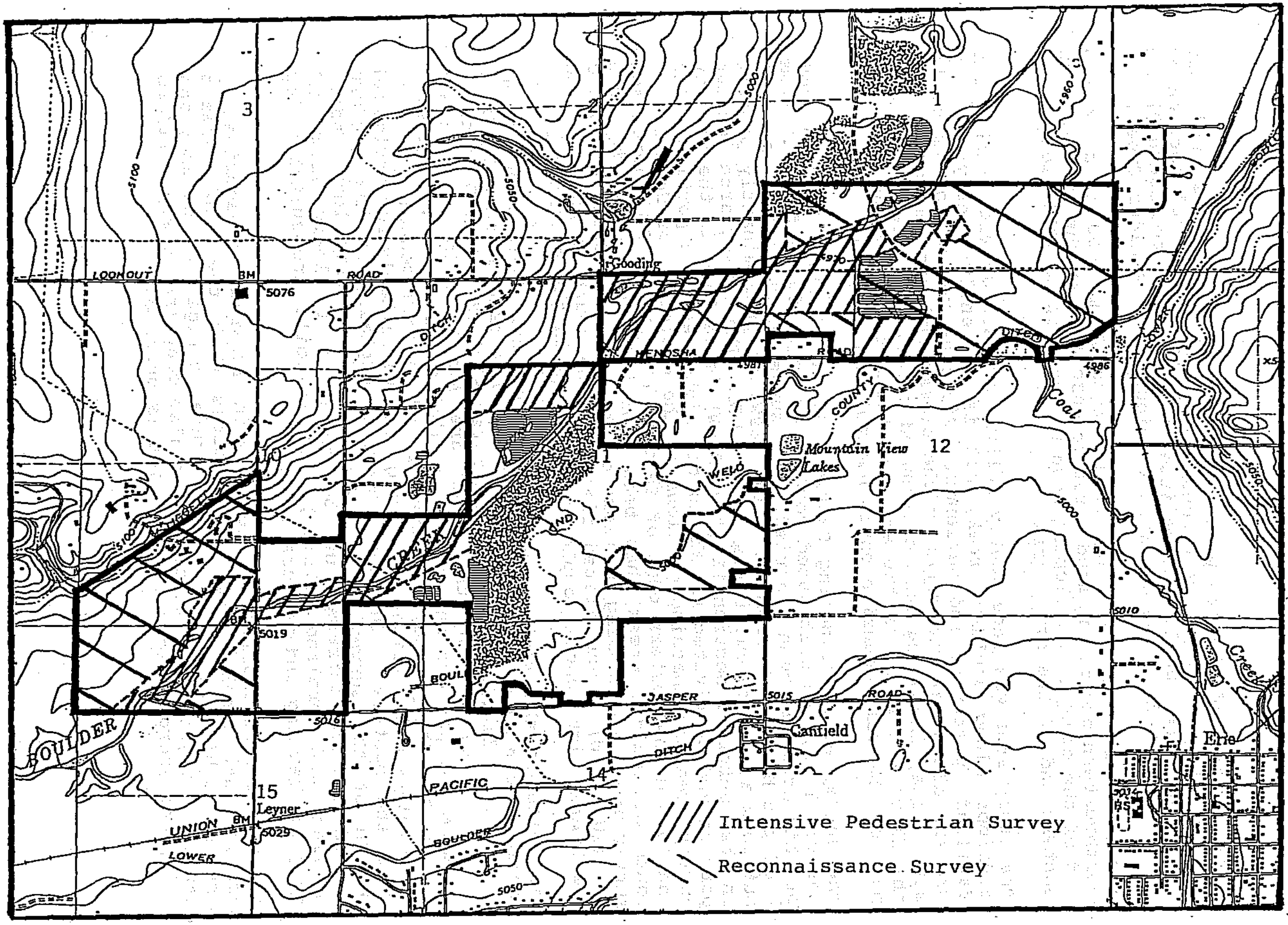

FIGURE 1 – Lower Boulder Creek Study Area
USGS Erie, Colo 7.5' Quad 1967/PR '79 PM 6, T 1N, R 69W
Sections 1, 10, 11, 12, 14, 15

water source of the study area. It feeds the Boulder and Weld County Ditch which passes through the southern central portion of the study area. Boulder Creek itself is a part of the South Platte drainage system. Coal Creek is a tributary of Boulder Creek.

The elevation of the study area ranges from 5060 feet at the northwestern end of the study area to 5030 feet at the southwestern end of the study area, sloping down to the east to 4970 feet in the eastern end of the study area.

The study area was once gently rolling grasslands with a riparian corridor along Boulder Creek, but is currently gently rolling farmland, pastures, and wetlands. Riparian vegetation is still present along the waterways of the creeks and ditches within the study area, including some cottonwood trees. Detailed studies of the flora and fauna of the area are being conducted by others as part of the comprehensive environmental master plan.

The survey area straddling Sections 1 and 12 (T1N, R69W) is now pasture land, and cultivated cornfields and alfalfa fields. some of this area has been quarried. The survey area located in the N ½ of the NE ¼ of Section 11 (T1N, R69W) is predominantly pasture but some areas are cultivated in alfalfa. The survey area located in the center of Section 11 (T1N, R69W) is wetland in the western portion and cultivated fields in the higher eastern portion. The survey area encompassing portions of the eastern ½ of Sections 10 and 15 and the western edge of Section 11 (T1N, R69W), north and south of Boulder Creek, has been quarried and reclaimed. The survey area encompassing portions of the west ½ of Sections 10 and 15 (T1N, R69W) is cultivated fields in the southern portion, and the Dawson High School Complex and Grounds in the northern ¼.

The soils in the western most border of the study area are an Ascalon brown sandy loam, soils "formed on terraces and uplands in loamy mixed alluvium and wind-laid materials" (Moreland & Moreland 1975:5). Soils along the creek are Niwot soils, clay loams suitable for pasture and meadow or mining for gravel. Soils in most of the study area, the central and eastern central portion, are Loveland soils (light clay loam) and are suitable for irrigated crops and pasture. The Coal Creek floodplain, in the eastern portion of the survey area contains McClave clay loam, soils "formed on low terraces and bottom lands in loamy alluvium" (Moreland and Moreland 1975:18). These soils are suitable for irrigated farming and pasture land.

The potential suitability of the soils in the area, as described by Moreland and Moreland (1975) coincides with the study area's current and historic land use as pasture, irrigated cropland, and quarries for gravel. The study area also contains several oil/gas wells, and energy resource extraction is ongoing.

HISTORIC CONTEXT, PREVIOUS INVESTIGATIONS, AND EXISTING DATA

The known culture history of the general area is summarized in Eighmy (1984) and Mehls (1984).

The study area has historically been rural and remains so. The closest communities are Canfield and Erie.

The area around the modern Town of Erie was originally settled in 1859 after coal was discovered (Smith 1989:11). Early Erie area homesteaders sold chunks of coal, and by the early 1860s Erie was an established stage stop, with major mining interests operating in earnest in the area by 1866 (Smith 1989:11). Several important coal mines were in the area around Erie, a part of Colorado's Northern Coal Field, a.k.a. the Boulder-Weld Coal Field. Coal mining does not seem to have taken place within the study area, but did occur just to the south. The economic impacts of the coal mines may well have played a role in the lives of people in the area, however.

Irrigation in the area began around 1859, with the Lower Boulder Ditch receiving the first ditch decree (Dyni 1989:85 & 99). By the beginning of the 1870s the Boulder Valley Railroad had reached Erie (Dyni 1989:49). The town of Canfield had a railroad depot by 1873, and the Canfield Mill, a grist mill to serve local wheat farmers. Dyni (1989:81) indicates that by the 1880s there was fairly extensive open-range grazing of cattle in the area, not from large cattle ranches, but rather from farmers raising dairy cattle. Families living in the southern portion of the study area would have sent their children to the Canfield School, established in 1880. By 1901 the Gooding School was operating, and children living in the northern portion of the study area would attend that school (Dyni 1991). Farming/ranching were the primary economic pursuits in the study area.

Historic themes relevant to the study area are: Agriculture, from ca. 1859 to the present; Water Resources, from ca. 1859 to the present, particularly the development of irrigation ditches; and Transportation, from the 1860s. Mining and Extractive Industries seem to have been engaged in only during recent times (oil and gas wells, gravel or aggregate quarrying).

A file search of the study area was conducted by the Colorado Office of Archaeology and Historic Preservation (OAHP) on September 24, 1997. It revealed that no previous investigations have been conducted in the study area, though two ditches, with segments running through the study area, had been recorded previously, outside of the study area. These ditches are the Liggett Ditch (**5BL860**) and the Boulder and Weld County Ditch (**5BL861**).

OBJECTIVES

The primary objectives of the present study were to provide Boulder County Parks and Open Space with an inventory of archaeological and historic sites, to assess the significance of any sites located, and to provide recommendations on how to manage the cultural properties in the study area.

Prehistoric sites in this area of the plains are generally limited to small scatters of lithic debris and tools left by groups following a hunter-gatherer adaptation. Bone beds from kill/butcher sites are present on the plains, and stone circles, firepits, and both ephemeral camps and campsites with substantial layers of culturally deposited material are present in eastern Boulder County (Gleichman, et al. 1995). Any of these types of prehistoric cultural properties could potentially occur in the study area. Most historic sites in the surrounding area are related to coal mining, homesteads, agricultural pursuits, and railroading in the late 19th or early 20th centuries.

Information obtained from prehistoric sites, if found, could be applicable to a number of research concerns such as regional chronology, settlement patterns, resource utilization, site function, and cultural affiliation. Many of these issues are outlined in Eighmy's (1984) "Colorado Plains Prehistoric Context". Data concerning historic resources could be used to address questions about late 19th and early 20th century occupation and use of the plains. Some of these questions have been outlined in Mehls' (1984) "Colorado Plains Historic Context" and in Friedman's (1989) "Boulder Historic Context Project".

Prehistoric sites tend to be in areas near water sources or other critical natural resources. There are permanent water sources within the study area, Coal Creek passes through the east end of the study area and Boulder Creek runs throughout. It was expected that the chances of locating prehistoric materials in the study area would be minimal for several reasons. The area is predominantly within the Boulder Creek floodplain, and while floodplains were used prehistorically, the preferred habitation areas were terraces and bluffs above the floodplain. Any prehistoric sites which were present would have been subject to floods, and probably either washed away or buried. The area has also been cultivated for several generations, and some of the area has been quarried for gravel. The creek has been channelized. These historic disturbances to the area may also have destroyed or masked prehistoric manifestations. Indeed, the OAHP file search revealed no discoveries of prehistoric material in a sample of five previous, nearby surveys.

METHODS

Extensive gravel quarrying in the study area, the presence of marshlike wetlands, and to a lesser extent the presence of cultivated fields preclude the necessity for systematic intensive pedestrian inventory. An intensive (100%) pedestrian inventory was completed over approximately 212 acres. This level of inventory was intended for unquarried land that wasn't marshlike and had potential for cultural resources. Most of the area along Boulder Creek was also examined intensively.

Visual reconnaissance was performed in areas that could be visually assessed for cultural features upon the ground surface from a distance but did not warrant systematic walkover, either because of gravel quarrying or limitations in ground visibility due to the presence of hayfields or crops. 300 acres were surveyed in this manner.

The remainder of the study area was not examined.

Pedestrian survey was performed by systematically walking a series of adjacent linear transects with surveyors spaced between 20 and 30 meters in interval. Ground visibility was generally poor, averaging between 0-15% in all areas except in the portion of the survey area located immediately NW of the intersection of Kenosha road and 119th St. In that area the visibility was high at 50 - 80%. This is an often used horse pasture, which would explain the increase in visibility.

Evidence of cultural manifestations was sought in the form of prehistoric and historic debris, structural remains, or any unusual surface anomaly. When an artifact or feature was encountered, the area was thoroughly explored, and the nature of the manifestation was determined and appropriately recorded.

Sites were defined as assemblages of more than five artifacts in a definable area, or artifacts with buildings, structures, or features. Isolated finds were five artifacts or less, or solitary features or structures without associated artifacts.

Sites and isolates were recorded by completing the necessary Colorado Cultural Resource Survey forms, creating a scaled sketch map, and photographing the physical remains.

Historical research was conducted both through interviews with persons knowledgeable about the history of the area, and through archival research at the Boulder County Courthouse and at the Carnegie Branch Library for Local History.

RESULTS

During the course of the survey four previously unrecorded sites and two isolated finds were identified and documented. Two historic ditch sites, the Liggett Ditch and the Boulder and Weld County Ditch, that had been previously recorded outside of the study area had segments located within the current study area. The cultural properties are summarized below, and additional, detailed information is present on the Colorado Cultural Resource Survey forms, a detached appendix of this report.

Several other cultural manifestations were noted during this survey that were not documented as formal cultural properties, i.e., as sites or isolated finds, due primarily to insufficient age, but in some cases due to indeterminable age. These other manifestations are listed with map locations in Appendix A.

SITES

Site 5BL860.19 is the segment of the **Liggett Ditch** which runs from SW to NE along the north boundary of the County Open Space parcel in Section 10 (the Alexander Dawson property). Other segments of the ditch out of the study area have been previously recorded. The ditch is active, and has a date of fee appropriation of May 1, 1868. The ditch has priority number 30 for water from Boulder Creek.

Site 5BL861.8 is the segment of the **Boulder and Weld County Ditch** which extends from the headgate in the NW ¼ of Section 15 and winds east and northeast through Sections 14, 11, and 12 (T1N, R69W), and continues past the east boundary of Section 12 at the Boulder-Weld County line, the east boundary of the study area. Other segments of the ditch out of the study area have been previously recorded. The ditch is active, and has a date of fee appropriation of May 1, 1871. The ditch has priority number 33 for water from Boulder Creek.

The Boulder and Weld County Ditch also carries the water allocated to the **Martha Mathews Ditch**. The Martha Mathews Ditch had a date of fee appropriation of June 1, 1861, with priority number eight for water from Boulder Creek. While there was apparently a separate ditch structure for the Martha Mathews Ditch at one time, the ditch no longer exists.

Site 5BL7098 is the **Duffy Pigeon Barn** (Figure 2). The barn is one and one-half story vernacular wood frame building, 24'3"x 18'8". The walls rest on perimeter beams set on the ground. They are framed on 4x4"s on the south, 2x4"s on the east and west walls, and various size poles on the north wall. Corner posts appear to be railroad ties. Sheathing is vertical planks, 1x9"s, 1x10"s, and 1x12"s, with metal signs overlaying. The metal signs say "Duffys' Old Fashioned Root Beer". The floor is poured concrete. The gabled roof is corrugated metal over milled planks, with a 6/12 slope. The hay mow or loft rests on 2x4"s and poles @ 24" on center. There are three, possibly four doors and two window openings on the first floor. The hay mow has window openings on the E and W ends for loading hay. There is ¼" hardware cloth skirting the perimeter of the building at ground level. The barn currently contains modern trash.

Historic Data.
The barn was part of a farm complex purchased by Mr. Duffy. Duffy owned "Duffys, Inc." of Denver CO, and produced "Duffys' Delicious Drinks" a line of soda pop. A house formerly stood south and east of the barn. Duffy had the house and all other out-buildings demolished in 1944 or 1945. The barn, originally used for stock, was converted to use as a pigeon barn, housing homing pigeons. It was so used until about 1968-1970, when Doniphan purchased the property. The barn was vacant thereafter. (Emma Snyder, personal communication 1997).

FIGURE 2 - View north at 5BL7098, the Duffy Pigeon Barn.

Site 5BL7099 consists of bridge remnants, possibly from the Denver-Cheyenne Stage Road. This site is currently located beneath the current bridge crossing Boulder Creek on 109th St, about 600 meters (m.) North of Jasper Rd. The bridge remnants consist of two upright wooden posts on the north side of Boulder Creek, in the water adjacent to the creek bank. The posts are 10" in diameter, 5'10" apart, and extend 3'3" above the water line. They are oriented along an E/W line just west of the current bridge center line. Directly north of the posts, on the ground surface and extending below a pile of sandstone slabs, are at least 4 planks measuring 9" wide by 2" thick of indeterminant length, but at least 10' long. These planks are stacked at least two thicknesses high. The length is oriented E/W. There are at least two more planks of apparently the same dimensions located to the east of these planks. Only a length of 2' is visible as these planks also extend beneath sandstone rubble. There are many slabs of Lyons sandstone scattered and piled on the creek bank, some with concrete attached, which were apparently associated with the bridge or the stage road. They vary in size, with the largest 10' by 5'5" by 1'10" thick. The smallest is about 1' by 6". Thicknesses vary, for example 4", 6", 8" and 10" thick. On the south side of the creek this rubble is to the east of the current bridge abutments and on the north side the rubble is concentrated beneath the current bridge and also slightly to the east. More recent concrete fragments are also scattered on the creek banks.

Historic Data

A map of Road No. 135, platted July 13, 1901, identifies it as the "Old Denver and Cheyenne Stage Road". Road No. 135 (since renumbered) extended from south of Longmont to Baseline, and followed the route of what is now Highway 287, in part, jogging over to cross Boulder Creek on what is now 109th Street. The Overland Stage Line ran stagecoaches on the Denver-Cheyenne Stage Road in the 1860s and 1870s. The Overland Stage Line was owned by Ben Holladay and taken over by Wells Fargo in 1866. The successor to Wells Fargo was Jno. Hughes & Co. Other stagecoach companies operating in the area were the Boulder Stage, with daily coaches between Erie and Boulder; and the Mason & Ganow Line and the Denver & Cheyenne Coach Line, both operating between Denver and Cheyenne (Hutchinson 1994).

The stage station at this crossing of Boulder Creek was known as the Boone Station in the early 1860s. In 1866 William Buford was granted approval to build a toll bridge over Boulder Creek by the Sixth Session of the Legislative Assembly of the Territory of Colorado. The stage stop at the toll bridge became known as the Buford Station. Tolls were 50 cents for a vehicle pulled by one pair of animals, and ten cents for each additional pair. A vehicle pulled by one animal was 30 cents. Animals not in harness or yoke were two cents per head (Hutchinson 1994:50, Rothrock 1946). Aside from the bridge remnants and sandstone slabs described above, there is currently no archaeological evidence of stage station buildings

FIGURE 4 - View east-northeast at 5BL7100, the Howell-Robinson Farm. Buildings 1 & 2 at left, Buildings 3 & 4 in center, and concrete stave silos at right.

FIGURE 5 - View northwest at 5BL7100, the Howell -Robinson Farm. Building 1, left, a barn from ca. 1925. Building 2, right, mortis-and-tenon braced frame granary, from ca. 1875, later converted to a barn.

nails. The lower floor is supported by RS pine 2x8"s @ 12" oc, sitting on the ground. The lower floor, as well as the exterior vertical siding and 3/8"x 2" battens are all nailed with common wire nails (post 1880).

This construction indicates that the building was originally framed for a grain crib, and sheathed only on the inside. Later, exterior siding was added, to protect the frame from the rain, and the floor was replaced (or added). Furthermore, the carpenter was a very conservative workman, to construct a mortised and pinned frame when the balloon frame type of construction had been common and accepted in the west by the 1860s.

Building 3 is a shed, 30'x 17', constructed of randomly spaced 6x6" posts and some railroad ties, open to the south. Various purlins (2x4", 2x6", pine poles) nailed to the posts support walls of vertical sheathing of random width RS boards with milled 3/8"x3" pine battens over the cracks. The single slope (shed) roof of 2/12 pitch is composition over tight boards on 2x6" @ 24" oc. All nails are wire. An 8' long steel track is attached at a height of 6' to hold a door hung by rollers.

Building 4 is a milking barn, 48'x 19'6", built around 1915 with later additions. The west portion of this long gable-roofed building is an 8' wide runway, with the east portion the stall area. A 3'x 10' room has been formed in the SW corner with ¼" plywood walls. The south end of the building constitutes a 11'x 14' room built separately, lined with white-painted ¼" fir plywood, wired for electricity with "romex" cable, indicating 1950s. The barn has a poured concrete floor, poured concrete half-walls 3" thick and 36" high, and a grade beam for the west wall and for stanchions @ 8' east of the west wall. Walls above the concrete half-wall are framed of 2x4" studs @ 48" oc, 2x4" purlins, sheathed with board-and-batten siding, with white paint over red. The roof is wood shingles, but at one time was covered by composition strip roofing common in the 1930s. The roof has varying slopes and rafters, indicating several different building campaigns. The W is approx. 3.5/12 on 2x4" @ 20" oc, with rafter ends exposed at eaves (ca. 1915) and coming to 75" from ground. The E of 3/12 on 3" diameter poles @ 24" oc, while the E slope of the south room roof is 6/12. Doors are board-and-batten. The east facade has a row of windows with scraps of "flex-o-glas" in them, with two more in the south 11'x14' room. The west facade has four fixed wood sash windows.

Historic Data

The chain of ownership for this property is shown in Table One. Samuel D. Graham was the original holder of the S½ of the SE¼ of Section 1. Samuel D. and Rebecca S. Graham, originally patented these properties and adjacent properties in Section 12 as well as other area patents. Samuel D. Graham received a warrant for a 160-

TABLE ONE
CHAIN OF TITLE FOR 5BL7100

HOWELL-ROBINSON FARM (5BL7100) - BOULDER COUNTY CLERK RECORDS			
DATE	**GRANTOR**	**GRANTEE**	**REFERENCE**
Aug 28 1866	[Patent filing?]	Samuel D. Graham	Treasurer Ledger 39
Jan 2 1872	United States	Samuel D. Graham	Warrant 10537 book O:492
Jan 06 1876	Samuel D. and Rebecca S. Graham	William R. Howell	Warranty Deed book 42:211
[1895-1905]	[W.R. Howell Estate or Howell heirs?]	Hattie L. Robinson	[see book 280:341]
Mar 01 1924	Hattie L. Robinson	The Colorado Bank and Trust Company	W.D. #200276 book 501:492
Jun 25 1929	The Colorado Bank and Trust Company	James T. Sappington	W.D. #263492 book 573:46
Jun 25 1929	James T. Sappington	The Colorado Bank and Trust Company	W.D. #265961 book 581:46
Feb 29 1932	Liquidation of the Colorado Bank and Trust Company	Union Central Life Insurance Company of Ohio	Court Order Rec. #370770 book 684:432
Nov 28 1934	Union Central Life Insurance Company	H. and Louise Newman	W.D. #314117 book 621:447
Nov 30 1959	H. and Louise Newman	Catherine Mary and George J. Bauer	W.D. #695269 book 1222:157
Mar 10 1962	Catherine Mary and George J. Bauer	Arthur H. and Lurline F. Meisner	W.D. #695270 book 1222:158
May 01 1968	Arthur H. and Lurline F. Meisner	Lee Mendel	W.D. #877774 film 634
May 01 1968	Lee Mendel	Geneva M. Bailey and Bailey Construction Company	W.D. #877777 film 634
Apr 01 1981	Geneva M. Bailey [Quit Claim]	Bailey Construction Co.	#473325 film 1188
Sep 17 1990	Bailey Construction Company	Columbine Land Resources, Inc.	W.D. #1064928 film 1644
Oct 25 1991	Columbine Land Resources, Inc.	Boulder County [Easement]	#1139678 film 1699

acre land patent due to military service with "Montoyas Salas, Captain, Packer Company New Mexican Volunteers Navajo Indian Wars" (Book O:492). Records also indicate that Graham had mining claims in the Ward district in 1865-66 (Book E:99 & 229). Graham appears in the 1860 Census as a 45-year-old miner, born in Pennsylvania, living in Boulder City. The Board of County Commissioners records (Carnegie Collections 791, box 1, file 7) indicate that Samuel Graham had some carpentry skills as well; he was hired to construct tables and chairs for the County offices in 1862.

Graham may have been the carpenter who constructed Building 2, the granary, using a mortise-and-tenon braced frame. The building apparently dates to 1875 or earlier, when the property was owned by the Grahams.

The other extant buildings all apparently date from the period of Howell-Robinson occupancy of the property. Jennie E. Stewart's 1948 compilation, "Boulder County Pioneers," gives a brief portrait of the Howell Family. The Canadian-born William R. Howell (1834-1895) prospected in Colorado in the spring of 1859 immediately after graduating from the Mt. Carroll Seminary in Illinois. He patented lands 12 miles east of Boulder, eventually increasing his holdings to 1040 acres. In 1864, he married Cornelia Sheldon. Beginning in 1869, he served two terms (four years) as sheriff.

The Census records indicate that in 1860, W. Howell was a miner in the Boulder Creek Settlement. By the 1885 Census, William Howell was raising stock at Canfield. By the 1900 Census, his wife "Cora Howell," then age 55, is widowed. The daughter, Hattie Howell Robinson, age 23, has been married only for a year to Fredrick Robinson, age 28. A second daughter, Carrie L. Howell, age 19, is yet unmarried. County Clerk documents indicate that by 1908 Carrie will be a "Stone," and by 1910 that will have changed to "Wood". Also present at the Howell estate, by the 1900 Census, are three boarders, including John and Sawdey Grant and Robert Greenwood.

W.R. Howell constructed a ditch to irrigate portions of his property from Boulder Creek, as did a preceding, neighboring homesteader, Martha M. Mathews, whose property was later subsumed in the W.R. Howell Estate. Later, Fred Robinson also platted a seepage ditch across area properties.

By the 1910 Census, the household was headed by the Robinsons, at "#27 Boulder and Erie Road," in the Canfield area. Fred E. Robinson was farming. He and Hattie had three young children, William (age 9), Irene (age 3) and Harrold (age 5 months). Fred's widowed mother, Eliza E. Robinson, age 68, was also living with them. Fred was born in Illinois and Eliza in Kentucky, both came to Colorado via Missouri. There were also four farmhands and two servants living with them. The servants are Ms. Jessie Mitchell (age 24), of Mexican-English descent, from Australia, and Minnie L. McCluskey (age 18), from Colorado. Ms. McCluskey is married to farmhand William McCluskey (age 21), originally from Missouri. Other farm hands include the former boarder, John Grant of England (age 50), Massadonia Laray of Mexico (age 60) and Edd Hollowell of Illinois (age 24). Based on the live-in help present, the farm was very active during this period. Fred Robinson would be dead by 1923 (book 482:486). County Clerk records indicate that the Robinsons were about $30,000 in debt. Hattie settled these debts and sold the property to the Colorado Bank and Trust Company in 1924.

A life insurance company acquired the property in 1932 upon the liquidation of the Colorado Bank and Trust Company. In 1934 the Newman family bought the property. The Newmans farmed the land until 1959, growing mainly sugar beets, barley, and corn (Ralph Newman, personal communication 1997).

In 1968 the Baily Construction Co. bought the land. They demolished the house, moved some outbuildings off the land, and used the other buildings for storage and vehicle maintenance.

Site 5BL7103 is the **Howell Ditch.** The concrete and steel headgate for the Howell Ditch is present at the diversion along Boulder Creek. A long diversion consisting of a rock berm 2-3 meters wide and about 200 meters long runs parallel and north of Boulder Creek. The diversion was constructed about ten years ago to continue supplying water to the ditch after Boulder Creek shifted course, leaving the headgate dry. Water flowing through the headgate goes into a pipe, so no ditch is visible on the surface behind the headgate. The entire ditch is not piped, so an open ditch is present to the north, out of the study area.

The Howell Ditch has a date of fee appropriation of December 1, 1859, and is priority number three for water from Boulder Creek. It formerly had an appropriation of 35 cubic feet/second (CFS), but now has 5 CFS. The ditch was constructed circa 1864 by William R. Howell, a pioneer who was prospecting in Colorado in the spring of 1859, but apparently took up agriculture almost immediately (see discussion with Howell-Robinson Farm, above).

ISOLATED FINDS

Isolated find **5BL7101** consists of a concrete stave silo located West of 119th Street between Kenosha Road and Jasper Road. Concrete stave silos were supposedly originally constructed in the 1930s by the Dotson Manufacturing Co. of Wichita, Kansas. Some local people have stated that concrete stave silos were present in Boulder County in the 1920s. Many such silos were built in Boulder County in the late 1930s and 1940s. This silo was apparently used by the farm located to the NE, along 119th Street, out of the study area.

Isolated find **5BL7102** consists of a portable cattle loading chute (Figure 6). It is located less than 50 m SW of the bend in Kenosha Road where it becomes North 115th Street. The cattle loading chute is deteriorated but standing, and is framed of 4x4" studs at the four corners, with 2x4" studs at the center of each side, with spaced horizontal 1x10"s and 1x6"s for the sides. Hoops at both ends of the chute form a cylindrical frame for a top. The hoops are metal straps, 3 cm wide and 3 m long. The wheels have rubber tires.

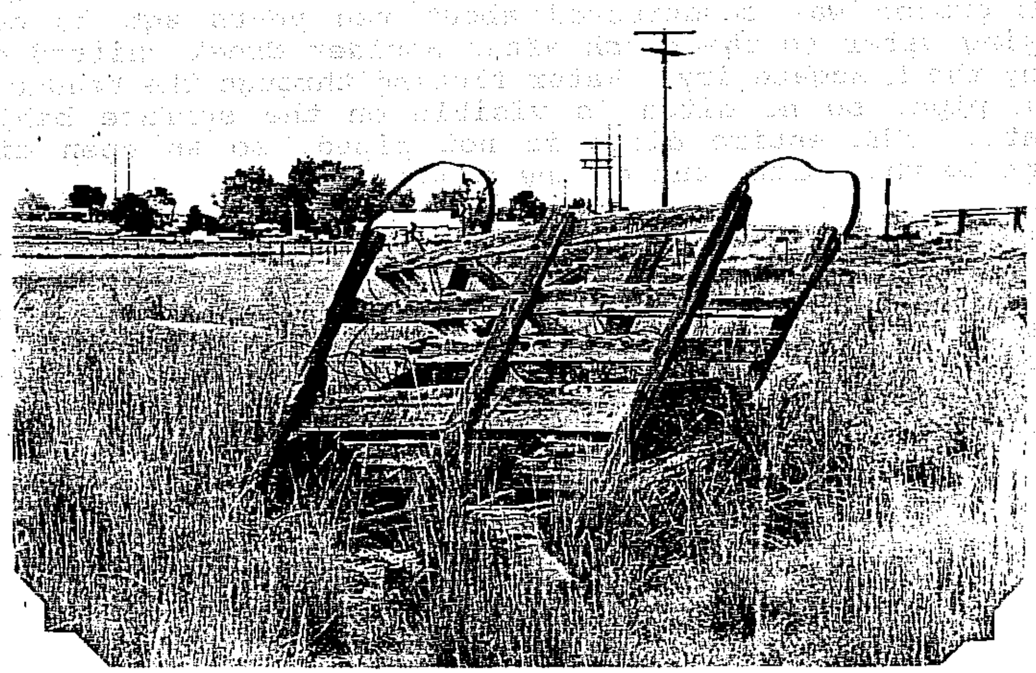

FIGURE 6 - View northeast at 5BL7102, cattle loading chute.

DISCUSSION

As expected, no prehistoric cultural remains were located. This absence is attributed to the land comprising the study area being within the 100-year floodplain of Boulder Creek, and due to the historic disturbance from gravel quarrying and cultivation.

Cultural resources from the historic period relate to the long term agricultural use of the area. The dates of appropriation of 1859 for the Howell Ditch (5BL7103) and 1861 for the Martha Mathews Ditch indicate that agriculture in the area was being actively planned and pursued shortly after pioneers arrived in the Boulder Valley. It's noteworthy that historic documents indicate the appropriation dates for these early ditches precede actual construction of the ditches.

The presence of the Howell-Robinson Farm (5BL7100) demonstrates that habitation of the area by Euro-Americans took place by the mid-1860s, and that agriculture has been practiced essentially continuously ever since. Samuel and Rebecca Graham were the original owners of the property and held it from 1866 to 1876. Samuel Graham was a miner and carpenter, and probably the person who constructed a mortise-and-tenon, pinned braced frame granary at the farm site about 1875. Balloon frame construction had been common and favored by the 1860s. Samuel Graham was 60 years old in 1875, and may have been exercising carpentry skills and a building style learned earlier in life.

William and Cornelia Howell bought the property in 1876 and their family owned it until 1924. W.R. Howell had been active in the area for some time, like many other pioneers prospecting at first and then settling on the plains to farm. Howell's appropriation of water from Boulder Creek in 1859 was only the third claim on the creek's water. It indicates he either abandoned mining quickly after arriving, or was planning on staying in the area regardless of his success at prospecting. It is unknown where the Howell family lived prior to buying this property, but was probably in the vicinity. Howell was involved with law enforcement, and his farm eventually was over 1000 acres. The oldest daughter, Hattie, married Fred Robinson in 1899, and they acquired the property and actively farmed it until 1924. A dairy operation was clearly part of the farm pursuits at this time.

There has probably been two or three different houses at the farm over its life. Whatever house was present in the 1960s was demolished, along with other outbuildings. The remaining buildings were built at several different times, and demonstrate a variety of construction types and materials, as well as changing uses over the years, not uncommon for a farm with a long history.

The presence of the Denver-Cheyenne Stage Road, and other stage routes in the area in the 1860s and 1870s; and the arrival of the Boulder Valley Railroad (later Union Pacific) in the 1870s indicates the importance of early "mass" transportation in the area. This is perhaps mainly due to the economic importance of the coal mines in the Erie vicinity. It is also likely due in part to the active farms in the area, and the commerce involved in supplying farms and moving produce to markets.

MANAGEMENT RECOMMENDATIONS

Cultural resources in the study area were evaluated for their significance and eligibility to the National Register of Historic Places (NRHP), and for eligibility for local Landmarking.

NRHP eligibility is judged according the criteria set forth in 36CFR 60.4 below:

"National Register Criteria" means the following criteria established by the Secretary of the Interior for the use in evaluating and determining the eligibility of properties for listing in the National Register: The quality of significance in American history, architecture, archaeology, engineering and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling and association and:

(A) That are associated with events that have made a significant contribution to the broad patterns of our history; or

(B) That are associated with the lives of persons significant in our past; or

(C) That embody the distinctive characteristics of a type, period or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(D) That have yielded, or may be likely to yield, information important in prehistory of history.

Local Landmarking is designed to recognize cultural properties of local significance in Boulder County.

The **Liggett Ditch (5BL860)** and the **Boulder and Weld County Ditch (5BL861)** have been determined to be ineligible to the NRHP by the Office of Archaeology and Historic Preservation, Colorado Historical Society. They are structurally and associationally insignificant.

The **Duffy Pigeon Barn (5BL7098)** is not eligible to the NRHP or for local Landmarking. The building is architecturally undistinguished, and lacks integrity of setting and association due to the demolition of the rest of the farm complex. The building is on the verge of collapse, and may be a hazard.

The bridge remnants **(5BL7099)** from the Denver-Cheyenne Stage Road are not eligible to the NRHP due to loss of integrity of design, workmanship, setting, and association. The site has no archaeological potential. This site is of considerable historic interest, and may be eligible for local Landmarking, however its location along the creek under a busy bridge may inhibit any interpretive potential.

The **Howell-Robinson Farm (5BL7100)** is not eligible to the NRHP due to loss of integrity of design, materials, workmanship, and association. The demolition of the domicile and other out-buildings leaves only three barns, a shed, and two silos. Building 2, the mortise-and tenon braced frame granary/barn dating to the early 1870s may be eligible for local Landmarking as an example of this type of construction. The building is not in great condition, but some consideration should be given as to whether it may serve any purpose if preserved in place, or whether it can be moved and preserved elsewhere (e.g., at the Erie Historical Society property).

The **Howell Ditch (5BL7103)** is not eligible to the NRHP. The headgate is recent, much of the ditch has been piped, and it no longer retains integrity as a 19th Century ditch.

Isolated finds are not eligible to the NRHP. Neither the silo **(5BL7101)** or the cattle loading chute **(5BL7102)** would seem to merit local Landmarking, but they are features of the cultural landscape which relate to the agricultural history of the area, and they may be of interest to the public.

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APPENDIX A

OTHER MANIFESTATIONS

OTHER MANIFESTATIONS

Cultural manifestations listed here have not been formally documented as cultural properties due to insufficient age, (i.e., less than 50 years old) or indeterminable age. The numbered descriptions match the numbers on the following map.

In addition to the manifestations described here, Boulder Creek itself has numerous cultural modifications. The creek has been channelized in places. The creek has concrete pieces scattered down the banks in several places, probably put there as rip-rap, or perhaps simply dumped opportunistically. East of 109th Street, the creek banks had wet concrete poured down them in several places, again either as rip-rap or bank support, or just as a convenient dumping area. The concrete may have come from Other Manifestation #4, described below, a probable concrete batch plant.

1. Concrete supports or abutments placed on either side of Boulder Creek with concrete running across the creek bed between the two abutments. It is located immediately upstream of the origin of the Boulder and Weld County Ditch. Probably part of the diversion structure for the ditch. Old headgate for Martha Mathews Ditch is here also.

2. Pile of granite stones, ca. 20 meters (m.). diameter, near the bridge over Hwy 287; also some concrete blocks with rebar, probably from an earlier bridge.

3. Pile of wood planks, beams, boards, posts, and some bolts.

4. Remnants of a wash plant for aggregate or a batch plant, includes a group of four upright concrete slabs, concrete foundation with concrete trough, and a second concrete foundation. Plywood and 2x4"s, and asphalt fragments are scattered about. This was used in the 1960s or early 1970s. Local people say this was also part of a gold mining scheme.

5. A partially buried metal bar, possibly an axle or bed frame post.

6. A metal pipe, 2 m. long & 10 cm. diameter with metal plate attached with bolts and cables, also 2 sheet metal pieces 100 m. east.

7. Collapsed building (shed), 3 m. x 2 m. Construction is tongue and groove siding, on 2x4" stick frame. It has a gabled roof, using plank and sheet metal roofing. The entire building was approximately 4 m. high.

8. Modern deteriorated truck bed, wagon bed. Metal frame, plank and 2x4" construction. Bolts, wire nails. 3 m. x 4 m. Also a 3x1 m. galvanized, soldered and riveted metal tank with valve openings.

9. A collection of massive concrete and rebar slabs, having the appearance of used bridge supports, or some other type of substantial construction feature. They have been placed on the north side of a bermed area surrounding a man-made pond. The extent of the concrete features is about 30 m. along this berm.

10. 14 metal posts arranged in a semi-circle on the perimeter of a .75 m high raised terrace or berm. The posts have old, large truck, tires over them.

11. A concrete lined well which appears to be abandoned. It measures 1.25m in diameter and is of an indeterminate depth.

12. A standing residential structure. The address is 4731 119th Street. This house was built after World War II, according to the occupants.

13. Modern trash pit.

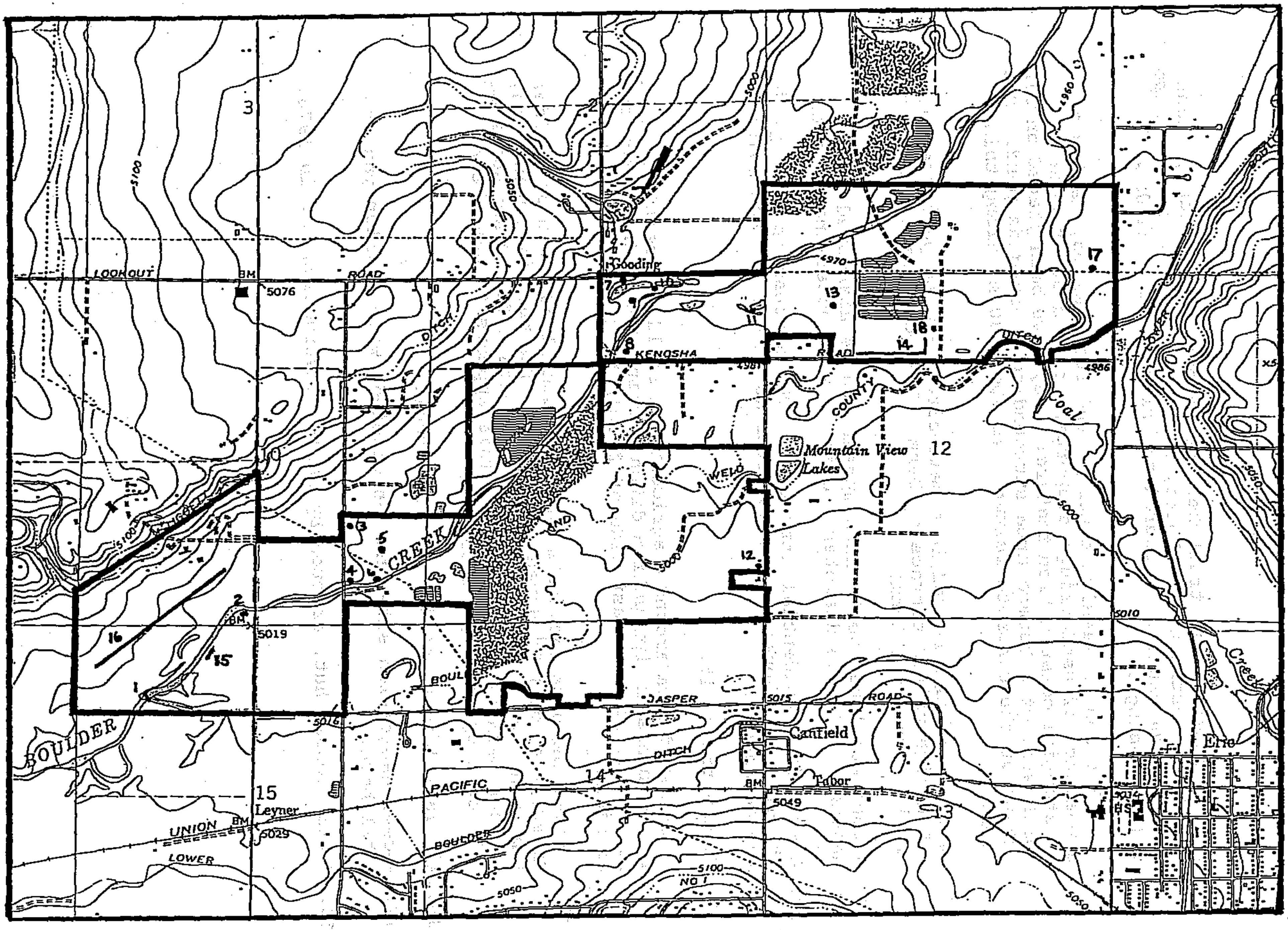
14. An L-shaped Berm around a agricultural field, currently fallow. The berm has an irrigation ditch running along the center of it. 150 m. long on east side of field, 340 m. along south side of field.

15. A low-lying berm located along the south flood plain of Boulder Creek, west of 107th Street (Hwy 287). The berm is 1.5 m. high, 1 m. wide and ca. 100 m. in length, with a few other spots of earthen berm along the creek. This appears to have been bulldozed up for flood control.

16. Airplane landing strip, Dawson School.

17. Recent habitation site, now unoccupied, with trailer pad and metal barn.

18. Metal quonset hut, erected by Baily Construction Co. in 1976.

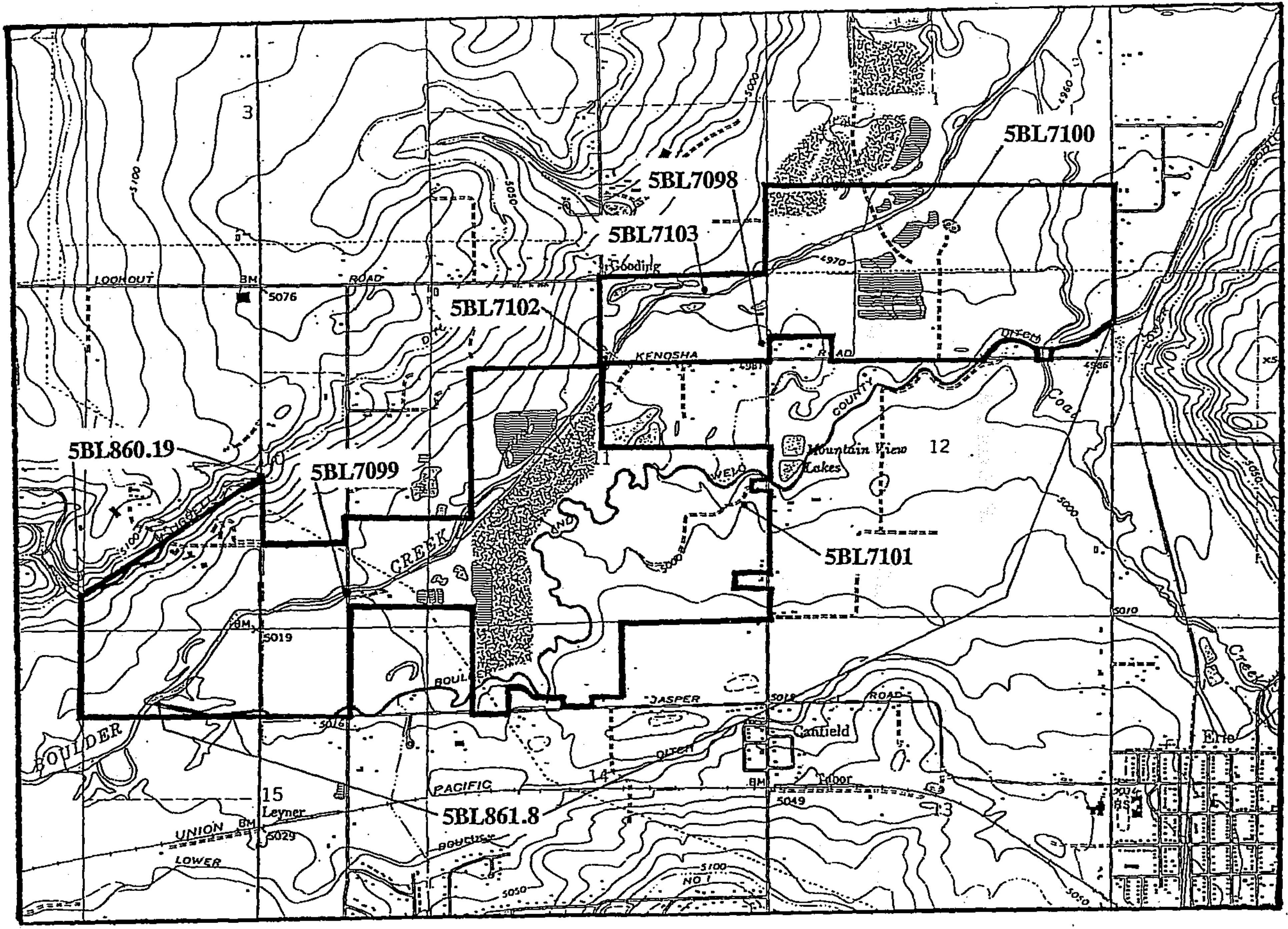


OTHER MANIFESTATIONS

Lower Boulder Creek Study Area
USGS Erie, Colo 7.5' Quad 1967/PR '79 PM 6, T 1N, R 69W
Sections 1, 10, 11, 12, 14, 15

APPENDIX B

RESOURCE LOCATION MAP



Lower Boulder Creek Study Area
USGS Erie, Colo 7.5' Quad 1967/PR '79 PM 6, T 1N, R 69W
Sections 1, 10, 11, 12,

Lower Boulder Creek / Coal Creek Corridor Master Plan
Upland Vegetation Community Inventory and Management Recommendations

Report

October 24, 1997

Prepared for:
Anderson and Company
420 Sunset Street
Longmont, CO 80501

Prepared by:
Maureen O'Shea-Stone
170 S. 33rd. Street
Boulder, CO 80303

1.0 INTRODUCTION

This inventory and report are based on walked reconnaissance field surveys conducted at the Lower Boulder Creek/ Coal Creek Corridor site July through September, 1997. The purpose of these surveys was to identify upland plant communities, compile preliminary upland community species lists, map the location and extent of weed populations, and the location of any sensitive, rare, or threatened and endangered plant species.

2.0 METHODS

The size of the site, as well as physical considerations such as access and creek crossings, necessitated conducting the field surveys in subunits. Individual units were defined by physical boundaries such as roads, private property lines, ditches, Boulder Creek, and Coal Creek. Because of the land use history of the site, these physical boundaries often coincided with plant community boundaries as well. Each unit was mapped on mylar overlays of aerial photos. Major roads and drainages were also traced and labeled on the overlays for orientation. Each unit was photographed and described in terms of plant community composition, structure, and general ecological quality. Particular attention was paid to the location and extent of noxious weed populations and any habitat that appeared suitable for sensitive, rare, or threatened and endangered plant species. All botanical nomenclature follows Weber, 1990.

3.0 INVENTORY RESULTS

Results of the inventory surveys are presented below. Figure 3.1 locates the discussed communities and populations. Table 3.1 presents results of surveys for sensitive, rare, or threatened and endangered plant species. A list of upland plant species found during the survey is located in Appendix A. Site photographs are located in Appendix B.

3.1 Upland Plant Communities

Six general types of upland plant communities were identified during this study: 1) cottonwood groves, 2) cobble bars 3) reclaimed fields/pastures, 4) weedy fields, 5) cultivated fields, and 6) cottonwood/ shrub.

Cottonwood groves

This community occurs in the western half of the site where mature cottonwoods, and other trees, form a canopy layer in upland areas contiguous with the Boulder Creek riparian corridor (Figure 3.1). Plains cottonwoods (*Populus deltoides*) dominate these areas, with smaller canopy contributions by narrowleaf cottonwoods (*P. angustifolia*), crack willow (*Salix fragilis*), box-elder (*Negundo aceroides*), and Russian-olive (*Elaeagnus angustifolia*). Undisturbed natural communities of this type are usually notable for a thick, diverse shrub component. This understory is instead dominated by a weedy forb community of perennial peppergrass (*Cardaria latifolia*), Canada thistle (*Cirsium arvense*), bouncingbet (*Saponaria officinalis*), ragweed (*Ambrosia psilostachya*) and some grasses such as smooth brome (*Bromus inermis*), bentgrass (*Agrostis stolonifera*), and bluegrass (*Poa* spp.) with few individuals of snowberry (*Symphoricarpos* spp.) and wild rose (*Rosa* spp.). Large stands of teasel (*Dipsacus sylvestris*) grow in moister depressions. This understory plant community occurs throughout the site wherever there is a tree canopy and grades into contiguous areas.

Cobble bars
This community type also occur in the west end of the site. Two of these areas are on "islands" in Boulder creek. A third is slightly east of the other two, on the south side of the creek. Dredging of the creek corridor and formation of artificial channels apparently created these areas. Portions of these areas have a canopy of the tree species described above (Photo 1). The center of these areas have no tree canopy and much of the surface is exposed cobbles and sand. These areas support a diverse weedy community dominated by cheatgrass (*Anisantha tectorum*), giant mullein (*Verbascum thapsus*), ragweed, hairy golden aster (*Heterotheca villosa*), and silver sage (*Artemisia frigida*). The largest island also supports a population of brittle cactus (*Opuntia fragilis*). Scattered individuals of diffuse knapweed (*Acosta diffusa*) occur on the two islands. The larger cobble bar to the east supports a large population of diffuse knapweed (Photo 2).

Reclaimed fields/pastures
These types of communities occupy the largest portion of upland area on the site. All are dominated by grasses and exhibit a notable paucity of forb and shrub diversity. The particular species mix in each area appears to reflect its land use history. Some areas support weedy grasses associated with cultivated crops. Some areas support thick cover by introduced pasture grasses. Some are entirely dominated by introduced grasses used for reclamation. And some support a mix of native and introduced grasses. Several of these different areas show signs of very intensive grazing by cattle and horses.

One area at the east end of the site (Figure 3.1) appears to be a fallow field dominated by pasture grasses such as timothy (*Phleum pratense*), and weedy grasses such as barnyard grass (*Echinochloa crus-galli*), witchgrass (*Panicum capillare*), smooth brome, foxtail barley (*Critesion jubatum*), and longspine sandbur (*Cenchrus longispinus*).

Pasture grasses dominate the area west of Highway 287 and north Boulder Creek (Photo 3). This is very similar to the fields between Highway 287 and N. 109th street, on both sides of the creek (Photo 4). These areas support abundant stands of slender wheatgrass (*Elymus trachcaulus*), western wheatgrass (*Pascopyrum smithii*), and intermediate wheat grass (*Elytrigia intermedia*) interspersed with smooth brome, blue grasses, white sweet-clover (*Melilotus alba*), and alfalfa (*Medicago sativa*). Other common forbs of pasture and fields also occur in these areas: tumble mustard (*Sysimbrium altissimum*), chicory (*Cichorium intybus*), clasping peppergrass (*Lepidium perfoliatum*), perennial peppergrass, gumweed (*Grindelia squarrosa*), prickly lettuce (*Lactuca serriola*), ragweed, golden hairy aster, and Canada thistle. The area west of Highway 287, and the area east of Highway 287 and south of Boulder Creek, were grazed late in the summer, but not heavily so (Photo 5). The area east of the highway and north of the creek did not appear to be grazed this season, or the last, which may explain its very good grass cover and relatively sparse weed component. However, the southern edge of this field does support a thick stand of cheat grass interspersed with Russian thistle (*Salsola australis*), clasping peppergrass, and field bindweed (*Convolvulus arvensis*).

The fields north of Boulder Creek and between N. 109th Street and the curve in Kenosha Road to the east were grazed by the time they were surveyed in July. The grazing intensity in the western portion of this area was so severe that identification of plants was difficult. Most plants occur as small patches of stems with large areas of bare ground between. Species identified in this area include puncturevine (*Tribulus terrestris*), tumble mustard, western wheat grass, field bindweed, smooth brome, Russian thistle, salsify (*Tragopogon dubius*), clasping peppergrass, foxtail barley, and alfalfa.

The east portion of this area surrounds a large pond. The vegetation is dominated by large clumps of tall wheatgrass (*Lophopyrum elongatum*) grazed to short stalks surrounded by large areas of bare ground, clumps of saltgrass (*Distichlis spicata*), and slender wheatgrass (*Elymus trachycaulus*). One very large crack willow dominates the southern edge of this field. A population of butter-and-eggs (*Linaria vulgaris*) occurs in the southwest corner of this field. A population of musk thistle (*Carduus nutans*) occurs along a ditch in the southeast end. A population of diffuse knapweed occurs along the curve in Kenosha Road at the east edge of the field.

The largest area in this type occupies the area south of Boulder Creek, between N. 109th Street and N. 119th Street. All of this area appears to have been grazed by cattle this summer. In places, the grazing intensity is severe, plants are grazed to short stalks, and the soil is heavily disturbed (Photo 6). This area is dominated by common reclamation grasses and has a notably sparse forb component.

The triangular area on the western edge of this unit is strongly dominated by smooth brome with some slender wheatgrass and intermediate wheatgrass (Photo 7). Large amounts of bare ground occur throughout this area. This community grades into another to the east dominated by crested wheatgrass (*Agropyron cristatum*). Grazing effects are most pronounced in a rectangle at the western edge of the main portion of this area. The soil in this area is highly disturbed and supports a sparse community of heavily grazed sweetclover (*Melilotus* spp.) and stunted sandbar willow (*Salix exigua*) (Photo 8).

The eastern portion of this area surrounds a large pond and extensive wetlands. Smooth brome and crested wheatgrass are the dominant vegetation in this area. Mesic swales support patches of saltgrass and foxtail barley, teasel and Canada thistle. Thick patches of three-awn (*Aristida purpurea*) occur on xeric soils. Some small patches throughout this area are distinctive due to very thick cover by native wheatgrasses such as western wheatgrass and slender wheatgrass.

Weedy fields

Much of the upland vegetation in the eastern portion of the study area (east of the curve in Kenosha Road) supports fields dominated by weedy forbs, or weedy forbs with grasses. The area south of Boulder Creek and east of the Kenosha Road curve is notable for its solid cover by large Russian-thistle plants (Photo 9). Sections of the area to the east were mowed and are dominated by Russian-thistle, field bindweed, prickly lettuce, bindweed, tarweed (*Madia glomerata*), horseweed (*Conyza canadensis*), Canada thistle, curly dock (*Rumex crispus*), musk thistle, and perennial peppergrass (Photo 10). The northeast corner of this area is vegetated by a solid mat of crane's bill (*Erodium cicutarium*), puncturevine, spurrey (*Spergula arvensis*), and purslane (*Portulaca oleracea*). This area grades into a thick stand of cheat grass and a few individuals of diffuse knapweed to the north on a sand and gravel bench. Clumps of tamarix (*Tamarix ramoissima*) are located on the north edge of the westernmost pond and on the west side of the eastern pond.

Fields to the west and south of "Bill's reservoirs" are dominated by smooth brome and the same complex of forbs found to the west: Russian-thistle, prickly lettuce, bindweed, tarweed, horseweed, Canada thistle, curly dock, and perennial peppergrass with field bindweed and some alfalfa (Photo 11). A thin strip of land to the east of the reservoirs is dominated by tall wheatgrass (Photo 12). This area is littered with large pieces of metal, wire, concrete, and broken glass. The area north of the reservoirs supports little grass and the same weed complex described above.

Cultivated fields

Cultivated fields of corn and oats were planted at the west and east sides of the study area. A fallow wheat field is mapped at the eastern side of the site, along County Line Road. A large field located at the southern edge of the area just west of N. 119th Street was mowed before it was surveyed in late August (Photo 13). The area north of Boulder Creek and just east of the curve in Kenosha Road is a hay field.

Cottonwood/ shrub

This small community is located in a dry oxbow of the Coal Creek channel at the east side of the study site. This area is dominated by large plains cottonwoods. Thickets of chokecherry (*Padus virginiana*), wild plum (*Prunus americana*), wild grape (*Vitis riparia*) and Virginia creeper (*Parthenocissus inserta*) grow on the steep banks of the oxbow with numerous dead or dying sandbar willow along the bottom. Poison hemlock (*Conium maculatum*) and Canada thistle grow in thick stands on less-steep portions of the banks. One small portion of the ravine holds standing water with a fringe of catttails (*Typha latifolia*), sedges (*Carex* sp.), goldenrod (*Solidago serotinoides*), and wild rose.

3.2 Sensitive, Rare, or Threatened and Endangered Plants

The site is in proximity to, or contains suitable, habitat for four specific plant species: Bell's twinpod (*Physaria bellii*), plains ragweed (*Ambrosia linearis*), Ute Ladies'-tresses (*Spiranthes diluvialis*), and Fork-tip three-awn (*Aristida basiramea*) (Colorado Natural Heritage Program, 1996). None of these plants were located on the study site. (Table 3.1).

Table 3.1. Possible sensitive, rare, or threatened and endangered plant species, Lower Boulder Creek/Coal Creek Corridor Master Plan Area.

Species	Federal Status	State Status	Comments
Bell's Twinpod (*Physaria bellii*)	C2*	Rare in state	No suitable habitat on site
Plains ragweed (*Ambrosia linearis*)	C2*	Imperiled in state	Not found on site
Ute Ladies'-tresses (*Spiranthes diluvialis*)	Threatened	Imperiled in state	No suitable habitat on site
Fork-tip three-awn (*Aristida basiramea*)	None	Critically imperiled in state	Not found on site

* formerly listed as a candidate species

3.3 Weed Populations

One of the most notable aspects of the entire study area was the large diversity and frequency of weedy plant species in the upland areas. Twenty-two of the 108 identified upland plant species are listed as noxious weeds under the Colorado Weed Law. Although some of these are native plants that are adapted to colonize disturbed ground, many more are adventive, or non-native. The state lists ten weeds as having the highest priority for control based upon their widespread distribution and negative economic impacts. Five of these ten weeds occur on the site: diffuse knapweed, Canada thistle, musk thistle, butter-and-eggs, and field bindweed. Other non-native species of special concern due to their known invasive abilities and subsequent displacement of native species include cheatgrass, tamarix, teasel, Russian-olive, Russian-thistle, and perennial peppergrass (Whitson, et. al., 1996).

4.0 MANAGEMENT RECOMMENDATIONS

Preliminary recommendations for management of upland vegetation at the site are described below. The primary objective of these recommendations is restoration and enhancement of upland habitat throughout the site. Processes to achieve this objective include control of non-native plant populations and prevention of new weed introductions; controlling deleterious effects of livestock grazing; preservation of existing native plants populations; and manipulation of the recovery of communities that have been degraded by non-native species invasion and land use patterns.

4.1 Weed Management

Controlling existing weed populations is considered a high priority management objective. This objective could be implemented in a two-level approach: 1) elimination of small populations of the most invasive non-natives in the near future, and 2) long-term, integrated management of the others. Fortunately, some of the most pernicious non-native plants on the site now occur in small, discrete populations. These populations of diffuse knapweed, Russian-thistle, tamarix, cheatgrass, musk thistle, and butter-and-eggs identified during the survey should be controlled in the near future to prevent their spread. Teasel, Canada thistle, field bindweed, and perennial peppergrass are far more ubiquitous across the site and will need to be controlled using integrated pest management techniques. Prevention of future infestations must be a component of all other management activities.

4.2 Grazing

As noted above, grazing by cattle has contributed to severe upland plant community degradation in several areas on the site. Appropriate plantings and complete removal of domestic animal grazing would be the most straightforward approach to plant community restoration and enhancement of these areas. However, if grazing must continue as a component of agricultural operations, several practices could ameliorate much of the present damage. These would include planting to increase community diversity and rest periods to allow new vegetation to establish. Adjusting grazing to minimize negative impacts to native plants and provide opportunities for native plant reproduction would also enhance the recovery of these areas. In theory, prescriptive livestock grazing can also be carefully used as a management practice to simulate the effects of the natural processes that are no longer part of the ecosystem such as grazing, flooding, and native ungulate grazing.

4.3 Protection and Enhancement of Native Vegetation

As noted above, much of the upland area on the site is degraded by grazing or supports communities dominated by reclamation species and weeds. Perhaps the most valuable native plant community is the cottonwood grove-type discussed above. These areas are very important to the restoration of native plant communities and wildlife habitat. The mature trees in these areas should be protected during the implementation of any other management procedures. Understory seedlings and saplings should be protected and encouraged. Controlling the weed populations that occur in the understory, and planting the native shrubs and herbaceous plants that would be found in this component of a native community, would enhance the ecological value of these groves.

Fields currently dominated by weeds add little to the ecological health of the upland areas. These areas are good candidates for large-scale seeding with native plants. Proper seed selection and caution to prevent the reintroduction of new weeds would result in more diverse plant communities that more closely approximate natural grassland communities.

Although the areas currently planted in reclamation grasses have very low species diversity, many also have a high percentage of cover by established vegetation. These areas are therefore notable by being relatively free of large populations of adventive weeds. Long-term management of these areas should include planting of native species to increase diversity and ecological function. However, if management priorities must be set, these areas could be considered as stable and their enhancement not as critical as some of the issues discussed above.

5.0 REFERENCES

Colorado Natural Heritage Program. 1996. Colorado's natural heritage: rare and imperiled animals, plants, and natural communities. Volume 2, No. 1. April.

Weber, William A. 1990. Colorado flora:eastern slope. University Press of Colorado. Niwot, CO.

Whitson, T. D, L.C. Burrill, S.A. Dewey, D.W. Cudney, B.E. Nelson, R.D. Lee, and R. Parker. 1996. Weeds of the West. Western Society of Weed Science. Newark, CA.

APPENDIX A

Upland Plant Species

Binomial	Common Name	Colorado Listed Noxious Weed*	Family
Negundo aceroides (Acer)	Box-elder		Aceraceae - Maple Family
Spergula arvensis	Corn spurrey		Alsinaceae - Chickweed Family
Amaranthus retroflexus	Redroot pigweed		Amaranthaceae - Amaranth Family
Toxicodendron rydbergii (T. radicans)	Poison ivy		Anacardiaceae - Sumac Family
Conium maculatum	Poison hemlock	yes	Apiaceae - Parsley Family
Apocynum cannabinum	Hemp dogbane		Apocynaceae - Dogbane Family
Asclepias speciosa	Showy milkweed		Asclepiadaceae - Milkweed Family
Acosta diffusa (Centaurea)	Diffuse knapweed	yes*	Asteraceae - Sunflower Family
Ambrosia artemisiifolia	Common ragweed		Asteraceae - Sunflower Family
Ambrosia psilostachya	Ragweed		Asteraceae - Sunflower Family
Ambrosia trifida	Giant ragweed		Asteraceae - Sunflower Family
Arctium minus	Common burdock	yes	Asteraceae - Sunflower Family
Artemisia frigida	Fringed sagebrush		Asteraceae - Sunflower Family
Artemisia ludoviciana	Prairie sage		Asteraceae - Sunflower Family
Aster porteri	Aster		Asteraceae - Sunflower Family
Carduus nutans	Musk thistle	yes*	Asteraceae - Sunflower Family
Cichorium intybus	Chicory	yes	Asteraceae - Sunflower Family
Cirsium arvense	Canada-thistle	yes*	Asteraceae - Sunflower Family
Conyza canadensis	Horseweed		Asteraceae - Sunflower Family
Grindelia squarrosa	Curlycup gumweed		Asteraceae - Sunflower Family
Helianthus annuus	Common sunflower		Asteraceae - Sunflower Family
Heterotheca villosa	Hairy golden aster		Asteraceae - Sunflower Family
Lactuca serriola	Prickly lettuce		Asteraceae - Sunflower Family
Madia glomerata	Tarweed		Asteraceae - Sunflower Family
Senecio vulgaris	Common groundsel	yes	Asteraceae - Sunflower Family
Solidago serotinoides	Goldenrod		Asteraceae - Sunflower Family
Tragopogon dubius	Western salsify		Asteraceae - Sunflower Family

Binomial	Common Name	Colorado Listed Noxious Weed*	Family
Lepidium perfoliatum	Clasping pepper-grass	yes	Brassicaceae - Mustard Family
Cardaria latifolia (Lepidium)	Perennial peppergrass	yes	Brassicaceae - Mustard Family
Sisymbrium altissimum	Tumble mustard		Brassicaceae - Mustard Family
Opuntia fragilis	Brittle cactus		Cactaceae - Cactus Family
Humulus lupulus	Hops		Cannabaceae - Hops Family
Saponaria officialis	Bouncing Bet	yes	Caryophyllaceae - Pink Family
Bassia scopularia (Kochia)	Ironweed	yes	Chenopodeaceae - Goosefoot Family
Chenopodium album	Goosefoot		Chenopodeaceae - Goosefoot Family
Salsola australis (S. iberica)	Russian-thistle	yes	Chenopodeaceae - Goosefoot Family
Convolvulus arvensis	Field bindweed	yes*	Convolvulaceae - Morning glory Family
Carex sp.	Sedge		Cyperaceae - Sedge Family
Dipsacus sylvestris (D. fullonum)	Teasel	yes	Dipsacaceae - Teasel Family
Elaeagnus angustifolia	Russian-olive		Elaeagnaceae - Oleaster Family
Amorpha fruticosa	Leadplant		Fabaceae - Pea Family
Astragalus sp.	Locoweed		Fabaceae - Pea Family
Glycyrrhiza lepidota	Wild licorice		Fabaceae - Pea Family
Medicago sativa	Alfalfa		Fabaceae - Pea Family
Melilotus alba	White sweet-clover		Fabaceae - Pea Family
Melilotus officinalis	Yellow sweet-clover		Fabaceae - Pea Family
Robinia pseudoacacia	Black locust		Fabaceae - Pea Family
Thermopsis rhombifolia	Golden banner		Fabaceae - Pea Family
Erodium cicutarium	Cranes' bill	yes	Geraniaceae - Geranium Family
Lemna minor	Duckweed		Lemnaceae - Duckweed Family

Binomial	Common Name	Colorado Listed Noxious Weed*	Family
Fraxinus pensylvanica	Ash		Oleaceae - Olive Family
Oenothera albicaulis	Evening-primrose		Onagraceae - Evening-primrose Family
Oenothera villosa	Evening-primrose		Onagraceae - Evening-primrose Family
Plantago major	Common plantain		Plantago - Plantain Family
Agropyron cristatum	Crested wheatgrass		Poaceae - Grass Family
Agrostis scabra	Ticklegrass		Poaceae - Grass Family
Agrostis stolonifera	Redtop		Poaceae - Grass Family
Anisantha tectorum (Bromus)	Cheat grass	yes	Poaceae - Grass Family
Aristida purpurea	Three-awn		Poaceae - Grass Family
Avena fatua	Oats		Poaceae - Grass Family
Bouteloua curtipendula	Side-oats grama		Poaceae - Grass Family
Bouteloua gracilis	Blue grama		Poaceae - Grass Family
Bromopsis inermis (Bromus)	Smooth brome		Poaceae - Grass Family
Bromopsis porteri (Bromus)	Nodding brome		Poaceae - Grass Family
Cenchrus longispinus	Sandbur	yes	Poaceae - Grass Family
Critesion jubatum (Hordeum)	Foxtail barley		Poaceae - Grass Family
Dicanthelium oligosanthes			Poaceae - Grass Family
Distichlis spicata	Saltgrass		Poaceae - Grass Family
Echinochloa crus-galli	Barnyard grass		Poaceae - Grass Family
Elymus trachycaulus (Agropyron)	Slender wheatgrass		Poaceae - Grass Family
Elytrigia dasystacya (Agropyron)	Thickspike wheatgrass		Poaceae - Grass Family
Elytrigia intermedia (Agropyron)	Intermediate wheatgrass		Poaceae - Grass Family
Glyceria grandis	American mannagrass		Poaceae - Grass Family
Koeleria macrantha	Prairie junegrass		Poaceae - Grass Family
Lophopyrum elongatum (Agropyron)	Tall wheatgrass		Poaceae - Grass Family
Panicum capillare	Witchgrass		Poaceae - Grass Family
Pascopyrum smithii (Agropyron)	Western wheat grass		Poaceae - Grass Family
Phalaroides arundinacea	Reed canarygrass		Poaceae - Grass Family
Phleum pratense	Timothy		Poaceae - Grass Family
Poa pratensis	Kentucky bluegrass		Poaceae - Grass Family
Poa sp.	Blue grass		Poaceae - Grass Family
Polypogon monspeliensis	Rabbitfoot grass		Poaceae - Grass Family

Binomial	Common Name	Colorado Listed Noxious Weed*	Family
Puccinellia distans	Alkaligrass		Poaceae - Grass Family
Sorghum halepense	Johnsongrass	yes	Poaceae - Grass Family
Sporobulus cryptandrus	Sand dropseed		Poaceae - Grass Family
Triticum aestivum	Wheat		Poaceae - Grass Family
Polygonum sp.			Polygonaceae - Buckwheat Family
Rumex crispus	Curly dock		Polygonaceae - Buckwheat Family
Portulaca oleracea	Purslane		Portulacaceae - Purslance Family
Padus virginiana (Prunus)	Chokecherry		Rosaceae - Rose Family
Potentilla sp.	Cinquefoil		Rosaceae - Rose Family
Prunus americana	Wild plum		Rosaceae - Rose Family
Rosa woodsii	Wild rose		Rosaceae - Rose Family
Symphoricarpos occidentalis	Snowberry		Rosaceae - Rose Family
Populus angustifolia	Narrow leaf cottonwood		Salicaceae - Willow Family
Populus deltoides	Plains cottonwood		Salicaceae - Willow Family
Salix babylonica	Weeping willow		Salicaceae - Willow Family
Salix exigua	Sand bar willow		Salicaceae - Willow Family
Salix fragilis	Crack willow		Salicaceae - Willow Family
Linaria vulgaris	Butter-and-eggs	yes*	Scrophulariaceae Figwort Family
Verbascum thapsus	Great mullien	yes	Scrophulariaceae Figwort Family
Physalis virginiana	Ground-cherry		Solanaceae - Nightshade Family
Solanum rostratum	Buffalobur		Solanaceae - Nightshade Family
Tamarix ramoissima	Tamarix	yes	Tamaricaceae - Tamarisk Family
Typha latifolia	Broad-leaved cattail		Typhaceae - Cattail Family
Ulmus pumila	Chinese elm		Ulmaceae - Elm Family
Verbena hastata	Vervain		Verbenaceae - Vervain Family

Binomial	Common Name	Colorado Listed Noxious Weed*	Family
Parthenocissus inserta	Virginia creeper		Vitaceae - Grape Family
Vitis riparia	Wild grape		Vitaceae - Grape Family
Tribulus terrestris	Puncture vine	yes	Zygophyllaceae - Caltrop Family

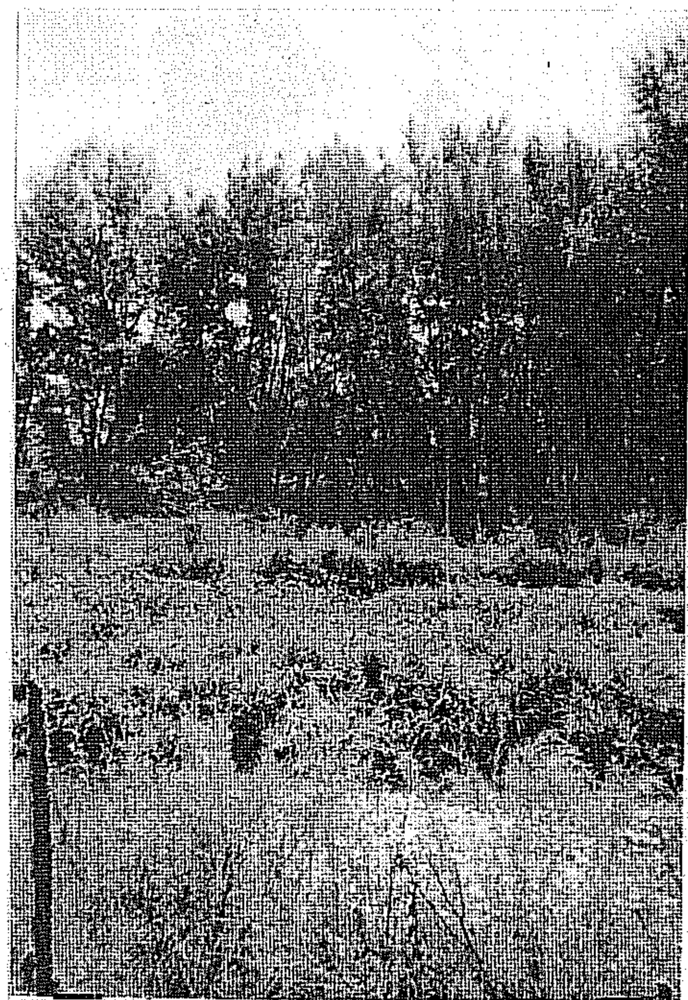
Note: Nomenclature follows Weber, W. A. 1990. Colorado Flora: Eastern Slope. Univ. Press of Colorado. Niwot. CO. Names in parentheses are common synonomies.

* Top ten weed species prioritized for control by State of Colorado due to widespread distribution and negative economic impact.

APPENDIX B

Photographs

Photo 1



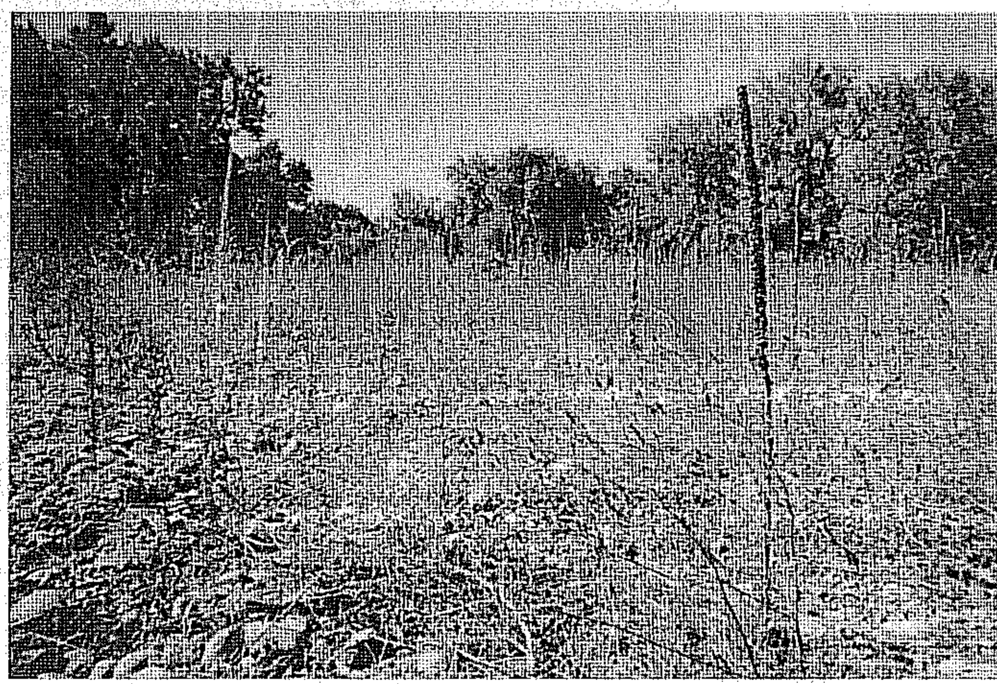


Photo 2

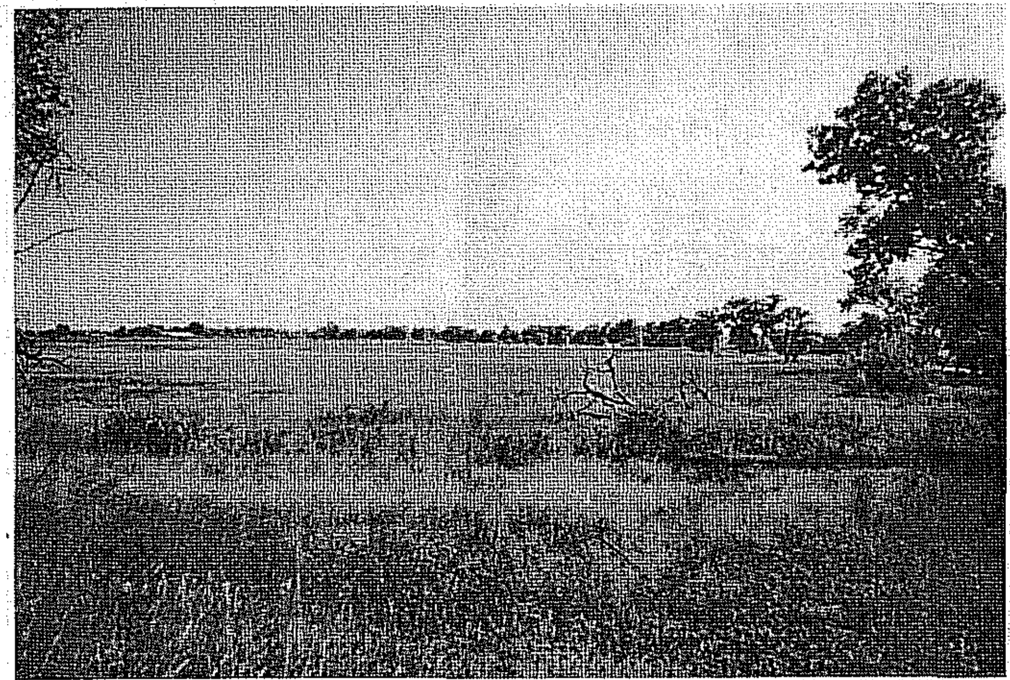


Photo 3

Photo 4

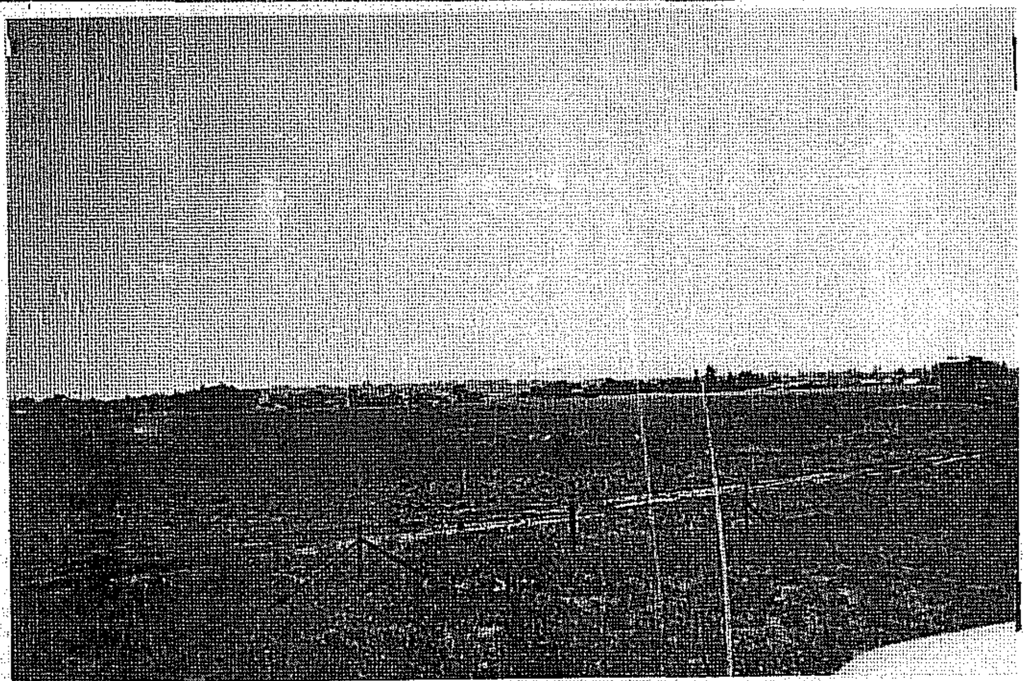


Photo 5

Photo 6

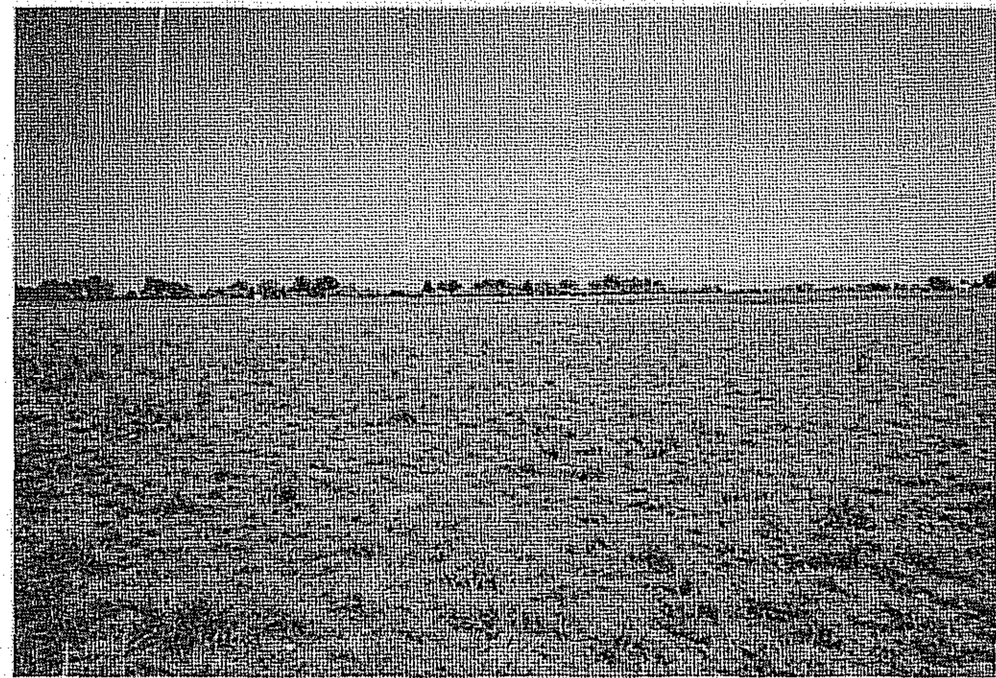


Photo 7

Photo 8

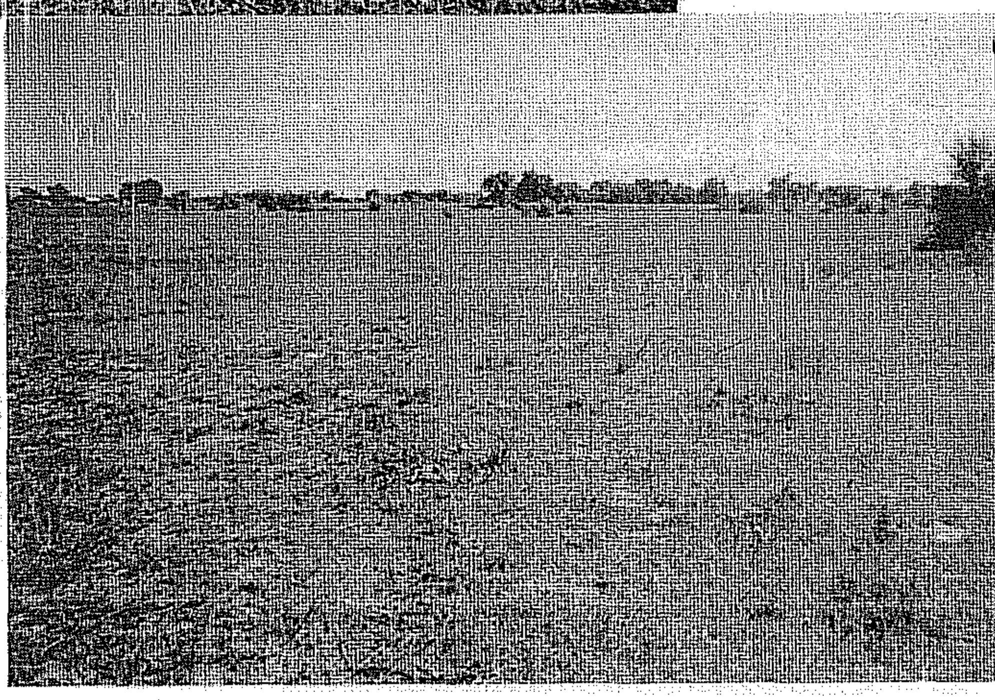


Photo 9

Photo 10

Photo 11

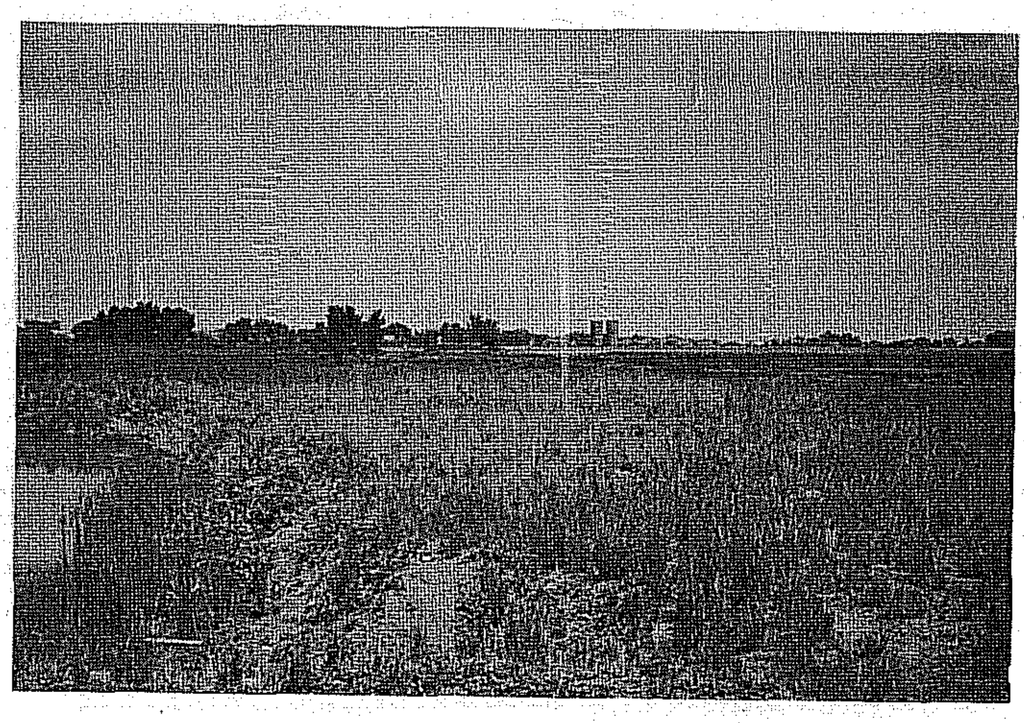


Photo 12

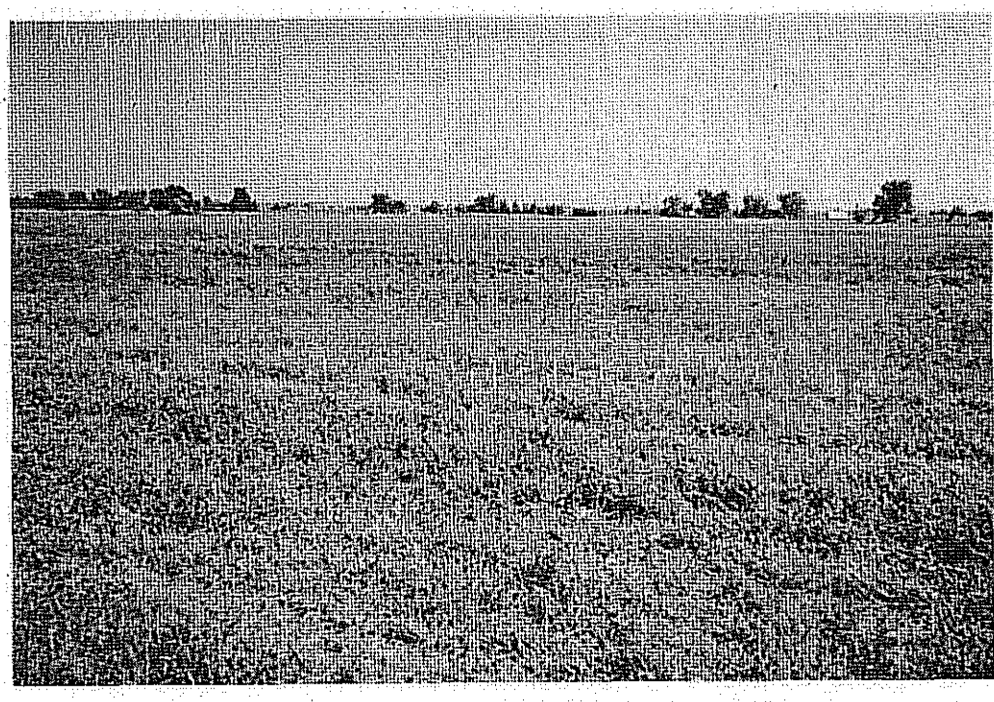


Photo 13

Mapping, Ecological Characterization and Functional Assessment of Wetlands and Riparian Areas Along Lower Boulder Creek

Prepared for:

Anderson and Company
420 Sunset Street
Longmont, Colorado 80501

By:

Don D'Amico
Wetland Ecologist
901 Brooklawn Drive
Boulder, Colorado 80303
(303) 494-7959

28 January 1998

INTRODUCTION

Wetlands are among the most biologically diverse and productive ecosystems on earth (Mitsch and Gosselink 1993). In their natural state, they provide a variety of benefits including flood conveyance, shoreline stability, water quality improvement, food chain support, fish and wildlife habitat and recreational values (Adamus 1983). Despite their many social, economic and ecological values, wetland losses due to human exploitation have been extensive. Many wetlands have been significantly degraded by activities such as filling, draining, stream dewatering and channelization. Historically Boulder Creek occupied a broad floodplain and supported numerous wetlands. Aerial photographs from 1937 show prairie marshes, wet meadows and extensive riparian woodlands. Due to floodplain development, channelization, streamflow alterations and other factors, the aerial extent and types of wetlands that once existed in the Boulder Creek floodplain have been dramatically altered.

The purposes of this study are to (1) map the locations of wetlands along lower Boulder Creek, (2) perform an ecological characterization, and (3) evaluate the functions currently being performed by these wetlands. The results of this study can be used to help formulated land management decisions, guide restoration activities and identify important areas for preservation.

METHODS

REVIEW OF EXISTING WETLAND MAPS AND PREVIOUSLY CONDUCTED STUDIES

Prior to field work, a review of previous studies was performed to identify data gaps and help guide field surveys. Three major studies are summarized below.

A. U.S. Fish and Wildlife Service National Wetland Inventory

As part of the National Wetlands Inventory, the U.S. Fish and Wildlife Service identified wetlands primarily by stereoscopic analysis of 1:58,000 scale color infrared aerial photographs. The final products of this analysis show wetland boundaries and wetland classifications (Cowardin et al. 1979) on 1:24,000 scale USGS topographic maps. While NWI maps show the locations and characteristics of most wetlands in a given area, there are inherent limitations in their utility. For example, land use changes such as gravel mining, changing irrigation practices, residential development and other modifications that occurred since the photographs were taken were common in the study area. In addition, certain wetland types are difficult to identify on aerial photographs including temporarily flooded meadows, forested wetlands and wetlands with a high water table but no standing water. As a result of these limitations, NWI maps were used as a preliminary source of information on the general locations of major wetlands in the study area but not used for more detailed field surveys.

B. Wetland Inventory on Private Property in Boulder County

Wetland mapping was performed in 1993 by Wright Water Engineers for Boulder County Parks and Open Space and the U.S. Environmental Protection Agency, Region VIII. The results of this study are discussed in a final report entitled Wetland Identification and Inventory for Private Property in Unincorporated Boulder County (Wright Water Engineers, 1993). As the title states, the study was performed on private property in Boulder County which required contacting landowners and requesting permission to access their properties. Access was granted approximately 20 percent of the time. When access was denied, wetlands were either surveyed from a road or other vantage point, or not surveyed at all. In the lower Boulder Creek study area, these limitations resulted in:

1. A total of seven wetlands identified in the study area (although separate wetland areas with the same water source were recorded as the same wetland).
2. A total of 14 plant species identified in all wetlands in the study area and a maximum of eight species identified in any one wetland.
3. No soils information from any wetlands in the study area.
4. General hydrologic information collected on some wetlands (water source and maximum water depth).
5. Some wetlands being missed altogether.

C. Boulder County Parks and Open Space and Boulder County Nature Association Survey of Plains Riparian Vegetation in Boulder County

The purposes of this study were (1) to quantify the extent of riparian vegetation along seven streams on the plains of Boulder County and (2) to measure qualitative parameters such as tree canopy coverage, shrub understory coverage and cottonwood regeneration. Vegetation surveys on Boulder Creek immediately west of the study area showed mostly mature (>11" dbh) cottonwood (*Populus* spp.) trees with little or no regeneration, many crack willows (*Salix fragilis*, a non-native species) and small Russian olive (*Elaeagnus angustifolia*) trees, and poor structural diversity. Furthermore, the study found that willows comprised the majority of Boulder Creek's overstory. Although willows were not identified to the species level, it is likely that crack willows were the major component.

FIELD SURVEYS

A. WETLAND MAPPING

At the beginning of the study, blueline reproductions of 1"=400' aerial photographs taken in 1984 by Public Service Company of Colorado were used to locate wetlands in the study area. It quickly became apparent that since the photographs were taken, significant changes to the study area landscape had occurred. Gravel mining, natural and man-caused channel alterations, and development had taken place which rendered the photographs impractical for wetland mapping. Subsequently, a 1"= 400' black and white aerial photograph taken 9 October 1996 was used as a base map.

A provisional wetland map of the study area was then prepared by reviewing existing wetland maps and reports for known wetlands. As stated above, these sources show the larger, more conspicuous wetlands such as ponds, marshes and riparian areas. Information was added to this map by analyzing the most recent aerial photograph for additional wetland signatures. The map produced from these information sources provided a draft wetland map from which field surveys were based. It is important to note that the purpose of this wetland mapping project was not to plot the exact wetland/upland boundary, but to identify and characterize each individual wetland and map its location.

Information on plant communities, physical (i.e., hydrologic and soils) attributes and general boundaries of the wetlands identified on the base maps was gathered by visiting each wetland. Others too small or inconspicuous to see on the aerial photographs were located in the field and added to the map by walking the entire study area. Data collection methods for vegetation, soils and hydrology are discussed below.

B. ECOLOGICAL CHARACTERIZATION AND CLASSIFICATION

Vegetation data was collected from each wetland to describe the composition of plant communities. Sampling plots approximately 50 m^2 were subjectively located in homogeneous stands of vegetation using the relevé method (Mueller-Dombois and Ellenberg 1974). Depending on the number of stands identified in an individual wetland area, from one to eight plots were sampled per wetland. All plant species occurring in each plot were recorded along with an ocular estimate of the percent cover of each species. Rare or uncommon species encountered outside sampling plots were also noted. A wetland plant species list (flora) was developed from this data, and for each species the U.S. Fish and Wildlife Service's wetland indicator status (Reed 1988) is presented. The wetland indicator status represents the fidelity of each species to wetlands in the Central Plains Region.

Vegetation data was analyzed with the aid of the computer program TWINSPAN (Hill 1979), a hierarchical divisive cluster technique which uses species composition and abundance data to develop a hierarchical classification of plant communities. Classification is important for (1) understanding community structure, (2) gaining insight into underlying environmental factors contributing to variation within communities, (3) identifying which wetland types are common versus rare, and (4) evaluating functional attributes of wetlands (Gauch 1982).

TWINSPAN constructs a two-way ordered table from a site-by-species matrix which can then be represented in the form of a dendrogram. Cut levels of 0, 5, 10, 25 and 50; a minimum group size of five and six division levels were used to perform the analysis.

Information on hydric soils was collected from each wetland by examining physical soil characteristics in soil pits within each vegetation community. Hydric soils were identified using methods in USDA (1996) and soil color determined with Munsell soil color charts (Munsell Color, Baltimore MD). Matrix color immediately below the A horizon and mottle color (when present) were examined to determine whether hydric soil conditions existed. In addition, redoxomorphic features such as gleying, the presence of mottles, high organic content and hydrogen sulfide odor were noted.

Each wetland was evaluated to determine whether it was created by human activities or occurs naturally in the landscape. Natural wetlands occur associated with Boulder Creek as oxbow sloughs, floodplain surfaces or terraces, or where a naturally high water table exists. In the study area, created wetlands are typically the result of gravel mining or irrigation. Where a wetland occurs naturally in the landscape and is partially the result of human alteration, both influences were recorded. For example, a naturally occurring wet meadow may be supplemented by irrigation water and be larger as a result.

To help characterize the hydrologic regimes supporting the wetlands, general hydrologic information was gathered from each wetland. Included was information on water depth or depth to water table, water source and hydroperiod. In addition, electrical conductivity (an indicator of salinity) and pH of surface and ground water were measured when possible. These data were used to develop an understanding of environmental factors contributing to the variability in plant community composition.

C. <u>FUNCTIONAL ASSESSMENT</u>

A functional assessment was performed to identify the extent to which the study wetlands perform important ecological and societal functions. Information on wetland functions is for the most part qualitative as it was beyond the scope of this study to perform a quantitative assessment of each function. However, wetland functions can be assessed qualitatively using methods of Adamus (1983) and Adamus et al. (1987).

The following functions were evaluated for each wetland: ground water recharge, ground water discharge, flood retention, shoreline anchoring, sediment trapping, long- and short-term nutrient retention and removal, within basin and downsteam food web support, fish habitat, wildlife habitat, and passive recreation/heritage value. Each function was rated on two different scales. The first scale is based on how well the wetland performs a particular function and ranges from 1 (does not perform this function) to 5 (performs this function to a very high degree). The second rating is the confidence in the first rating and ranges from "a" (low confidence) to "c" (high confidence). See Adamus et al. (1987) for a detailed discussion of wetland functions.

Each wetland was assigned a number, photographed and the physical limits of each wetland were drawn on the aerial photograph. Data collected from each wetland was compiled on field data sheets, a sample of which is attached. Field investigations were conducted in August and September, 1997.

D. <u>*Spiranthes diluvialis* HABITAT</u>

This study also included surveying wetlands with suitable habitat for the presence of the federally threatened orchid, *Spiranthes diluvialis*. Guidelines discussed in the "*Interim Survey Requirements for Spiranthes diluvialis*" (USFWS 1992) were used to determine which wetlands had suitable habitat. When a wetland with suitable hydrology and plant species that are known to associate with *Spiranthes* was located, the wetland was searched for the presence of the orchid. However, intensive "hands and knees" surveys were not performed. Although no individuals were found during the study, wetlands with habitat that could potentially support this species were noted.

E. Restoration/Enhancement Opportunities

The restoration potential of wetlands that have been degraded or altered by human activities is discussed and recommendations given for restoring or enhancing their biological and functional attributes. Possible restoration techniques include exposing the water table by excavation, modifying the stream channel and slope of the streambank, prohibit grazing by fencing wetlands and riparian areas, weed control, planting and seeding wetland plants or a combination of the above.

RESULTS

Fifty-one wetland areas were mapped in the study area (Figure 1). It is important to note that while the 51 wetland areas are distinct and physically separated from one another, some may be connected hydrologically and temporally. For example, the floodplain surfaces immediately adjacent to the stream channel are all influenced by surface water in the stream. Furthermore, channel meandering and other fluvial processes will change the location, aerial extent and physical characteristics of many of these surfaces over time.

Nearly half (25 of 51) of the wetlands in the study area are natural landscape features (Table 1). The majority of these (14 of 25, 56%) are floodplain surfaces adjacent to the channel of Boulder Creek and are subjected to frequent and regular flooding. Historic aerial photographs show that Boulder Creek meandered across an extensive floodplain. However, altered flow regimes, channelization and land development have straightened and shortened the channel and reduced the extent of these wetlands. In addition, while stream-side wetlands were likely dominated by woody species such as cottonwoods and willows in the past, they are now typified by herbaceous species such as *Phalaroides arundinaceae* which is capable of tolerating anoxic soil conditions. The remainder of the natural wetlands, in order of occurrence, are off-channel sloughs (5), riparian forests (4), and emergent marshes (2).

Fifteen wetlands were apparently created as a result of gravel mining which historically took place throughout much of the study area. Gravel mining lowers the ground surface and often exposes the shallow alluvial aquifer, creating conditions suitable for the development of wetlands. These wetlands occur as ponds or lakes and contain mostly aquatic plant communities. The shorelines are often straight and steep sided with narrow linear zones of emergent vegetation such as cattails or bulrush.

Agricultural wetlands are created when irrigation ditches leak or irrigation return flow accumulates. Soils are often only seasonally saturated (during irrigation season) and plant communities are adapted to these fluctuating water tables. One of the largest wetlands in the study area (wetland 19) is supported by leakage from the Boulder and Weld County Ditch and irrigation return flow from irrigated row crops to the east.

Four wetlands in the study area (#2, 12, 15 and 20) are naturally occurring wetlands augmented by irrigation water. Two wetlands (#5 and 35) are located in previously gravel mined areas and are at least partially supported by irrigation return flows

Community Classification

One hundred thirty seven vascular plant species were identified in 114 plots located in 51 wetland areas (Table 2). Species richness averaged 7.6 species per plot with the highest species diversity occurring predominantly in off-channel sloughs and marshes such as wetlands 4, 5, 7 and 16. The three most common species encountered in the study plots were *Phalaroides arundinaceae*, *Schoenoplectus pungens*, and *Lepidium virginicum*, recorded in 47, 46 and 39 plots, respectively.

Twelve community types were chosen to characterize the wetland vegetation of the study area (Figure 2). Although the TWINSPAN divisions partially reflect the importance of the hydrologic regime, other factors such as landscape position and water chemistry also strongly influence species composition.

The first TWINSPAN dichotomy differentiated vegetation types according to water depth and duration of flooding, with true aquatic stands with perennial standing water grouped separately from seasonally flooded or saturated, non-aquatic stands (Figure 2). The aquatic stands are dominated by submersed species such as *Potamogeton pectinatus*, *Myriophyllum sibericum,* and *Ruppia cirrosa*. This aquatic cluster is further divided in the second level of division into two community types, one dominated by *Ruppia cirrosa* and another dominated by *Potamogeton pectinatus*.

Plots which are seasonally flooded or with water tables at or below the soil surface comprise the other cluster in the first division. These include a large, diverse group of vegetation comprising 106 of the 114 study plots. Further divisions in this cluster correspond to additional partitioning by hydrologic regime and soil and water chemistry.

The non-aquatic plots are partitioned in the second division into emergent marsh communities or moist soil communities with the depth of flooding the most likely factor contributing to vegetation dissimilarities. In the subsequent division, emergent marshes are separated into bulrush marshes with *Schoenoplectus lacustris* subsp. *acutus* as the dominant component and cattail marshes dominated by *Typha latifolia* or *T. angustifolia*.

In the third division, TWINSPAN divides the moist soil plots into salt marsh/meadow communities and riparian communities. The overriding factor differentiating these two groups is clearly soil and water salinity as most of the species in the salt marsh/meadow group are facultative or obligate halophytes (salt-loving plants). Three plots are split from the larger salt marsh/meadow group in the fourth division due to the distinct association of *Critesion jubatum* and *Spergularia media*. The fifth and final division in this group divides the remaining 14 plots into *Schoenoplectus pungens* marshes and *Critesion jubatum/Distichlis spicata* meadows.

The largest of the division level three groups contains 63 riparian plots which vary in elevation relative to the stream channel. This variation results in the plots being subjected to differing flood frequencies, depth and duration of flooding, and disturbance regimes which in turn influences vegetation composition. This is evident in the separation of 26 terrace (e.g. high elevation) plots from 37 floodplain (e.g., low elevation) plots (sensu Osterkamp and Hupp 1984). The floodplain surfaces are flooded on average every one to three years while a decade or more may pass between flooding on terraces.

Floodplain plots are also influenced by base flows in the stream and typically have a high water table for much of the growing season. Thus, disturbance and flood tolerant species such as *Phalaroides arundinaceae* dominate many of these communities. *Salix exigua* is another major component of these communities, often occurring as a co-dominant or "overstory" species. Although rarely flooded, four *Populus deltoides* (plains cottonwood) plots are included in the floodplain group and are split from the more frequently flooded plots. *Bromopsis inermis*, a non-native pasture grass, is the dominant understory species in these plots.

In division five, less frequently flooded terrace plots dominated by weedy species such as *Lepidium virginicum* and *Breea arvense* are separated from more frequently flooded plots dominated by *Carex lanuginosa* and *Schoenoplectus pungens*.

In summary, this community classification illustrates the importance of hydrologic regime and water and soil chemistry in determining the species composition of communities in this study. The stands represented in this study are arranged along a water table gradient with true aquatic communities at one end of the gradient and those with a high water table but not permanent standing water at the other end. Soil and water salinity further influence species composition with salt tolerant bulrush marshes and salt marsh/meadow communities distinctly different from freshwater cattail marshes and riparian wetlands, respectively.

Functional Evaluation

The number of wetlands performing functions to a high or very high degree (rating of 4 or 5, respectively) is shown in Table 3 (for a complete functional rating for each wetland, refer to Table 4). This summary shows that wildlife habitat and shoreline anchoring are performed to a high or very high degree by more than two thirds of the wetlands in the study area. Riparian areas typically support a disproportionate number of vertebrate species (Brinson et al 1981, Knopf 1985, Snyder and Miller 1992) and wetlands adjacent to streams or along floodplain corridors help to sustain this diversity. Riparian forests, especially #49 and #50, and large diverse marsh wetlands such as #16 are particularly important wildlife habitat.

Shoreline anchoring is an important function performed by the floodplain wetlands. The dense herbaceous vegetation combined with willow shrubs stabilize the creek banks and help to prevent erosion, especially during high flows. Gravel ponds and lakes with narrow bands of emergent vegetation also perform this function well. The stems of cattail and bulrush help to dissipate wave action and prevent erosion while the extensive rhizomatous root systems stabilize the soil.

Due to their landscape position, connectivity to the stream and high primary productivity, almost half of the wetlands performed both within basin and downstream food web support to a high degree. The stream transports nutrients produced in riparian forests and floodplain wetlands to organisms inhabiting aquatic communities. As a result, these wetland types typically perform this function.

Short-term nutrient retention is performed by wetlands that are highly productive and trap sediments. The floodplain wetlands and cattail marshes in the study area have these characteristics and retain nutrients during the growing season. However, when plant biomass breaks down after senescence and is flushed downsteam, nutrients are then released and long-breaks down after senescence and is flushed downsteam, nutrients are then released and long-term nutrient retention is not achieved.

Riparian areas are aesthetically pleasing partly because they are associated with streams and are largely undeveloped (due to floodplain restrictions). Most of the study area is also Boulder County Parks and Open Space land where passive recreation is one of the permitted land uses. While the potential for passive recreation is high along Boulder Creek, increased human disturbance can impact the wildlife habitat value of these communities and reduce this function.

Spiranthes diluvialis Habitat Evaluation

The U.S. Fish and Wildlife Service has established habitat requirements and survey guidelines for *Spiranthes diluvialis* (USFWS 1992). Habitat requirements of this species include (1) a seasonally high water table (within 18" of the ground surface for at least one week during the growing season), (2) proximity to stream channels or floodplains, (3) associate vegetation typically found in wetlands (Facultative Wetland or Obligate wetland status), and (4) sites that are jurisdictional wetlands. Several wetlands in the study area had associate species and physical conditions suitable for *Spiranthes* including wetlands 2, 4, 12, 16, 24, 49 and 50. However, none of these were ideal habitat due to non-native weed infestation and past human disturbances, mostly gravel mining. No individual orchids were observed during the wetland vegetation surveys.

The plant is difficult to observe unless in the flowering or fruiting state and may only bloom during years when environmental conditions are suitable. Spiranthes populations are known from upstream on Boulder Creek and it is possible that they occur in wetlands in the study area. Further investigations are therefore needed.

Priority Wetlands for Preservation

Several factors were considered when deciding which wetlands in the study area are the highest priority for preservation. It should be noted however that in the semi-arid west, wetlands comprise a small portion of the landscape while supporting a disproportionate number of species and performing important ecological and societal functions. Thus, careful consideration should be be given to preserving all wetlands regardless of quality.

First, the relative rarity or uniqueness of the wetland was evaluated. For example, cattail marshes, lakes and ponds are relatively common wetland types in the Boulder Valley and along the Colorado Front Range while riparian forests, salt marshes and sedge meadows are not as common. Second, plant species diversity and the number of wetland plant communities in each wetland was considered. The rationale for this factor was based on the assumption that diverse plant communities are more likely to provide habitat for a greater number of invertebrate and vertebrate species and therefore contribute to greater biological diversity in the study area. Third, wetlands that perform a number of wetland functions to a high degree were deemed more valuable than those that performed fewer functions to a lesser degree.

Wetland 5. This wetland is characterized by an emergent salt marsh surrounded by expansive salt marsh/salt meadow communities. Many species of waterfowl and passerine birds were observed while conducting the field survey. In addition, five different community types were recorded and plant species diversity was high. The wetland also performed 11 of the 12 functions to a high or very high degree.

Wetland 16. At least six plant community types were identified in this wetland including salt marsh, freshwater marsh, riparian forest and aquatic. Species diversity was high and there was little evidence of disturbance from grazing. Ten wetland functions were performed to a high or very high degree.

Wetland 30. This abandon oxbow slough exhibits high species diversity and good structural diversity. Many willows and cottonwoods line the edges of a mix of emergent marsh and open water. This wetland type was probably more common in the Boulder Creek floodplain prior to channelization and stream flow alterations.

Wetlands 49 and 50. These two areas support the largest riparian forests in the study area. Although cottonwood and willow regeneration is minimal and weeds are common throughout the understory, the potential exists to restore communities and ecological processes with proper management.

Restoration/Enhancement Opportunities

Restoration and enhancement efforts should be directed at developing and maintaining conditions that promote diverse wetland plant communties and maximizing the performance of ecological functions. Several recommendations are outlined below.

1. Develop a water management plan to restore as much as practicable the historic flow regime of Boulder Creek. Flows which promote channel meandering, transport and deposit sediment in low energy areas and provide sites suitable for cottonwood establishment and long-term forest maintenance should be developed. Although instream flows studies and stream enhancement projects typically addressed habitat for non-native fish species, native fish habitat and adequate flows to maintain riparian trees and shrubs should be addressed. The County should also consider purchasing or transferring water rights to ensure adequate flows and work towards developing public/private partnerships and intergovernmental agreements to achieve this goal.

2. Restore channel meandering by removing lateral dikes and installing engineered structures (i.e., wing deflectors, boulders) to deflect flow and initiate lateral channel movement. When done in conjunction with the first recommendation, this would eventually create point bars on the inside of meander bends where seedling establishment could occur. This would be most appropriate east of Highway 287 where extensive channelization and gravel mining has occurred in the past. The benefits of this type of restoration would likely not be evident for a decade or more but would continue with relatively minimal effort indefinitely.

3. Use grazing as a management tool to control undesireable weeds and promote healthy native plant communities. Although it may not be desirable to eliminate grazing altogether, it should be closely controlled to prevent wetland and riparian degradation. Cattle browse and trample tree seedlings and small trees (Hanson et al. 1988, Krueper 1995) and the long- and short term effects of grazing on riparian trees is poorly understood. Grazing exclosures should be erected and monitored yearly to determine the influence of grazing on the plant communities in

the riparian area.

4. Enhance wetlands in the gravel mined areas north and south of the creek between Highway 287 and 109th Street by excavating to the seasonal high water table and introducing native wetland plants (through seeding or transplanting). A variety of hydrologic regimes should be established to promote a variety of plant communities and habitat diversity.

5. Control undesirable non-native plants using integrated weed management techniques (e.g., mowing, burning, herbicide application). *Lepidium virginicum*, an aggressive non-native species, is ubiquitous throughout wetlands in the study area. Effort should be directed at reducing its aerial extent and spread. In addition, Russian olives are also found in many of the riparian areas. These trees should be removed to prevent their eventual displacement of native cottonwoods and willows.

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Table 1. Origin of wetlands in the study area. Agricultural/Natural and Agricultural/Mining categories indicate natural or gravel mine created wetlands supplemented by irrigation water.

Origin	Total	Percent	Wetland numbers
Natural	25	49	4, 7, 9, 10, 11, 13, 16, 21, 22, 23, 24, 25, 26, 27, 30, 32, 33, 34, 40, 42, 43, 48, 49, 50, 51
Mining	15	29	3, 6, 8, 17, 28, 29, 31, 36, 37, 38, 39, 41, 44, 45, 46
Agricultural	5	10	1, 14, 18, 19, 47
Ag/Natural	4	8	2, 12, 15, 20
Ag/Mining	2	4	5, 35

Table 2. Plant species occurring in wetlands of lower Boulder Creek. National Wetland indicator status' are: FACU= facultative upland, FAC=facultative, FACW=facultative wetland, OBL=obligate wetland, NI=no indicator, NL=not listed. See text for definitions of indicator status rankings. Species nomenclature follows Weber and Wittmann (1996).

SCIENTIFIC NAME	COMMON NAME	INDICATOR STATUS
Agropyron trachycaulum	slender wheatgrass	FACU
Agrostis gigantea	black bentgrass	NI
Agrostis stolonifera	spreading bentgrass	FAC+
Alopecurus aqualis	short-awn foxtail	OBL
Amartanthus retroflexis	red-root amaranth	FACU
Ambrosia psilostachya	ragweed	FAC
Apocynum cannabinum	dogbane	FAC
Arctium minor	burdock	NL
Asclepias incarnata	marsh milkweed	OBL
Asclepias speciosa	showy milkweed	FAC
Aster lanceolatus subsp. hesperius	siskiyou aster	OBL
Bassia sieversiana	Mexican summer cypress	FAC
Bidens cernua	nodding beggarstick	OBL
Bolboschoenus maritimus subsp. paludosus	alkali bulrush	OBL
Breea arvense	Canada thistle	FACU
Bromopsis inermis	smooth brome	NL
Callitriche verna	water starwort	OBL
Carex bebbii	Bebb's sedge	OBL
Carex emoryi	Emory's sedge	OBL
Carex lanuginosa	wolly sedge	OBL
Carex nebraskensis	Nebraska sedge	OBL
Carex praegracilis	clustered field sedge	FACW
Chenopodium album	white goosefoot	FAC
Chenopodium glaucum	oakleaf goosefoot	FACW
Chenopodium rubrum	coast blight goosefoot	OBL
Clematis ligusticifolia	virgin's bower	FACU
Convolvulus arvensis	bindweed	NL
Conyza canadensis	Canada wildrye	FACU-
Critesion jubatum	foxtail	FACW
Cyperus oderatus	rusty flatsedge	FACW
Cyperus rivularis	shining flatsedge	FACW
Daucus carota	Queen Anne's lace	NL
Dipsacus sylvestris	teasel	NI
Distichlis spicata	inland saltgrass	NI
Echinochloa crus-galli	barnyard grass	FACW
Elaeagnus angustifolia	Russian olive	FAC
Eleocharis palustris	spikerush	OBL
Elodea canadensis	waterweed	OBL
Elytrigia repens	quackgrass	FAC
Epilobium ciliatum	hairy willowherb	OBL
Equisetum arvense	horsetail	FAC
Glyceria grandis	giant mannagrass	OBL
Glyceria striata	fowl mannagrass	OBL
Glycyrrhiza lepidota	wild licorice	FACU
Grindelia squarrosa	curlycup gumweed	FACU-

Table 2. Cont'd.

Helianthus nuttallii	Nuttall's sunflower	FAC
Hipochaete hymale	horsetail	FACW
Impatiens capensis	spotted touch-me-not	FACW
Juncus arcticus	Arctic rush	OBL
Juncus articulatus	rush	NL
Juncus compressus	rush	NL
Juncus gerardii	Gerard's rush	NL
Juncus interior	inland rush	FAC
Juncus longistylus	long-style rush	FACW
Juncus torreyi	Torrey's rush	FACW
Lactuca serriola	prickly lettuce	FAC
Leersia oryzoides	rice cutgrass	OBL
Lemna minor	duckweed	OBL
Lepidium virginicum	peppergrass	FACU
Lycopus americanus	American bugleweed	OBL
Lycopus unifloris	northern bugleweed	OBL
Maianthemum stellatum	false solomon's seal	FAC
Melilotis alba	white sweetclover	FACU
Mentha arvensis	field mint	FACW
Mentha spicata	spearmint	OBL
Mimulus glabratus	monkeyflower	OBL
Mollugo verticulata	green carpet weed	FAC
Muhlenbergia asperifolia	alkali muhly	FACW
Myriophyllum sibericum	Eurasian water milfoil	OBL
Nasturtium officinale	watercress	OBL
Negundo aceroides	box elder	FAC
Nepeta cataria	catnip	FACU
Panicum capillare	witchgrass	FAC
Pascopyrum smithii	western wheatgrass	FACU
Persicaria amphibia	water smartweed	OBL
Persicaria hydropiper	marshpepper smartweed	OBL
Persicaria lapathifolia	willowweed	OBL
Persicaria maculata	lady's thumb	OBL
Persicaria punctata	dotted smartweed	OBL
Phalaroides arundinacea	reed canarygrass	FACW+
Plantago lanceolata	English plantain	FAC
Plantago major	common plantain	FAC
Poa compressa	Canada bluegrass	FACU
Poa pratensis	Kentucky bluegrass	FACU
Polygonum arenastrum	knotweed	FACW
Polypogon monspeliensis	rabbitfoot grass	OBL
Populus angustifolia	narrowleaf cottonwood	FACW
Populus argentea	silver poplar	NL
Populus deltoides	plains cottonwood	FAC
Populus x acuminata	lanceleaf cottonwood	FAC
Potamogeton foliosus	leafy pondweed	OBL
Potamogeton nodosus	long-leaf pondweed	OBL
Potamogeton pectinatus	sago pondweed	OBL
Potamogeton pusillus	small pondweed	OBL
Potentilla recta	cinquefoil	NL

Table 2. Cont'd.

Prunus americana	wild plum	NL
Puccinellia airoides	Nuttall alkali grass	OBL
Ranunculus macounii	buttercup	OBL
Ranunculus repens	buttercup	NL
Ribes odoratum	buffalo currant	FAC
Rorippa teres	marsh yellowcress	FACW
Rorripa palustris	bog yellowcress	OBL
Rumex altissimus	pale dock	FAC
Rumex aquaticus	western dock	OBL
Rumex crispus	curly dock	FACW
Rumex stenophylla	narrowleaf dock	FACW+
Rumex triangulivalvis	dock	NL
Ruppia cirrosa	widgeon grass	OBL
Sagittaria cuneata	northern arrowhead	OBL
Sagittaria latifolia	broadleaf arrowhead	OBL
Salix amygdaloides	peach-leaf willow	FACW
Salix exigua	sandbar willow	OBL
Salix fragilis	crack willow	FAC
Schoenoplectus lacustis subsp. acutus	hard-stem bulrush	OBL
Schoenoplectus lacustis subsp. creber	soft-stem bulrush	OBL
Schoenoplectus pungens	three square	OBL
Scirpus lineatus	bulrush	NL
Scirpus microcarpus	small-fruited bulrush	OBL
Solidago canadensis	Canada goldenrod	FACU
Sparganium eurycarpum	big burreed	OBL
Spartina pectinata	prairie cordgrass	FACW
Spergularia media	sandspurry	OBL
Stachys palustris	marsh hedgenettle	OBL
Sueda calcioliformis	seepweed	FACW
Symphoricarpos occidentalis	snowberry	FACU
Tamarix ramosissima	saltcedar	FACW
Taraxacum officinale	dandelion	FACU
Thinopyrum ponticum	wheatgrass	NL
Typha angustifoila	narrowleaf cattail	OBL
Typha latifolia	broadleaf cattail	OBL
Ulmus pumila	elm	NL
Verbascum thapsus	mulein	NL
Verbena hastata	blue vervain	FACW
Veronica americana	American speedwell	OBL
Veronica anagalis-aquatica	water speedwell	OBL
Veronica catanata	pink water speedwell	OBL
Zannichellia palustris	horned pondweed	OBL

Table 3. Functions performed to a high or very high degree by wetlands in the study area.

FUNCTION	NUMBER	PERCENT
Ground Water Recharge	8	16
Ground Water Discharge	7	14
Flood Retention	10	20
Shoreline Anchoring	34	67
Sediment Trapping	15	29
Short-term Nutrient Retention/removal	21	41
Long-term Nutrient Retention/removal	3	6
Within Basin Food Web Support	22	43
Downstream Food Web Support	23	45
Fish Habitat	14	27
Wildlife Habitat	35	69
Passive Recreation/Heritage	21	41

Wetland #	Ground water recharge	Ground water discharge	flood retention	Shoreline anchoring	Sediment trapping	Short-term nutrient retention	Long-term nutrient retention	Within basin food web support
1	5c	2b	3b	3c	3c	3b	2b	2b
2	3c	4c	2b	3b	3c	3b	2b	4b
3	3b	2b	4c	5c	4c	2b	3b	3b
4	4b	2b	3c	4b	3b	4b	3a	3a
5	3c	4c	4c	4c	4c	4b	4b	5b
6	5c	2b	4b	3b	3b	3b	2b	2c
7	2c	2c	2c	4c	4c	3c	2c	2c
8	4c	5c	4c	2b	2b	3b	2b	2b
9	2c	2c	3b	4c	3b	3b	2b	4b
10	2b	2b	2b	4c	3c	3b	2b	3b
11	2b	2b	3b	4c	3c	3b	2b	3b
12	3b	3b	4b	4b	3b	3b	4b	4b
13	2b	2b	3b	4c	3c	3c	3c	4c
14	3b	2c	3c	4c	4b	3b	2c	3c
15	4b	3b	2c	3b	3c	4b	3c	3b
16	5b	4c	3c	4c	3c	4b	4b	4b
17	3b	4c	4c	3c	4c	3b	3b	3b
18	4c	3c	3c	3c	3c	3c	3c	3c
19	3c	4c	3b	4c	3c	4c	3c	4c
20	4b	3b	2b	4c	2c	3c	3c	4c
21	2b	2b	2b	3c	3c	3c	2b	3b
22	2b	2b	3c	5c	4c	3c	2c	3c
23	2b	2c	3c	4c	3c	3c	2c	3c
24	3b	3b	5c	4c	4b	4b	2b	4b
25	3c	2c	3c	3c	3b	3b	2b	3b
26	2b	3c	4b	3b	3c	3c	2b	3b
27	3b	2c	3b	5c	4c	4b	2b	4b
28	3b	2b	3b	3b	2b	4b	2c	4b
29	3b	2c	3b	5c	4c	4c	3b	4b
30	2b	3b	5c	5c	4c	4c	3b	4b
31	2b	2c	3b	3b	2b	2b	2b	3b
32	2c	2c	3c	5c	3c	4c	3b	4c
33	2c	2c	3c	5c	3c	4b	2b	4b
34	2b	2b	4c	5c	5c	4c	2b	4b
35	2b	4c	2c	4c	4c	4c	3c	3b
36	2c	2c	3b	4c	3b	4c	2c	4c
37	2b	2c	2c	3c	2b	2b	3b	4c
38	2b	2c	2c	3c	2b	3b	3b	3b
39	2b	2c	2c	3c	2b	3b	3b	3b
40	2c	2b	3b	5c	3c	4b	2b	4b
41	2c	2b	3b	3c	3c	3c	3c	3c
42	2b	2b	3c	5c	3c	4c	2c	3c
43	2b	2c	3c	5c	3c	4b	2b	3c
44	2c	2c	3c	3c	3c	4c	2c	3c
45	2c	3c	3c	4c	3c	4c	2c	3c
46	2c	2c	3c	4c	3c	3c	2c	3c
47	3c	2c	2c	4c	2c	3c	2c	2c
48	2b	2b	2b	4c	3b	3a	2a	4b
49	2c	2c	3c	4c	4c	3c	2c	4c
50	2c	2c	3c	5c	4c	4c	2c	3c
51	2c	2c	4c	5c	4c	3c	2c	4c

Table 4. Functional rating of all wetlands in Lower Boulder Creek.

Wetland #	Downstream food web support	Fish habitat	Wildlife habitat	Passive rec/ heritage
1	3b	1c	2c	2c
2	3b	1c	4c	2c
3	3c	4c	4c	3c
4	3b	2c	4c	3c
5	4c	4c	5c	4c
6	2c	1c	2c	2c
7	3c	1c	3b	2b
8	3b	1c	2c	2c
9	3b	1c	4c	3c
10	4b	1c	4c	2c
11	4b	2c	3c	3c
12	4c	3c	5c	4c
13	4b	2c	5c	4c
14	3b	1c	4c	3c
15	3b	1c	4c	3c
16	5b	4c	5c	5c
17	3b	5c	3c	4c
18	2c	1c	2c	2c
19	4c	2c	4c	4c
20	4c	2c	5c	4c
21	4b	1c	4c	3b
22	4c	2c	4c	4c
23	4c	2b	5b	4c
24	3c	2c	5c	4c
25	3b	2c	4c	3b
26	3b	2b	3b	3b
27	5c	2c	5c	4b
28	2b	4c	3c	3c
29	3c	2c	5c	4c
30	4b	1c	5c	4c
31	2b	5c	4c	3c
32	5b	2b	4c	3c
33	5c	2c	5c	3c
34	5c	2c	4c	3c
35	3b	2c	4c	3b
36	2c	5c	4c	4c
37	2c	5c	3c	3c
38	2b	4c	3c	2c
39	2b	4c	3c	2c
40	5c	2b	5c	4c
41	2c	5c	3c	3c
42	4c	2c	5c	4c
43	4c	1c	4c	3c
44	2c	5c	3c	3c
45	2c	5c	4c	4c
46	2c	5c	4c	4c
47	3c	1c	3c	2c
48	4b	1c	4c	3c
49	5c	2c	5c	4c
50	4c	2c	5c	4c
51	4c	2c	5c	4c

Table 4. Functional rating of all wetlands in Lower Boulder Creek.

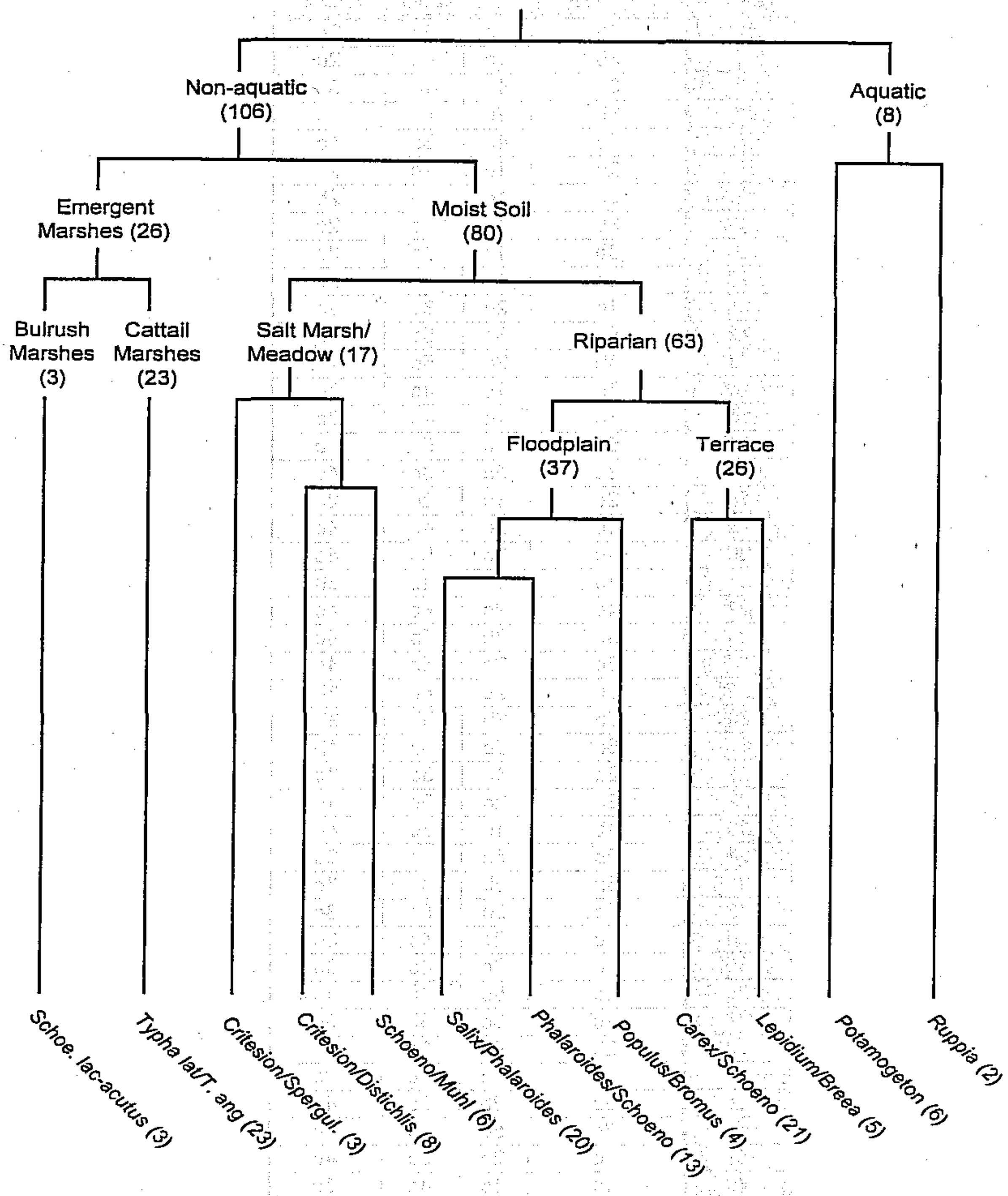

Figure 2. Dendrogram of TWINSPAN classification for study plots on lower Boulder Creek. Community abbreviations are: Schoe.lac-acutus=Schoenoplectus lacustris subsp. acutus, Typha lat/T. ang=Typha latifolia/Typha angustifolia, Critesion/Spergul.=Critesion jubatum/Spergularia media, Critesion/Distichlis=Critesion jubatum/Distichlis spicata, Schoeno/Muhl=Schoenoplectus pungens/Muhlenbergia asperifolia, Salix/Phalaroides=Salix exigua/Phalaroides arundinceae, Phalaroides/Schoeno=Phalaroides arundinaceae/Schoenoplectus pungens, Populus/Bromus=Populus deltoides/Bromopsis inermis, Carex/Schoeno=Carex lanuginosa/Schoenoplectus pungens, Lepidium/Breea=Lepidium virginicum/Breea arvense, Potamogeton=Potamogeton pectinatus, Ruppia=Ruppia cirrosa.

EVALUATION OF WILDLIFE HABITAT
LOWER BOULDER CREEK

Carron A. Meaney, Ph.D.
12 November 1997

INTRODUCTION

The purpose of this informal report is to review the habitat and potential mammalian fauna along lower Boulder Creek and a small portion of Coal Creek for Boulder County Open Space, on a project headed by Peggy Anderson of Anderson and Associates.

METHODS

I used the aerial photographs provided by Peggy, covered them with Mylar, and made notes in a field notebook and on these maps during 8 site visits between August 2 and September 29, 1997. I walked or viewed all of the areas outlined as part of the project. A number of mammal species were seen or heard; others are known from skull and/or bone fragments found on the site, scat, tracks, or dens (for example, beaver lodges). The majority of the species, however, are inferred from their distribution and the presence of suitable habitat as indicated in Armstrong (1972), Armstrong (1984), and Fitzgerald et al. (1994). Nomenclature follows Jones et al. (1992).

RESULTS

Most species of mammals are not seen directly; rather they are inferred from the presence of suitable habitat. However, a few species were seen, or direct signs of them were seen or heard. I observed white-tailed deer (*Odocoileus virginianus*), black-tailed prairie dogs (*Cynomys ludovicianus*), and rock squirrels (*Spermophilus variegatus*). Steve Jones observed raccoons (*Procyon lotor*) and beaver (*Castor canadensis*). I found scat and tracks of coyotes (*Canis latrans*), black bear (*Ursus americanus*), and deer (*Odocoileus* sp.) I found skulls and/or bones of a vole, *Microtus* sp. (in a coyote scat), gopher (Geomyidae), cottontail (*Sylvilagus* sp.), and deer. And I heard calls of a yellow-bellied marmot (*Marmota flaviventris*). A beaver lodge and bank den are located on the oxbow north of Boulder Creek, between Kenosha Road and County Line Road; and an active pathway with beaver tracks was found along the Boulder and Weld Irrigation Ditch, just north of Jasper Road.

A few of these "sightings" are noteworthy. The rock squirrels have made use of the large pile of concrete riprap, located in the southwest corner of Boulder Creek and 109th Street. I have also observed them on the east side of 109th, where there are some large downed tree trunks that provide cover and predator protection. Rock squirrels

live in family groups, and I assume that a family group has taken up residence in this area. Rock squirrels are opportunistic, and have in the past decade or so moved into more urban situations, especially along the Front Range in Colorado.
The calls of the yellow-bellied marmot are noteworthy. I heard it (or them) call on three separate occasions, but was never close enough to observe the animal(s) directly. Their calls do carry quite well (one of their names is "whistle-pig"). I suspect that at least one animal has established a den under a slab of concrete, where a burrow is visible, just east of 109th St. on the north side of the creek. I assume that the animal(s) came from the population at White Rocks Ranch, about four miles west of the present site. Marmots typically establish dens in rock piles in the foothills and mountains in Colorado, but they are adaptable and will also set up house in wood piles, concrete piles, and also do some digging of dens. This location would be the easternmost locality for marmots in Boulder County.

Recommendation: Both the rock squirrels and the yellow-bellied marmot(s) are interesting additions to the mammalian fauna, and can provide animal viewing opportunities for recreationists; the presence of the marmot is more surprising than the rock squirrels. I recommend monitoring for their ongoing presence (a simple undertaking), and avoiding changes or disturbances to the areas on either side of 109th St. unless plans are made to accommodate these species.

Recommendation: The presence of beaver is not surprising. Monitoring of beaver activity would be useful to be aware of potential destruction of trees and shrubs along the creek.

The presence of the black bear is unusual so far east from the foothills. An article in the Lafayette News, Wednesday September 17, 1997, was an excellent confirmation to a scat that I found on Jasper Road. The bear in question had been feeding on Russian-olive seeds, and an unidentified, striped seed. The young bear was relocated, and may be the last of bear sightings on the site. No recommendation.

The prairie dog towns have been mapped (see attached). The relatively large area to the east of Kenosha Road to the footbridge, and south of Boulder Creek should be considered as one interconnected colony. A small colony north of the creek should also be considered as part of this larger prairie dog town. Two other prairie dog colonies were found and mapped, one at the northwesternmost corner of the project area, and one just east of 109th St., on the north side of the creek.

Recommendation: These animals are a significant resource for the predators that they attract, especially raptors, for the wildlife watching opportunities, and because they provide good habitat or habitat elements for sixty-four species of vertebrates (Campbell and Clark 1981). I strongly recommend that this town be left intact. The other two colonies are small. The one by 109th street is interesting in that three or four members of the squirrel family (marmot, rock squirrel, prairie dogs, and fox squirrels) are all visible within one small area. Hopefully, there is no pressure from adjacent landowners to eliminate these small colonies and they can be left intact. If adjacent landowners are having problems, there are some alternative approaches involving visual barriers (vegetation and fencing) that can be used to deter expansion of colonies in particular directions.

I searched for signs of bats in the three abandoned buildings, but found none. Although a number of bat species are possible (see Table 1), big brown bats (*Eptesicus fuscus*) and little brown bats (*Myotis lucifugus*) are very likely. Red bats (*Lasiurus borealis*) are possible as they favor riparian habitats; if present, this would be a western distributional limit for them. Bats are vulnerable to human activities and are in need of conservation efforts. It will therefore be important to determine whether bats are present and, if so, which species.

A list of the mammalian fauna of possible occurrence on the site is provided in Table 1. Information was gathered from a number of sources and from the field site visits. The Environmental Element of the Boulder County Comprehensive Plan of 1984 was used to identify the Basis for Record (documented, hypothetical, etc.); the status of "O" for observed was added to reflect my and Steve Jones' field observations. "Colorado's Natural Heritage: Rare and imperiled animals, plants, and natural communities", April 1996, was used for the global and state status listings as determined by the Colorado Natural Heritage Program. The federal status was taken from "Endangered and Threatened Wildlife and Plants", October 31, 1996, 50 CFR 17.11 & 17.12, published by the U.S. Fish and Wildlife Service. State status was taken from a draft list titled "Colorado's Endangered, Threatened, Special Concern, Undetermined Status and Candidate Species", and provided to me by the Colorado Division of Wildlife. Status codes are explained in Tables 2 and 3.

PREBLE'S MEADOW JUMPING MOUSE

Preble's meadow jumping mice (*Zapus hudsonius preblei*), a state Species of Special Concern that has been proposed for federal listing as endangered, are restricted to well-developed riparian vegetation along creeks and ditches in Colorado. Areas of potentially suitable habitat along Boulder Creek, Coal Creek, and a number of ditches in the project area have been mapped (see attached map). The entire length of the two creeks in the project area has been mapped as potentially suitable. Below I discuss four creek segments and the ditches.

<u>Coal Creek</u>: This section is cultivated and not grazed. The shrub canopy is dense, and although willows and grasses are not abundant, this section does present elements suitable for jumping mice. Jumping mice have been found in recent years further upstream on Coal Creek (by Highway 93 in 1989, and in Jefferson County in 1995 and 1996). This site does appear to provide excellent opportunities for hibernacula (hibernation sites), in that there is very dense shrub cover up out of the drainage.

Recommendation: Move cultivation back from stream corridor, provide 30 meters between water's edge and cultivation.

<u>Boulder Creek from Kenosha east</u>: The vegetation is generally not well-developed along the creek in this section. There are a couple of exceptions, a good patch of willows on the north side, in-between Kenosha Road and the foot bridge, and also a pocket of trees and shrubs on the south side, north of the prairie dog colony.

Recommendation: Allow recreational use in this area, fishing (and beaver watching), cycling, etc. If this area is to be developed for jumping mouse habitat, it will need willow sprigging and/or other additions to the riparian vegetation.

Boulder Creek from U.S. 287 to Kenosha Road: This section does have a tree and shrub canopy all along the north side and on the south side between U.S 287 and 109th St.; however, grazing is active and has reduced the vegetation. The section between 109th and Kenosha Road on the south side, with the exception of the wetland at the eastern end, is heavily grazed and entirely denuded of riparian vegetation. On the north side, east of the point where the property boundary forms a 90 degree angle at the creek, there is an oxbow with well-developed vegetation a beaver lodge; this is an important wildlife area.

Recommendation: Fence the cows out 30 meters from the creek, especially on the north side between 109th and Kenosha, where the vegetation will return with little effort. Protect the north side.

Boulder Creek west from US 287: This section has oxbows and is well-vegetated. This section does provide suitable habitat for jumping mice and for many other species, including bedding areas for deer, good cover for small mammals, and denning sites for raccoons, coyotes, and foxes.

Recommendation: This section should be protected as much as possible.

Ditches: A number of ditches are present on the property and present possible suitable habitat for jumping mice, and have been mapped as such. Of particular interest is the Boulder and Weld Irrigation Ditch; it occurs on the property in two segments, one short segment off of Coal Creek, and a much longer segment between Kenosha and Jasper roads. A third section of this ditch, just north of Jasper Road and west of 109th, is not as well-vegetated, nor is the ditch that parallels Boulder Creek and empties into the wetland southwest of the curve in Kenosha Road. These have both been mapped as they may be dispersal sinks and used for movement by these mice.

Recommendation: Protect the Boulder and Weld Irrigation Ditch, and mitigate ditch-clearing activities, as much as possible.

GENERAL RECOMMENDATIONS AND COMMENTS:

- Three or four members of the squirrel family (rock squirrel, black-tailed prairie dog, yellow-bellied marmot, and fox squirrel) are present in a small area and contribute significantly to the biodiversity of the area. All should be actively protected, including the prairie dogs which provide a significant food base for raptors and other predators.
- Fencing cows out of the vegetated riparian corridors 30 meters away from the creek will vastly enhance habitat for many species, including Preble's meadow jumping mice.
- Revegetation (willow plugs, etc.) along denuded sections of Boulder Creek after cows have been removed, would enhance the habitat for small mammals. Revegetation may also occur naturally.

- Small mammal surveys are recommended to determine biodiversity of this invisible, but ecologically significant, faunal community.
- Monitoring of rock squirrels and marmot(s) is desirable and simple to achieve.
- Bat surveys are recommended, with the use of bat detectors to determine presence/absence, followed by mist-netting to determine species if presence is determined.

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Table 1. Mammal species and their possible occurrence along lower Boulder Creek and Coal Creek.

Mammals	Basis for Record	CNHP Global Status	CNHP State Status	Federal Status	State Status	Comp Plan
<u>Marsupials</u>						
Virginia opossum	D					
<u>Shrews</u>						
Masked shrew	D					
Least shrew	D					
<u>Bats</u>						
Little brown bat	D					
Long-legged myotis	D					
Western small-footed myotis	D					
Silver-haired bat	D					
Big brown bat	D					
Eastern red bat	D	G5	S2B			
Hoary bat	D					
<u>Rabbits</u>						
Eastern cottontail	H					V
Desert cottontail	D					
Black-tailed jackrabbit	H					
White-tailed jackrabbit	D					III,V
<u>Rodents</u>						
Yellow-bellied marmot	O?					
Spotted ground squirrel	D					IV,V
Thirteen-lined ground squirrel	D					IV
Rock squirrel, observed	O					IV
Black-tailed prairie dog	O					
Fox squirrel	D					
Northern pocket gopher	D					
Plains pocket gopher	D					IV,V
Olive-backed pocket mouse	H				SU	IV,V
Plains pocket mouse	H					IV,V
Silky pocket mouse	H				SU	IV,V
Hispid pocket mouse	D					IV,V
Ord's kangaroo rat	H					IV,V
Beaver	O					IV

Table 1. (Cont'd) Mammal species and their possible occurrence along lower Boulder Creek and Coal Creek.

Mammals	Basis for Record	CNHP Global Status	CNHP State Status	Federal Status	State Status	Comp Plan
Plains harvest mouse	H					V
Western harvest mouse	D					
Deer mouse	D					
Northern grasshopper mouse	H					V
Long-tailed vole	D					
Meadow vole	D					V
Prairie vole	D					
Muskrat	D					IV
Meadow jumping mouse	D	G5T2	S2	PE	SC	IV,V
Porcupine	D					
<u>Carnivores</u>						
Coyote	O					
Gray wolf	Ex	G4	SX	E	E	I
Red fox	D					
Swift fox	H	G3	S3?		SU	IV,V
Black bear	O					
Grizzly bear	Ex	G4	SX	T	E	I,II
Raccoon	O					
Long-tailed weasel	D					
Black-footed ferret	Ex	G1	SH	E	E	II
Mink	D					
Badger	D					
Striped skunk	D					
Northern river otter	Ex	G5	S3S4		E	I
Mountain lion	D					
Bobcat	D					III
<u>Ungulates</u>						
Mule deer	D					
White-tailed deer	O					
Elk	D					
Pronghorn	Ex					
American bison	Ex					

Basis for Record (Adopted from David Armstrong's contribution to the Environmental Element of the Boulder County Comprehensive Plan, 1984):
O = Observed on site in 1997, or inferred from scat or other sign; **D** = Documented by museum specimens or historic records for Boulder County; **H** = Hypothetical occurrence, as judged from documented occurrence in similar habitat an/or in adjacent counties; **Ex** = Extirpated.

Table 2. Definition of Natural Heritage Global Rarity Ranks. These ranks should not be interpreted as legal designations.

Global Rank (G): Based on the range-wide status of a species.

G1	Critically imperiled globally because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction. (Critically endangered throughout its range).
G2	Imperiled globally because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction throughout its range. (Endangered throughout its range).
G3	Very rare or local throughout its range or found locally in a restricted range (21 to 100 occurrences). (Threatened throughout its range).
G4	Apparently secure globally, though it might be quite rare in parts of its range, especially at the periphery.
G5	Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
GX	Presumed extinct.
G#?	Indicates uncertainty about an assigned global rank.
GU	Unable to assign rank due to lack of available information.
GQ	Indicates uncertainty about taxonomic status.
G#T#	Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.

Note: Adopted from Colorado's Natural Heritage: Rare and imperiled animals, plants, and natural communities, April 1996, Volume 2, No 1.

Table 2 (Cont'd). Definition of Natural Heritage State Rarity Ranks. These ranks should not be interpreted as legal designations.

State rank (S): Based on the status of a species in an individual state. S ranks may differ between states based on the relative abundance of a species in each state.

S1	Critically imperiled in state because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extirpation from the state. (Critically endangered in state).
S2	Imperiled in state because of rarity (6 to 20 occurrences), or because of other Factors demonstrably making it very vulnerable to extirpation from the state. (Endangered or threatened in state).
S3	Rare in state (21 to 100 occurrences).
S3S4	Watchlisted; specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted
S#B	Refers to the breeding season imperilment of elements that are not permanent residents.
S#N	Refers to the non-breeding season imperilment of elements that are not permanent residents. Where no consistent location can be discerned for migrants or non-breeding populations, a rank of SZN is used.
SZ	Migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected.
SH	Historically known from the state, but not verified for an extended period, usually 15 years; this rank is used primarily when inventory has been attempted recently.
SX	Presumed extirpated from state.
S#?	Indicates uncertainty about an assigned state rank.
SU	Unable to assign rarity rank, often because of low search effort or cryptic nature of the element.
SA	Accidental in the state.
SR	Reported to occur in the state, but unverified.
S?	Unranked; some evidence that species may be imperiled, but awaiting formal rarity ranking.

Note: Adopted from Colorado's Natural Heritage: Rare and imperiled animals, plants, and natural communities, April 1996, Volume 2, No 1.

Table 3. Federal and State status codes, and Boulder County Comprehensive Plan codes.

Federal Status, pursuant to the Endangered Species Act of 1973.

E	Federally listed as Endangered
T	Federally listed as Threatened
PE	Proposed as Endangered in March 1996

State Status, as determined by the Colorado Division of Wildlife, Department of Natural Resources.

ST	State threatened
SE	State endangered
SU	Species of undetermined status
SC	Species of special concern

Boulder County Comprehensive Plan, Environmental Element, 1984

Class I.	Extirpated species, for which there is historical documentation, which which no longer occur in Boulder County.
Class II.	Threatened and Endangered species.
Class III.	Species undergoing long-term, non-cyclical population declines
Class IV.	Species of restricted habitat.
Class V.	Species of undetermined status.
Class VI.	Additional "mammal species of special concern," Colorado Natural Heritage Inventory, Department of Natural Resources, and The Nature Conservancy.

HABITAT USE BY BREEDING BIRDS IN LOWER BOULDER CREEK DRAINAGE

Stephen R. Jones
Environmental Consultant
1 September 1997

ADDENDUM TO BREEDING BIRD STUDY

On 1 November I visited the old barn south of Boulder Creek near the eastern study area boundary to verify a possible barn owl sighting. When I looked into the barn, a great horned owl flew out. Last July I observed a family of great horned owls (2 adults and 2 young) along Boulder Creek approximately 100 m north of this barn.

Also on 1 November, I observed 2 ferruginous hawks, 5 red-tailed hawks, and 1 prairie falcon hunting in and around the prairie dog colonies south of Boulder Creek, between Kenosha Road and the eastern study area boundary.

INTRODUCTION

I conducted a one-season breeding bird study on Boulder County Open Space properties along lower Boulder Creek and lower Coal Creek. The purpose of the study was to collect baseline information concerning habitat use by breeding bird populations on the properties and to determine nesting locations of Boulder County avian species of special concern (Hallock 1993). Management recommendations in this report are directed toward maximizing species richness and breeding bird population density on the properties while protecting habitat for species of special concern.

Methods

Between 30 May-13 July I walked four 0.6-2.2 km transects (three replications, 30 May-9 June, 11-15 June, 25 June-13 July) noting all species seen or heard and marking sighting locations of Boulder County species of special concern on a 7½′ topographic map (Figure 1). Surveys were conducted between 0445 and 0800 MST. I varied the order and direction of transect surveys to minimize seasonal and temporal biases. At 200 m intervals along each transect, I marked point-count stations with blue surveyor's tape. I stopped at each point-count station for five minutes, counting all birds seen or heard, excepting young of the year, within a 100 m radius.

Breeding behaviors were noted for each observed species. I used a simplified version of Colorado Breeding Bird Atlas protocol (see Appendix II) to classify each species as "seen or heard" (no breeding behavior noted or no suitable breeding habitat available) "probable breeder" (exhibited nesting behavior in suitable habitat), or "confirmed breeder" (evidence of nesting such as a nest with eggs or recently fledged young).

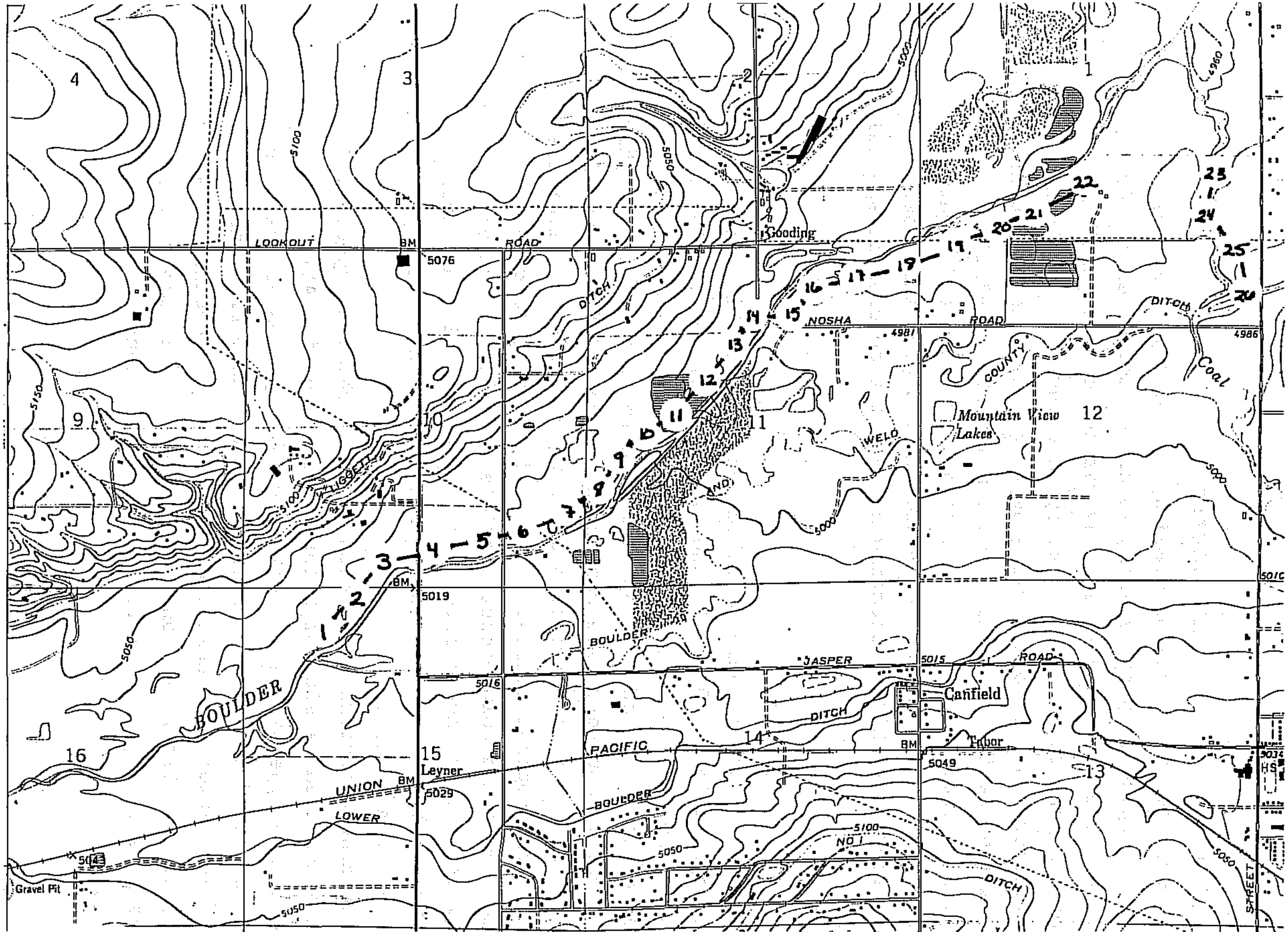

Figure 1. Transects and Point-Count Stations

I also conducted three nocturnal owl surveys along each transect (2, 9, 13 August). In suitable nesting habitat along Boulder Creek (areas with trees or soft embankments for nesting) I stopped every 300 m to play an eastern screech-owl territorial call for 5 minutes (30 seconds on, 30 seconds off, 5 plays). In suitable habitat along Coal Creek, I followed the same procedure, but I also played a common barn owl territorial call for 5 minutes at each stop.

RESULTS AND DISCUSSION

I observed a total of 58 species within the study area between 30 May-20 July (Table 1). Of this total, 24 species definitely nested within the study area, 23 species probably nested, and 11 species were migrants or summer visitants who nest in other regions of Boulder County. I observed 11 Boulder County species of special concern (Table 1). Wood ducks, yellow warblers, and yellow-headed blackbirds definitely nested within the study area. Gray catbirds and blue grosbeaks probably nested. Double-crested cormorants, great blue herons, great egrets, and black-crowned night herons nested in rookeries adjacent to the study area. A single peregrine falcon and a single ovenbird foraged within the study area but did not nest.

Plots located in the Boulder Creek riparian corridor west of US 287 supported relatively high densities of nesting birds (Table 2). This riparian corridor contains many mature cottonwoods and willows. It has been fenced to exclude cattle. In contrast, the Boulder Creek riparian corridor east of Kenosha Road, which is not fenced and contains few mature trees, supported relatively low densities of breeding birds (Table 2). The Coal Creek riparian corridor north of Kenosha Road supported relatively high densities of shrub-nesting birds, including gray catbirds, yellow-breasted chats, lazuli buntings, blue grosbeaks, and song sparrows. This narrow riparian corridor is bordered by irrigated croplands; there is no evidence of recent grazing by cattle. Exclusion of cattle from this area may account for the abundant shrub growth along the creek.

Nesting Raptors

Red-tailed hawks nested along Boulder Creek approximately 700 m east of 109th Street and south of the creek approximately 900 m east of Kenosha Road. Great horned owls nested at three

Table 1

1997 BREEDING SEASON OBSERVATIONS
30 MAY-20 JULY

1: Boulder Creek west from US 287 (.6 km)
2: Boulder Creek east from US 287 to Kenosha Road (2.2 km)
3: Boulder Creek east from Kenosha Road (1.9 km)
4: Coal Creek (1.7 km)

Boldface: Boulder County species of special concern
Underlined: Species not previously documented nesting in county

x--Seen or heard   X—Probable nesting   X̲--Confirmed nesting

Species	1	2	3	4
American White Pelican	x	x		
Double-crested Cormorant*	x	x	x	
Great Blue Heron*	x	x	x	x
Great Egret*	x	x	x	
Black-crowned Night Heron*	x	x	x	
Canada Goose	X̲	X̲	X	X
Wood Duck	X	X̲	X	X
Mallard	X̲	X̲	X̲	X
Red-tailed Hawk	X	X̲	X̲	
Peregrine Falcon		x		
American Kestrel	X	X	X	X
Sora		X		
Killdeer	X	X	X	X
Spotted Sandpiper		X	X	
Common Snipe	X	X		
Ring-billed Gull			x	
Rock Dove	X	X	X̲	X
Mourning Dove	X	X̲	X	X
Great Horned Owl	X̲	X̲	X̲	
Common Nighthawk			X	
Downy Woodpecker	X	X		
Northern Flicker	X	X	X	
Belted Kingfisher		X	X	X̲
Western Wood-Pewee	X	X	X	X
Western Kingbird		X	X	X
Eastern Kingbird		X̲	X̲	X̲
Tree Swallow	X			
Rough-winged Swallow			X	X̲
Cliff Swallow	X̲	X̲	X̲	X̲
Barn Swallow	X	X	X̲	X
Blue Jay	X	X		X
Black-billed Magpie	X̲	X̲	X̲	X̲

Common Raven		x		
Black-capped Chickadee	X	X	X	
House Wren	X	X	X	X
Marsh Wren		X		
American Robin	X	X	X	X
Gray Catbird				X
European Starling	X	X	X	X
Warbling Vireo				X
Yellow Warbler	X	X	X	X
Common Yellowthroat	X	X	X	X
Ovenbird	x			
Yellow-breasted Chat				X
Lazuli Bunting				X
Blue Grosbeak			X	X
Vesper Sparrow		x		
Song Sparrow	X	X	X	X
Red-winged Blackbird	X	X	X	X
Yellow-headed Blackbird		X	X	X
Western Meadowlark	X	X	X	X
Brewer's Blackbird	X	X	X	
Common Grackle	X	X	X	X
Brown-headed Cowbird	X	X	X	X
Bullock's Oriole	X	X	X	X
Orchard Oriole		x		
American Goldfinch	X	X	X	X
House Sparrow	X	X	X	

*These species are included on the County special concern list because they each nest at a single location (rookery) within the county. None nest within the study area.

Table 2

PLOT DENSITIES OF BREEDING BIRDS

Area	Mean Species Per Plot	Mean Indiv. Per Plot	Total Species	Special Concern
Boulder Creek West of 287	11.1	22.2	39	7
Boulder Creek 287 - Kenosha	9.2	18.4	48	8
Boulder Creek Kenosha East	8.4	14.0	42	8
Coal Creek Kenosha North	8.9	14.1	35	6

Boulder Creek West of 287: 3 plots
Boulder Creek 287 - Kenosha: 11 plots
Boulder Creek Kenosha East: 8 plots
Coal Creek Kenosha North: 4 plots

locations along Boulder Creek (Figure 2). I observed American kestrels throughout the study area but found no nests. Suitable eastern screech-owl nesting habitat exists along Boulder Creek west of US 287, but no screech-owls responded to tape playbacks. Common barn owls have nested in a hole in an embankment along Coal Creek approximately 5 km south of the study area; similar habitat exists along Coal Creek north of Kenosha Road.

Management: Divert future trails away from red-tailed hawk nest sites.

Species of Special Concern

The Boulder County Avian Species of Special Concern List (Hallock 1993) includes birds in the following categories:

(1) Boulder County rare and declining.
(2) Boulder County rare.
(3) Boulder County declining but not yet rare.
(4) Boulder County isolated populations.
(5) Federal endangered, threatened, or special concern.
(6) State endangered, threatened, or special concern.
(7) Rocky Mt. region (U.S. Forest Service) special concern.
(8) Audubon Society "Blue List" of declining species.

The following species meet one or more of the above criteria and were observed within the study area between 30 May and 13 July.

1. Double-crested Cormorant, Great Blue Heron, Great Egret, and Black-crowned Night Heron (Boulder County isolated populations)

These herons and cormorants nest in protected rookeries along Boulder Creek between 95th Street and US 287 and at Panama Reservoir. They fish and fly over Boulder Creek from the rookery eastward to the County line. Highest concentrations occur along Boulder Creek from the rookery eastward to Kenosha Road.

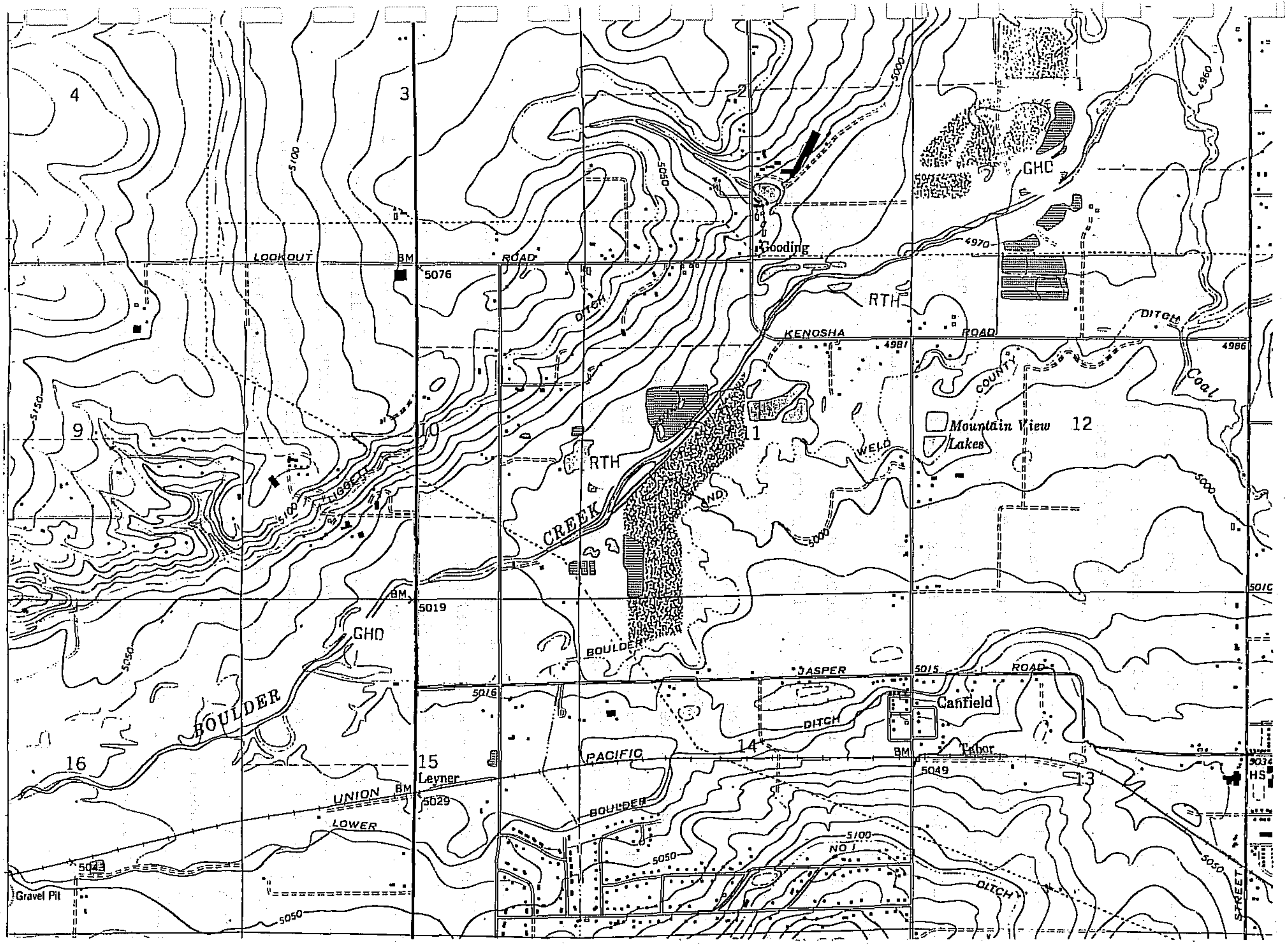

Figure 2. Raptor Nest Locations, 1997

GHO--Great Horned Owl   RTH--Red-tailed Hawk

Management: Areas of the creek where herons and cormorants forage should be protected from disturbance. I recommend that any future trails west of Kenosha Road be placed at least 100 m away from the creek and visually buffered from the creek bed.

2. Wood Duck (Boulder County isolated populations)

Wood ducks nest in tree cavities along prairie streams and around reservoirs in eastern Boulder County. Local nesting populations have increased since the 1970s (Boulder County Audubon Society, 1978-97). Populations are limited by availability of tree cavities or nest boxes (Ehrlich et al 1988).

I observed a pair of wood ducks with recently fledged young in the large pond north of Boulder Creek between 109th Street and Kenosha Road (Figure 3). I also observed adult wood ducks in a wetland south of Boulder Creek, near Plot 17, flying over Boulder Creek near Plot 2, and flying over Coal Creek, near Plot 23.

Management: Retain all standing dead trees along Boulder Creek and Coal Creek. Divert any future trails away from Boulder Creek between the western boundary of the study area and Kenosha Road.

3. Peregrine Falcon (Federal endangered, State threatened, Boulder County rare and stable)

I observed a single adult peregrine falcon perched in a small cottonwood on the south bank of Boulder Creek near Plot 11 on 30 May (Figure 4). Peregrine falcons nest in Boulder County on Eldorado Mountain, in the Boulder Mountain Park, and in the mountains west of Lyons (Armstead and Lederer 1994, Jerry Craig, Colo. Div. of Wildl., pers. commun.). They frequently hunt in prairie wetlands (Andrews and Righter 1992).

Management: Protect the Boulder Creek stream corridor between the western boundary of the study area and Kenosha Road from disturbance by recreational users. Divert trails away from

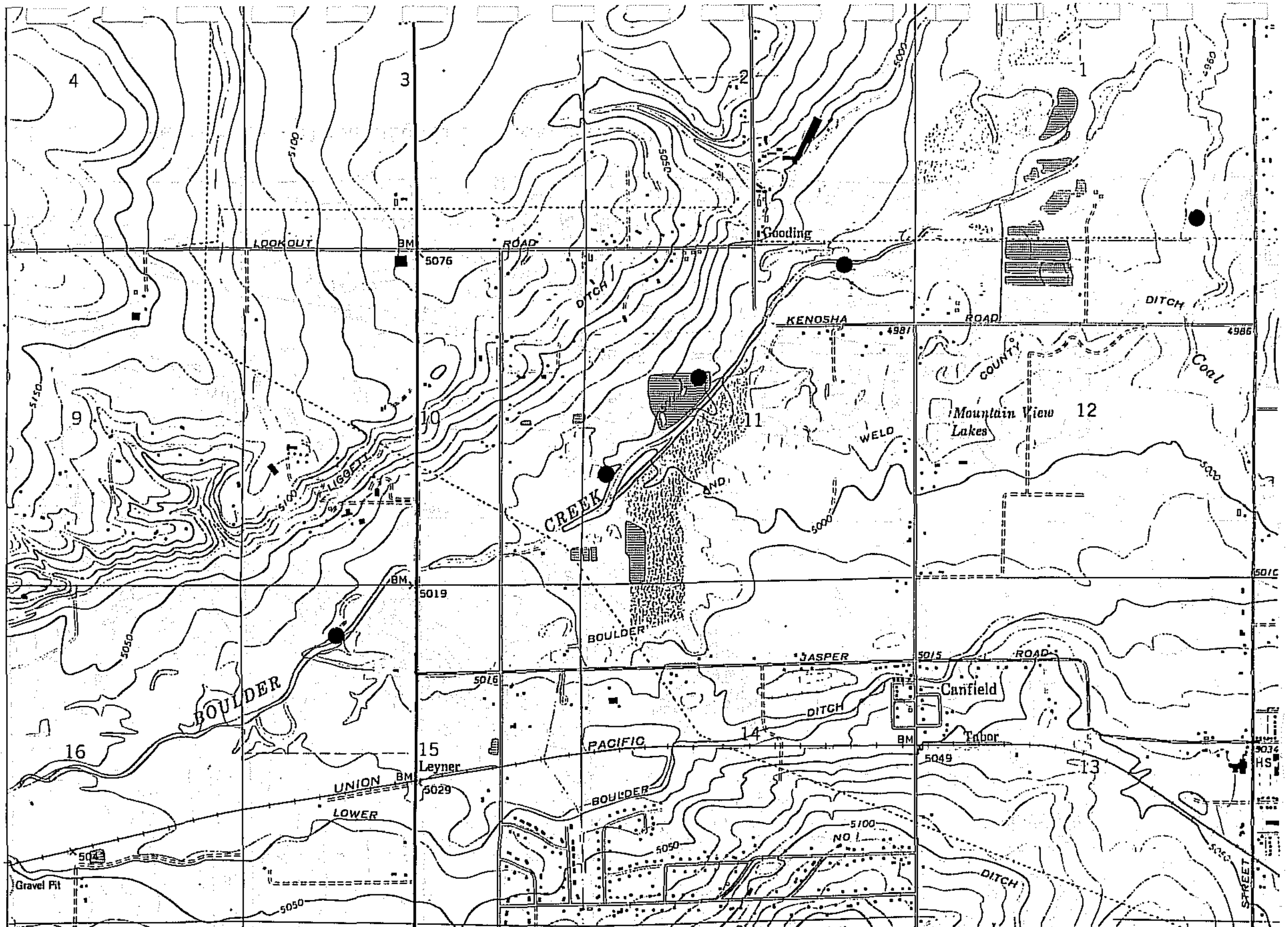

Figure 3. Wood Duck Sighting Locations, 30 May-20 July, 1997

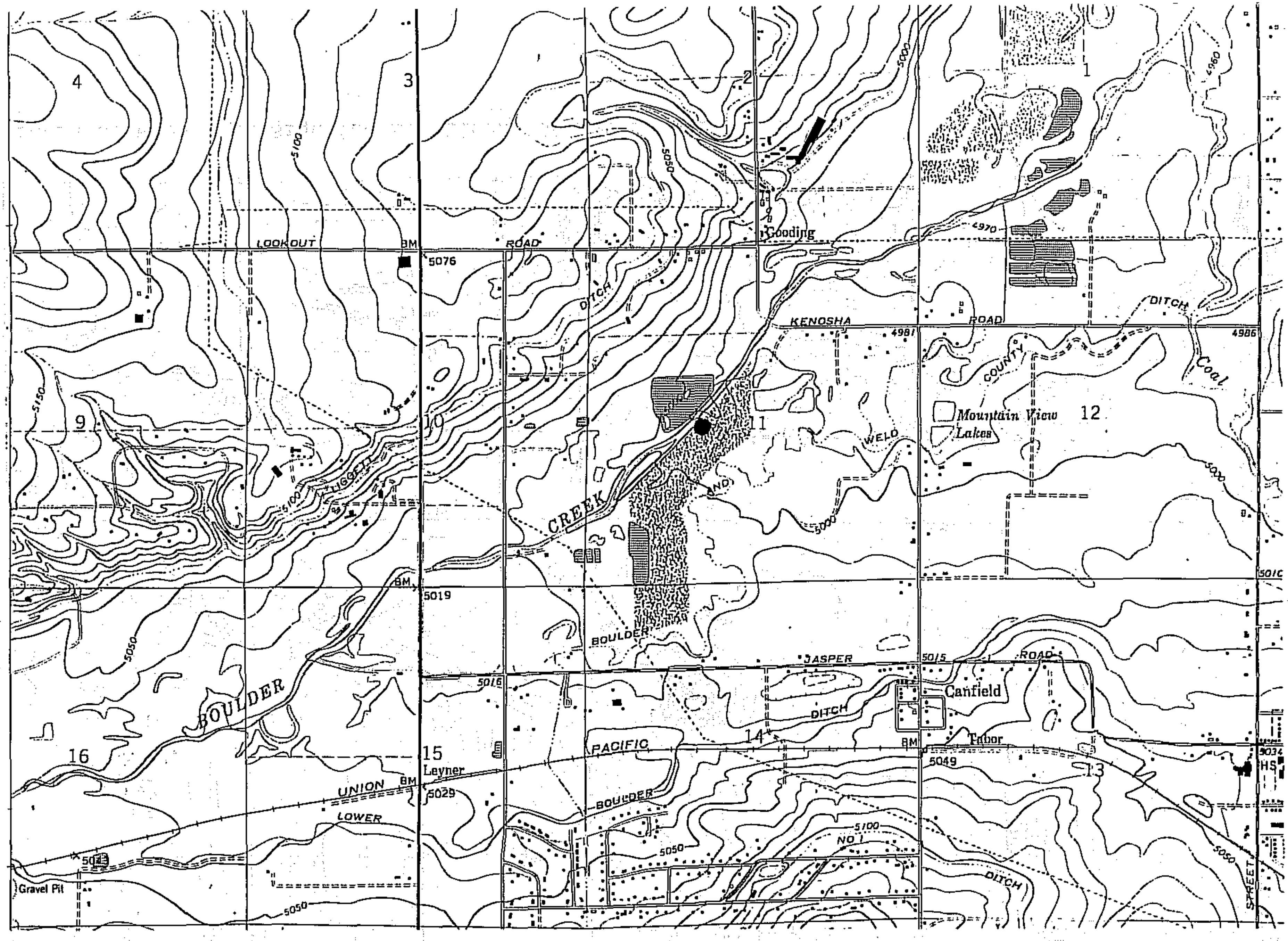

Figure 4. Peregrine Falcon Sighting Location, 30 May, 1997

wetlands and away from the stream corridor.

4. Gray Catbird (Boulder County isolated populations)

Gray catbirds nest uncommonly in Boulder County foothills shrublands (Boulder County Audubon Society 1978-97, Jones 1993). They nested historically on the plains, but I know of no recent nesting records in that part of the county. Numbers of catbirds nesting throughout Boulder County have declined since the early twentieth century, when this species was considered locally common. In Colorado nesting gray catbirds are confined to two locations: mesic shrublands at the base of the Front Range foothills and riparian understory along the South Platte River east of Fort Morgan (Andrews and Righter 1992).

I observed a singing male catbird along Coal Creek, 500 m south of Kenosha Road, on 11 and 15 June (Figure 5). Suitable nesting habitat also exists along Coal Creek north of Kenosha Road.

Management: Protect and encourage shrub growth along Coal Creek.

4. Yellow Warbler (Audubon blue list)

Yellow warblers nest in lowland and mid-elevation riparian woodlands, in urban woodlands, and around farmhouses throughout Boulder County. Brood parasitism by cowbirds and loss of riparian woodland habitat have diminished populations in parts of North America (Ehrlich et al 1992). However, data from the U.S. Fish and Wildlife breeding bird surveys suggest a slight increase in U.S. populations from 1966-93 (U.S. Fish and Wildlife Service 1993). Status of nesting populations in Boulder County and Colorado has not been sufficiently documented to indicate a downward trend (Boulder County Audubon Society 1978-97, U.S. Fish and Wildlife Service 1993, Hallock 1997).

I observed breeding yellow warblers throughout the study

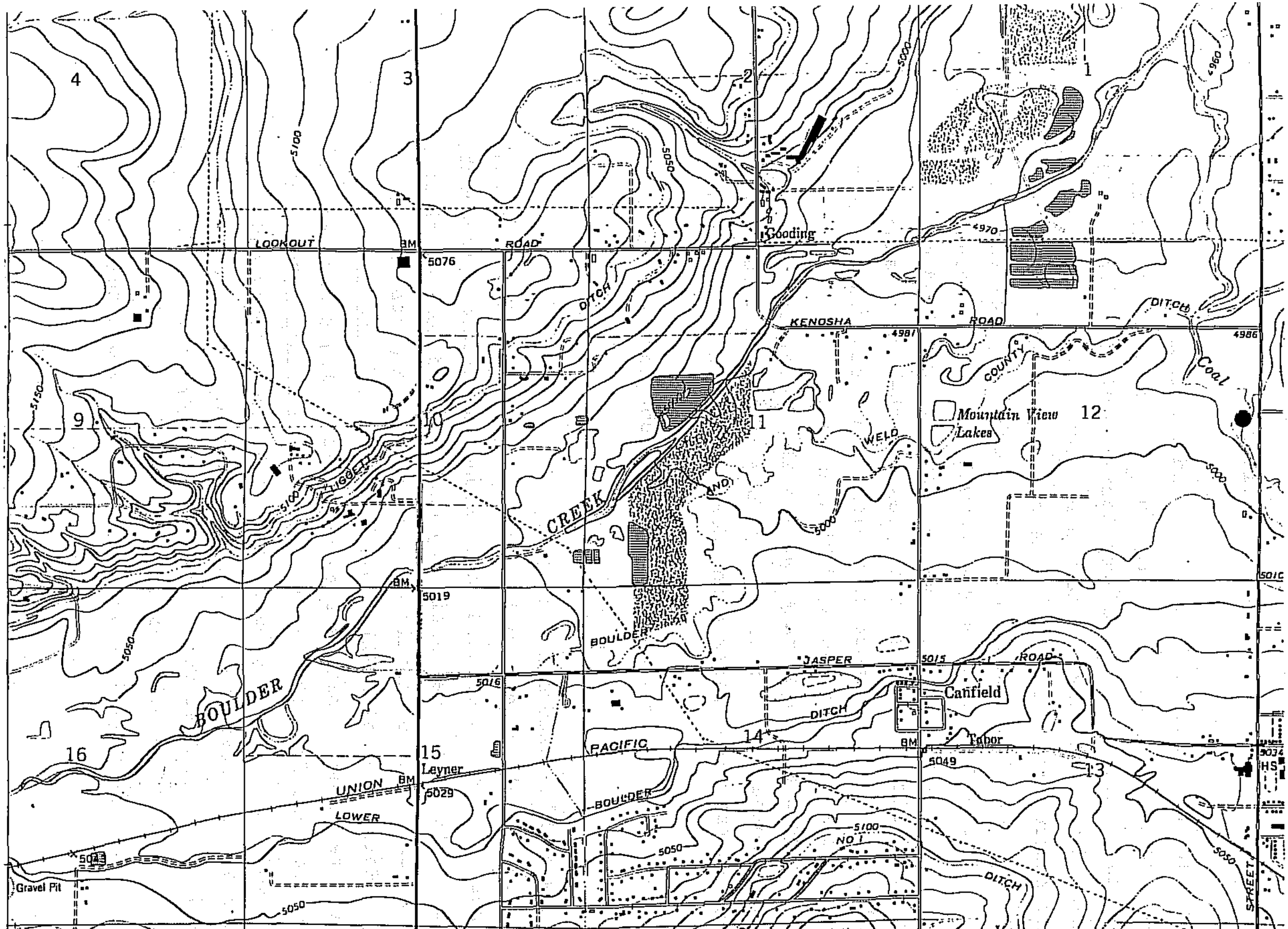

Figure 5. Gray Catbird Sighting Location, 11 and 15 June, 1997

area. Highest densities occurred in riparian areas that contained mature cottonwoods and willows.

Management: Preserve mature trees and encourage shrub growth within riparian corridors.

5. Ovenbird (Boulder county rare and stable)

A small, geographically isolated ovenbird population nests in foothills riparian thickets and in aspen or ponderosa pine forests in the Front Range foothills. Most nesting records are from Jefferson and Douglas counties (Andrews and Righter 1992). Breeding season sightings of ovenbirds are not unusual in Boulder County, but nesting has not been confirmed (Jones 1990, Andrews and Righter 1992).

I observed a singing male ovenbird along Boulder Creek, 200 m west of US 287, on 30 May (Figure 6). I could not find this bird on subsequent visits. The study area is probably peripheral to this species' normal breeding range.

Management: Protect shrub growth and mature deciduous trees along Boulder Creek.

6. Blue Grosbeak (State undetermined status)

This species appears on the Boulder County special concern list because it was listed as a species of concern by the state during the 1980s. It does not appear on the most recent Colorado Natural Heritage Program list of rare and imperiled birds (Colorado Natural Heritage Program 1996). Blue grosbeaks are uncommon breeders in shrub habitat in eastern Boulder County.

I observed several pairs of blue grosbeaks along Coal Creek north of Kenosha Road and along Boulder Creek east of Kenosha Road (Figure 7). These grosbeaks appear to breed in dense willow and chokecherry shrublands in these areas.

Management: Protect and encourage shrub growth along riparian corridors.

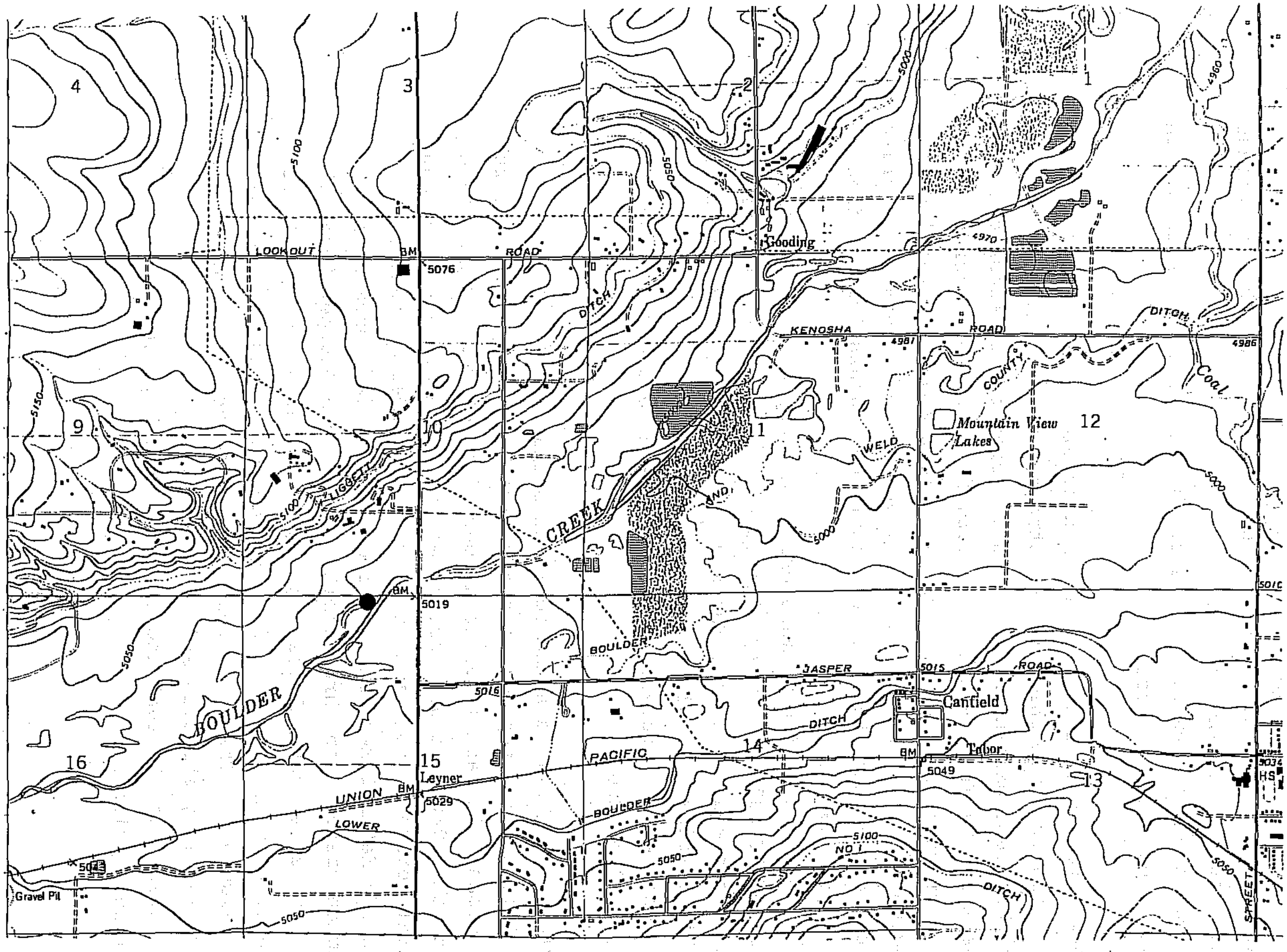

Figure 6. Ovenbird Sighting Location, 30 May, 1997

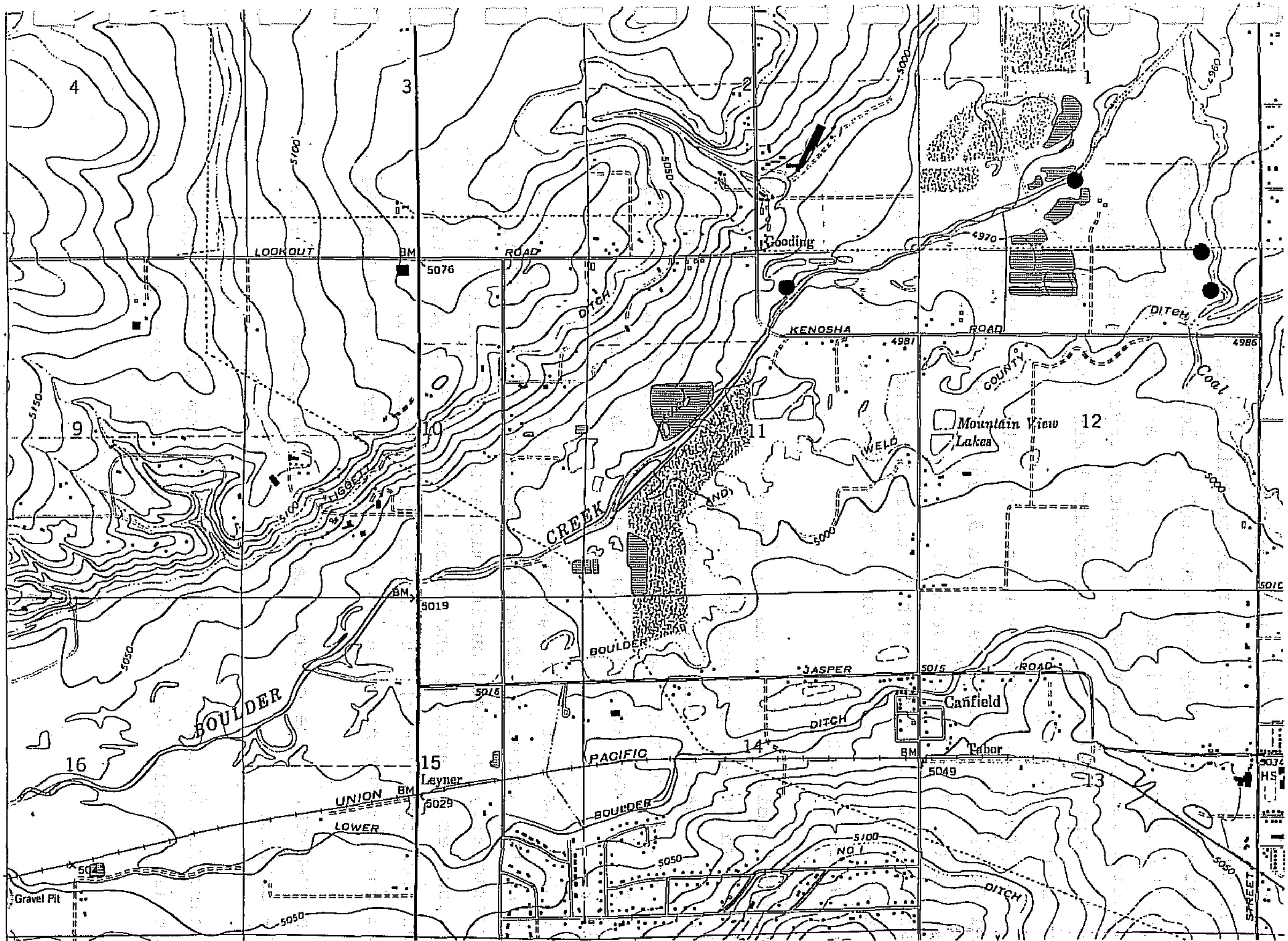

Figure 7. Blue Grosbeak Sighting Locations, 30 May-20 July, 1997

7. Yellow-headed Blackbird (Boulder County isolated populations)

Yellow-headed blackbirds nest colonially in cattail marshes throughout Colorado. They are abundant in low- to mid-elevation areas where large cattail marshes are bordered by grasslands or agricultural fields (Andrews and Righter 1992). Several nesting colonies occupy cattail marshes around lakes and reservoirs in eastern Boulder County.

Yellow-headed blackbirds nested in cattail marshes north of Boulder Creek, between plots 8 and 9, and south of Boulder Creek, between plots 17 and 19 (Figure 8).

Management: Preserve cattail marshes along Boulder Creek. Fence the marsh north of the creek between plots 8 and 9 to exclude grazing cattle.

Additional Species of Special Interest

1. Marsh Wren (no previous Boulder County nesting records)

Two male marsh wrens sang persistently in the cattail marsh north of Boulder Creek, between plots 8 and 9, 30 May-13 July (Figure 9). I observed two marsh wrens in this same location on 1 September.

Marsh wrens nest in large cattail marshes at low to middle elevations throughout Colorado (Andrews and Righter 1992). They are occasionally observed during migration at Sawhill and Walden Ponds, Boulder Reservoir, and Sombrero Marsh (Boulder County Audubon Society 1978-97). Why marsh wrens choose particular cattail marshes for breeding is not known (Andrews and Righter 1992).

Management: Fence cattail marsh between plots 8 and 9 to exclude cattle.

2. Orchard Oriole (no previous Boulder County nesting records)

Orchard orioles nest in Colorado lowland riparian woodlands,

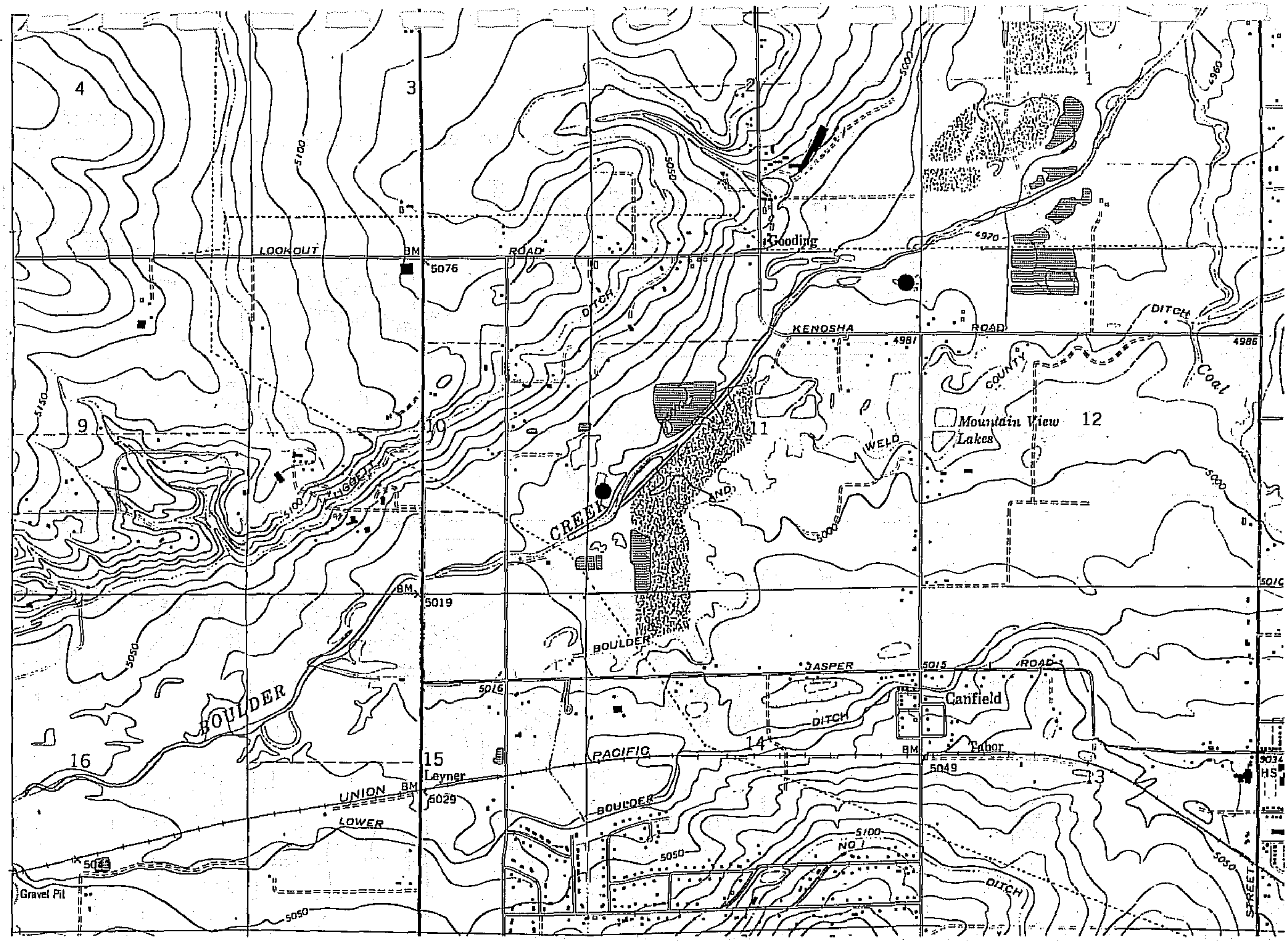

Figure 8. Yellow-headed Blackbird Nesting Locations, 1997

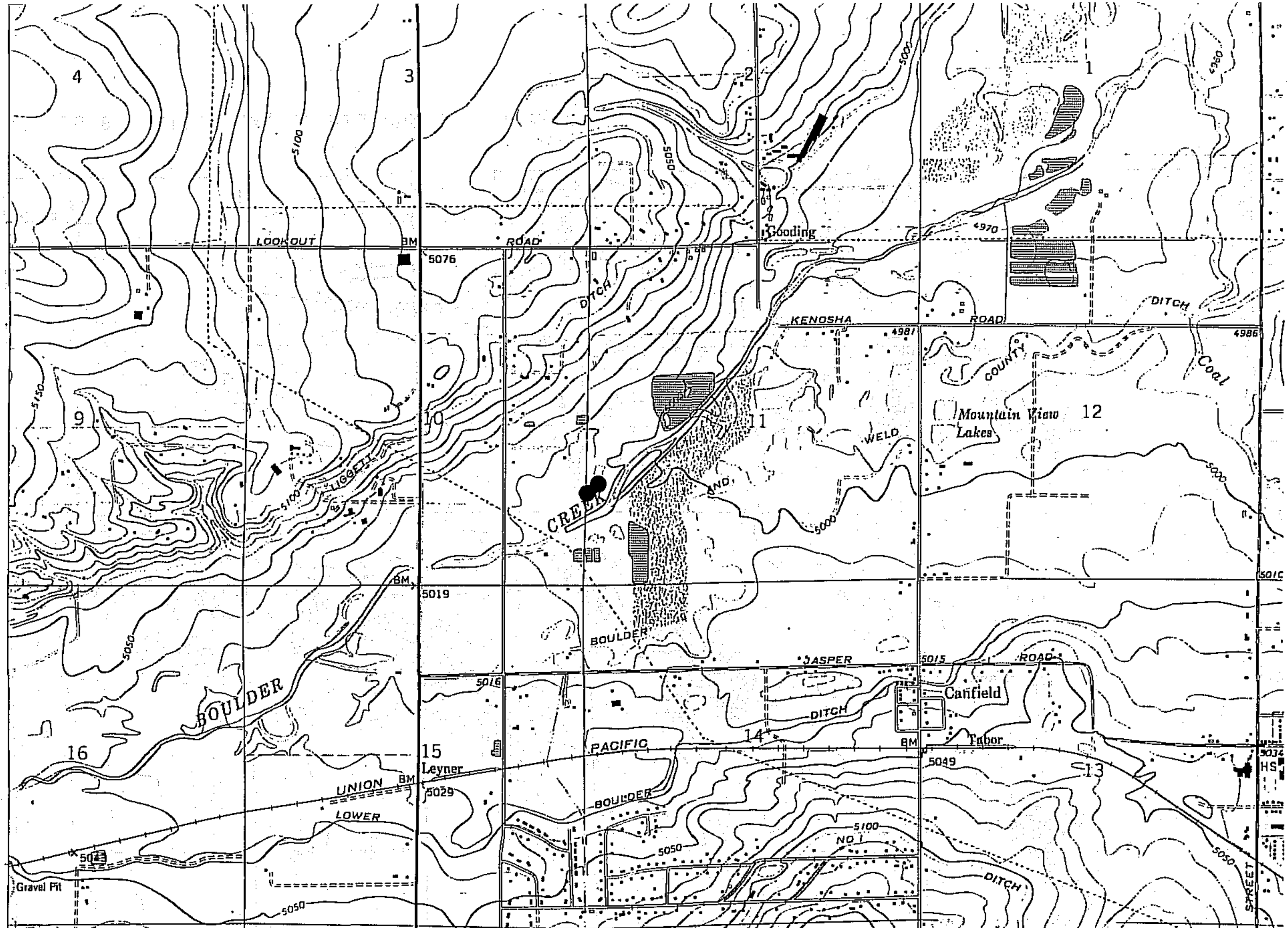

Figure 9. Marsh Wren Sighting Location, 30 May, 15 June, 13 July, 1 September, 1997

primarily on the eastern plains. Recent breeding records from the Front Range foothills indicate their nesting range may be expanding westward (Andrews and Righter 1992). Several orchard oriole sightings have been reported in eastern Boulder County in recent years (Boulder County Audubon Society 1978-97).

I observed a male orchard oriole along Boulder Creek 100 m east of 109th Street on 30 May (Figure 10). This male exhibited aggressive territorial behavior toward a Bullock's oriole male that was nesting in the vicinity. I could not find this orchard oriole during subsequent visits to the area.

Management: Protect mature cottonwoods and willows along Boulder Creek east of 109th Street.

Avian Habitats of Special Interest

Figure 11 shows areas that supported relatively high densities of nesting birds, that supported nesting populations of two or more Boulder County species of special concern, or that contained nesting habitat that is either uncommon in occurrence or threatened in Boulder County. Characteristics of these areas are summarized below.

1. Boulder Creek West of US 287

Mean plot density (3 plots): 11.1 species, 22.2 individuals

Special concern (nesting only): yellow warbler

This stretch of Boulder Creek contains many mature cottonwoods and willows and supports relatively high densities of nesting birds. It also serves as a foraging area for herons and egrets that nest in the rookery between 95th Street and US 287.

Management: Manage as riparian restoration and demonstration area closed to public access to protect shrub growth and minimize disturbance to herons and nesting birds.

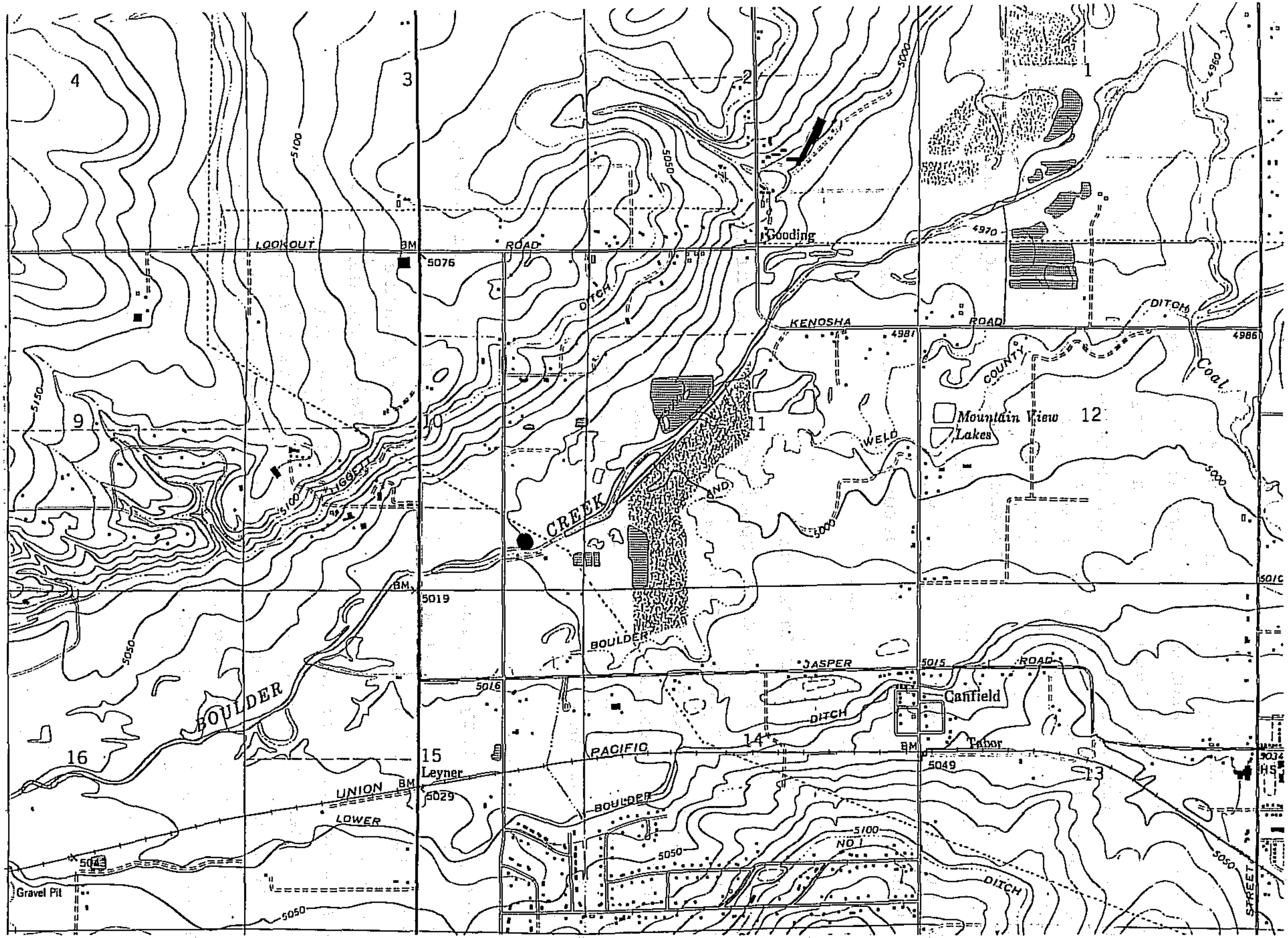

Figure 10. Orchard Oriole Sighting Location, 30 May, 1997

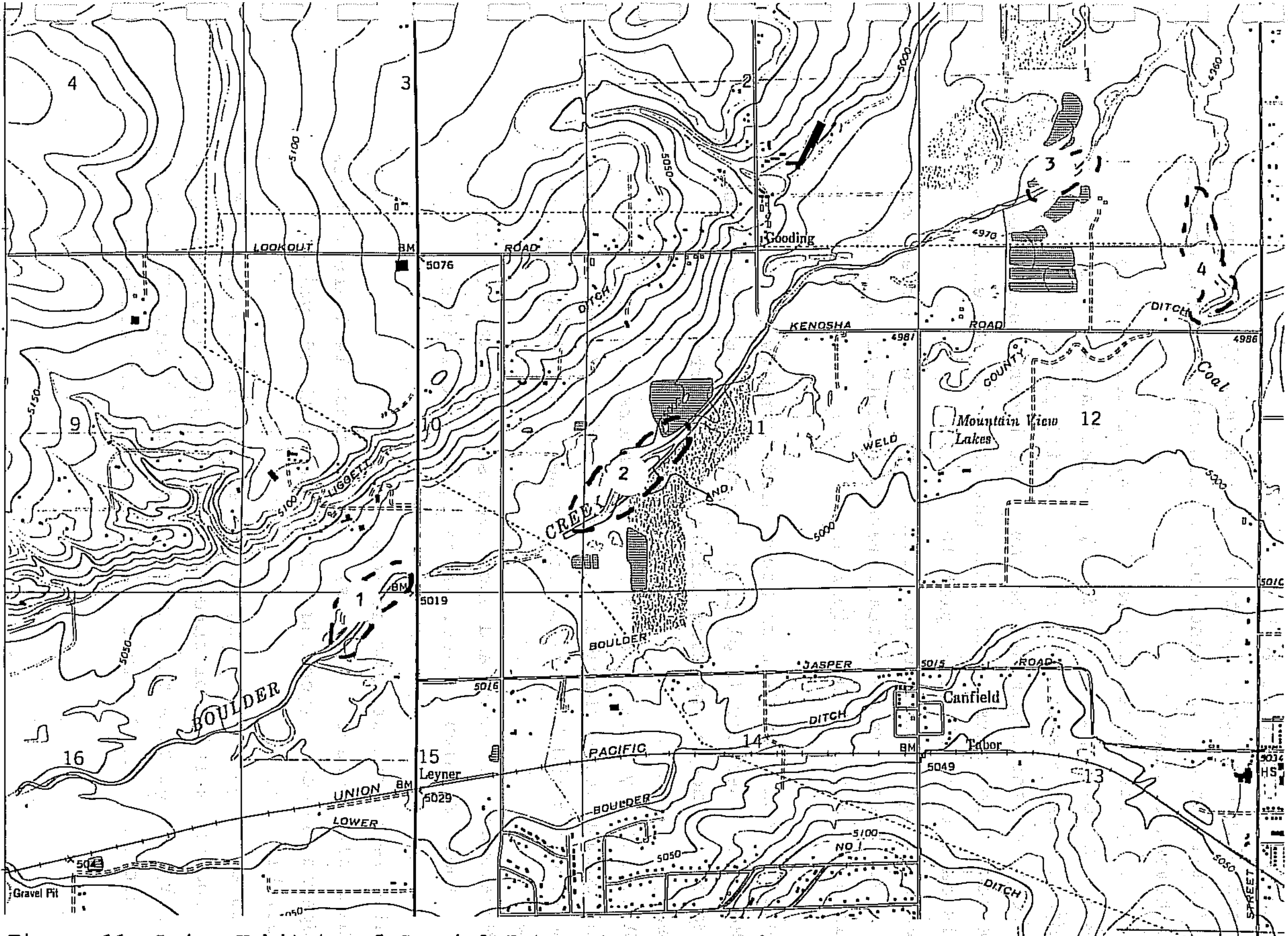

Figure 11. Avian Habitats of Special Interest

1. High quality riparian, wood duck, yellow warbler
2. Riparian/marsh, wood duck, red-tailed hawk, marsh wren, yellow warbler, yellow-headed blackbird
3. Riparian shrub, blue grosbeak
4. Riparian shrub, gray catbird, yellow warbler, blue grosbeak

2. Boulder Creek East of 109th Street

Mean plot density (4 plots): 9.4 species, 17.1 individuals

Special concern (nesting only): wood duck, yellow warbler, yellow-headed blackbird

Other special interest: marsh wren, orchard oriole

A mosaic of riparian woodland, cattail marsh, and grassland supports several nesting species of special concern. The cattail marsh north of the creek may be the first known nesting location in the county for marsh wrens. Red-tailed hawks nested 200 m east of this cattail marsh, near plot 10.

Management: Divert future trails away from riparian corridor and cattail marsh. Fence cattail marsh to protect it from trampling by cattle. Fence riparian corridor.

3. Boulder Creek Near Eastern Study Area Boundary

Mean plot density (2 plots): 9.9 species, 16.7 individuals

Special concern (nesting only): yellow warbler, blue grosbeak

A relatively well developed shrub understory supports nesting common yellowthroats, blue grosbeaks, and song sparrows. Yellow warblers and Bullock's orioles nest in cottonwoods and willows.

Management: Protect and encourage shrub growth. Control weeds. Remove Russian olives. Fence riparian corridor.

4. Coal Creek north of Kenosha Road

Mean plot density (4 plots): 8.9 species, 14.1 individuals

Special concern (nesting only): gray catbird, yellow warbler, blue grosbeak

Dense shrub growth along narrow strips on both sides of Coal Creek supports a suite of shrub-nesting species once common, but now mostly absent from the plains of Boulder County. This is the only location I know of in the county where gray catbirds

(Boulder County isolated), yellow-breasted chats, blue grosbeaks (Boulder County special concern), and song sparrows nest in the same habitat.

Management: Protect and encourage shrub growth. Exclude cattle. Control weeds without compromising natural shrub growth. Widen riparian corridor by 10-20 m by moving agricultural field boundaries away from the creek. Avoid trail construction within 50 m of creek.

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APPENDIX I

PLOT SUMMARIES

BOULDER CREEK WEST FROM US 287 (1-3)

Plot 1: 5/30, 6/9, 7/9 (500 m west of US 287)

Great blue heron	1	4	2	2.3
Black-crowned heron	1			0.3
Mallard			6	2.0
Barn swallow	1	1	2	1.3
Cliff swallow	5	5	10	6.7
Black-capped chickadee	1	1	2	1.3
House wren	1	2	2	1.7
American robin	4	3		2.3
European starling	2	1	3	2.0
Yellow warbler	2	2	1	1.7
Song sparrow	1		1	0.7
Red-winged blackbird	1	3		1.3
Brown-headed cowbird	2			0.7
Common grackle	3		2	1.7
Bullock's oriole	1			0.3
American goldfinch	2			0.7
Species	15	9	10	11.3
Individuals	28	22	31	27.0

Plot 2 5/30, 6/9, 7/9 (300 m west of US 287)

Mallard		2		0.7
Mourning dove		1	1	0.7
Northern flicker			1	0.3
Western wood-pewee	2	2	1	1.7
Barn swallow	1		5	2.0
Cliff swallow		5		1.7
Black-billed magpie	1			0.3
House wren	1	1	1	1.0
American robin	2	2	2	2.0
European starling	1			0.3
Yellow warbler	1	2	2	1.3
Common yellowthroat	1	1		0.3
Ovenbird	1			0.3
Song sparrow	2	2	1	1.7
Red-winged blackbird			5	1.7
Brown-headed cowbird	1			0.3
American goldfinch	2		1	1.0
Species	12	9	10	10.3
Individuals	16	18	20	18.0

Plot 3: 5/30, 6/9, 7/9 (100 m west of US 287)

Double-crested cormorant		3		1.0
Great blue heron	2	1	1	1.3
Black-crowned heron		1		0.3
Mallard	2			0.7
Rock dove	1			0.3
Mourning dove	1	2	1	1.3
Northern flicker		1	1	0.7
Downy woodpecker		1		0.3
Barn swallow	1	1		0.7
Cliff swallow			5	1.7
Black-billed magpie	1			0.3
House wren	1	2	3	2.0
American robin		1	1	0.7
European starling	2		3	1.7
Yellow warbler		1		0.3
Common yellowthroat	1			0.3
Song sparrow	2	2	3	2.3
Red-winged blackbird		1		0.3
Western meadowlark			1	0.3
Common grackle	4	4	5	4.3
Species	11	13	10	11.3
Individuals	18	21	24	21.0

Summary

Mean Species/plot (3 plots): 11.1
Mean Individuals/plot: 22.1
Total Species: 37
Total Special Concern: 6 seen, 1 nesting

BOULDER CREEK FROM US 287 TO KENOSHA ROAD (4-14)

Plot 4 5/30, 6/13 (100 m east of US 287)

Great blue heron	2	6	1	3.0
Mourning dove		1	2	1.0
Western wood-pewee		1		0.3
Eastern kingbird			2	0.7
Cliff swallow	25	20	20	21.7
Black-billed magpie	2	1		1.0
Black-capped chickadee			1	0.3
House wren	2	2	2	2.0
American robin	2			0.7
European starling	2		1	1.0
Yellow warbler			1	0.3
Common yellowthroat	2	1	1	1.3
Song sparrow	1			0.3
Red-winged blackbird	1			0.3
Common grackle			2	0.7
Bullock's oriole			1	0.3
Species	9	7	11	9.0
Individuals	39	32	34	35.0

Plot 5 5/30, 6/13, 7/13 (50 m west of 109 Street)

White pelican		2		0.7
Double-crested cormorant			1	0.3
Great blue heron		1		0.3
Black-crowned heron		1		0.3
Mourning dove	1	1	1	1.0
Western wood-pewee	1	1		0.7
Eastern kingbird	2	3		1.7
Cliff swallow	8	10	25	14.3
Black-billed magpie		1		0.3
Black-capped chickadee		1		0.3
House wren	1	1	2	1.3
American robin	1			0.3
European starling	2	2		1.3
Yellow warbler	1	1		0.7
Common yellowthroat			1	0.3
Red-winged blackbird			1	0.3
Western meadowlark	2	1		1.0
Brown-headed cowbird	2			0.7
Common grackle			1	0.3
Species	10	13	7	10.0
Individuals	21	26	32	26.3

Plot 6 5/30, 6/15, 7/13 (100 m east of 109 Street)

Great blue heron	1	2	1	1.3
Canada goose	2			0.7
Mourning dove			2	0.7
Western wood-pewee	1			0.3
Eastern kingbird			2	0.7
Cliff swallow			7	2.3
House wren	2	1	2	1.7
American robin		1		0.3
European starling		3		1.0
Yellow warbler		1	1	0.7
Song sparrow			1	0.3
Western meadowlark	2	2	1	1.7
Common grackle	3	2		1.7
Orchard oriole	1			0.3
Bullock's oriole	2			0.7
Species	8	7	8	7.7
Individuals	14	12	17	14.3

Plot 7 5/30, 6/15, 7/13 (300 m east of 109 Street)

Great blue heron	3			1.0
Black-crowned heron		1		0.3
Canada goose	4			1.3
Killdeer	1			0.3
Mourning dove	2	2	2	2.0
Eastern kingbird			1	0.3
Cliff swallow	1		7	2.7
European starling			1	0.3
Yellow warbler	1	1		0.7
Red-winged blackbird		3	2	1.7
Yellow-headed blackbird	1			0.3
Western meadowlark	2	1		1.0
Brown-headed cowbird	1	1		0.7
Common grackle	3			1.0
Bullock's oriole	1			0.3
Species	11	6	5	7.3
Individuals	20	9	13	14.0

Plot 8 5/30, 6/15, 7/13 (500 m east--cattail marsh)

Black-crowned heron	1			0.3
Great egret	1			0.3
Canada goose			2	0.7
Wood duck			5	1.7
Killdeer	1		1	0.7
Mourning dove		1		0.3
Western wood-pewee		1		0.3
Eastern kingbird		1		0.3
Cliff swallow		1	2	1.0
Marsh wren	1	1		0.7
American robin	1	1		0.7
European starling		1		0.3
Common yellowthroat	1		2	1.0
Song sparrow			1	0.3
Vesper sparrow	1			0.3
Red-winged blackbird	2	2	3	2.3
Yellow-headed blackbird	10	3	2	5.0
Western meadowlark	1	1	2	1.3
Common grackle		1		0.3
Bullock's oriole	1	1		0.7
Species	11	12	9	10.7
Individuals	21	15	20	18.7

Plot 9 5/30, 6/15, 7/13 (700 m east)

Great blue heron		2		0.7
Red-tailed hawk	3	1		1.3
Mourning dove		1	2	1.0
Belted kingfisher			1	0.3
Downy woodpecker			1	0.3
Western wood-pewee	2	2		1.3
Eastern kingbird		2	1	1.0
Cliff swallow		2	5	2.3
Black-capped chickadee			1	0.3
House wren	2		2	1.3
American robin	1		1	0.7
European starling	2		4	2.0
Yellow warbler	2	1	1	1.3
Common yellowthroat	2			0.7
Song sparrow		1		0.3
Red-winged blackbird		2	5	2.3
Western meadowlark	2	1	1	1.3
Brown-headed cowbird	2			1.7
Common grackle	2		2	1.3
Bullock's oriole		1		0.3
American goldfinch		1		0.3
Species	10	12	13	11.7
Individuals	20	17	27	21.3

Plot 10 5/30, 6/15, 7/13 (900 m east--north side channel)

Great blue heron	1			0.3
Mallard		2		0.7
Red-tailed hawk	2	1		1.0
Western wood-pewee	2			0.7
Eastern kingbird	1			0.3
Cliff swallow	1	4	1	2.0
Blue jay		1		0.3
House wren	1		1	0.7
American robin			1	0.3
European starling			3	1.0
Common yellowthroat	1			0.3
Red-winged blackbird	1	2	2	1.7
Western meadowlark	1			0.3
Brown-headed cowbird	2	1	2	1.7
Bullock's oriole	1			0.3
Species	11	6	6	7.7
Individuals	14	11	10	11.7

Plot 11 5/30, 6/15, 7/13 (1100 m east)

Great blue heron			3	1.0
Black-crowned heron	1	1		0.7
Mallard		2		0.7
Peregrine falcon	1			0.3
American kestrel			1	0.3
Spotted sandpiper		1		0.3
Mourning dove			1	0.3
Eastern kingbird	2	1		1.0
Western kingbird	2			0.7
Cliff swallow		8		2.7
Barn swallow	1	1	2	1.3
Common raven	1			0.3
European starling		1	2	1.0
Common yellowthroat	1	1		0.7
Song sparrow		1		0.3
Red-winged blackbird	1		4	1.7
Western meadowlark	1			0.3
Bullock's oriole		1		0.3
American goldfinch		2		0.7
Species	9	11	6	8.7
Individuals	11	20	13	14.7

Plot 12 5/30, 6/15, 7/13 (1300 m east--Pond)

Great blue heron		1	1	0.7
Double-crested cormorant	1			0.3
Mallard		1		0.3
Spotted sandpiper	2	1		1.0
Eastern kingbird		1	2	1.0
Cliff swallow		5	4	3.0
Black-billed magpie		1		0.3
Common raven	2			0.7
House wren	1			0.3
American robin			1	0.3
European starling	3	5	1	3.0
Yellow warbler	1			0.3
Common yellowthroat	1	2	1	1.3
Song sparrow	1	1		0.7
Red-winged blackbird	1	2	2	1.7
Brown-headed cowbird		2		0.7
Common grackle	2	1	1	1.3
American goldfinch	2			0.7
Species	11	12	8	10.3
Individuals	17	23	13	17.7

Plot 13 5/30, 6/15, 7/13 (1500 m east, prostrate willow)

Great blue heron	1	1		0.7
Black-crowned heron			1	0.3
Wood duck		2		0.7
Common snipe	1			0.3
Mourning dove	1	1	2	1.3
Cliff swallow		2	2	1.3
Black-capped chickadee	2			0.7
House wren			3	1.0
American robin		1		0.3
European starling		2	1	1.0
Yellow warbler		2		0.7
Common yellowthroat	1		1	0.7
Song sparrow	1	1	1	1.0
Red-winged blackbird	1	1	1	1.0
Yellow-headed blackbird	1			0.3
Western meadowlark	2	2		1.3
Brown-headed cowbird	3			1.0
Common grackle		1	2	1.0
Species	10	11	9	10.0
Individuals	14	16	14	14.7

Plot 14 5/30, 6/15, 7/13 (1700 m east)

Great blue heron		3		1.0
Black-crowned heron		1	1	0.7
Killdeer			1	0.3
Common snipe			1	0.3
Northern flicker			1	0.3
Cliff swallow			2	0.7
Black-billed magpie			1	0.3
House wren	2			0.7
European starling	1	2	3	2.0
Common yellowthroat	2	1		1.0
Song sparrow	1			0.3
Red-winged blackbird	1			0.3
Western meadowlark	1	2	3	2.0
Brown-headed cowbird		1		0.3
Common grackle		2		0.7
Bullock's oriole	1	1		0.7
House sparrow			1	0.3
Species	7	8	9	8.0
Individuals	9	13	14	12.0

Summary

Mean Species/plot (11 plots): 9.2
Mean Individuals/plot: 18.4
Total Species: 48
Total Special Concern: 8 seen, 3 nesting

Also: territorial marsh wrens (no historical nesting records in Boulder County)

BOULDER CREEK EAST FROM KENOSHA ROAD (15-22)

Plot 15 6/9, 6/11, 7/11 (100 m east of Kenosha Rd.--cottonwoods)

Mallard	1			0.3	
Great blue heron	1		1	0.3	
Great egret			1	0.3	beaver
Double-crested cormorant			1	0.3	
Northern flicker	1	1		0.7	
Mourning dove		1		0.3	
Belted kingfisher			1	0.3	
Cliff swallow			4	1.3	
Black-capped chickadee		1	1	0.7	
House wren	3	1	1	1.7	
American robin	1			0.3	
European starling	2	3		1.7	
Common yellowthroat		1		0.3	
Western meadowlark	1	1	1	1.0	
Brown-headed cowbird		1		0.3	
Common grackle	1	2		1.0	
Species	8	9	8	8.3	
Individuals	11	12	11	11.3	

Plot 16 6/9, 6/11, 7/11 (300 m east of Kenosha Road)

Black-crowned heron		1	1	0.7
Mallard		1		0.3
Mourning dove			1	0.3
Black-capped chickadee			1	0.3
House wren	1			0.3
European starling		2		0.7
Common yellowthroat		1	1	0.7
Song sparrow	1	1	1	1.0
Red-winged blackbird	1	2	1	1.3
Western meadowlark	1	1	1	1.0
Common grackle	3			1.0
Species	5	7	7	6.3
Individuals	7	9	7	7.7

Plot 17 6/9, 6/11, 7/11 (500 m east--cattail marsh)

Great blue heron	1	1	2	1.3
Black-crowned heron	1	1	2	1.3
Canada goose		30		10.0
Mallard	2			0.7
Wood duck	1			0.3
Red-tailed hawk		1		0.3
Mourning dove			1	0.3
Common nighthawk		1		0.3
Northern flicker		1		0.3
Eastern kingbird		2		0.7
Barn swallow			1	0.3
Common yellowthroat	1			0.3
Song sparrow	1	1	2	1.3
Red-winged blackbird	5	5	4	4.7
Brown-headed cowbird		1	4	1.7
Brewer's blackbird			1	0.3
Species	7	10	8	8.3
Individuals	12	44	17	24.3

Plot 18 6/9, 6/11, 7/11 (700 m east--"Keep Out" sign)

Mallard	1		2	1.0	beaver
Red-tailed hawk	2	2		1.3	
Mourning dove	1	1		0.7	
Eastern kingbird	2	2	1	1.7	
Black-billed magpie			1	0.3	
Black-capped chickadee			1	0.3	
House wren		1		0.3	
European starling	1	2	3	2.0	
Yellow warbler		1		0.3	
Common yellowthroat	2	1		1.0	
Song sparrow	1	1	3	1.7	
Red-winged blackbird			1	0.3	
Yellow-headed blackbird	1			0.3	
Western meadowlark	1	1		0.7	
Brown-headed cowbird		1		0.3	
Bullock's oriole	1	1		0.7	
Species	10	11	7	9.3	
Individuals	13	14	12	13.0	

(Red-tailed hawk nest 500 m south of point station)

Plot 19 6/9, 6/11, 7/11 (900 m east)

Double-crested cormorant		1		0.3	
Great egret		1		0.3	
Mallard	2		2	1.3	
Red-tailed hawk			1	0.3	
Mourning dove	1			0.3	
Eastern kingbird			2	0.7	
Barn swallow	1			0.3	
American robin		2		0.7	
European starling	1			0.3	
Yellow warbler	1			0.3	
Common yellowthroat	1		1	0.7	
Song sparrow	1		2	1.0	
Yellow-headed blackbird	1	2	1	1.3	
Western meadowlark	1	2		1.0	
Brown-headed cowbird	1	1		0.7	
Species	10	6	6	7.3	
Individuals	11	9	9	9.7	

Plot 20 6/9, 6/11, 7/11 (1100 m east)

Great blue heron	1			0.3	beaver
Great egret	1			0.3	
Mallard	1			0.3	
Wood duck			2	0.7	
Killdeer			1	0.3	
Mourning dove		1		0.3	
Barn swallow	2		1	1.0	
Cliff swallow	2	2		1.3	
Rough-winged swallow	1	1		0.7	
European starling		1		0.3	
Common yellowthroat	1	1		0.7	
Song sparrow			2	0.7	
Red-winged blackbird	5	4	4	4.3	
Western meadowlark	2		1	1.0	
Brown-headed cowbird		1	1	0.7	
Species	9	7	7	7.7	
Individuals	16	11	12	13.0	

Plot 21 6/9, 6/11, 7/11 (1300 m east--bridge)

Double-crested cormorant	1			0.3
Great blue heron	1			0.3
Mallard	1			0.3
American kestrel			1	0.3
Killdeer		1	1	0.7
Ring-billed gull			1	0.3
Mourning dove			3	1.0
Belted kingfisher		1		0.3
Eastern kingbird			1	0.3
Barn swallow	1		1	0.7
Cliff swallow	5	7		4.0
Rough-winged swallow	2			0.7
House wren		1		0.3
European starling	2	3		1.7
Common yellowthroat	1	1		0.7
Red-winged blackbird	3	3	6	4.0
Western meadowlark	1	3		1.3
Brown-headed cowbird	1			0.3
House sparrow			1	0.3
Species	11	8	8	9.0
Individuals	19	20	15	18.0

Plot 22 6/9, 6/11, 7/11 (1500 m east--at river bend)

Mallard	1			0.3
Western kingbird			1	0.3
Barn swallow	1		1	0.7
Cliff swallow		2		0.7
Black-capped chickadee	1	2	2	1.7
Black-billed magpie		1		0.3
House wren	1	1	2	1.3
American robin			1	0.3
European starling			3	1.0
Yellow warbler	1		1	0.7
Common yellowthroat	1	2		1.0
Blue grosbeak			1	0.3
Song sparrow			2	0.7
Red-winged blackbird	2	3	2	2.3
Western meadowlark	1	1		0.7
Brown-headed cowbird			2	0.7
Common grackle	1		2	1.0
Bullock's oriole		1		0.3
American goldfinch	1	1	1	1.0
Species	10	9	13	10.7

Individuals	11	14	21	15.3

(Great horned owl nest, 150 m west, north bank--fledged young)

Summary

Mean Species/plot (8 plots): 8.4
Mean Individuals/plot: 14.0
Total Species: 42
Total Special Concern: 8 seen, 4 nesting

COAL CREEK (23-30)

Plot 23 6/9, 6/11, 7/9 (800 m north of Kenosha Road)

Wood duck		2		0.7
Mourning dove	1	2		1.0
Cliff swallow	1	1		0.7
Barn swallow			1	0.3
Eastern kingbird	2	2		1.3
Blue jay			1	0.3
Black-billed magpie	2	3		1.7
House wren		1	1	0.7
American robin			2	0.7
European starling	2	8	1	3.7
Warbling vireo			1	0.3
Yellow warbler	1			0.3
Common yellowthroat	1		1	0.7
Yellow-breasted chat			2	0.7
Red-winged blackbird	1	3		1.3
Yellow-headed blackbird			1	0.3
Brown-headed cowbird			2	0.7
Species	8	8	10	8.7
Individuals	11	22	13	15.3

Plot 24 6/9, 6/11, 7/9 (600 m north of Kenosha Road)

Mourning dove	1	1	2	1.3
Belted kingfisher	2			0.7
Cliff swallow	2	1	2	1.7
Barn swallow			2	0.7
Rough-winged swallow		1		0.3
Black-billed magpie	1	2	1	1.3
House wren		1	2	1.0
American robin	2		2	1.3
Yellow warbler	1			0.3
Common yellowthroat		1	1	0.7
Yellow-breasted chat	2	2	2	2.0
Song sparrow	1	1		0.7
Brown-headed cowbird		2	2	1.3
Bullock's oriole	1		1	0.7
Species	9	9	10	9.3
Individuals	13	12	17	14.0

Plot 25 6/9, 6/11, 7/9 (400 m north of Kenosha Road)

Mourning dove			1	0.3
Western wood-pewee	1		1	0.7
Cliff swallow		3		1.0
Rough-winged swallow	2			0.7
European starling			2	0.7
Yellow warbler	1		1	0.7
Common yellowthroat	2	1		1.0
Yellow-breasted chat	3	2	2	2.3
Blue grosbeak		2	1	1.0
Song sparrow		1	1	0.7
Red-winged blackbird	1	3		1.3
Brown-headed cowbird	1	1		0.7
Common grackle			1	0.3
Bullock's oriole	3	2		1.7
House finch			1	0.3
Species	8	8	9	8.3
Individuals	14	15	11	13.3

Plot 26 6/9, 6/11, 7/9 (200 m north)

Rock dove		2		0.7
Mourning dove		1	1	0.7
Cliff swallow	2	2		1.3
Black-billed magpie			1	0.3
House wren	1		2	1.0
European starling	2	5	2	3.0
Yellow warbler	1	1	1	1.0
Common yellowthroat	1			0.3
Yellow-breasted chat	1	2	3	2.0
Song sparrow			2	0.7
Brown-headed cowbird	1	1		0.7
Common grackle	1	1		0.7
Bullock's oriole	1			0.3
American goldfinch		2	1	1.0
Species	9	9	8	8.7
Individuals	11	17	13	13.7

Summary

Mean Species/plot (4 plots): 8.9
Mean Individuals/plot: 14.1
Total Species: 35
Total Special Concern: 6 seen, 3 nesting

APPENDIX II
BREEDING CODES

Migrant

- Seen or heard, but suitable breeding habitat does not exist within study area.

Observed

- Seen or heard in suitable breeding habitat.

Probable Breeder

- Exhibited territorial behavior in suitable breeding habitat. Behaviors include singing, territorial defense, copulation, and agitated behavior.

Confirmed Breeder

- Evidence of nesting: occupied nest, nest with young, feeding young, fledged young or used nest.

13810 N. 115th Street
Longmont, CO 80501
(303) 651-2514

Lower Boulder Creek and Coal Creek Restoration

Fisheries and Channel Existing Conditions and Recommendations

Queen of the River Fish Co., Inc./Aquatic Services

Description of Existing Conditions:

Fisheries:

The identification and distribution of fish species in Boulder Creek and Coal Creek has been underway since the early part of this century. The efforts reviewed for this document, in chronological order of completion, included Juday (1904), Cockrell (1908), Ellis (1914), Hendricks, (1947), Li (1968), Probst (1982), Chart, et al(1987), and Nessler(1997). The information that is most timely and pertinent to this effort has been completed since 1968 and includes Li (1968), Probst (1982), and Chart, et al(1987). Nessler, et al, 1997 did not give specific sample sites so we could not discern fishes sampled in the St Vrain River from those found specifically in the Boulder Creek and Coal Creek tributaries. Table 1 describes the fish species found by each analysis in Boulder and Coal Creeks.

Table 1. Summary of species collected and reported in Boulder and Coal Creeks since 1967.

Common name	Scientific Name	Li (1968)		Probst (1982)		Chart et al, (1987)
Creek chub	Semotilus atromaculatus	x		x		
Longnose Dace	Rhinicthys cataractae	x		x		x
Common Shiner	Luxilus cornutus	x				
Red shiner	Notropis (Cyprinella) lutrensis	x		x		
Bigmouth shiner	Notropis dorsalis	x		x		
Sand shiner	Notropis stramineus	x		x		x
Brassy minnow	Hybognatis hankinsoni	x		x		
Fathead minnow	Pimephales promelas	x		x		x

Common name	Scientific Name	Li (1968)		Probst (1982)		Chart et al, (1987)
Central (Common) stoneroller	*Campastomas anomalum*	x		x		
Longnose sucker	*Catastomus catastomus*	x		x		
Western white sucker	*Catastomas commersonii*	x		x		
Plains killifish *	*Fundulus kansae*	x				
RioGrande killifish *	*Fundulus zebrinus*			x		
Plains topminnow	*Fundulus sciadicus*	x		x		
Johnny darter	*Etheostoma nigrum*	x		x		
Common carp	*Cyprinus carpio*			x		
Gizzard shad	*Dorosoma cepedianum*					
Largemouth bass	*Micropterus salmoides*			x(may be lentic habitat)		x
Green sunfish	*Lepomus cyanellus*			x		

* Plains killifish and Rio Grande killifish are now accepted to be *Fundulus zebrinus* and the same species by the American Fisheries Society.

Hendricks, 1947 in his description of the fishes of Boulder County states that 33 species of fish populated waters in Boulder County, of which 31 species live below 6500 feet M.S.L. Although he does not identify specific subdrainages or reaches in the county, this number (31 spp) is somewhat useful in comparing the number of species found in Boulder Creek / Coal Creek during 1968 (15 spp), 1982 (16 spp, 1 from lentic habitat), and 1987 (7 spp). This information indicates that the number of species found in Boulder Creek/Coal Creek has diminished over time. Species such as longnose dace, sand shiners, fathead minnows, stonerollers, and white suckers appear to be holding on in this system while other native species have not. The limitations causing the reductions in fish species diversity in our study area have been identified by researchers as far back as 1947. Hendricks, 1947; Li, 1968; Probst, 1982; and Chart, 1987 all refer to water quality deterioration, habitat degradation/alteration, and exotic species introduction as pertinent factors causing the demise of fish species in the St Vrain drainage and specifically its tributaries.

Quantitative fish habitat ratings developed based on a qualitative scoring system completed at 5 stations throughout the study area indicated that all habitat scored poor except Station 2 where improvements have been completed(see score sheet results in Appendix I). Factors identified as potential problems include lack of shade /instream/ stream side cover, poor pool quantity and quality, poor bank stability, and only fair channel stability and food abundance. These conditions are typical of streams that have experienced channelization, poor and lacking riparian habitat conditions, water quality deteriorization, flow depletions, and poor instream habitat conditions.

Table 2. Channel Stability and Fish Habitat Ratings for Boulder and Coal Creeks completed 1997.

Variable	B.C.@BV Farms	BC@ Hway 287	B.C. @ 109th	B.C.@ Kenosha Rd	Coal Crk north of Kenosha Rd
Channel Stability*	(87) Fair	(77) Fair	(136) Poor	(104) Fair	(152) Poor
Fish Habitat**	(29) Poor	(39) Fair	(23) Poor	(23) Poor	(15) Poor

* Lower score is better out of a possible 152.
**Higher score is better out of a possible 50.

Flows:

Boulder Creek flows have been monitored daily through the study reach during certain periods since 1927. Data for the period of 1956-1977 was not identified by study team engineers and is assumed to be unavailable. Certain periods of some years also exist as gaps in the data base. The only information available for this analysis regarding Coal Creek was flood flow and floodplain definition information. Review of the database for flows realized in Boulder Creek at the mouth of its confluence with the St Vrain was chosen for this effort to afford inclusion of Coal Creek flows. The next most upstream monitoring point was at 75th Street east of the City of Boulder. Use of 75th St data would have precluded the flows that are realized both in our study area as well as in Coal Creek.

The volume of water yielded from the Boulder Creek watershed (439 square miles) varied over the analysis period from 2706 acre feet in 1954 to 160,275 acre feet in 1983. Analysis of this database indicated that a normal water yield year provided approximately 43,000 acre feet of water, while *typical* low water yield years provide approximately 20,000 acre feet, and *typical* high water yield years provide 100,000 acre feet. Table 3 illustrates database years 1979-1993 and the associated low and high flow/timing realized during these years.

Table 3. Boulder Creek- Yield/Flow/Time Relationships 1979-1993					
Year	**Yield (Ac-Ft)**	**High Flow (CFS)**	**Occurrence Date**	**Low Flow (CFS)**	**Occurrence Date**
1979	69,202	926	June 9	5.2	Sept. 19
1980	109,834	1,740	May 1	3.3	Oct. 13
1981	20,383	298	May 29	0.48	Sept. 2
1982	37,133	398	May 13	3.2	Aug. 19
1983	160,275	1,600	May 19	7.9	Sept. 10
1984	72,782	384	May 15	5	Aug. 11
1985	46,894	402	June 10	7.7	June 20
1986	44,311	456	June 9	9.6	June 29
1987	58,295	568	June 10	7.3	Aug. 10
1988	36,337	443	May 20	1.7	Sept. 9
1989	28,705	65	Dec. 23	0.8	May 7
1990	no data	no data	no data	no data	no data
1991	no data	no data	no data	no data	no data
1992	44,498	234	May 14	1.4	July 24
1993	49,725	983	June 18	5.4	May 8

Analysis of the flow database was used to identify the flow regimes realized during the time period of the database with respect to normal, typical high, and typical low water yield years. The development of channel alterations that would provide Boulder Creek with a functioning channel and floodplain/riparian area that is representative of a natural system requires an understanding of the flow events that occur with some regularity. A critical flow event that must be characterized is the high flow events that are realized. Table 4 illustrates the five high water yield years and the associated high and low flows that were realized during these events.

Table 3. Boulder Creek- Flow/Timing Relationships-High Flow Years					
Year	**Yield (Ac-Ft)**	**High Flow (CFS)**	**Occurrence Date**	**Low Flow (CFS)**	**Occurrence Date**
1938	99,607	695	May 24	1.3	Aug. 27
1942	143,614	1620	May 3	0.3	Aug. 11
1947	100,647	1930	June 23	0.6	Apr. 14
1980	109,834	1740	May 1	3.3	Oct. 13
1983	160,275	1600	May 19	7.9	Sept. 1

Further understanding can be provided by analysis of the daily flows realized in the system during typical periods of flow extremes. Figures 3-4 illustrate the flows realized in Boulder Creek at the mouth during years of normal, typical high, and typical low flow years. It is worthy of note than none of these illustrated periods represent the greatest extremes of flow that are in the database, but instead characterize events that typically occur. Examination of this information indicates that typical years realize a peak flow of around 400-500 cfs during May-June with low flows of 1.5-10 cfs during August-September. High yield years realize peak flows of 700-1900 cfs --during two -peaks March-May and May-July and low flows of 0.3-8 cfs during August-September. Typical low yield years realize peak flows of 100-200 cfs during May-June and low flows of <1 cfs during August-September.

Fig.3 Flows Realized in Boulder Creek During Typical Hydraulic Yield Years

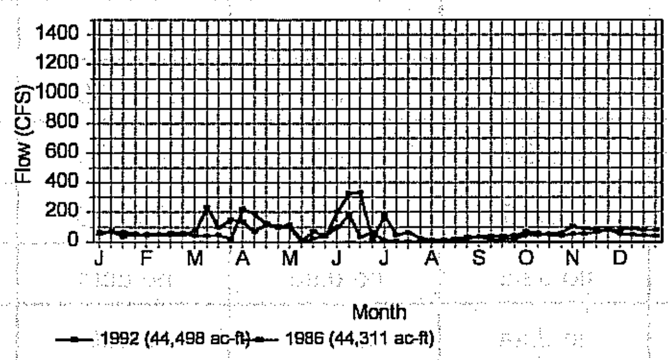
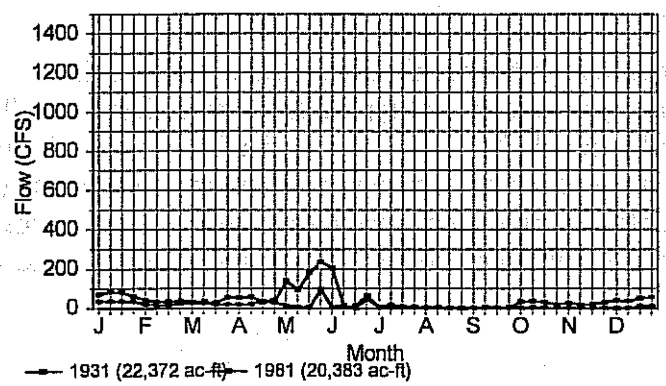


Fig.4 Flows Realized in Boulder Creek During Low Hydraulic Yield Years



Flood events that occur with standardized frequencies were also examined by this effort. Predicted flood flows for 10 yr, 50 year, 100 year, and 500 year events have been identified for Boulder and Coal Creeks in the study area. Predicted flood flows identified for Boulder Creek were identified as 3000 cfs for the 10 year flood event, 9400 cfs for the 25 year flood event, 14000 cfs for the 100 year flood event, and 31,800 cfs for the 500 year event (at the confluence with the St Vrain river). Additionally, information was found that identifies the width of the floodplain at many points along Boulder Creek within the study area. The floodplain width that contains the 100 year event varied throughout the study area from 750' at Highway 287 to 1050' at 109th to 1490' at Kenosha Road to 1150' at Coal Creek. Table 4 summarizes the predicted flood flows and available floodplain information identified. An interesting note is that review of the existing 30 year database indicates that the predicted peak flows for the 10 year flood flow event have never been realized in recorded history. Our analysis indicates that we have only realized flows that are 66% of the predicted 10 year event.

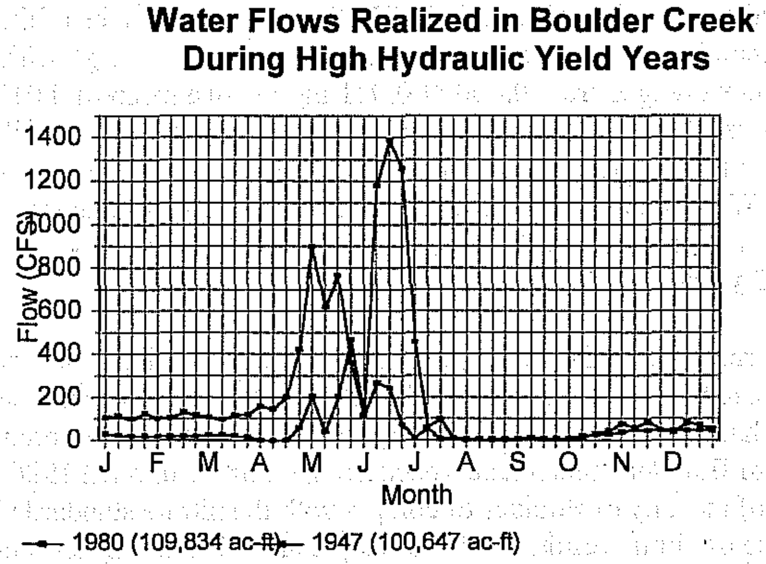


Table 4. Discharge Probabilities for Boulder & Coal Creeks @ Coal Creek Confluence. with floodway dimensions (Mullen Engineering)							
Creek	**10 yr (CFS)**	**50 yr (CFS)**	**100 yr (CFS)**	**500 yr (CFS)**	**100 yr Floodway L**	**Dimension R**	**Flood Total**
Boulder	3,000	9,400	14,000	31,800	840'	110'	950'
Coal	6,050	9,940	12,200	18,350			

* From centerline of creek facing downstream

Water Quality

Boulder Creek is contained within segment 9 of the Basin and its water quality is classified for aquatic life warm water 1, recreation 1, water supply, and agriculture use. Coal Creek is classified as a warm water 2, recreation 2, and agriculture use stream. Water quality numeric standards have been established by the Colorado Water Quality Control Commission and can be viewed in Appendix III. Water quality information has been collected on Boulder Creek for a number of decades and on Coal Creek for at least one decade. Coal Creek flows are dominated by greywater return flows from wastewater facilities managed by the cities of Superior, Erie, Lafayette, and Louisville. Water quality requirements incorporated into recently drafted discharge permits for the aforementioned dischargers on Coal Creek will require upgrades and establishment of new treatment facilities that will improve water quality.

Data characterizing water quality in Boulder Creek at the 95th Street bridge was completed by this firm in 1986. The data base identified water quality in the creek changed significantly over that realized above the City of Boulder's 75th Street plant. Results of this analysis in 1986 indicated that the monthly mean of nitrate nitrogen ranged from 1-3 mg/l with an annual mean of 2.37 mg/l; free ammonia ranged from 0.00009-0.041 mg/l with a mean of 0.0129; total dissolved solids ranged from 206-407, total phosphorous ranged from 0.4-3.15 mg/l , orthophosphorous ranged from 0.4-4.8 mg/l; pH ranged from 7.1-7.9 units; and temperatures ranged from 3.3-22 degrees Celsius. Water quality analysis completed for the City of Lafayette recently reported to the media that free ammonia limits were exceeded in Boulder Creek above the Coal Creek confluence 13 times in 2 years.

The Colorado Water Quality Control Commission's listing of a nitrate numeric standard in Boulder Creek of 10 mg/l without clarification that the standard is actually based on nitrate-nitrogen has caused considerable interpretive confusion by researchers regarding compliance by the City of Boulder. Statements based on the aforementioned 1986 database regarding the inability of the City of Boulder to comply with the nitrate standards in the creek are erroneous due to use of nitrate results (which are typically 4.4 times higher then nitrate-nitrogen results) as well as the fact that the City's compliance point for water quality standards is located just upstream of the Coal Creek confluence which is a number of miles downstream from the 95th Street bridge. Media reports on studies completed on Boulder Creek for the City of Lafayette indicate continued ammonia loading of Boulder Creek..

Historic data and recent reports indicate nitrogen compounds in Boulder Creek are elevated in the lower reaches (above those realized above). During winter low flow periods Boulder Creek flows are comprised primarily of wastewater return flows from municipal water treatment plants. This represents an impediment to the development and maintenance of aquatic communities. Extensive studies and modeling have been completed on Boulder Creek with respect to nitrogen compounds and their fate in the stream. A primary concern voiced by professional water quality managers is the elevated levels of nitrogen and the interaction of conditions in Boulder Creek that increase the toxic free ammonia potion of total ammonia occurring in this natural system. These conditions include increases in pH caused by aquatic photosynthetic activity and temperature increases correlated to season and flow reductions/balance. Decreases in dissolved oxygen concentration (correlated to temperature increases, oxygen demand increases, and elevation decreases) is also a condition of concern.

Channel Conditions:

Flowing water channels evolve, establish, and behave in the landscape similarly worldwide based on the interaction of a set of variables. Channel typing is a technique used to characterize natural channels based on measurements of important channel and landform variables that describe a channel and its components. Based on the results of these measurements a channel can be classified in a hierarchy that provides a better understanding and increases predictive capability of professionals working with the channel in question. Roughly 16,165 feet of Boulder Creek channel (3.06 miles) are included in the study area from just upstream of Colorado Highway 287 to a point just upstream of the Coal Creek Confluence. An additional 7400 feet of channel located on the Boulder Valley Farm was added to represent a reference reach. The reference reach was chosen to describe the historic geomorphology of Boulder Creek. Moderate to low channelization and flood plain manipulation has occurred in this reach. Roughly 0.8 miles of Coal Creek channel was evaluated for this effort. The techniques used for this analysis are described in Pfankuch(1975), Rosgen (1985), Rosgen and Mitchell (1986)and Rosgen(1996). Level II surveys of 6 stations within the reference and study reaches were completed for this document. Appendix II documents the cross section database developed for each station in this study.

Reference Reach: Boulder Creek on Boulder Valley Farms

The Boulder Creek channel located in the reference reach on Boulder Valley Farms illustrates the historic configuration of this channel both before and after the installation of the Lower Boulder Ditch diversion. Prior to diversion of water from this channel Boulder Creek operated as is characterized by a C3 channel type (See Figure 6). This channel type is described in Rosgen 1996 as a "slightly entrenched, meandering, riffle pool, cobble dominated channel in a well developed flood plain." Table 5 compares the data collected with those used to define this type of channel.

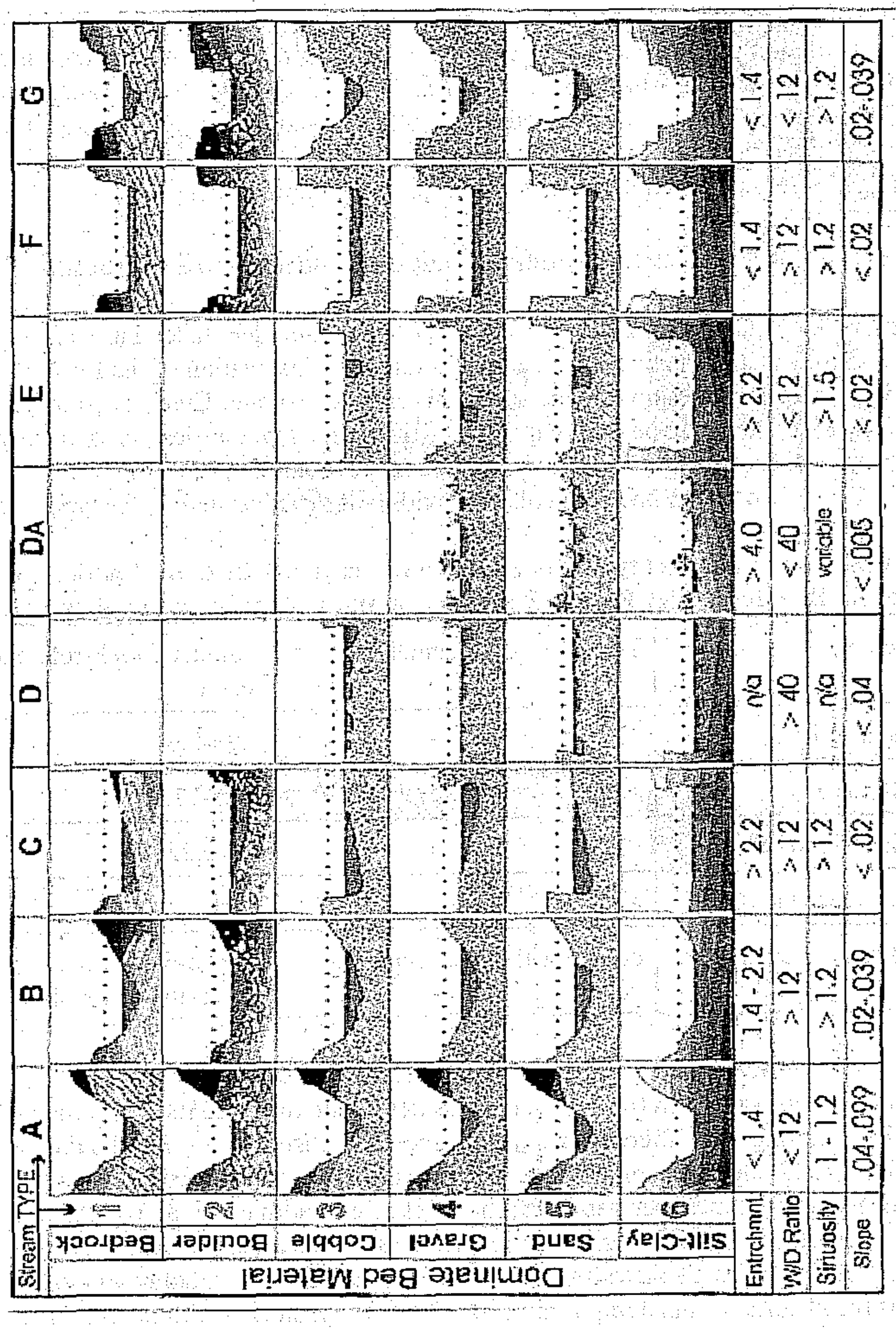
Table 5.Comparison of channel type descriptors with data obtained on Boulder Creek reference reach, Boulder Valley Farms, Boulder County, Colorado. September 1997.

Channel Descriptor	Textbook-C3 channel	Boulder Creek-reference reach
Entrenchment ratio	>2.2	4.96-8.6
Width/depth ratio	>12	25.5-25.75
Water surface slope	<2%	0.1-0.22%
Sinuosity(meander factor)	>1.2	1.18
Dominant Particle size in channel	cobble with some sands and gravel	cobble-60%;gravel-18%;sand-18%;silt-4%

Study Reach: Lower Boulder and Coal Creeks:

The valley floor gradient through the study area was determine to be 0.38%. The channel observed to be operating was different than the channel that existed in this floodplain previous to water diversion and floodplain manipulation. The primary observable difference was in the area of floodplain utilized and the meander pattern of the creek. Belt width of the active and historic floodplain was developed by measuring historic channel scars on available aerial photographs. Now Boulder Creek utilizes a belt width or active flood prone area of roughly 400'-600' of valley floor whereas the historic channel required 1000'-1200'. The historic width measured correlates well with the predicted floodway identified for the 100 year flood event at this point on the creek. The historic meander factor realized was 1.3-1.6 as opposed to the 1.18 measured in the present channel. The reduced flow both at the peak of the 1.5 year runoff event as well as those realized throughout the irrigation season have provided the channel less energy to carve and maintain

Figure 6. Channel type descriptions based on delineative criteria (from Rosgen, 1996)



historic channel dimensions. Man induced channelization, bankside berms, reduced floodplain access for flood flows, and flood flow peak attenuation have further reduced the channels ability to maintain natural channel dimensions consistent with a C3 channel. We have defined the channel in the reference reach as a modified C3 based especially on the reduced meander factor.

To explain the conditions that exist on the Boulder and Coal Creek channels it is necessary to define certain terms. The bankfull channel is that area of the channel width to a vertical elevation that contains the 1.5 year runoff event(annual high flow). This is typically an aquatic dominated environment. The floodplain is the horizontal channel area to a vertical depth which contains some flood frequency event(IE 10 year, 50 year, 100 year) The floodplain is typically riparian habitat. The low terrace elevation is by definition an abandoned floodplain that the river has cut down through to a depth which isolates the terrace from all but the most extreme flood flows.

Examination of historic and recent aerial photographs illustrates that the Boulder Creek and Coal Creek channels have been dramatically altered through the study area. Boulder Creek in the study area is isolated from its historic floodplain by long reaches of manmade bankside dikes. These structures have contained flows, eliminated the function of the floodplain (and its vegetative components) and initiated a down cutting process of the creek channel that has spanned decades since the dikes were constructed. Supply of greater than historic flows and the attendant increase in the annual and periodic high flow events in Coal Creek have caused channel disequilibrium. Evaluation of these two channels through the study reach has illustrated that these channel areas are actively involved in incision into the valley floor. Incision or entrenchment is a geomorphological adjustment that is typical of channelized reaches of streams. Table 6 illustrates the results of our channel typing data collection.

Table 6. Summary of Level II Survey data for Boulder Creek and Coal Creek. Boulder County, Colorado 1997.

Channel Descriptor	Sta.1 BC. Boulder Valley Farms	Sta.2-BC. Boulder Valley Farms	Sta 3- BC. 0.3 miles east of 109th	Sta.4-BC. 0.3 miles east of Kenosha Rd	Sta.5-BC @ diversion east of Kenosha Rd	Sta.6-Coal 0.5 miles north of Kenosha Rd
Entrenchment Ratio	3.22	1.6	1.3	1.99	1.92	1.2
Bankfull width	59'	56'	67.2'	49.6'	105.6	32'
Bankfull mean depth	2.29'	2.2'	1.79'	1.57'	1.35'	3.1'
Width/Depth Ratio	25.76	25.45	37.5	31.6	78.2	10.3
2XBankfull width (flood prone width)	190.4'	89.9'	88'	97.6'	1.92'	38.4'
Water Surface Slope	0.25%	0.22%	0.35%	0.39%	no data	0.28

Channel Descriptor	Sta.1 BC. Boulder Valley Farms	Sta.2-BC. Boulder Valley Farms	Sta 3- BC. 0.3 miles east of 109th	Sta.4-BC. 0.3 miles east of Kenosha Rd	Sta.5-BC @ diversion east of Kenosha Rd	Sta.6-Coal 0.5 miles north of Kenosha Rd
Sinuosity (Meander factor)	1.18	1.03	1.10	1.02	1.01	1.53
Substrate Particle sizes	Cobble-60% Gravel-18% Sand-18% Silt-4%	Cobble-58% Gravel-19% Sand-18% Silt-5%	Cobble-52% Gravel-29% Sand-15.5% Silt-3.5%	Cobble-49% Gravel-38% Sand-12% Silt-1%	Cobble-42% Gravel-33% Sand-24% Silt-1%	Cobble-3% Gravel-4% Sand-48% Silt-45%
Channel Type	C3	F3	F3	F3	D3b	G5

The C3 channel type described by the channel and floodplain found at station 1 once dominated the Boulder Creek channel throughout its lower reaches. Remnants of the channel before channelization can be observed throughout the study reach. Dewatering due to diversion has reduced the intensity of flood flow events and the energy they provide to maintain the channel and the floodplain. Man caused disturbances have erected dikes for many decades to contain flood flows, especially the important channel forming 1.5 year events. Historic management efforts have straightened channels to reduce land area dominated by the creek reducing the channel sinuosity or meander factor. In areas such as the reach below the 109th St bridge and on the property north of Kenosha Rd, channelization was accompanied by filling of the floodplain to a historic low terrace elevation. The responses of a channel to this manipulation is to increase energy due to an inability to dissipate high flows in its floodplain or through meanders, increase bank and bed shear stress during high flows and eventually to erode the least resistive physical component of the channel. The primary alluvial substrate materials in Boulder Creek are small cobble to large gravel. Data indicates that significant channel entrenchment or down cutting of the bed has occurred along the stream from Boulder Valley Farms to the end of our study area. The most significant area of entrenchment occurs in the reach downstream of the 109th St. bridge (Station 3). The channel bottom in the Station 3 cross section has down cut to an elevation 5' below the historic floodplain. In essence the Boulder Creek and Coal Creek Channels have abandoned their floodplains due to horizontal restriction by dikes, vertical down cutting due to entrenchment, placement of graded stream side structures to an elevation of the historic terrace and a combination of these factors.

Rivers are dynamic and subject to adjustment when the variables that define their form are changed. These changes manifest themselves in the channel dimension(cross sectional area), pattern (meander factor), and profile (gradient). The channel that initially cut into the Boulder Creek valley floor through the study area maintained itself as a stable C3 channel type. The historic Boulder Creek channel has, through water diversion and channelization, lost its ability to continue to maintain itself as a C3 channel. This C3 channel, responding to geomorphological changes (isolated from its floodplain, channelization, high sediment loads, altered flood flows, reduction of channel maintenance flows, etc) has changed its form. Constriction of the channel into a floodprone area less that twice its bankfull width (C3 typically have more than 2.2 times the bankfull width for a floodprone area) and straightening of the meanders has artificially created an

F3 channel that is down cutting into the floodplain. Stations 2, 3, 4 illustrated in Table 6 of this effort document this channel change. Down cutting has increased the bed load of material in this stream and caused deposition in flatter areas of the channel (Station 4). The normal adjustments that manifest in natural systems is for the wide flat F3 channel to down cut its bed after widening its belt width to incise a flatter, narrower, meandering E3 channel. Our efforts have documented that the only area where the present channel had some access to its floodplain it created a D3 channel that is braided instead. The Boulder creek channel is in a state of disequilibrium with its watershed due to anthropomorphic influences that presently exceed the watersheds ability to adjust to a more stable channel type in this study area.

Proposed Boulder Creek/Coal Creek Aquatic Resources Improvement Recommendations

Fisheries

Inventories completed by the Colorado Division of Wildlife in 1995-96 have identified the status of native fishes in the St Vrain River Drainage as diverse. Nessler, et al (1997) states that tributary drainage samples of the St Vrain River were comprised primarily of fathead minnows, longnose dace, creek chubs, white suckers, and green sunfish. Environmentally sensitive species which were common in the main stem made up only 2% of the fish sampled in subdrainages such as Boulder and Coal Creeks. Nessler, et al (1997) states that if the limiting factors which have precluded the colonization of Boulder and Coal Creeks by rare or sensitive species can be identified and mitigated, that these two subdrainages may provide valuable habitat for these species. It has been speculated by the CDOW that a significant amount of the effort for native fishes in this drainage will be to maintain and enhance their abundance The flowing water resources of Boulder Creek and Coal Creek would be most valuable for the enhancement and maintenance of the native fish species of this foothill stream transitional area. These species include fathead minnows, longnose dace, white sucker, creek chub, sand shiner, longnose sucker, stonerollers, green sunfish, johnny darter, plains topminnow, and brassy minnow. It is only reasonable that rehabilitation /enhancement efforts completed by the Boulder County Open Space Department in the Boulder Creek riparian corridor compliment and contribute to this regional commitment.

Development of cooperative agreements with the Colorado Division of Wildlife, water users, point source dischargers, and adjacent landowners to address limiting factors for target species in these creeks should be pursued. Once limiting factors are mitigated, development of off channel and in channel habitat which afford an ability to establish populations of sensitive species would assist greatly in an effort to re-establish native fishes. Many opportunities exist in this project area for both types of habitat developments. Some opportunities exist in off channel ponds throughout the property to develop brood stock populations of sensitive fish which could be periodically harvested and transferred to new habitat sites.

Water Quality Improvements

The concerns being voiced and efforts being implemented by water quality managers for these creeks should be continued. Reducing ammonia loading would increase the value of all other improvements undertaken in the name of rehabilitating the function of these two creeks and the quality of life for its residents. The periodic increases in toxic free ammonia must be addressed if sustained improvement of these watersheds are to be realized. The complexity of the system identified by computer modeling efforts bespeaks the complexity of the solution. While numeric standards and compliance testing are important elements of any water quality management effort, certainly emphasis on performance testing is also important. It is equally as important to demonstrate aquatic communities are healthy while determining the numeric levels of water quality parameters being realized in these creeks. Dialog should be initiated which would promote a basin wide interest, organization and cooperation in water quality improvement. The health of Boulder and Coal Creeks and their residents would benefit greatly from being involved in a basinwide approach to water quality management. Boulder County Parks and Open Space as primary managers of lower Boulder Creek face involvement in a number of federally mandated programs if water quality issues are not addressed in these two creeks. Section 303(d) of the Clean Water Act requires states to identify waters that do not or are expected not to meet water quality standards and list them. Once listed, Colorado must prioritize, analyze the problem , and allocate responsibility for controlling the pollution. The EPA has already been sent a letter by the Colorado Environmental Coalition expressing concern for failure to pursue the Section 303(d) mandate in Colorado. Federal intervention in water quality management and potential listing of sensitive species as endangered or threaten by the federal agencies charged with enforcement of the Endangered Species Act will trigger a loss of jurisdiction and incredible cost for species recovery. Avoidance of such intervention should be motivation to achieve improvement for all entities involved. Development of healthy aquatic systems and healthy populations of sensitive aquatic species in lower Boulder Creek and Coal Creek represents an opportunity for all state, municipal, and county jurisdictions to do their essential part to assure that such outcomes do not occur.

Development of a healthy riverine aquatic system must employ as its foundation a lotic environment with all of its functioning parts. The system's ability to function laterally and longitudinally is important in creating and maintaining channel width/depth ratios, entrenchment ratios, pool/riffle ratios, and appropriate cross sectional areas that represent optimized capabilities of the creek to perform intended water quality improvements for the long term (increased depths, solar heating abatement, oxygenation, bed and bank stability, etc). Boulder Creek and Coal Creeks must be conveyed in channels that represent equilibrium for the land forms, flows, energy, and sediment supply that characterizes them. This plan must create channels with floodplains that contain riparian areas that assist in landform stability, nutrient fixation, and habitat improvement.

Channel Improvements

The channel areas of Boulder and Coal Creeks in our study area are in states of disequilibrium with their watersheds. A sustainable balance between the channel, water, and sediment supply does not exist. Our analysis has defined these channels as entrenched channels. The result of this disequilibrium is constant maintenance of the channel, maintenance of structures in the channel (diversions, bridge abutments, banks), and degraded riparian and aquatic habitat. Other deleterious changes that are perpetuated by this disequilibrium are elimination of the riparian vegetative species and an inability of the channel to maintain the remnants of the riparian community that is holding on. Renovation of these two channels must address as its most basic objective, development of an equilibrium for this channel with the flows it realizes and the sediment supplied to it. The most appropriate and long term approach would be to realign the channel in a more natural and stable form. It is our recommendation that this project seek to create a channel type which is formed to convey the flows represented by the hydrologic database. This new channel should have as its components a bankfull width and cross-sectional area capable of conveying adequately the 1.5 year flows, a floodplain that is of an elevation that provides over bank flooding and containment for at least the 10 year flood event, and proper longitudinal and geometric profiles to allow alignment of the channel with the existing bridge abutments and the down stream channel on neighboring property. Their are 4 approaches (adapted from Rosgen, 1997) that can be used to rehabilitate this channel. A description and summary of pros and cons can be viewed in Table 7. These approaches are arranged in a prioritization for use based on their value in achieving a stable, natural channel with its attendant increases in wildlife and fisheries values.

Table 7. Prioritized approaches for rehabilitation of an entrenched channel (adapted from Rosgen, 1997)

Approach	Method	Pro	Con
I. Convert G or F stream type to C or E *at previous floodplain level*	1. Re-establish channel on old floodplain using relic channel or construction of a new channel. 2. Design new channel for dimension, pattern, and profile characteristics of stable form 3. Fill existing incised channel or create discontinuous oxbow lakes level with new floodplain elevation 4.would require realignment of flows from previous channel into new channel	1.Re-establishes floodplain and stable channel 2.Reduces bank height and stream bank erosion. 3.Reduces land loss 4.Raises ground water table 5.Increases and improves aquatic, terrestrial, and riparian habitat 6.Improves land productivity(greater access to floodplain) 7. Improves aesthetics 8. Long term risk of failure is low 9.Longevity of improvement and increase in wildlife values is maximum	1. Floodplain establishment could cause flood damage to urban, agricultural, and industrial development 2. Downstream end of project could require grade control structures from new to previous channel to prevent initiation of head cutting. 3. Additional volume of floodway storage could increase stress on bridge abutments 4. High risk initially while channel components establish/stabilize

Approach	Method	Pro	Con
II. Convert F or G stream types to C or E at existing streambed level or higher but not at the original floodplain level	1. Must establish the proper belt width provides for the minimum meander width ratio for the C or E . 2. Excavate channel walls to create proper beltwidth if it is not present. 3. Construct new channel and habitat in existing channel bed. 4. Create new floodplain with proper elevations to allow flooding of specified flow events. 5. Remove and dispose of excess materials 6. Re-establish riparian habitat and community	1. Decreases bank heights and erosion 2. Allow riparian vegetation to establish and stabilize banks/floodplain 3. Establishes floodplain to help take stress off channel during floods 4.Improves/creates diverse aquatic habitat opportunities 5. Prevents wide scale flooding of original land surface area 6.Reduces sediment supply and transport load to the channel 7.Downstream grade control is easier 8. Reduces shear stress on banks and bed over those realized in entrenched channel 9.Longevity of improvements and wildlife values is maximum	1. Does not raise groundwater table 2. Shear stress and velocity higher during flood depending on width of newly created floodplain 3.Upper banks must be sloped and stabilized to reduce erosion during flood events that approach their elevation. 4. Increased vegetation from riparian zone increase debris for jam potential. 5. High risk initially while all components establish but longevity of restoration is maximized
III. Convert to a new stream type without an active floodplain, but containing a flood prone area. Convert G to B, or F to Bc,	1. Excavate channel to change stream type establishing proper dimensions, pattern, and profile. 2. Convert channelized F to an F channel with proper geometry, profile, dimensions, and floodprone area 3. Conversion of F to a Bc stream type requires decrease in width to depth ratio and increase in entrenchment ratio	1. Reduces land required 2. Doesn't require relocation of channel side improvements 3.Decreases flood stage realized over prior channel for same flood event 4.Improves aquatic habitat	1. Requires intensive bank and bed stabilization 2. High cost of materials 3.Reduced habitat diversity created over high priority approaches 4.Does not raise groundwater table

Approach	Method	Pro	Con
IV. Stabilize channel in place	Placement of instream, bankside, and bank stabilization structures using a varied set of materials.	1. Excavation volumes are reduced 2. Land needed is minimal	1. High cost to achieve stabilization of the channel 2. High risk due to excessive shear stress and velocity 3. Doesn't address sediment supply and energy equilibrium of channel 4. Limited riparian, terrestrial, and aquatic habitat improvement opportunities

The following is a reach by reach description of the recommendations for enhancement of channel, fishery, and riparian system improvement in the study area

Reach 1-Western study area boundary to Colorado State Highway 287

Alternative C (Table 7-Approach I)-

- Realign existing modified F3 channel into its historic channel establishing a modified C3 channel
- Re-establish the channel morphometry emulating the reference reach (above on Boulder Farms) including sinuosity, water slope gradient(0.001-0.02); entrenchment ratio, width/depth ratio, channel cross-sectional area, bankfull width, flood prone area(2xbankfull width), flood plain belt width(~400-500')
- Divert existing flows into old river meanders changing the 1.03 to a 1.3 meander factor
- Establish an entrenchment ratio(bankfull width/mean bankfull depth) of >12
- Rebuild bends and point bars
- Develop instream, overhead, and bank cover for native fishes
- cut and fill and abandon existing channel as needed
- Maintain and enhance diversion structure in more appropriate configuration
- Allow already abundant riparian vegetation to revegetate site, use willow and bank grass matting as appropriate
- Maximize use of native materials (rocks, rootwads, logs, regrading)

Alternative B and A(Table 7- Approach IV)-

- Preservation with periodic channel maintenance
- Instream structure repair/maintenance
- Develop more mosaic instream and bank side habitat structure targeting sensitive native fishes
- Vegetation manipulation and weed control

Reach 2 -Colorado State Highway 287 east to 109th Street

Alternative C(Table 7-Approach IV)

- Stabilization/enhancement of existing channel
- Structural enhancement/stabilization of existing channel meander
- Reform width depth ratios of existing channel
- Channel/bank contouring
- Establish some flood plain access and function(<5 year)
- Vegetation manipulation
- Install some native fish habitat

Alternative B and A(Table 7-limited Approach IV)-Enhancement of limited native fish habitat

- Install structures targeting certain sensitive fish species
- Vegetation manipulation
- Allow natural seepage areas to create wetland habitats
- Determine best management practice for communication of river with off channel habitats

Reach 3- 109th Street to Kenosha Road(Dawson)

Alternative C (Table 7-Approach II)-

- Complete channel realignment into a historic C3 configuration
- Establish modified C3 channel with proper meander pattern with functioning 400'-600' flood plain(as defined by reference reach-Boulder Valley Farms)
- Excavate banks to width of 400-600' at existing bed elevations
- Develop longitudinal alignment with channel and bridge abutments
- Use excess excavated material to fill in and contour existing pond shorelines
- Structurally establish proper width/depth ratio and channel geometry
- Provide overflow and backwater elevations in flood plain; create wetlands
- Open channel up for flood access to 1.5-10 year flood plain
- Create native fish instream habitat
- Vegetation manipulation/enhancement
- Maximize use of native materials in channels (rock, logs, rootwads)

Alternative B(Table 7-Approach III)

- Stabilization/enhancement of existing F3 channel
- Excavate channel banks 200' wide to a depth of existing bed
- Structural enhancement/stabilization of F3 channel and geometry
- Develop longitudinal alignment of channel and bridge abutments
- Reform width depth ratios of existing channel
- Channel/bank contouring
- Establish some flood plain access and function to 1.5-5 year floodplain
- Vegetation manipulation
- Install some native fish habitat

Alternative A(Table 7-Approach IV)

- Enhancement of limited native fish habitat
- Install structures targeting certain sensitive fish species
- Stabilize banks and bed
- Vegetation manipulation

Reach 4-Kenosha Road to Section 1 and 2 boundary line

Alternative C(Table 7-Approach II)

- Continue rehabilitation of entrenched F3 channel to a C3 channel
- Establish modified C3 channel with proper meander pattern with functioning 400'-600' flood plain(as defined by reference reach-Boulder Valley Farms)
- Excavate banks to width of 400-600' at existing bed elevations
- Develop longitudinal alignment with channel and bridge abutments
- Use excess excavated material to fill in and contour existing pond shorelines
- Structurally establish proper width/depth ratio and channel geometry
- Provide overflow and backwater elevations in flood plain; create wetlands
- Open channel up to access to 1.5-10 year flood plain
- Create native fish instream habitat
- Vegetation manipulation/enhancement

Alternative B(Table 7-Approach III)

- Excavate channel banks 200' wide to a depth of existing bed
- Structural enhancement/stabilization of F3 channel and geometry
- Reconfigure D3 braided section and install historic diversion at outside of meander
- Develop longitudinal alignment of new channel with downstream reach 5
- Reform width depth ratios of existing channel
- Channel/bank contouring
- Use excavated fill from channel to recontour existing gravel pit shoreline/littoral areas
- Establish some flood plain access and function to(1.5-5 year)
- Vegetation manipulation/installation
- Install some native fish habitat

Alternative A(Table 7-Approach IV)

- Enhancement of limited native fish habitat
- Install structures targeting certain sensitive fish species
- Stabilize banks and bed
- Vegetation manipulation

Section 5-Section 1 and 2 boundary line to lower property boundary

Alternative C(Table 7-Approach III)

- Stabilize through alignment and structures existing F3 channel within beltwidth provided(120'-150')
- Eliminate channel braiding through proper floodprone area design/grading
- Install channel structures
- Vegetation enhancement/manipulation

- Provide final and stable grade control for longitudinal alignment of the project into the existing channel at the property boundary

Alternative B (Table 7-Approach IV)

- Structurally stabilize present F3 channel alignment where appropriate
- Install structures targeting certain sensitive fish species
- Vegetation manipulation

Alternative A(Table 7-Approach IV)

- Enhancement of limited native fish habitat
- Install structures targeting certain sensitive fish species
- Stabilize banks and bed
- Vegetation manipulation

Reach 6-Coal Creek from Kenosha Road to eastern study area boundary

Alternative C(Table 7-Approach I)

- During all months of the year divert the existing flows comprised primarily of wastewater treatment return flows from existing channel and introduce them to a man-made innovative wetlands treatment system
- Develop a natural wetland system on the 27 acre cultivated area west of Coal Creek prioritizing function as tertiary treatment of greywater flows
- Determine most appropriate wetland plant species combinations
- Establish optimized water retention times and flow patterns through the system
- Renovate existing diversion structure north of Kenosha Road to serve existing water rights and divert remainder of flows to terrace elevation west of the existing creek
- Provide a diversity of native fishery and wildlife habitat including tree islands, hiding cover, nesting cover, nursery areas etc.
- Abandon sufficient water storage/use rights to provide additional water rights needed
- Revegetate with diversity of native wetland and riparian plant species

Alternative B (Table 7-Approach I)-

- Reintroduce creek to abandoned historic channels using controlled historic flows
- Determine historic flow regime of Coal creek
- Determine historic channel integrity, location, and availability on west side of existing alignment
- Design, construct, locate and align necessary channel portions that are missing
- Elevate the channel and water surface elevation at Kenosha Road or just downstream
- Open historic and newly created channel and introduce historic flows
- Create bypass capabilities for excess flows in a pipeline, a smaller version of Approach 1 or use the existing creek alignment to convey flows
- Vegetation manipulation in newly created and existing channel alignments
- Install fish habitat structures in new alignment
- Removal of Debris and jam potentials

Alternative A(Table 7-Approach IV)-

- Stabilize the existing channel alignment
- Install series of very low head dams with vegetative/rock reinforcement
- Complete bank sloping and minimize mass wasting areas
- Incorporate channel alignment to emphasize some meander to increase function
- Vegetation introduction/manipulation
- Install fish habitat structures limited to low head bank placed rock, double wing deflectors, and floating log cover
- Remove and reduce debris jam potential

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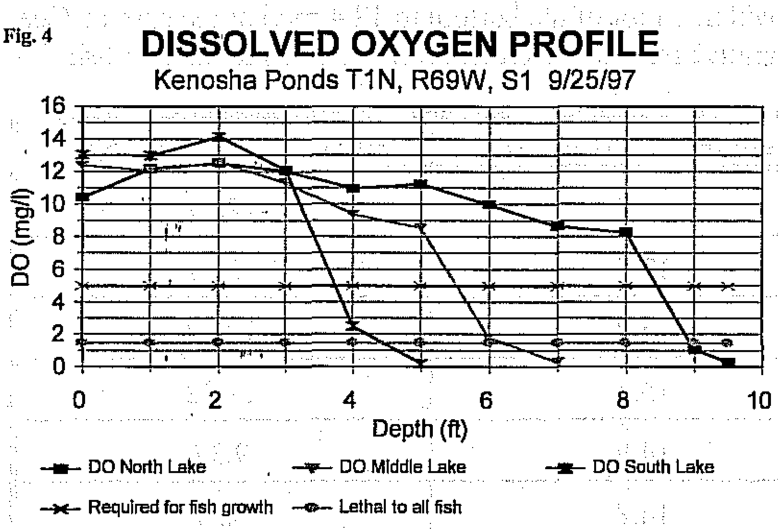
Kenosha Ponds-Master Plan Work Product

Definition of Existing Conditions

The ponds located immediately north of Kenosha Road and south of lower Boulder Creek in T1N,R69W, S1 known as Bill's Ponds were surveyed to determine their suitability as fish habitat. Site maps are provided in Figures-1-3 which illustrate the results of these surveys completed in August 1997.

Fig. 4



North Lake

North Lake was estimated to be 8.3 surface acres with an average depth of 6.5 feet representing 53.9 acre feet of storage. Maximum depth observed in North Lake was 9 feet. Organic sediment was present at 52 of 65 sample points in the pond and had an average depth of 0.18 feet with a maximum depth of 0.5 feet. Aquatic vegetation was observed at 5 of 65 sample points and was identified to be 3'-6' in height. Sago Pondweed (*Potamogeton pectinatus*) and Parrotfeather (*Myriophyllum spp*) were the only species of plants identified. Dissolved oxygen profiles completed in September 1997 varied from 1.09 mg/l within 1 foot of the bottom to 10.43 mg/l at the surface(see Table 1). Figure 3 illustrates comparative results of dissolved oxygen profiles taken and their value to fish present.

Table 1. Numeric results of dissolved oxygen profiles at North Lake, Boulder County, CO. September, 1997

Depth(ft)	Temperature(Celsius)	Dissolved Oxygen(mg/l)
Surface	18.3	10.43
1	17	12.17
2	16.6	12.5
3	16.2	12.04
4	16	10.94
5	15.9	11.23
6	15.9	9.98
7	15.9	8.65
8	15.8	8.3
9	15.8	1.09

Middle Lake:

Middle Lake was estimated to be 4.2 surface acres with an average depth of 4.97 feet representing a storage volume of 20.87 acre feet. Maximum depth observed in this lake was 6.2 feet. Organic sediment was observed at 31 of 60 sample points having an average depth of 0.45 feet and a maximum depth of 1 foot. Aquatic vegetation (Parrotfeather) was observed at only 2 of 60 sample points having an average depth of 4.5 feet. Dissolved oxygen profiles completed in September 1997 ranged from 1.8 mg/l within 1 foot of the bottom to 12.4 mg/l at the surface (see Table 2). Figure 4 illustrates the comparative results of oxygen profiles and their value to fish present in this lake.

Depth(ft)	Temperature(Celsius)	Dissolved Oxygen(mg/l)
Surface	17.8	12.37
1	17.5	12.07
2	15.7	12.57
3	15.2	11.32
4	14.9	9.37
5	14.8	8.57
6	14.9	1.84

South Lake:

South Lake was estimated to be 3.5 surface acres with an average depth of 4.59' representing a storage volume 16.06 acre feet. Maximum depth observed in this lake was 6 feet. Organic sediment was observed at 35 of 71 sample points with an average depth of 0.33 feet and a maximum depth of 1.7 feet. Aquatic vegetation was not observed in this pond. Dissolved oxygen profiles completed in September 1997 ranged from 2.5 mg/l within 1 foot of the bottom to 13.05 at the surface (Table 3). Figure 4 illustrates the comparative results of oxygen profiles and their value to fish present in the lake.

Depth(ft)	Temperature(Celsius)	Dissolved Oxygen(mg/l)
Surface	18.2	13.05
1	17.8	12.97
2	15	14.13
3	14.8	12.09
4	14.8	2.51
5	14.9	2.11
6	14.9	1.80

Little Lake:

Little Lake was estimated to be 2 surface acres with an average depth of 4.6 feet representing a storage volume of 9.2 acre feet. Maximum depth observed in this lake was 6.6 feet. No sediment, vegetation, or dissolved oxygen profiles were developed for this pond.

Recommendations:

All of the ponds described by this effort are characterized by slightly fluctuating water levels (<1 foot), shallow depth, flat bottom contours, very little littoral habitat, low aquatic vegetation production and lack of in lake structure. These attributes represent poor natural fish habitat for sport fish; however, they represent excellent conditions for semi-intensive production of fish. The primary fish culture attributes these ponds have is potential isolation of individual ponds from each other, adequate depths to overwinter fish in most years, and bottom/side contouring that afford easy harvest of fish for transport to other sites. The lack of vegetation , organic sediment build up, and in lake structure represent very little impediments to seining operations for the harvest of fish that are produced. It is our recommendation that these ponds be used for the production of native fishes that are presently having difficulty in this drainage. Native fishes have well known species associations so it is possible that multiple species would be raised in each pond. The brood stock and offspring of identified native fishes that are maintained here could be used to restock Boulder and Coal Creeks once water quality, channel, and fish habitat improvements are completed. Excess production could be used to start or enhance fish populations in the St Vrain watershed. Other watersheds could benefit from this facility as well. Use of this site as a native species hatchery would require the least site alteration of any alternative being suggested. This program would involve the jurisdictions of Boulder County Parks and Open Space, the Colorado Division of Wildlife, the Colorado Department of Natural Resources, and perhaps the Colorado Water Conservation Board. Other appropriate partners would include the City of Boulder, Town of Erie, City of Lafayette, City of Louisville, City of Superior, St Vrain and Left Hand Water Conservation District, and perhaps the Northern Colorado Water Conservation District.

Alternative C-Native Species Production/brood stock program

- Discuss and define project with potential partners
- Develop project partnerships, endorsements and responsibilities
- Develop agreements with CDOW regarding appropriate species for production and conduct of operation
- Develop project plan for use of site as native species fish hatchery/production faciltiy
- Identify responsibilities, timing, ingress/egress, site/program needs, liability, fate of project products, etc. for each partner
- Develop agreements with partners
- Provide suitable access/storage for vehicles and equipment necessary for implementation of plan
- Develop and implement landscape/aesthetic plan for site stabilization
- Implement and operate project plan

The use of Bill's Ponds for native fish production precludes our ability to provide sport fishing in these lakes. Providing sport fishing to the citizens of eastern Boulder county could still be accommodated on this property in the lakes north of Boulder Creek in this section. These four ponds represent a total surface area of 22 acres. These lakes will require additional definition to determine their suitability and predict their functionality as sport fisheries. It is known that game fish production has occurred in these ponds historically. The use of these ponds for fishing would require rehabilitation of access, re-contouring of lake banks, revegetation and stabilization of the affected sites, installation of fish habitat/attraction structures, potential reclamation of the fish population, and restocking with gamefish. Implementation of this part of the project would represent an additional value to the citizens of Boulder County and Colorado as a demonstration site for the compatibility of sport fishing and sensitive species recovery.

Sport fishing can be developed in Bill's Ponds, but it will be to the exclusion of most native fish. The development of sport fisheries in this basin would be best served by re-contouring of the pond banks, development of interconnection between all lakes, development of additional littoral and lacustrine wetland habitat, installation of fish structure, and attainment of 12 foot depths in at least 20 % of the interconnected basin. The pond bank areas would require revegetation with suitable grass, shrub, and woody vegetation to provide shade, bank stability and allochthonous energy inputs.

Alternative B-Renovate existing ponds for Sport Fisheries

- Remove dikes between lakes creating interconnection
- Recontour shoreline plan view creating points and bays
- Dredge lake depths to 12' over 3.6 acres
- Excavate shoreline below waterline to create additional littoral and wetland habitat around 40% of the shoreline
- Re-grade banks to reduce slopes
- Create angler access/wading areas
- Physically stabilize shoreline where necessary(rocks, rootwads, logs, etc)
- Revegetate banks with appropriate grasses, shrubs, and woody vegetation
- Design and Install universal access fishing dock(s)
- Determine necessity and chemically reclaim fish population if warranted
- Restock pond with self propagating warm water species including largemouth bass (or smallmouth bass), bluegills, white crappie, fathead minnows, and gizzard shad.

Appendix I

Channel Stability Evaluation

Reach Location: Survey Date 9/16/97 Time 2:45pm Obs. MJM

Stream Width___ ft. X avg. Velocity______ f/s=_____ Flow cfs

Client BoCo Open Space

Stream Boulder Creek W/S No.__-__-__-__-__-__-__

Reach Gradient___% Stream Order ___ Stream Stage _____ Sinuosity Ratio ______

Reach Description & Other Identification Station B- reference reach @ Boulder Valley Farms

Temperature °F or °C Air____, Water_____, Other__________

Item Rated	Key #	Stability Indicators By Classes Excellent		Good		Stability Indicators By Classes Fair		Poor	
Landform Slope	1	Bank slope gradient < 30%	(2)	Bank slope gradient 30-40%	(4)	Bank slope gradient 40-60%	(6)	Bank slope gradient 60% +	(8)
Mass Wasting or Failure (existing or potential)	2	No evidence of past or any potential for future mass wasting into channel.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6)	Moderate frequency & size, with some raw spots eroded by water during high flows	(9)	Frequent or large, causing sediment nearly year long or imminent danger of same.	(12)
Debris Jam Potential (floatable objects)	3	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4)	Present, volume and size are both increasing.	(6)	Moderate to heavy amounts, predominantly larger sizes.	(8)
Vegetative Bank Protection	4	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding root mass.	(3)	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(6)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	< 50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12)
Channel Capacity	5	Ample for present plus some increases. Peak flows contained. W/D ratio <7	(1)	Adequate. Overbank flows rare. W/D ratio 8-15	(2)	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25	(3)	Inadequate. Overbank flows common. W/D ratio >25	(4)
Bank Rock Content	6	65%+ w/ large, angular boulders 12" + numerous	(2)	40-60% mostly small boulders to cobbles 6-12"	(4)	20-40% w/most in the 3-6" diameter class	(6)	< 20% rock fragments of gravel sizes 1-3" or less	(8)
Obstructions Flow Deflectors Sediment Traps	7	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools & riffles stable.	(2)	Some present, Causing erosive cross currents and minor pool filling. Obstructions and deflector newer and less firm.	(4)	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting & filling of pools	(6)	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	(8)
Cutting	8	Little or none evident. Infrequent raw banks less than 6" high generally.	(4)	Some. Intermittently at outcurves and constrictions. Raw banks may be up to 12"	(8)	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	(12)	Almost continuous cuts, some over 24" high. Failure of overhangs frequent	(16)
Deposition	9	Little or no enlargement of channel or point bars.	(4)	Some new increase in bar formation, mostly from coarse gravels	(8)	Moderate deposition of new gravel & coarse sand on old and some new bars	(12)	Extensive deposits of predominantly fine particles. Accelerated bar development.	(16)
Rock Angularity	10	Sharp edges and corners, plane surfaces roughened	(1)	Rounded corners and edges, surfaces smooth and flat	(2)	Corners & edges well rounded in two demensions	(3)	Well rounded in all dimensions, surfaces smooth	(4)
Brightness	11	Surfaces dull, darkened or stained. Gen. not bright.	(1)	Mostly dull, but may have up to 35% bright surfaces	(2)	Mixture, 50/50 dull & bright, ± 15% ie. 35-65%	(3)	Predominantly bright, 65%+ exposed or scoured surfaces	(4)
Consolidation or Particle Packing	12	Assorted sites tightly packed and/or overlapping	(2)	Moderately packed with some overlapping	(4)	Mostly a loose assortment with no apparent overlap	(6)	No packing evident. Loose assortment, easily moved	(8)
Bottom Size Distribution and Percent Stable Materials	13	No change in sizes evident. Stable materials 80-100%	(4)	Distribution shift slight. Stable materials 50-80%	(8)	Moderate change in sizes. Stable materials 20-50%	(12)	Marked distribution change. Stable materials 0-20%	(16)
Scouring and Deposition	14	Less than 5% of bottom affected by scouring/deposition	(6)	5-30% affected. Scour at constrictions & where grades steepen. Some deposition in pool	(12)	30-50% affected. Deposits & scour at obstructions, pools constrictions and bends.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong	(24)
Clinging Aquatic Vegetation (Moss & algae)	15	Abundant. Growth moss-like, dark green. Perennial. In swift water also.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters	(2)	Present but spotty, mostly in backwater areas, seasonal blooms make rocks slick	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present	(4)
		Excellent Column Total →		Good Column Total →	48	Fair Column Total →	39	Poor Column Total →	

Add Values in each column and record in spaces below

E____+G 48 +F 39 +P____=___87___Total Reach Score **Fair**

Adjective ratings: <38-Excellent, 39-76-Good, 77-114-Fair, 115+-Poor

Queen of the River Fish Co., Inc. / Aquatic Consultants

Stream Fish Habitat Evaluation

Client BoCo Open Space **Prescription Watershed** South Platte **Stream** Boulder Creek

Legal Section____ **Township**____ **Range**____ **Aerial Photo Number**____ **USGS Quad**____

Date 9/16/97 **Time** 2:45pm **Gradient**____**%** **Sinuosity**____ **Ratio** **DOW Stream Code**____ **Reach Number**____

Evaluated by Mitchell/Beauprez **Velocity**____**ft/sec** **Flow**____**cfs** **Pool-Riffle Ratio**____ **Mean Width**____

Soils____ **Channel Type**____ **Mean Depth**____

Reach Description Station B- reference reach @ Boulder Valley Farms **Bankfull Width** 56'

Circle Appropriate Rating for Each Parameter

Channel Stability	60-76	8	<60, 76-90	6	91-107	4	>107	2
Bank Stability (%damaged/exposed)	<3%	8	3-10%	6	11-20%	4	>20%	2
Cover Shade	60-80%	4	>80%; 26-59%	3	10-25%	2	<10%	1
Cover Streamside	abundant	4	common	3	some	2	none	1
Cover Instream	abundant	4	common	3	some	2	none	1
Spawning Areas (% bottom w/ > 1 sq.ft. gravel)	>25%	8	15-25%	6	5-14%	4	<5%	2
Pools No./50' reach	>6	4	5-6	3	3-4	2	0-2	1
Pools Mean size	>stream width	4	≈stream width	3	≈1/2 stream width	2	<1/2 stream width	1
Pools Mean depth	>2 ft.	4	1-2 ft.	3	1/2-1 ft.	2	<1/2 ft.	1
Pools % Pools	40-60%	4	30-40%	3	20-30%	2	<20%	1
Food No. Organisms per sq. ft. of Rock Surface	>100	4	51-100	3	25-50	2	<25	1
Food % may-stone-caddisfly	>75%	4	50-75%	3	25-49%	2	<25%	1
Column Totals	**Total**		**Total**	12	**Total**	12	**Total**	5

Overall Fish Habitat Ratings of this Reach (enter total score in appropriate space)

Excellent (50-60)____ Good (40-49)____

Fair (30-39)____ Poor (15-29) 29 **Poor**

Summary of all Reaches of this Stream (after last reach is evaluated) Miles of Stream Rated:____

Excellent____ Good____ Fair____ Poor____

Channel Stability Evaluation

Reach Location: Survey Date 9/16/97 Time______ Obs. MJM

Stream Width 59' ft. X avg. Velocity______ f/s=______ Flow cfs

Client BoCo Open Space

Stream Boulder Creek W/S No. - - - - - - -

Reach Gradient___% Stream Order ____ Stream Stage _____ Sinuosity Ratio _______

Reach Description & Other Identification Upper Station- BC @ 287, W of Bridge

Temperature °F or °C Air____, Water_____, Other__________

Item Rated	Key #	Stability Indicators By Classes: Excellent		Good		Stability Indicators By Classes: Fair		Poor	
Landform Slope	1	Bank slope gradient < 30%	(2)	Bank slope gradient 30-40%	(4)	Bank slope gradient 40-60%	(6)	Bank slope gradient 60%+	(8)
Mass Wasting or Failure (existing or potential)	2	No evidence of past or any potential for future mass wasting into channel.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6)	Moderate frequency & size, with some raw spots eroded by water during high flows	(9)	Frequent or large, causing sediment nearly year long or imminent danger of same.	(12)
Debris Jam Potential (floatable objects)	3	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4)	Present, volume and size are both increasing.	(6)	Moderate to heavy amounts, predominantly larger sizes.	(8)
Vegetative Bank Protection	4	90% + plant density. Vigor and variety suggests a deep, dense, soil binding root mass.	(3)	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(6)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	< 50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12)
Channel Capacity	5	Ample for present plus some increases. Peak flows contained. W/D ratio <7	(1)	Adequate. Overbank flows rare. W/D ratio 8-15	(2)	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25	(3)	Inadequate. Overbank flows common. W/D ratio >25	(4)
Bank Rock Content	6	65%+ w/ large, angular boulders 12" + numerous	(2)	40-60% mostly small boulders to cobbles 6-12"	(4)	20-40% w/most in the 3-6" diameter class	(6)	< 20% rock fragments of gravel sizes 1-3" or less	(8)
Obstructions Flow Deflectors Sediment Traps	7	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools & riffles stable.	(2)	Some present, Causing erosive cross currents and minor pool filling. Obstructions and deflector newer and less firm.	(4)	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting & filling of pools	(6)	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	(8)
Cutting	8	Little or none evident. Infrequent raw banks less than 6" high generally.	(4)	Some. Intermittently at outcurves and constrictions. Raw banks may be up to 12"	(8)	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	(12)	Almost continuous cuts, some over 24" high. Failure of overhangs frequent	(16)
Deposition	9	Little or no enlargement of channel or point bars.	(4)	Some new increase in bar formation, mostly from coarse gravels	(8)	Moderate deposition of new gravel & coarse sand on old and some new bars	(12)	Extensive deposits of predominantly fine particles. Accelerated bar development.	(16)
Rock Angularity	10	Sharp edges and corners, plane surfaces roughened	(1)	Rounded corners and edges, surfaces smooth and flat	(2)	Corners & edges well rounded in two demensions	(3)	Well rounded in all dimensions, surfaces smooth	(4)
Brightness	11	Surfaces dull, darkened or stained. Gen. not bright.	(1)	Mostly dull, but may have up to 35% bright surfaces	(2)	Mixture, 50/50 dull & bright, ± 15% ie. 35-65%	(3)	Predominantly bright, 65%+ exposed or scoured surfaces	(4)
Consolidation or Particle Packing	12	Assorted sites tightly packed and/or overlapping	(2)	Moderately packed with some overlapping	(4)	Mostly a loose assortment with no apparent overlap	(6)	No packing evident. Loose assortment, easily moved	(8)
Bottom Size Distribution and Percent Stable Materials	13	No change in sizes evident. Stable materials 80-100%	(4)	Distribution shift slight. Stable materials 50-80%	(8)	Moderate change in sizes. Stable materials 20-50%	(12)	Marked distribution change. Stable materials 0-20%	(16)
Scouring and Deposition	14	Less than 5% of bottom affected by scouring/deposition	(6)	5-30% affected. Scour at constrictions & where grades steepen. Some deposition in pool	(12)	30-50% affected. Deposits & scour at obstructions, pools constrictions and bends.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong	(24)
Clinging Aquatic Vegetation (Moss & algae)	15	Abundant. Growth moss-like, dark green. Perennial. In swift water also.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters	(2)	Present but spotty, mostly in backwater areas, seasonal blooms make rocks slick	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present	(4)
		Excellent Column Total ➜		Good Column Total ➜	56	Fair Column Total ➜	27	Poor Column Total ➜	

Add Values in each column and record in spaces below

E____+G____+F 56 +P 27 = 83 Total Reach Score **Fair**

Adjective ratings: <38-Excellent, 39-76-Good, 77-114-Fair, 115+-Poor

Queen of the River Fish Co., Inc. / Aquatic Consultants

Stream Fish Habitat Evaluation

Client BoCo Open Space **Prescription Watershed** Boulder Creek **Stream** Boulder Creek

Legal Section____ **Township**____ **Range**____ **Aerial Photo Number**____ **USGS Quad**____

Date 9/16/97 **Time** 12pm **Gradient**____**%** **Sinuosity**____ **Ratio** **DOW Stream Code**____ **Reach Number**____

Evaluated by Mitchell/Beauprez **Velocity**____**ft/sec** **Flow**____**cfs** **Pool-Riffle Ratio**____ **Mean Width**____

Soils____ **Channel Type**____ **Mean Depth**____

Reach Description BC @ 287 W. of Bridge **Bankfull Width** 59'

Circle Appropriate Rating for Each Parameter

Channel Stability	60-76	8	<60, 76-90	6	91-107	4	>107	2
Bank Stability (%damaged/exposed)	<3%	8	3-10%	6	11-20%	4	>20%	2
Cover Shade	60-80%	4	>80%; 26-59%	3	10-25%	2	<10%	1
Streamside	abundant	4	common	3	some	2	none	1
Instream	abundant	4	common	3	some	2	none	1
Spawning Areas (% bottom w/ > 1 sq.ft. gravel)	>25%	8	15-25%	6	5-14%	4	<5%	2
Pools No./50' reach	>6	4	5-6	3	3-4	2	0-2	1
Mean size	>stream width	4	≈stream width	3	≈1/2 stream width	2	<1/2 stream width	1
Mean depth	>2 ft.	4	1-2 ft.	3	1/2-1 ft.	2	<1/2 ft.	1
% Pools	40-60%	4	30-40%	3	20-30%	2	<20%	1
Food No. Organisms per sq. ft. of Rock Surface	>100	4	51-100	3	25-50	2	<25	1
% may-stone-caddisfly	>75%	4	50-75%	3	25-49%	2	<25%	1
Column Totals	**Total**		**Total**	27	**Total**	12	**Total**	

Overall Fish Habitat Ratings of this Reach (enter total score in appropriate space)
Excellent (50-60)____ Good (40-49)____
Fair (30-39) 39 Poor (15-29)____ **Fair**

Summary of all Reaches of this Stream
(after last reach is evaluated) Miles of Stream Rated:____
Excellent____ Good____ Fair____ Poor____

Channel Stability Evaluation

Reach Location: Survey Date 10/97 Time ______ Obs. MJM ______ Stream Width ___ ft. X avg. Velocity ______ f/s= ______ Flow cfs

Client BoCo Open Space

Stream Boulder Creek W/S No. __-__-__-__-__-__

Reach Gradient ___ % Stream Order ___ Stream Stage ___ Sinuosity Ratio ___

Temperature °F or °C Air ____, Water ____, Other ______

Reach Description & Other Identification BC @ E 109th

Item Rated	Key #	Stability Indicators By Classes Excellent		Good		Stability Indicators By Classes Fair		Poor	
Landform Slope	1	Bank slope gradient < 30%	(2)	Bank slope gradient 30-40%	(4)	Bank slope gradient 40-60%	(6)	Bank slope gradient 60% +	(8)
Mass Wasting or Failure (existing or potential)	2	No evidence of past or any potential for future mass wasting into channel.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6)	Moderate frequency & size, with some raw spots eroded by water during high flows	(9)	Frequent or large, causing sediment nearly year long or imminent danger of same.	(12)
Debris Jam Potential (floatable objects)	3	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4)	Present, volume and size are both increasing.	(6)	Moderate to heavy amounts, predominantly larger sizes.	(8)
Vegetative Bank Protection	4	90% + plant density. Vigor and variety suggests a deep, dense, soil binding root mass.	(3)	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(6)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	< 50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12)
Channel Capacity	5	Ample for present plus some increases. Peak flows contained. W/D ratio <7	(1)	Adequate. Overbank flows rare. W/D ratio 8-15	(2)	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25	(3)	Inadequate. Overbank flows common. W/D ratio >25	(4)
Bank Rock Content	6	65%+ w/ large, angular boulders 12" + numerous	(2)	40-60% mostly small boulders to cobbles 6-12"	(4)	20-40% w/most in the 3-6" diameter class	(6)	< 20% rock fragments of gravel sizes 1-3" or less	(8)
Obstructions Flow Deflectors Sediment Traps	7	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools & riffles stable.	(2)	Some present, Causing erosive cross currents and minor pool filling. Obstructions and deflector newer and less firm.	(4)	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting & filling of pools	(6)	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	(8)
Cutting	8	Little or none evident. Infrequent raw banks less than 6" high generally.	(4)	Some. Intermittently at outcurves and constrictions. Raw banks may be up to 12"	(8)	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	(12)	Almost continuous cuts, some over 24" high. Failure of overhangs frequent	(16)
Deposition	9	Little or no enlargement of channel or point bars.	(4)	Some new increase in bar formation, mostly from coarse gravels	(8)	Moderate deposition of new gravel & coarse sand on old and some new bars	(12)	Extensive deposits of predominantly fine particles. Accelerated bar development.	(16)
Rock Angularity	10	Sharp edges and corners, plane surfaces roughened	(1)	Rounded corners and edges, surfaces smooth and flat	(2)	Corners & edges well rounded in two demensions	(3)	Well rounded in all dimensions, surfaces smooth	(4)
Brightness	11	Surfaces dull, darkened or stained. Gen. not bright.	(1)	Mostly dull, but may have up to 35% bright surfaces	(2)	Mixture, 50/50 dull & bright, ± 15% ie. 35-65%	(3)	Predominantly bright, 65%+ exposed or scoured surfaces	(4)
Consolidation or Particle Packing	12	Assorted sites tightly packed and/or overlapping	(2)	Moderately packed with some overlapping	(4)	Mostly a loose assortment with no apparent overlap	(6)	No packing evident. Loose assortment, easily moved	(8)
Bottom Size Distribution and Percent Stable Materials	13	No change in sizes evident. Stable materials 80-100%	(4)	Distribution shift slight. Stable materials 50-80%	(8)	Moderate change in sizes. Stable materials 20-50%	(12)	Marked distribution change. Stable materials 0-20%	(16)
Scouring and Deposition	14	Less than 5% of bottom affected by scouring/deposition	(6)	5-30% affected. Scour at constrictions & where grades steepen. Some deposition in pool	(12)	30-50% affected. Deposits & scour at obstructions, pools constrictions and bends.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong	(24)
Clinging Aquatic Vegetation (Moss & algae)	15	Abundant. Growth moss-like, dark green. Perennial. In swift water also.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters	(2)	Present but spotty, mostly in backwater areas, seasonal blooms make rocks slick	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present	(4)
		Excellent Column Total →	3	Good Column Total →	32	Fair Column Total →	45	Poor Column Total →	16

Add Values in each column and record in spaces below

E 3 +G 32 +F 45 +P 16 = 96 Total Reach Score Fair

Adjective ratings: <38-Excellent, 39-76-Good, 77-114-Fair, 115+-Poor

Queen of the River Fish Co., Inc. / Aquatic Consultants

Stream Fish Habitat Evaluation

Client BoCo Open Space **Prescription Watershed** St. Vrain **Stream** Coal Creek

Legal Section____ **Township** ____ **Range**____ **Aerial Photo Number**____ **USGS Quad**____

Date 10/14/97 **Time**____ **Gradient**____% **Sinuosity**____ **Ratio** **DOW Stream Code**____ **Reach Number**____

Evaluated by Mitchell **Velocity**____ft/sec **Flow**____cfs **Pool-Riffle Ratio**____ **Mean Width**____

Soils____ **Channel Type**____ **Mean Depth**____

Reach Description 0.25 m N. of Kenosha Road **Bankfull Width**____

Circle Appropriate Rating for Each Parameter

Channel Stability	60-76	8	<60, 76-90	6	91-107	4	>107	2
Bank Stability (%damaged/exposed)	<3%	8	3-10%	6	11-20%	4	>20%	2
Cover Shade	60-80%	4	>80%; 26-59%	3	10-25%	2	<10%	1
Cover Streamside	abundant	4	common	3	some	2	none	1
Cover Instream	abundant	4	common	3	some	2	none	1
Spawning Areas (% bottom w/ > 1 sq.ft. gravel)	>25%	8	15-25%	6	5-14%	4	<5%	2
Pools No./50' reach	>6	4	5-6	3	3-4	2	0-2	1
Pools Mean size	>stream width	4	≈stream width	3	≈1/2 stream width	2	<1/2 stream width	1
Pools Mean depth	>2 ft.	4	1-2 ft.	3	1/2-1 ft.	2	<1/2 ft.	1
Pools % Pools	40-60%	4	30-40%	3	20-30%	2	<20%	1
Food No. Organisms per sq. ft. of Rock Surface	>100	4	51-100	3	25-50	2	<25	1
Food % may-stone-caddisfly	>75%	4	50-75%	3	25-49%	2	<25%	1
Column Totals	**Total**		**Total**		**Total**		**Total**	15

Overall Fish Habitat Ratings of this Reach (enter total score in appropriate space)

Excellent (50-60)____ Good (40-49)____

Fair (30-39)____ Poor (15-29) 15 **Poor**

Summary of all Reaches of this Stream

(after last reach is evaluated) Miles of Stream Rated:____

Excellent____ Good____ Fair____ Poor____

Channel Stability Evaluation

Reach Location: Survey Date 10/14/97 Time 3pm Obs. MJM

Stream Width___ ft. X avg. Velocity______ f/s=______ Flow cfs

Client BoCo Open Space

Reach Gradient___% Stream Order ____ Stream Stage _____ Sinuosity Ratio ______

Stream Coal Creek W/S No.__-__-__-__-__-__-__-__

Temperature °F or °C Air____, Water____, Other________________

Reach Description & Other Identification 0.25 m N. of Kenosha Bridge

Item Rated	Key #	Stability Indicators By Classes: Excellent		Good		Stability Indicators By Classes: Fair		Poor	
Landform Slope	1	Bank slope gradient < 30%	(2)	Bank slope gradient 30-40%	(4)	Bank slope gradient 40-60%	(6)	Bank slope gradient 60% +	(8)
Mass Wasting or Failure (existing or potential)	2	No evidence of past or any potential for future mass wasting into channel.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6)	Moderate frequency & size, with some raw spots eroded by water during high flows	(9)	Frequent or large, causing sediment nearly year long or imminent danger of same.	(12)
Debris Jam Potential (floatable objects)	3	Essentially absent from immediate channel area.	(2)	Present but mostly small twigs and limbs.	(4)	Present, volume and size are both increasing.	(6)	Moderate to heavy amounts, predominantly larger sizes.	(8)
Vegetative Bank Protection	4	90%+ plant density. Vigor and variety suggests a deep, dense, soil binding root mass.	(3)	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(6)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	< 50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12)
Channel Capacity	5	Ample for present plus some increases. Peak flows contained. W/D ratio <7	(1)	Adequate. Overbank flows rare. W/D ratio 8-15	(2)	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25	(3)	Inadequate. Overbank flows common. W/D ratio >25	(4)
Bank Rock Content	6	65%+ w/ large, angular boulders 12" + numerous	(2)	40-60% mostly small boulders to cobbles 6-12"	(4)	20-40% w/most in the 3-6" diameter class	(6)	< 20% rock fragments of gravel sizes 1-3" or less	(8)
Obstructions Flow Deflectors Sediment Traps	7	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools & riffles stable.	(2)	Some present, Causing erosive cross currents and minor pool filling. Obstructions and deflector newer and less firm.	(4)	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting & filling of pools	(6)	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	(8)
Cutting	8	Little or none evident. Infrequent raw banks less than 6" high generally.	(4)	Some. Intermittently at outcurves and constrictions. Raw banks may be up to 12"	(8)	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident	(12)	Almost continuous cuts, some over 24" high. Failure of overhangs frequent	(16)
Deposition	9	Little or no enlargement of channel or point bars.	(4)	Some new increase in bar formation, mostly from coarse gravels	(8)	Moderate deposition of new gravel & coarse sand on old and some new bars	(12)	Extensive deposits of predominantly fine particles. Accelerated bar development.	(16)
Rock Angularity	10	Sharp edges and corners, plane surfaces roughened	(1)	Rounded corners and edges, surfaces smooth and flat	(2)	Corners & edges well rounded in two demensions	(3)	Well rounded in all dimensions, surfaces smooth	(4)
Brightness	11	Surfaces dull, darkened or stained. Gen. not bright.	(1)	Mostly dull, but may have up to 35% bright surfaces	(2)	Mixture, 50/50 dull & bright, ± 15% ie. 35-65%	(3)	Predominantly bright, 65%+ exposed or scoured surfaces	(4)
Consolidation or Particle Packing	12	Assorted sites tightly packed and/or overlapping	(2)	Moderately packed with some overlapping	(4)	Mostly a loose assortment with no apparent overlap	(6)	No packing evident. Loose assortment, easily moved	(8)
Bottom Size Distribution and Percent Stable Materials	13	No change in sizes evident. Stable materials 80-100%	(4)	Distribution shift slight. Stable materials 50-80%	(8)	Moderate change in sizes. Stable materials 20-50%	(12)	Marked distribution change. Stable materials 0-20%	(16)
Scouring and Deposition	14	Less than 5% of bottom affected by scouring/deposition	(6)	5-30% affected. Scour at constrictions & where grades steepen. Some deposition in pool	(12)	30-50% affected. Deposits & scour at obstructions, pools constrictions and bends.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong	(24)
Clinging Aquatic Vegetation (Moss & algae)	15	Abundant. Growth moss-like, dark green. Perennial. In swift water also.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters	(2)	Present but spotty, mostly in backwater areas, seasonal blooms make rocks slick	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present	(4)
		Excellent Column Total →		Good Column Total →		Fair Column Total →		Poor Column Total →	152

Add Values in each column and record in spaces below

E____+G____+F____+P____= 152 Total Reach Score **Poor**

Adjective ratings: <38-Excellent, 39-76-Good, 77-114-Fair, 115+-Poor

Queen of the River Fish Co., Inc. / Aquatic Consultants

Stream Fish Habitat Evaluation

Client BoCo Open Space **Prescription Watershed** St. Vrain **Stream** Boulder Creek
Legal Section____ **Township** ____ **Range**____ **Aerial Photo Number**____ **USGS Quad**____

Date 10/97 **Time**____ **Gradient**____% **Sinuosity**____ **Ratio** **DOW Stream Code**____ **Reach Number**____

Evaluated by Mitchell **Velocity**____ft/sec **Flow**____cfs **Pool-Riffle Ratio**____ **Mean Width**____

Soils____ **Channel Type**____ **Mean Depth**____
Reach Description BC @ E. 109th **Bankfull Width**____

Circle Appropriate Rating for Each Parameter

Channel Stability	60-76 8	<60, 76-90 6	91-107 4	>107 2
Bank Stability (%damaged/exposed)	<3% 8	3-10% 6	11-20% 4	>20% 2
Cover Shade	60-80% 4	>80%; 26-59% 3	10-25% 2	<10% 1
Streamside	abundant 4	common 3	some 2	none 1
Instream	abundant 4	common 3	some 2	none 1
Spawning Areas (% bottom w/ > 1 sq.ft. gravel)	>25% 8	15-25% 6	5-14% 4	<5% 2
Pools No./50' reach	>6 4	5-6 3	3-4 2	0-2 1
Mean size	>stream width 4	≈stream width 3	≈1/2 stream width 2	<1/2 stream width 1
Mean depth	>2 ft. 4	1-2 ft. 3	1/2-1 ft. 2	<1/2 ft. 1
% Pools	40-60% 4	30-40% 3	20-30% 2	<20% 1
Food No. Organisms per sq. ft. of Rock Surface	>100 4	51-100 3	25-50 2	<25 1
% may-stone-caddisfly	>75% 4	50-75% 3	25-49% 2	<25% 1
Column Totals	**Total**	**Total** 3	**Total** 16	**Total** 6

Overall Fish Habitat Ratings of this Reach (enter total score in appropriate space)
Excellent (50-60)____ Good (40-49)____
Fair (30-39)____ Poor (15-29) 25 **Poor**

Summary of all Reaches of this Stream
(after last reach is evaluated) Miles of Stream Rated:____
Excellent____ Good____ Fair____ Poor____

Channel Stability Evaluation

Reach Location: Survey Date 9/22/97 Time______ Obs. MJM

Stream Width___ ft. X avg. Velocity______ f/s=______ Flow cfs

Client BoCo Open Space

Reach Gradient___% Stream Order ___ Stream Stage ___ Sinuosity Ratio ______

Stream Boulder Creek W/S No._-_-_-_-_-_-_-_

Temperature °F or °C Air_____, Water_____, Other____________

Reach Description & Other Identification BC @ 0.5 m E. of Kenosha Bridge

Item Rated	Key #	Stability Indicators By Classes Excellent		Good		Stability Indicators By Classes Fair		Poor	
Landform Slope	1	Bank slope gradient < 30%	(2)	Bank slope gradient 30-40%	(4)	Bank slope gradient 40-60%	(6)	Bank slope gradient 60% +	(8)
Mass Wasting or Failure (existing or potential)	2	No evidence of past or any potential for future mass wasting into channel.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6)	Moderate frequency & size, with some raw spots eroded by water during high flows	(9)	Frequent or large, causing sediment nearly year long or imminent danger of same.	(12)
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Vegetative Bank Protection	4	90% + plant density. Vigor and variety suggests a deep, dense, soil binding root mass.	(3)	70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(6)	50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.	(9)	< 50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.	(12)
Channel Capacity	5	Ample for present plus some increases. Peak flows contained. W/D ratio <7	(1)	Adequate. Overbank flows rare. W/D ratio 8-15	(2)	Barely contains present peaks. Occasional overbank floods. W/D ratio 15-25	(3)	Inadequate. Overbank flows common. W/D ratio >25	(4)
Bank Rock Content	6	65%+ w/ large, angular boulders 12" + numerous	(2)	40-60% mostly small boulders to cobbles 6-12"	(4)	20-40% w/most in the 3-6" diameter class	(6)	< 20% rock fragments of gravel sizes 1-3" or less	(8)
Obstructions Flow Deflectors Sediment Traps	7	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools & riffles stable.	(2)	Some present, Causing erosive cross currents and minor pool filling. Obstructions and deflector newer and less firm.	(4)	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting & filling of pools	(6)	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	(8)
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Deposition	9	Little or no enlargement of channel or point bars.	(4)	Some new increase in bar formation, mostly from coarse gravels	(8)	Moderate deposition of new gravel & coarse sand on old and some new bars	(12)	Extensive deposits of predominantly fine particles. Accelerated bar development.	(16)
Rock Angularity	10	Sharp edges and corners, plane surfaces roughened	(1)	Rounded corners and edges, surfaces smooth and flat	(2)	Corners & edges well rounded in two demensions	(3)	Well rounded in all dimensions, surfaces smooth	(4)
Brightness	11	Surfaces dull, darkened or stained. Gen. not bright.	(1)	Mostly dull, but may have up to 35% bright surfaces	(2)	Mixture, 50/50 dull & bright, ± 15% ie. 35-65%	(3)	Predominantly bright, 65%+ exposed or scoured surfaces	(4)
Consolidation or Particle Packing	12	Assorted sites tightly packed and/or overlapping	(2)	Moderately packed with some overlapping	(4)	Mostly a loose assortment with no apparent overlap	(6)	No packing evident. Loose assortment, easily moved	(8)
Bottom Size Distribution and Percent Stable Materials	13	No change in sizes evident. Stable materials 80-100%	(4)	Distribution shift slight. Stable materials 50-80%	(8)	Moderate change in sizes. Stable materials 20-50%	(12)	Marked distribution change. Stable materials 0-20%	(16)
Scouring and Deposition	14	Less than 5% of bottom affected by scouring/deposition	(6)	5-30% affected. Scour at constrictions & where grades steepen. Some deposition in pool	(12)	30-50% affected. Deposits & scour at obstructions, pools constrictions and bends.	(18)	More than 50% of the bottom in a state of flux or change nearly yearlong	(24)
Clinging Aquatic Vegetation (Moss & algae)	15	Abundant. Growth moss-like, dark green. Perennial. In swift water also.	(1)	Common. Algal forms in low velocity & pool areas. Moss here too and swifter waters	(2)	Present but spotty, mostly in backwater areas, seasonal blooms make rocks slick	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present	(4)
		Excellent Column Total →		Good Column Total →	24	Fair Column Total →	72	Poor Column Total →	8

Add Values in each column and record in spaces below

E____+G 24 +F 72 +P 8 = 104 Total Reach Score **Fair**

Adjective ratings: <38-Excellent, 39-76-Good, 77-114-Fair, 115+-Poor

Queen of the River Fish Co., Inc. / Aquatic Consultants

Stream Fish Habitat Evaluation

Client BoCo Open Space **Prescription Watershed** St. Vrain **Stream** Boulder Creek

Legal Section_____ **Township** _____ **Range**_____ **Aerial Photo Number**_____ **USGS Quad**_____

Date 9/22/97 **Time**_____ **Gradient**_____**%** **Sinuosity**_____ **Ratio** **DOW Stream Code**_____ **Reach Number**_____

Evaluated by Mitchell **Velocity**_____**ft/sec** **Flow**_____**cfs** **Pool-Riffle Ratio**_____ **Mean Width**_____

Soils_____ **Channel Type**_____ **Mean Depth**_____

Reach Description BC 0.5 m E. of Kenosha Bridge **Bankfull Width**_____

Circle Appropriate Rating for Each Parameter

Channel Stability	60-76	8	<60, 76-90	6	91-107	4	>107	2
Bank Stability (%damaged/exposed)	<3%	8	3-10%	6	11-20%	4	>20%	2
Cover — **Shade**	60-80%	4	>80%; 26-59%	3	10-25%	2	<10%	1
Streamside	abundant	4	common	3	some	2	none	1
Instream	abundant	4	common	3	some	2	none	1
Spawning Areas (% bottom w/ > 1 sq.ft. gravel)	>25%	8	15-25%	6	5-14%	4	<5%	2
Pools — **No./50' reach**	>6	4	5-6	3	3-4	2	0-2	1
Mean size	>stream width	4	≈stream width	3	≈1/2 stream width	2	<1/2 stream width	1
Mean depth	>2 ft.	4	1-2 ft.	3	1/2-1 ft.	2	<1/2 ft.	1
% Pools	40-60%	4	30-40%	3	20-30%	2	<20%	1
Food — **No. Organisms per sq. ft. of Rock Surface**	>100	4	51-100	3	25-50	2	<25	1
% may-stone-caddisfly	>75%	4	50-75%	3	25-49%	2	<25%	1
Column Totals	**Total**		**Total**		**Total**	16	**Total**	7

Overall Fish Habitat Ratings of this Reach (enter total score in appropriate space)

Excellent (50-60)_____ Good (40-49)_____

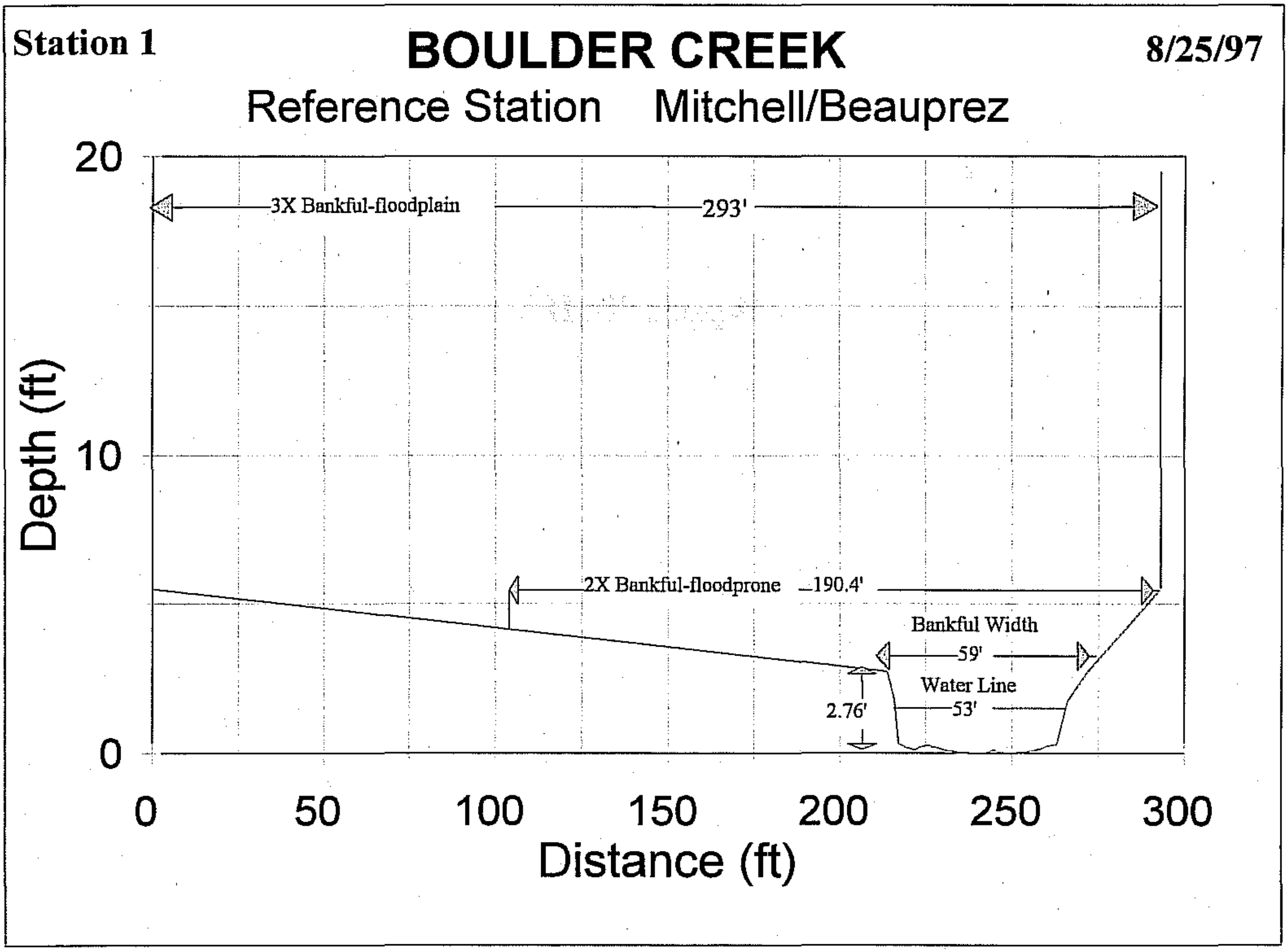
Fair (30-39)_____ Poor (15-29) 23 **Poor**

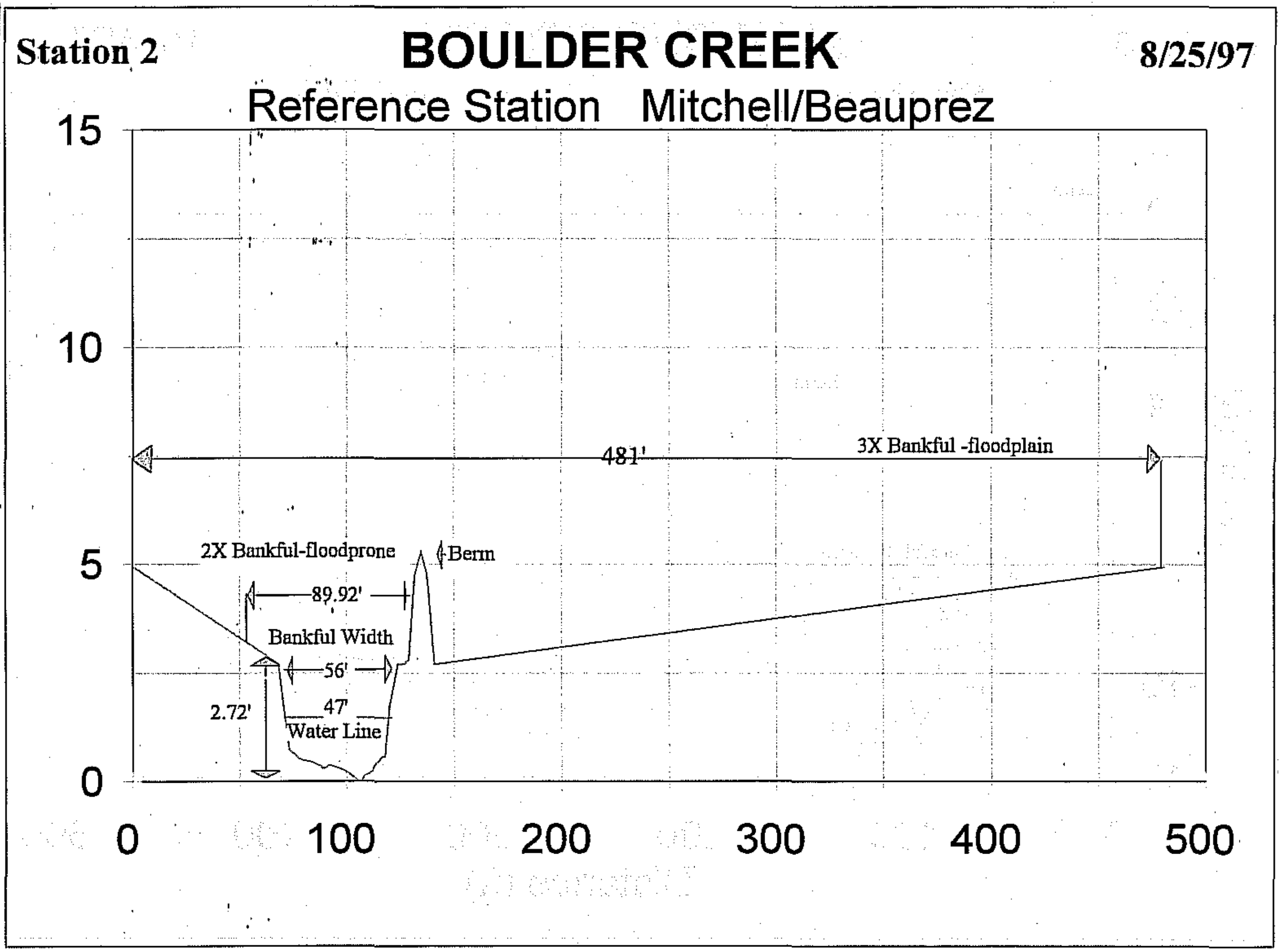
Summary of all Reaches of this Stream

(after last reach is evaluated) Miles of Stream Rated:_____

Excellent_____ Good_____ Fair_____ Poor_____

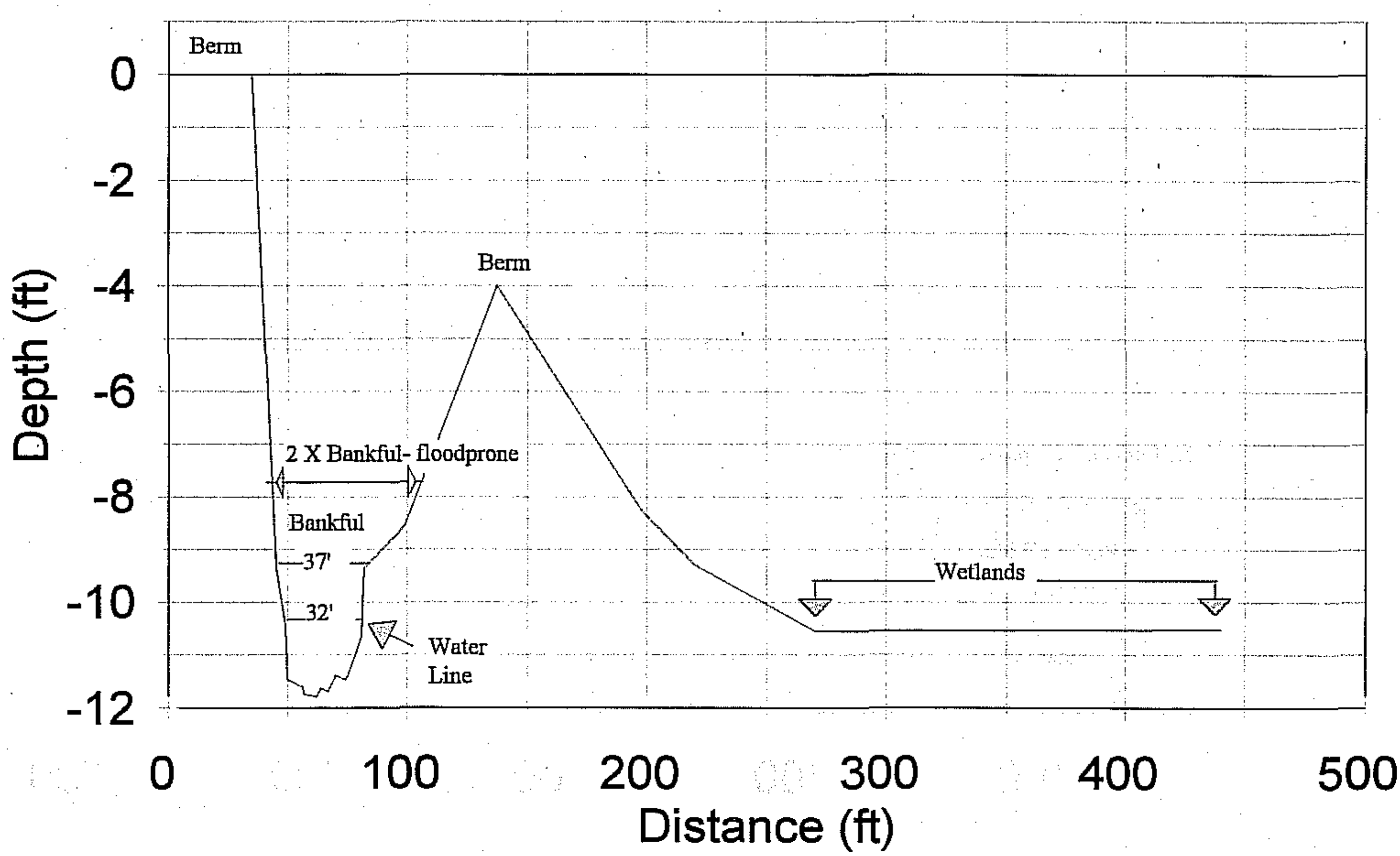
Appendix II


Station 1
BOULDER CREEK
8/25/97
Reference Station Mitchell/Beauprez
3X Bankful-floodplain
293'
2X Bankful-floodprone
190.4'
Bankful Width
59'
Water Line
53'
2.76'
Depth (ft)
20
10
0
0
50
100
150
200
250
300
Distance (ft)


Station 2
BOULDER CREEK
8/25/97
Reference Station Mitchell/Beauprez
15
10
5
0
481'
3X Bankful -floodplain
2X Bankful-floodprone
Berm
89.92'
Bankful Width
56'
2.72'
47'
Water Line
0
100
200
300
400
500

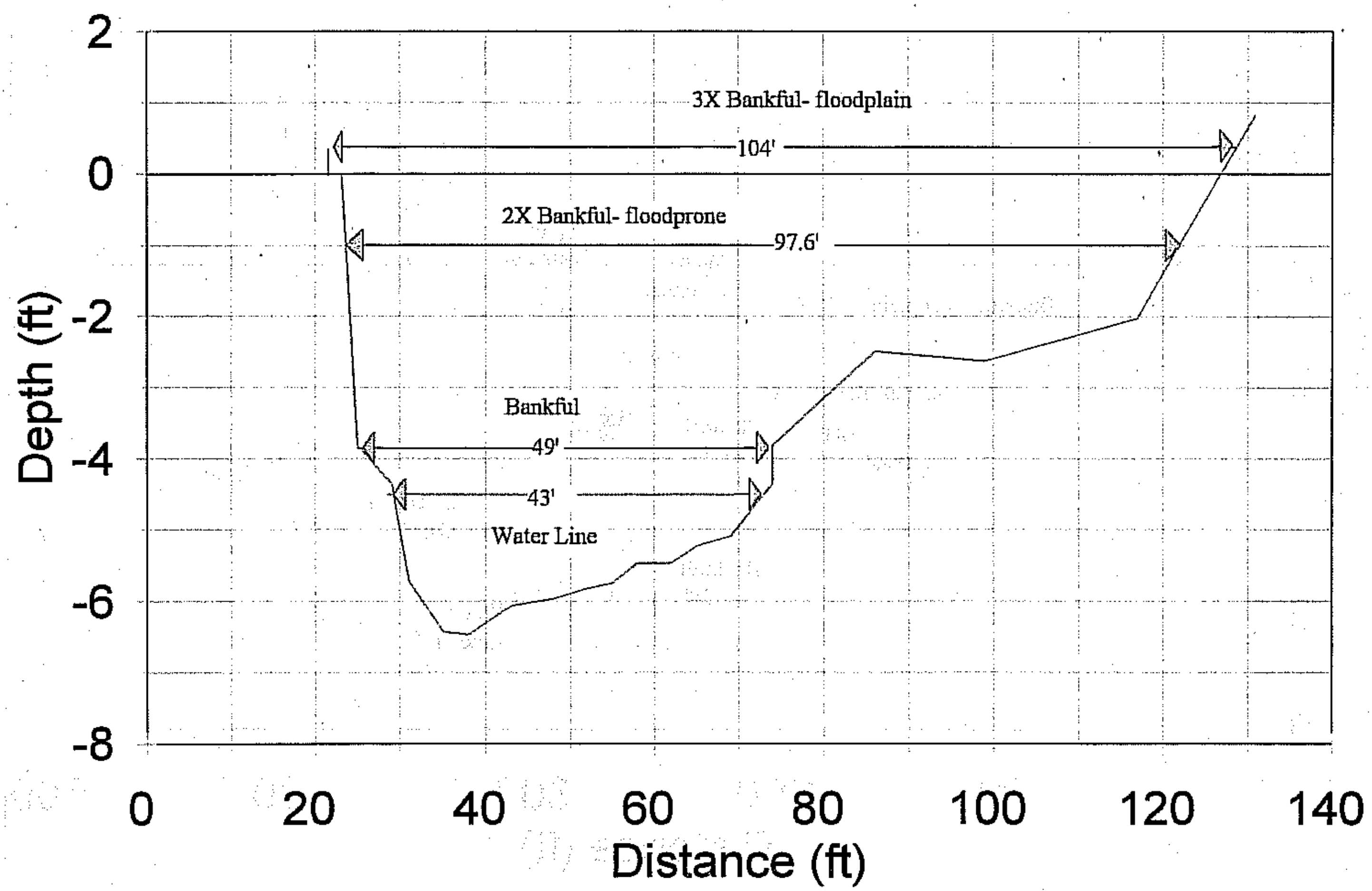
Station 3 **BOULDER CREEK** **11/13/97**

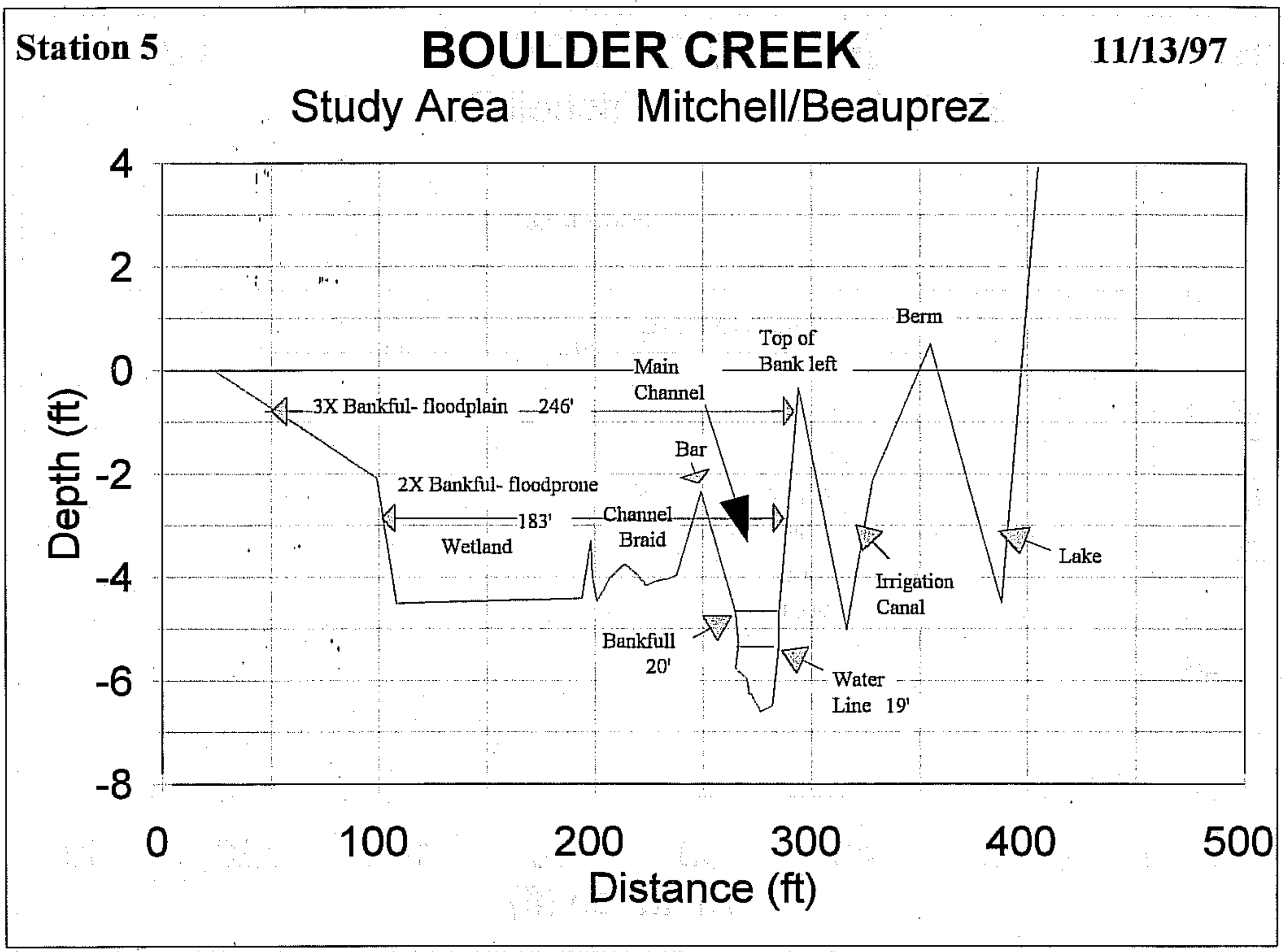
Study Area Beauprez/Liley



Station 4 BOULDER CREEK 11/13/97

Study Area Mitchell/Beauprez





Station 5
BOULDER CREEK
11/13/97
Study Area
Mitchell/Beauprez
3X Bankful- floodplain 246'
2X Bankful- floodprone
183'
Wetland
Main
Channel
Top of
Bank left
Berm
Bar
Channel
Braid
Irrigation
Canal
Lake
Bankfull
20'
Water
Line 19'
Depth (ft)
Distance (ft)
4
2
0
-2
-4
-6
-8
0
100
200
300
400
500

Appendix III

STREAM CLASSIFICATIONS and WATER QUALITY STANDARDS

REGION: 2 and 3

BASIN: Boulder Creek

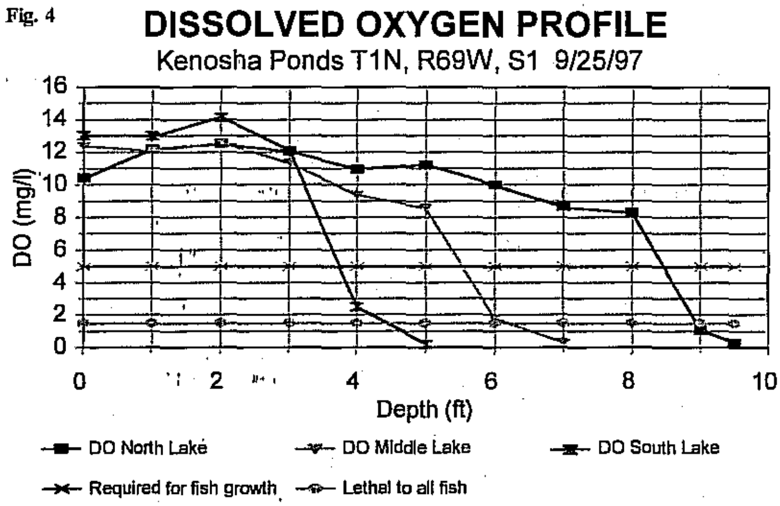
Stream Segment Description	Desig	Classifications	NUMERIC STANDARDS: PHYSICAL and BIOLOGICAL	NUMERIC STANDARDS: INORGANIC mg/l		NUMERIC STANDARDS: METALS ug/l			TEMPORARY MODIFICATIONS AND QUALIFIERS
7a. Mainstem of Coal Creek from highway 93 to highway 36 (Boulder Turnpike).	UP	Aq Life Warm 1 Recreation 2 Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=2000/100ml	NH_3(ac)=TVS NH_3(ch)=0.06 Cl_2(ac)=0.019 Cl_2(ch)=0.011 CN=0.005	S=0.002 B=0.75 NO_2=0.5	As(ch)=100(Trec) Cd(ac/ch)=TVS CrIII(ac/ch)=TVS CrVI(ac/ch)=TVS Cu(ac/ch)=TVS Fe(ch)=1000(Trec)	Pb(ac/ch)=TVS Mn(ch)=1000(Trec) Hg(ch)=0.01(Tot) Ni(ac/ch)=TVS Se(ac/ch)=TVS	Ag(ac)=TVS Zn(ac/ch)=TVS Eff. 3-2-98: Ag(ch)=TVS	
7b. Mainstem of Coal Creek from Highway 36 to the confluence with Boulder Creek.	UP	Aq Life Warm 2 Recreation 2 Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=2000/100ml	Cl_2(ac)=0.019 Cl_2(ch)=0.011 CN=0.005	S=0.002 B=0.75 NO_2=0.5	As(ch)=100(Trec) Cd(ac/ch)=TVS CrIII(ac/ch)=TVS CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ch)=1000(Trec) Hg(ch)=0.01(Tot) Ni(ac/ch)=TVS	Se(ac/ch)=TVS Ag(ac)=TVS Zn(ac/ch)=TVS Eff. 3-2-98: Ag(ch)=TVS	
8. All tributaries to South Boulder Creek from South Boulder Road to the confluence with Boulder Creek and all tributaries to Coal Creek from Highway 93 to the confluence with Boulder Creek.	UP	Aq Life Warm 2 Recreation 2 Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=2000/100ml						
9. Mainstem of Boulder Creek from a point immediately above the confluence with South Boulder Creek to the confluence with Coal Creek.		Aq Life Warm 1 Recreation 1 Water Supply Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=200/100ml	NH_3(ac)=TVS NH_3(ch)=0.06 Cl_2(ac)=0.019 Cl_2(ch)=0.011 CN=0.005	S=0.002 B=0.75 NO_2=0.5 NO_3=10 Cl=250 SO_4=250	As(ac)=50(Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS Fe(ch)=300(dis)	Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ch)=50(dis) Mn(ch)=1000(Trec) Hg(ch)=0.01(Tot) Ni(ac/ch)=TVS	Se(ch)=10(Trec) Ag(ac)=TVS Zn(ac/ch)=TVS Eff. 3-2-98: Ag(ch)=TVS	
10. Mainstem of Boulder Creek from the confluence with Coal Creek to the confluence with St. Vrain Creek.	UP	Aq Life Warm 1 Recreation 2 Water Supply Agriculture	D.O.=5.0 mg/ pH=6.5-9.0 F.Coli=2000/100ml	NH_3(ac)=TVS NH_3(ch)=0.06 Cl_2(ac)=0.019 Cl_2(ch)=0.011 CN=0.005	S=0.002 B=0.75 NO_2=0.5 NO_3=10 Cl=250 SO_4=250	As(ac)=50(Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ch)=1000(Trec) Hg(ch)=0.01(Tot) Ni(ac/ch)=TVS	Ag(ac)=TVS Zn(ac/ch)=TVS Eff. 3-2-98: Ag(ch)=TVS	
11. All tributaries to Boulder Creek from a point immediately above the confluence with South Boulder Creek to the confluence with St. Vrain Creek, except for specific listings in Segments 5 and 7.	UP	Aq Life Warm 2 Recreation 2 Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=2000/100ml						
12. Boulder Reservoir and Coot Lake.		Aq Life Warm 1 Recreation 1 Water Supply Agriculture	D.O.=5.0 mg/l pH=6.5-9.0 F.Coli=200/100ml	NH_3(ac)=TVS NH_3(ch)=0.06 Cl_2(ac)=0.019 Cl_2(ch)=0.011 CN=0.005	S=0.002 B=0.75 NO_2=0.5 NO_3=10 Cl=250 SO_4=250	As(ac)=50(Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS Fe(ch)=300(dis)	Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ch)=50(dis) Mn(ch)=1000(Trec) Hg(ch)=0.01(Tot) Ni(ac/ch)=TVS	Se(ch)=10(Trec) Ag(ac)=TVS Zn(ac/ch)=TVS Eff. 3-2-98: Ag(ch)=TVS	

Appendix IV

Kenosha Ponds-Master Plan Work Product
Definition of Existing Conditions

The ponds located immediately north of Kenosha Road and south of lower Boulder Creek in T1N,R69W, S1 known as Bill's Ponds were surveyed to determine their suitability as fish habitat. Site maps are provided in Figures-1-3 which illustrate the results of these surveys completed in August 1997.

Fig. 4



North Lake

North Lake was estimated to be 8.3 surface acres with an average depth of 6.5 feet representing 53.9 acre feet of storage. Maximum depth observed in North Lake was 9 feet. Organic sediment was present at 52 of 65 sample points in the pond and had an average depth of 0.18 feet with a maximum depth of 0.5 feet. Aquatic vegetation was observed at 5 of 65 sample points and was identified to be 3'-6' in height. Sago Pondweed (*Potamogeton pectinatus*) and Parrotfeather (*Myriophyllum spp*) were the only species of plants identified. Dissolved oxygen profiles completed in September 1997 varied from 1.09 mg/l within 1 foot of the bottom to 10.43 mg/l at the surface(see Table 1). Figure 3 illustrates comparative results of dissolved oxygen profiles taken and their value to fish present.

C-C
C-H
bonds

Table 1. Numeric results of dissolved oxygen profiles at North Lake, Boulder County, C0. September, 1997

Depth(ft)	Temperature(Celsius)	Dissolved Oxygen(mg/l)
Surface	18.3	10.43
1	17	12.17
2	16.6	12.5
3	16.2	12.04
4	16	10.94
5	15.9	11.23
6	15.9	9.98
7	15.9	8.65
8	15.8	8.3
9	15.8	1.09

Middle Lake:

Middle Lake was estimated to be 4.2 surface acres with an average depth of 4.97 feet representing a storage volume of 20.87 acre feet. Maximum depth observed in this lake was 6.2 feet. Organic sediment was observed at 31 of 60 sample points having an average depth of 0.45 feet and a maximum depth of 1 foot. Aquatic vegetation (Parrotfeather) was observed at only 2 of 60 sample points having an average depth of 4.5 feet. Dissolved oxygen profiles completed in September 1997 ranged from 1.8 mg/l within 1 foot of the bottom to 12.4 mg/l at the surface (see Table 2). Figure 4 illustrates the comparative results of oxygen profiles and their value to fish present in this lake.

Depth(ft)	Temperature(Celsius)	Dissolved Oxygen(mg/l)
Surface	17.8	12.37
1	17.5	12.07
2	15.7	12.57
3	15.2	11.32
4	14.9	9.37
5	14.8	8.57
6	14.9	1.84

South Lake:

South Lake was estimated to be 3.5 surface acres with an average depth of 4.59' representing a storage volume 16.06 acre feet. Maximum depth observed in this lake was 6 feet. Organic sediment was observed at 35 of 71 sample points with an average depth of 0.33 feet and a maximum depth of 1.7 feet. Aquatic vegetation was not observed in this pond. Dissolved oxygen profiles completed in September 1997 ranged from 2.5 mg/l within 1 foot of the bottom to 13.05 at the surface (Table 3). Figure 4 illustrates the comparative results of oxygen profiles and their value to fish present in the lake.

Depth(ft)	Temperature(Celsius)	Dissolved Oxygen(mg/l)
Surface	18.2	13.05
1	17.8	12.97
2	15	14.13
3	14.8	12.09
4	14.8	2.51
5	14.9	2.11
6	14.9	1.80

Little Lake:

Little Lake was estimated to be 2 surface acres with an average depth of 4.6 feet representing a storage volume of 9.2 acre feet. Maximum depth observed in this lake was 6.6 feet. No sediment, vegetation, or dissolved oxygen profiles were developed for this pond.

Recommendations:

All of the ponds described by this effort are characterized by slightly fluctuating water levels (<1 foot), shallow depth, flat bottom contours, very little littoral habitat, low aquatic vegetation production and lack of in lake structure. These attributes represent poor natural fish habitat for sport fish; however, they represent excellent conditions for semi-intensive production of fish. The primary fish culture attributes these ponds have is potential isolation of individual ponds from each other, adequate depths to overwinter fish in most years, and bottom/side contouring that afford easy harvest of fish for transport to other sites. The lack of vegetation , organic sediment build up, and in lake structure represent very little impediments to seining operations for the harvest of fish that are produced. It is our recommendation that these ponds be used for the production of native fishes that are presently having difficulty in this drainage. Native fishes have well known species associations so it is possible that multiple species would be raised in each pond. The brood stock and offspring of identified native fishes that are maintained here could be used to restock Boulder and Coal Creeks once water quality, channel, and fish habitat improvements are completed. Excess production could be used to start or enhance fish populations in the St Vrain watershed. Other watersheds could benefit from this facility as well. Use of this site as a native species hatchery would require the least site alteration of any alternative being suggested. This program would involve the jurisdictions of Boulder County Parks and Open Space, the Colorado Division of Wildlife, the Colorado Department of Natural Resources, and perhaps the Colorado Water Conservation Board. Other appropriate partners would include the City of Boulder, Town of Erie, City of Lafayette, City of Louisville, City of Superior, St Vrain and Left Hand Water Conservation District, and perhaps the Northern Colorado Water Conservation District.

Alternative C-Native Species Production/brood stock program

- Discuss and define project with potential partners
- Develop project partnerships, endorsements and responsibilities
- Develop agreements with CDOW regarding appropriate species for production and conduct of operation
- Develop project plan for use of site as native species fish hatchery/production faciltiy
- Identify responsibilities, timing, ingress/egress, site/program needs, liability, fate of project products, etc. for each partner
- Develop agreements with partners
- Provide suitable access/storage for vehicles and equipment necessary for implementation of plan
- Develop and implement landscape/aesthetic plan for site stabilization
- Implement and operate project plan

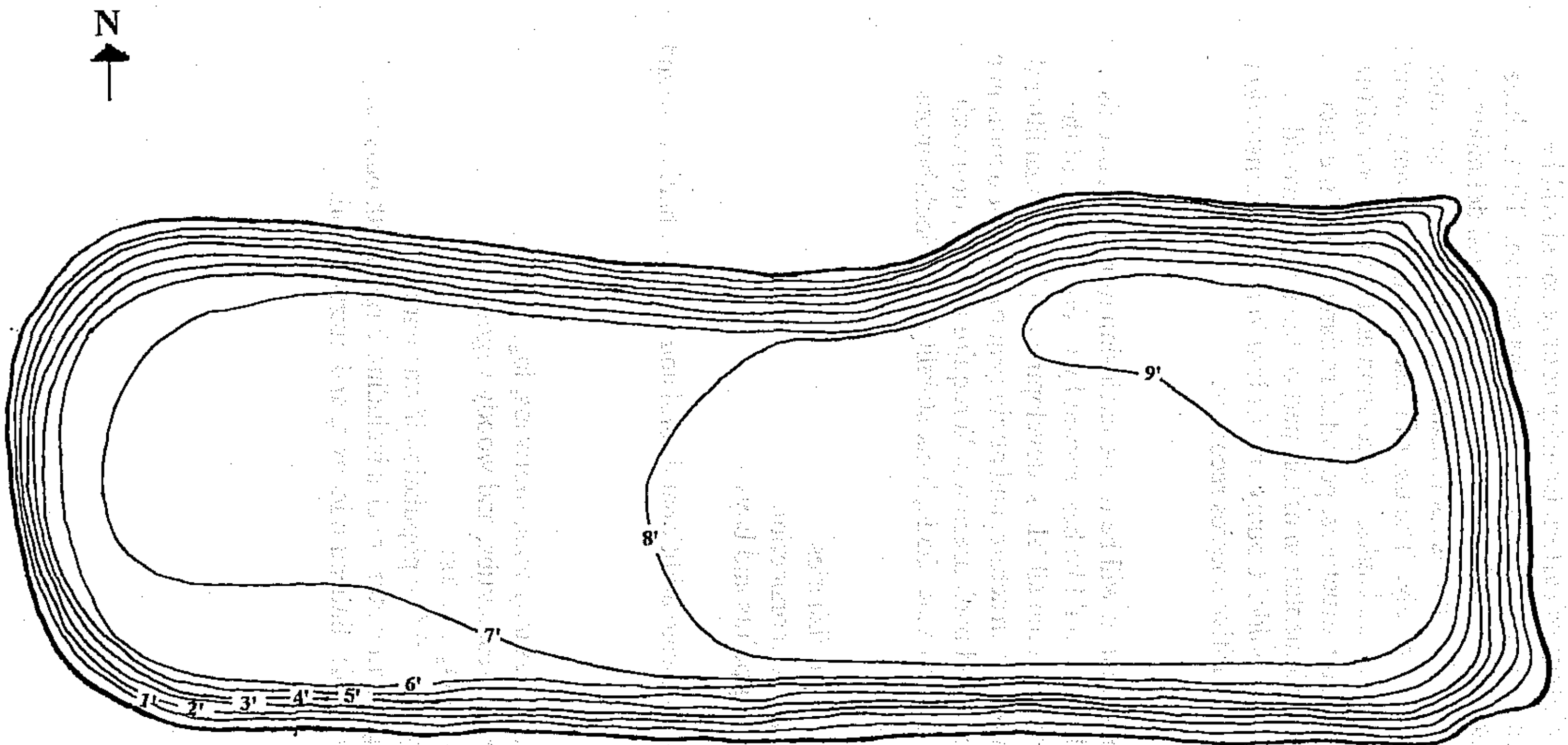
The use of Bill's Ponds for native fish production precludes our ability to provide sport fishing in these lakes. Providing sport fishing to the citizens of eastern Boulder county could still be accommodated on this property in the lakes north of Boulder Creek in this section. These three ponds represent a total surface area of 22 acres. These lakes will require additional definition to determine their suitability and predict their functionality as sport fisheries. It is known that game fish production has occurred in these ponds historically. The use of these ponds for fishing would require rehabilitation of access, re-contouring of lake banks, revegetation and stabilization of the affected sites, installation of fish habitat/attraction structures, potential reclamation of the fish population, and restocking with gamefish. Implementation of this part of the project would represent an additional value to the citizens of Boulder County and Colorado as a demonstration site for the compatibility of sport fishing and sensitive species recovery.

Sport fishing can be developed in Bill's Ponds, but it will be to the exclusion of most native fish. The development of sport fisheries in this basin would be best served by re-contouring of the pond banks, development of interconnection between all lakes, development of additional littoral and lacustrine wetland habitat, installation of fish structure, and attainment of 12 foot depths in at least 20 % of the interconnected basin. The pond bank areas would require revegetation with suitable grass, shrub, and woody vegetation to provide shade, bank stability and allochthonous energy inputs.

Alternative B-Renovate existing ponds for Sport Fisheries

- Remove dikes between lakes creating interconnection
- Recontour shoreline plan view creating points and bays
- Dredge lake depths to 12' over 3.6 acres
- Excavate shoreline below waterline to create additional littoral and wetland habitat around 40% of the shoreline
- Re-grade banks to reduce slopes
- Create angler access/wading areas
- Physically stabilize shoreline where necessary(rocks, rootwads, logs, etc)
- Revegetate banks with appropriate grasses, shrubs, and woody vegetation
- Design and Install universal access fishing dock(s)
- Determine necessity and chemically reclaim fish population if warranted
- Restock pond with self propagating warm water species including largemouth bass (or smallmouth bass), bluegills, white crappie, fathead minnows, and gizzard shad.

13810 N. 115th / Longmont, CO 80501 / (303) 651-2514 / 1-800-422-2514



Water Depth

Boulder County Open Space

North Lake

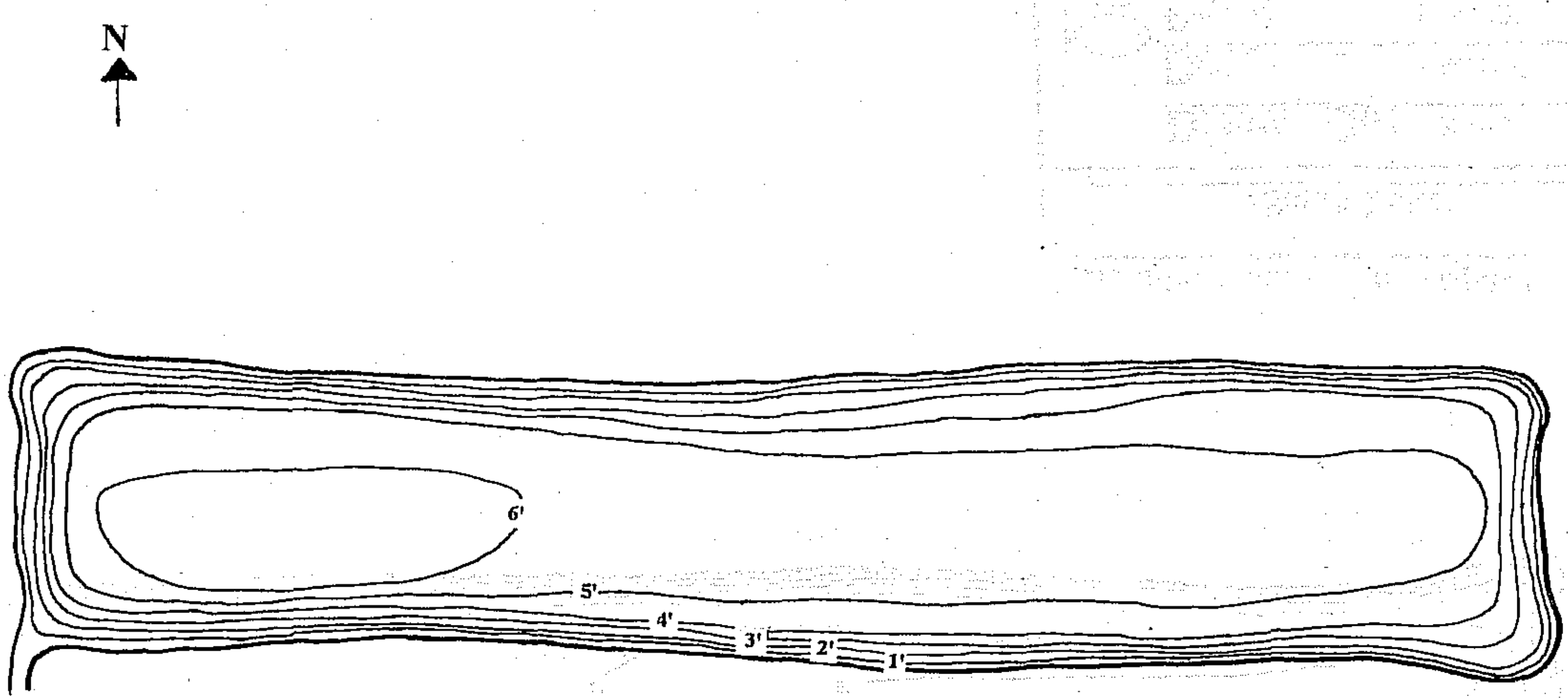
Drawn By: SMB

Date: 10-24-97

Scale: 1"=130'

American Lake Doctors
Queen of the River Fish CO., Inc./
Aquatic Services

13810 N. 115th / Longmont, CO 80501 / (303) 651-2514 / 1-800-422-2514



Water Depth

Boulder County Open Space

Middle Lake

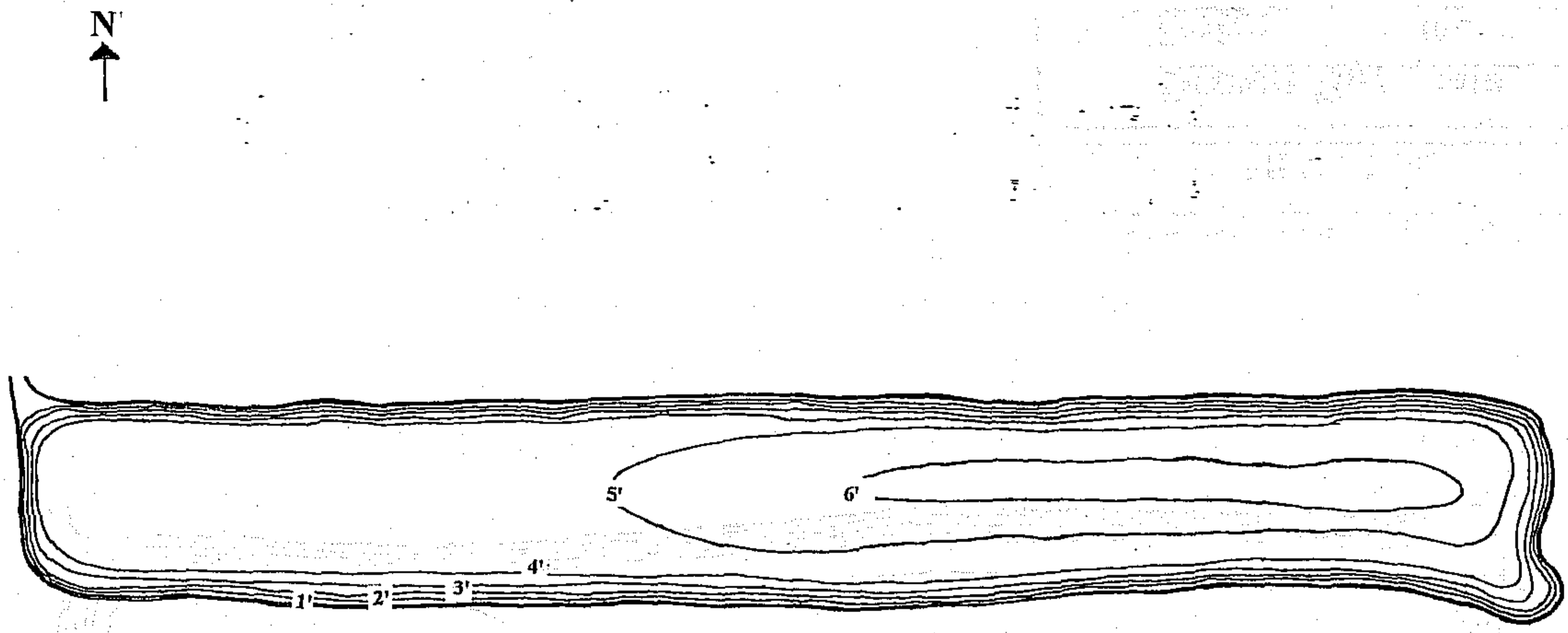
Drawn By: SMB

Date: 10-24-97

Scale: 1"=130'

American Lake Doctors
Queen of the River Fish CO., Inc./
Aquatic Services

13810 N. 115th / Longmont, CO 80501 / (303) 651-2514 / 1-800-422-2514



Boulder County Open Space

South Lake

Drawn By: SMB

Date: 10-24-97

Scale: 1"=130'

American Lake Doctors
Queen of the River Fish CO., Inc./
Aquatic Services

Water Depth

Potential Project Funding Sources, Partial List

American Zoo and Aquarium Association
Beldon Fund
Colorado Division of Wildlife Wetlands Program
Educational Foundation of America
FishAmerica Foundation
General Service Foundation
Homeland Foundation
Izaak Walton League of America, Save Our Streams
Kenney, William C., Watershed Protection Foundation
Levinson, Max and Anna, Foundation
National Environmental Education & Training Foundation
National Fish and Wildlife Foundation
Natural Resources Conservation (NRC) Matching Grants Program
North American Wetlands Conservation Act, U.S. Fish and Wildlife
Noyes, Jessie Smith, Foundation, Inc.
Outdoor Industry Conservation Alliance
Patagonia, Inc.
Recreational Equipment, Inc.
Strong Foundation for Environmental Values
Tides Foundation
Trout Unlimited
Turner Foundation, Inc.
US EPA, Catalog of Federal Funding Sources for Watershed Protection
US EPA, EPA/NSF/NASA Joint Program on Water and Watersheds
US EPA, Office of Wastewater Management
Weeden Foundation
Wildlife Forever

AMERICAN ZOO AND AQUARIUM ASSOCIATION
Conservation of Native Fish and their Habitats

A Memorandum of Understanding (MOU) between the American Zoo and Aquarium Association (AZA), the Service and several other federal agencies, signed in 1995, establishes a framework for cooperation to achieve common goals for the conservation of native fishes and their habitats and to enhance public awareness of fish conservation and restoration activities.

The AZA has agreed to stimulate interest among its member institutions in the opportunities to conduct research and restoration of aquatic habitats and native fish populations on federal lands. The AZA and the Service will stimulate interest in the development and sharing of environmental education information to enhance public awareness of the conservation issues and problems of native North American fishes.

Several areas of potential collaboration have been identified, such as basic biological research, technology development (e.g. developing captive propagation techniques for imperiled species), maintaining species in refugia, and conducting public outreach.

An "Introductions and Information" package has been developed which contains information about the AZA members and the federal partners.

For more information, contact Linda Andreason at (703) 358-2458 with the Hatcheries Division of the Service in Washington.

Website: www.aza.org
has information on species survival plans and other conservation activities

Beldon Fund

2000 P Street N.W., Suite 410
Washington, D.C. 20036
Tel: 202-293-1928 Fax: 202-659-3897
E-mail: beldon@igc.apc.org
EIN: 382786808 Type: Independent
EGA member
Contact: Diane Ives, Executive Director

History and philosophy. The Beldon Fund was founded in 1978 as a pass-through foundation, one that does not have an asset base. To provide a base, a corollary foundation, known as the Beldon II Fund, was established in 1988. Initially a modest $3 million, Beldon II Fund received major gifts in 1995 that make it the primary source for grant activity.

The foundation's primary interest is in supporting environmental organizations working at the state level. It also makes some grants to regional and national groups for efforts that support the work of state-level groups.

Officers and directors. *Officers:* John R. Hunting, President; Diane Ives, Secretary/Treasurer; R. Malcolm Cumming, Assistant Secretary/Treasurer.

Financial data.* Data for fiscal year ended December 31, 1996: *Assets:* $12,298,732 (M). *Total grants authorized:* $1,420,556.

*Includes Beldon Fund and Beldon II Fund.

Environmental awards. *Program and interests:* The foundation supports state and regional environmental organizations, national organizations working at the state level, and progressive state-wide coalitions. Its interests include:

- Hazardous waste and toxics use reduction.
- Training and technical assistance.
- Building grantee organizational capacity.

Issues.	Cli	Bio	Lan	Agr	Wat	Oce	Ene	Was	Tox	Pop	Dev
		•						•	•		

Activities.	Adv	Dir	Edu	Lit	Med	Pol	Res
	•						

Funding analysis.*

Fiscal year:	1995	1996
Env grants auth:	$1,346,815	$1,420,556
Number:	95	102
Range:	$2,000-$125,100	$1,000-$100,000
Median:	$10,000	$11,000
Pct $ auth (env/total):	100	100

Recipients (1995 highest):	*Number:*	*Dollars:*
Institute for Conservation Leadership	1	125,100
Americans for the Environment	3	109,900
Northeast Citizen Action Resource Center	2	70,000
League of Conservation Voters Education Fund	1	50,000
Environmental Community Action	1	40,000
Silicon Valley Toxics Coalition	1	40,000

Activity regions (1995 highest):	*Number:*	*Dollars:*
U.S. Mid-Atlantic	14	350,000
U.S. not specified	21	277,500
U.S. Southeast	10	133,500
U.S. West	9	120,000
U.S. Mountain	10	114,500

*Beldon Fund and Beldon II Fund. 1996 data as reported by foundation.

Sample grants (1995).*

Alabama Environmental Council. Birmingham, AL. $12,500. To build grassroots support to counter the wise use movement in Alabama.

Americans for the Environment. Washington, DC. $20,000. To support AFE's program of training, conferences, and educational outreach to environmental groups.
Arizona Toxics Information. Bisbee, AZ. $7,500. To educate the public on toxics issues, and the wise use movement's activities in Arizona.
Environmental Support Center. Washington, DC. $7,500. To convene the eighth annual State Environmental Leadership Conference.
Greenpeace Fund. Washington, DC. $10,000. To provide technical support and organize the public on toxics and solid waste issues in Alaska.
Missouri Environmental Fund. St. Louis, MO. $10,000. To launch a workplace giving campaign for environmental organizations in Missouri.
Montana Audubon Council. Helena, MT. $12,500. To provide skills training to volunteers in nine chapter groups in Montana.
Northeast Citizen Action Resource Center. Hartford, CT. $50,000. To improve the in-state fundraising capacity of five state progressive coalitions, by providing assistance on multi-year fundraising plans, offering challenge grants to the state coalitions, and providing expertise on fundraising techniques.
Progressive Leadership Alliance of Nevada. Carson City, NV. $10,000. To facilitate the joint activities of environmental, labor, and human rights groups in Nevada.
Vermont Natural Resources Council. Montpelier, VT. $13,500. To increase grassroots action to protect natural resources in the state.
*Sample grants include awards by Beldon Fund and Beldon II Fund.

Application process. *Initial contact:* Telephone call or letter of inquiry. Full proposal to include:
1. Proposal summary, including contact name and telephone number, grant period, and amount requested.
2. Need for program in light of related work by others.
3. Goals, objectives, and action plan.
4. Method of evaluation and, if appropriate, plan for continuity after the first year.
5. Most recent organizational financial statement, itemized program budget, list of other potential sources of funding for project.
6. Copy of IRS tax-exempt status determination letter.
7. List of board of directors.
8. Background and qualifications of organization and staff.

When to apply: Anytime.
Materials available: Annual report (includes "Application Procedure").

Emphases. *Recipients:* Nonprofit organizations.
Activities: Activism, advocacy, capacity building, citizen participation, collaborative efforts, training.
Types of support: Continuing support, general purposes, multi-year grants.
Geography: State-level projects within the United States.

Limitations. *Recipients:* Aquariums, botanical gardens, educational institutions, individuals, museums, public agencies, religious organizations, research institutions, zoos.
Activities: Audiovisual materials, conflict resolution, demonstration programs, direct services, education, exhibits, expeditions/tours, feasibility studies, fieldwork, innovative programs, inventories, land acquisition, litigation, lobbying, media projects, policy analysis/development, political activities, publications, research, seminars, symposia/colloquia, technical assistance, volunteerism.
Types of support: Advertising campaigns, annual campaigns, capital campaigns/expenses, computer hardware, debt retirement, emergency funding, endowments, equipment, facilities, fellowships, indirect costs, internships, lectureships, leveraging funds, loans, maintenance, matching funds, membership campaigns, mortgage reduction, professorships, program-related investments, scholarships, travel expenses.
Geography: International projects.

THE COLORADO DIVISION OF WILDLIFE WETLANDS PROGRAM

Prepared by:
Alex Chappell
Wetlands Program Coordinator
September 1997

Call them for copy
297-1192

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I. INTRODUCTION

This document describes how the various wetland efforts in the Division of Wildlife are being brought together for the purpose of coordination. Many, but not all, of those efforts have been identified and are described in the Wetlands Program. Much remains to be done, however. The Division of Wildlife has come so far in the year since the concept of a Wetlands Program was formed, that it became necessary to document and describe the program.

This description of the Wetlands Program will also answer several basic questions:

- what are the goals of the Wetlands Program?
- how will the goals be accomplished?
- what is the Wetlands Initiative?
- how is the Wetlands Initiative related to the Wetlands Program?
- what are Focus Areas? Focus Area Committees?
- what types of wetlands are being addressed by the Wetlands Program?

Hopefully, many of these questions and others will be answered in the following pages and if not, then the Wetlands Program Coordinator can be contacted for more information.

II. OVERVIEW OF THE WETLANDS PROGRAM

When resources are destroyed incrementally over decades, it is sometimes difficult for succeeding generations to recognize the cumulative loss. Such is the case with wetlands. Wetlands have generally not fared well in modern society. Colorado has lost wetlands resources since European settlement (estimates indicate a loss of 1 million acres) and all of its living residents - human, wildlife, and plant - have been affected by the loss. Not surprisingly, declines in many wildlife species are attributable to the degradation and destruction of the wetlands habitat base upon which they depend. In fact, the Colorado Natural Heritage Program classifies many species of wetlands-dependent birds and amphibians as "rare and imperiled." If this habitat loss continues, more species are likely to be similarly classified. Within Colorado, rapid population growth, increased urbanization and expanding and intensified agriculture are all accelerating the pressures on remaining wetlands (estimated to be only 1.5% of the state's surface area), and rapidly narrowing the window of opportunity to correct the situation.

Recently, society has recognized the need to reverse the trend of decline in wetlands. Eighty-three percent of the residents of Colorado support protection of wetlands. Environmental organizations, federal agencies, state agencies, municipalities, and the private sector have responded by becoming more involved in the protection of the remaining wetlands in our state and nation. The Division of Wildlife (DOW) similarly recognized this need. The DOW has evolved into an agency with an increased emphasis on wetlands conservation and management. It has created the position of Wetlands Program Coordinator and it has developed a Wetlands Program (WP), which endeavors to coordinate all the agency's wetlands-related efforts including waterfowl, endangered species, recreation, education, watchable wildlife, hunting, and fishing.

The WP for the DOW describes the wetlands conservation goals of the agency and a strategy to achieve those goals. The strategy includes the identification of every wetlands conservation effort in the DOW and the coordination of those efforts to maximize efficiency and effectiveness. The WP will be a true catalyst, a template to make things (wetlands conservation) happen quickly and efficiently.

The WP provides strategic plans and implementation plans for the DOW's many wetlands efforts. One of these efforts is the Wetlands Initiative (WI), a Great Outdoors Colorado Legacy Project. The WI is a 10 million dollar project to protect wetlands in Colorado. It is a cooperative venture between partners that have a broad interest and expertise in the conservation of wetlands. The WI uses an innovative approach to wetlands conservation, working with willing-to-participate land owners and entities. Furthermore, locally based committees distributed throughout the state play a major role in this great project and provide grassroots support.

Accomplishment of the WP goals will greatly contribute to the fulfilment of numerous Long Range Plan goals and numerous aspects and obligations of the Colorado Memorandum Of Agreement with Department of Interior. For example, the WP provides a means by which the DOW can fulfill the role of leader as directed to do so in the Long Range Plan. Thus, communication regarding wetlands conservation efforts has been established with several entities including the Department of Natural Resources (DNR), the Environmental Protection Agency (EPA), the Natural Resource Conservation Service (NRCS), the US Forest Service (USFS), the US Bureau of Land Management (BLM), the Army Corps of Engineers, the State Water Engineer; along with several private wetlands conservation companies and non-governmental organizations such as Audubon and the Colorado Riparian Association. The DOW is by no means the only entity involved in wetlands conservation, but it has now become a major player in the wetlands conservation arena.

The goals and components of the WP are described in TABLE 1 and TABLE 2. They provide the elements necessary for an effective wetlands conservation strategy, for delivery of on-the-ground projects, and for the opportunity to tap into the multitude of funds available for wetlands conservation.

The WP has a goal of protecting 100,000 acres of wetlands by the year 2005. By protecting significant wetlands, the Division of Wildlife Wetlands Program will provide major benefits to the people of Colorado including the protection of wildlife habitat (for wetlands dependent species such as fish, waterfowl, water birds, amphibians and more), open space, biological diversity, water quality, and important wetland functions such as groundwater recharge and flood control. Valuable educational and recreational opportunities will also be protected.

The Educational Foundation of America
35 Church Lane
Westport, Connecticut 06880-3515
Tel: 203-226-6498 Fax: 203-227-0424
E-mail: efa@efaw.org
EIN: 133424750 Type: Independent
EGA member
Contact: Diane M. Allison, Executive Director
Beth A. Scribner, Grants Associate

History and philosophy. Beginning his career as a professor at New York University, Richard Prentice Ettinger (d. 1971) authored a college textbook on finance, and then co-founded Prentice-Hall Publishing Company to publish textbooks. He had a lifelong interest in education, and in 1959 established The Educational Foundation of America. Partly as a result of a personal experience with cancer, Mr. Ettinger also developed an interest in medical and socio-medical problems, including disease prevention and patient care.

The foundation (EFA) works to carry out Richard Ettinger's principles: (1) invest in people; (2) give "seed" money for innovative ventures; (3) focus grants sharply, so that goals are definable, progress discernible, and achievement measurable; (4) limit grants to the short-term; and (5) support organizations with competent financial management.
Areas of interest include, but are not limited to: the arts, education, energy, the environment, human overpopulation & reproductive freedom, medicine, Native Americans, and peace.

Officers and directors. *Officer:* Lynn P. Babicka, President. *Senior Directors:* Joan P. Andrews, Jerry Babicka, Lynn P. Babicka, Barbara Bohart, Barbara P. Ettinger, Richard P. Ettinger, Jr., Sharon W. Ettinger, Wendy W. P. Ettinger, Elaine P. Hapgood, Heidi P. Landesman, David Orr, John P. Powers, W. Richard West, Jr.

Financial data. Data for fiscal year ended December 31, 1994 and 1996. *Assets (1996):* $162,000,000 (M) (est.). *Gifts received (1994):* $69,314. *Total grants disbursed (1996):* $7,000,000 (est.).

Environmental awards. *Program and interests:* Environmental grants occupy a significant portion of overall grantmaking activity. EFA will make an effort to support smaller, more grassroots organizations, and projects with sustainability, replicability, and potential for long-term environmental impact. Areas of interest include:

- Energy efficiency and conservation.
- Alternatives to nuclear energy.
- Sustainable agriculture and water quality issues.
- Public land resource conservation.
- Opposition to anti-environmental organizations.

It should be noted that EFA's considerable Population program "ultimately seeks to educate the public on the environmental impacts of overpopulation and to increase awareness that rapid population growth threatens natural resources as well as quality of life."

Issues.	*Cli*	*Bio*	*Lan*	*Agr*	*Wat*	*Oce*	*Ene*	*Was*	*Tox*	*Pop*	*Dev*
	•	•	•	•	•	•	•	•	•	•	•

Activities.	*Adv*	*Dir*	*Edu*	*Lit*	*Med*	*Pol*	*Res*
	•	•	•	•		•	

Funding analysis.

Fiscal year:	1993	1994
Env grants auth:	$2,188,271	$3,352,654
Number:	44	53
Range:	$7,500-$200,000	$10,000-$200,000
Median:	$40,000	$40,000
Pct $ auth (env/total):	45	47

Recipients (1994 highest):	*Number:*	*Dollars:*
Mineral Policy Center	1	200,000
Pace University	1	200,000
Solar Energy Research and Education Foundation	1	187,750
Southern Environmental		

Law Center	1	180,000
Food and Water, Inc.	1	160,000
Rocky Mountain Institute	1	160,000

Activity regions (1994 highest):	*Number:*	*Dollars:*
U.S. not specified	14	1,030,750
U.S. Southeast	6	474,200
New York/New Jersey	4	370,000
U.S. Northeast	4	306,904
U.S. West	8	292,455

Sample grants (1994).

Citizen Alert. Las Vegas, NV. $40,000. High-Level Radioactive Waste and Nuclear Weapons Testing generates public support for alternatives to the federally proposed high-level radioactive waste dump at Yucca Mountain, and ensures that nuclear weapons testing is not resumed.

Food and Water, Inc. Marshfield, VT. $160,000. Stop Pesticides Project harnesses consumer concern about food safety, specifically about the food industry's use of pesticides, by building a grassroots movement that will shift market demand toward pesticide-free food.

Friends of the Earth/Environmental Policy Institute. Washington, DC. $40,000. Sustainable USA educates the public about the connections among population, consumption, and the environment by adapting a model of sustainability, developed by Friends of the Earth Netherlands, to the United States.

Mineral Policy Center. Washington, DC. $200,000. Post 1872: From Beachhead to Breakout Campaign seeks to ensure comprehensive reform of the 1872 Mining Law and to address the broader issue of mining damage to land and water.

National Tribal Environmental Council. Albuquerque, NM. $15,000. Communication and Outreach and Environmental Education Program enhances tribal sovereignty and jurisdictional prerogatives through a range of services including the dissemination among tribes of information in newsletters and position papers regarding reservation-based air, water, and ground pollution.

The Project on Government Oversight. Washington, DC. $30,000. Secret Environmental Crimes aims to stop violations of environmental law, force the government agencies involved to take responsibility for these crimes, and expose the government's efforts to use the camouflage of secrecy in the name of national security to hide illegal activity.

Rocky Mountain Institute. Old Snowmass, CO. $160,000. Energy Outreach Project fosters efficient and sustainable use of energy resources as a path to global security by publishing and distributing written materials about numerous aspects of energy use.

Solar and Electric Educational Foundation. Phoenix, AZ. $20,000. High School Student Electric Vehicle Program promotes electric and solar car acceptance and use in the Southwest through educational programs that accelerate the vehicles' technological development while increasing academic motivation in high school participants.

Solar Energy Research and Education Foundation. Washington, DC. $187,750. Center for Renewable Energy and Sustainable Technology accelerates dissemination of information about solar energy to citizens and advocates through the use of advanced computer and communication technologies, including the Internet.

Vermont Law School. South Royalton, VT. $74,845. Environmental Law Center's Native American Fellowship Program covers tuition and most living expenses for five Native American students working to acquire their Master of Studies degrees in environmental law.

Application process. *Initial contact:* Letter of inquiry (2 pages), signed by an officer of the organization, to include:
Identification of the organization.
1. Mission.
2. Date of founding.
3. Location.
4. Region of focus.
5. Past and current projects.
6. Name(s) and brief description of founder(s).
7. Affiliation with other organizations.

Description of project for funding.
1. Purpose.
2. Intended results.
3. Duration.
4. Amount of budget and amount requested.
5. Funding strategy.

Append copy of IRS tax-exempt status determination letter. Letter of inquiry must be on recycled paper using both sides. If approved, foundation will request a full proposal, which must be prepared according to EFA's Grant Application Guidelines.
When to apply: Anytime.
Materials available: Annual report (includes "Grant Application Procedures and Guidelines").

Emphases. *Recipients:* Educational institutions, nonprofit organizations, public agencies, research institutions.
Activities: Activism, advocacy, conflict resolution, demonstration programs, education, innovative programs, litigation, planning, policy analysis/development, technical assistance, training.
Types of support: Pilot projects, projects, seed money, technical assistance.
Geography: United States only.

Limitations. *Recipients:* Individuals, religious organizations.
Activities: Conferences, fundraising, lobbying, political activities, symposia/colloquia.

Types of support: Annual campaigns, capital campaigns/expenses, debt retirement, emergency funding, endowments, facilities, general purposes, indirect costs, loans, maintenance, mortgage reduction, operating costs.
Geography: International grants.

FISHAMERICA FOUNDATION

FishAmerica Foundation was established by the Zebco Corporation in 1983 and receives support from the sportfishing industry. Its goals are to:

- combat the continuing threats to our water quality;
- stem shrinking fish populations;
- improve the opportunity for sport-fishing success;
- supplement stagnating and/or declining federal and state monies for water and fisheries agencies;
- go beyond current private effort which are limited either geographically or programmatically;
- provide funding for concerned groups to invest in projects in their local area; and
- encourage people to get involved in their local areas.

The Foundation favors projects that:

- Enhance fish populations and fisheries
- Conserve and enhance waterways and water quality

Application Forms: FishAmerica Foundation
1033 North Fairfax Street, Suite 200
Alexandria, VA 22314

Andrew Loftus, Managing Director
(703) 519-9691

Size of Grants: $2,000 - $10,000

Proposals Due: Anytime

Website: www.fishingworld.com

General Service Foundation

411 East Main Street, Suite 205
Aspen, Colorado 81611-2953
Tel: 970-920-6834 Fax: 970-920-4578
E-mail: gsf@rof.net
EIN: 366018535 Type: Independent
EGA member
Contact: Robert W. Musser, President

History and philosophy. General Service Foundation is a private foundation endowed by Clifton R. Musser (1869-1956) and his wife, Margaret Kulp Musser (1875-1967). In an effort to address some of the world's basic long-term problems, the foundation focuses on three areas: International Peace, Reproductive Health and Rights, and Resources.

Officers and directors. *Officers:* Robert W. Musser, President; Mary L. Estrin, Vice President; Marcie J. Musser, Vice President/Treasurer; Lani A. Shaw, Secretary. *Directors:* Christine K. Cassel, M.D., Mary L. Estrin, Robert L. Estrin, Margaret M. Halby, Terry L. Karl, Owen M. Lopez, Elizabeth W. Musser, Marcie J. Musser, Robert W. Musser, W. Todd Snidow. *Honorary Director:* Marion M. Lloyd.

Financial data. Data for fiscal year ended December 31, 1995. *Assets:* $42,081,084 (M). *Total grants disbursed:* $1,999,753.

Environmental awards. *Program and interests:* The Resources program has two priorities:

- Western Water.
  Improving the use, management, and quality of water in the United States, particularly west of the Mississippi River.
- International Resources.
  Promoting the conservation and sustainable utilization of natural resources in Latin America and the Caribbean, including tropical forests, wildlife, and fisheries.
  Preference is given to field projects that have local community involvement and leadership as a central theme and that test community-led initiatives to integrate sustainable utilization with conservation.
  Consideration will also be given to natural resource management training and leadership development programs for individuals from Latin America and the Caribbean.

Issues.	*Cli*	*Bio*	*Lan*	*Agr*	*Wat*	*Oce*	*Ene*	*Was*	*Tox*	*Pop*	*Dev*
		•	•	•	•	•			•	•	•

Activities.	*Adv*	*Dir*	*Edu*	*Lit*	*Med*	*Pol*	*Res*
	•		•	•			

Funding analysis.

Fiscal year:	1994	1995
Env grants auth:	$717,000	$906,100
Number:	38	38
Range:	$1,000-$52,500	$1,600-$70,000
Median:	$20,000	$20,000
Pct $ auth (env/total):	37	45

Recipients (1995 highest):	*Number:*	*Dollars:*
Native American Rights Fund	1	70,000
University of Missouri	1	50,000
ANAI, Inc.	1	48,000
Quebec-Labrador Foundation/Atlantic Center for the Environment	1	43,000
The Tides Center	1	40,000

Activity regions (1995 highest):	*Number:*	*Dollars:*
Mexico and Central America	7	188,000
U.S. Northwest	7	166,500
U.S. Mountain	7	152,000
U.S. not specified	3	115,000
Latin America	4	86,600

Sample grants (1995).

Center for Environmental Law & Policy. Seattle, WA. $30,000. To protect instream flow levels and water quality in the rivers and ecosystems of Washington state by submitting public interest comments on water rights applications.

Forest Guardians. Santa Fe, NM. $40,000 (2 years). For work in the Sierra Madre to build local communities' capacity to manage their forest resources and advocate for government policies that meet their basic needs.

Idaho Conservation League. Boise, ID. $20,000. To strengthen water pollution prevention, accelerate pollution clean-up, and encourage citizen involvement in local stream protection issues.

Indian Law Resource Center. Washington, DC. $30,000. To help Indian communities in Nicaragua, Honduras, and Belize protect their lands and natural resources.

Northern Plains Resource Council. Billings, MT. $20,000. To improve relationships among environmentalists, farmers, ranchers, and Native Americans in order to work collaboratively to protect Montana's water resources.

Oregon Water Trust. Portland, OR. $36,500 (2 years). To systematically identify, cultivate, evaluate and secure ecologically significant water rights in the Rogue River Basin of Oregon.

Sierra Club Legal Defense Fund. San Francisco, CA. $10,000. To develop a set of economically viable and environmentally sound alternatives for the Animas-La Plata project.

Southern Utah Wilderness Alliance. Salt Lake City, UT. $27,000. To build broad public support for SUWA's conservation-based plan for the Virgin River, and to implement that plan through direct participation in the Washington County Water Conservancy District's Management Plan Review process.

University of Missouri. St. Louis, MO. $50,000 (2 years). To support Latin American students' participation in the International Center for Tropical Ecology's Graduate Certificate Program in Tropical Biology and Conservation.

Western Colorado Congress. Montrose, CO. $10,000. To support efforts to protect the surface and groundwater resources of the Gunnison River and the San Juan Basin.

Application process. *Initial contact:* Letter of inquiry (2-4 pages) describing proposed project. If project meets foundation guidelines, an application form will be sent. Prospective applicants may also contact foundation by telephone or E-mail. Brief letters of inquiry may be faxed. Formal proposal to include:

1. Completed application form.
2. Organization name and address, copies of IRS tax-exempt status determination letters, and a statement that the letters are in effect and unchanged.
3. Purpose of funds, evidence supporting need for project, project objectives, amount requested, person responsible for administration, qualifications of organization and individuals involved in project, and description of what will be accomplished.
4. Project summary (2 pages), focusing on solution of problem to be addressed.
5. Budget for project.
6. Other funding obtained or requested and plan for long-term funding.
7. Copy of recent annual report or information including organization's program, annual budget, financial statement, and list of directors and officers.

Full proposals sent by facsimile will not be accepted; please do not submit applications in plastic binders.
When to apply: Deadlines for letters of inquiry are February 1 and September 1. The directors meet semiannually, in the spring and fall.
Materials available: Annual report (includes "Contribution Policy" and "Application Procedures").

Emphases. *Recipients:* Nonprofit organizations.
Activities: Advocacy, citizen participation, demonstration programs, fieldwork, innovative programs, litigation, training.
Types of support: Emergency funding, general purposes, operating costs, projects.
Geography: Western Water: west of the Mississippi; International Resources: Latin America, Mexico, and the Caribbean.

Limitations. *Recipients:* Individuals.
Activities: Lobbying, publications.
Types of support: Annual campaigns, capital campaigns/expenses, continuing support, debt retirement, endowments, equipment, facilities, loans, matching funds, scholarships.
Geography: Non-U.S. organizations (usually).

The Homeland Foundation

412 North Pacific Coast Highway, Suite 345
Laguna Beach, California 92651
Tel: 714-494-0365 Fax: 714-494-8392
EIN: 330200133 Type: Independent
EGA member
Contact: H. M. Bedolfe, Environmental Program Director

History and philosophy. The Homeland Foundation was established in 1986. Grantmaking priorities are: conservation of species and habitat, the environment, and welfare of women.

Financial data. Data for fiscal year ended December 31, 1993. *Assets:* $17,528,959 (M). *Gifts received:* $180,661. *Total grants disbursed:* $2,007,474.

Environmental awards. *Program and interests:* The environment program concentrates on preservation of species and habitat. *Recent grants:* 1993 grants included support for land conservation, forests, plant and animal species preservation, river protection, and coastal and marine issues.

Issues.	*Cli*	*Bio*	*Lan*	*Agr*	*Wat*	*Oce*	*Ene*	*Was*	*Tox*	*Pop*	*Dev*
		•	•		•	•					

Activities.	*Adv*	*Dir*	*Edu*	*Lit*	*Med*	*Pol*	*Res*
		•	•	•			•

Funding analysis.

Fiscal year:	1992	1993
Env grants disb:	$1,115,822	$1,001,715
Number:	61	60
Range:	$1,000-$250,000	$1,000-$255,000
Median:	$5,547	$7,675
Pct $ disb (env/total):	51	50

Recipients (1993 highest):	*Number:*	*Dollars:*
The Nature Conservancy, Headquarters	1	255,000
Wild Dolphin Project	1	100,000
Laguna Canyon Foundation	1	96,510
RARE Center for Tropical Conservation	1	69,500
The Nature Conservancy, Hawaii Field Office	1	33,150

Activity regions (1993 highest):	*Number:*	*Dollars:*
U.S. not specified	10	425,700
U.S. West	19	204,653
Tropics	4	105,500
U.S. Northwest	5	48,237
U.S. Northeast	2	44,975

Sample grants (1993).
Dian Fossey Gorilla Fund. Englewood, CO. $5,000.
Friends of the Peruvian Rain Forest, Inc. Philadelphia, PA. $2,500.
Friends of the River Foundation. San Francisco, CA. $2,000.
Friends of the Sea Lion. Laguna Beach, CA. $3,000.
Fundación Moises Bertoni. Asunción, Paraguay. $15,000.
International Primate Protection League. Summerville, SC. $5,000.
Manomet Observatory for Conservation Science. Manomet, MA. $29,975.
National Tropical Botanical Garden. Lawai, HI. $5,000.
The Nature Conservancy, Headquarters. Arlington, VA. $255,000.
Rainforest Alliance. New York, NY. $20,000.
School for Field Studies. Beverly, MA. $15,000.
Tropical Forest Foundation. Alexandria, VA. $15,000.
The Wilderness Society. Washington, DC. $10,000.
The Wolf Fund. Moose, WY. $5,000.

Application process. *Initial contact:* Short letter along with copy of IRS tax-exempt status determination letter.

When to apply: Application deadlines are March 1, June 1, September 1, and December 1. The board meets quarterly. Proposals are considered the quarter after they are received, i.e., proposals received by March 1 are considered at the June meeting.

Emphases. *Recipients:* Nonprofit organizations.
Activities: Capacity building, education, land acquisition, litigation, research (scientific).
Types of support: General purposes, multi-year grants, operating costs, pilot projects, seed money.
Geography: Far western United States; and New World Tropics only.

Limitations. *Recipients:* Individuals, public agencies.
Activities: Audiovisual materials, conferences, conflict resolution, exhibits, expeditions/tours, feasibility studies, fundraising, inventories, lobbying, media projects, networking, political activities, publications, research (medical/scholarly), seminars, symposia/ colloquia, volunteerism, workshops.
Types of support: Advertising campaigns, annual campaigns, capital campaigns/expenses, debt retirement, emergency funding, endowments, facilities, indirect costs, lectureships, loans, maintenance, mortgage reduction, professorships, program-related investments, scholarships, travel expenses.

IZAAK WALTON LEAGUE OF AMERICA
Save our Streams Program

The Izaak Walton League is a national organization with 350 chapters nationwide dedicated to protecting and restoring America's soil, woods, waters, air, and wildlife. Many of the local chapters are involved with **Save our Steams,** the League's grassroots river conservation program. The restoration project of SOS is Stream Doctor in which volunteers are taught how to diagnose stream problems, write a prescription for the stream's recovery, and institute emergency and long-term care for the stream.

The League will provide videos, publications, monitoring guides and training on how to use their bio-monitoring protocol. They maintain a database of who is doing monitoring, restoration and clean-up of streams around the country.

SOS is not a grant program, but they will provide information and technical expertise.

Who to Contact: Save Our Streams Program
707 Conservation Lane
Gaithersburg, MD 20878-2983
1-800-BUG-IWLA

Website: www.iwla.org

The William C. Kenney Watershed Protection Foundation

116 New Montgomery Street, Suite 800
San Francisco, California 94105
Tel: 415-543-0205 Fax: 415-543-6426
E-mail: JayPKK@aol.com
EIN: 943201589 Type: Independent
EGA member
Contact: Kimery Wiltshire, Director

History and philosophy. William (Wick) Kenney was a dedicated environmentalist and passionate white-water kayaker, as well as a computer consultant and trainer who worked with nonprofit organizations. Shortly before his death in 1994, Wick established the foundation to carry out his vision of a West where rivers run free and clean from headwaters to the sea.

The foundation focuses on protecting the remaining wild rivers in the West and ensuring the effectiveness of small western environmental organizations (annual operating budgets under $500,000) through technical assistance or training.
Grants are usually $5,000-$10,000 and are limited to the western states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Officers and directors. *Officers:* Linda Cloud, President; Jay Kenney, Vice President; Charles Kenney, Treasurer; Nancy Snow, Secretary. *Directors:* Linda Cloud, Charles Kenney, Jay Kenney, Mary Peterson, Nancy Snow, Kimery Wiltshire, Humphrey Wou.

Financial Data. Data for fiscal year ended December 31, 1996. *Total grants authorized:* $201,500. *Total grants disbursed:* $199,500.

Environmental Awards. *Recent grants:* 1996 grants supported water protection and environmental education throughout the western United States.

Issues.	*Cli*	*Bio*	*Lan*	*Agr*	*Wat*	*Oce*	*Ene*	*Was*	*Tox*	*Pop*	*Dev*
					•						

Activities.	*Adv*	*Dir*	*Edu*	*Lit*	*Med*	*Pol*	*Res*
	•			•			

Funding analysis.

Fiscal year:	1996
Env grants disb:	$201,500
Number:	24
Range:	$2,500-$10,000
Median:	$10,000
Pct $ disb (env/total):	100

Recipients (1996 highest):	*Number:*	*Dollars:*
Friends of the River Foundation	2	20,000
Central Sierra Environmental Resource Center (CSERC)	1	10,000
Colorado Rivers Alliance	1	10,000
Hells Canyon Preservation Council	1	10,000
Idaho Rivers United	1	10,000
Northern Alaska Environmental Center	1	10,000
Northern Plains Resource Council	1	10,000
Oregon Natural Resources Council	1	10,000
Rivers Council of Washington	1	10,000
Sawtooth Wildlife Council	1	10,000
Siskiyou Regional Education Project	1	10,000
Southeast Alaska Conservation Council	1	10,000
Southern Utah Wilderness Alliance	1	10,000
Utah Rivers Conservation Council	1	10,000
Western Organization of Resource Councils (WORC)	1	10,000

Activity regions (1996 highest):	*Number:*	*Dollars:*
U.S. Mountain	8	$70,000
U.S. Northwest	8	67,500
U.S. West	3	30,000
Alaska	2	20,000

U.S. South Central 2 9,000

Sample Grants (1996).
Central Sierra Environmental Resource Center. Twain Harte, CA. $10,000.
Colorado Environmental Coalition. Denver, CO. $5,000.
Colorado Rivers Alliance. Durango, CO. $10,000.
Hells Canyon Preservation Council. Joseph, OR. $10,000.
Idaho Rivers United. Boise, ID. $10,000.
National Audubon Society. Gibbon, NE. 5,000. Support for its Platte River conservation and education program.
Northern Plains Resource Council. Billings, MT. $10,000. Support for its Montana Waters Protection project.
Public Lands Action Network. Silver City, NM. $4,000. Support for the Gila Watch project.
Southeast Alaska Conservation Council. Juneau, AK. $10,000. Support for its Grassroots Constituency Building Program.
Utah Rivers Council. Salt Lake City, UT. $10,000.
Wyoming Outdoor Council. Lander, WY. $10,000. Support for its non point source water pollution project.

Application process. *Initial contact:* Letter of inquiry (1 page) to include information on project, outlining key objectives and collaboration efforts. Full proposal (2 copies), if requested, to include:
1. Cover form (from foundation).
2. Narrative (2 pages).
   - Problem to be solved.
   - How goal is to be accomplished.
   - Description of organization's strengths and weaknesses.
   - Relationships with other organizations working on the same issue.
   - Expected results.
3. Financial information.
   - Project budget (1 page).
   - Copy of current financial statement (preferably audited).
   - Copy of IRS tax-exempt status determination letter.
4. References (2-4) of people you work with and list of current foundation supporters.
5. List of board of directors, including occupation and town of residence.

Use of recycled paper and double-sided copies is suggested. Do not send proposal by special delivery, facsimile, or E-mail. Proposals in plastic binders or with an undue number of attachments, videos, or cassettes will not be accepted.
Organizations in Colorado, Montana, New Mexico, and Wyoming can contact Jay Kenney, Director, tel: 303-534-5722 or E-mail: JayPKK@aol.com.
When to apply: Letters of inquiry are due February 10 and September 2; proposals are due March 17 and October 14. Grants are awarded approximately three months after proposal application deadline.
Materials available: Annual Report (includes "Application" and "Grantmaking Guidelines.")

Emphases. *Recipients:* Nonprofit organizations.
Activities: Activism, advocacy, capacity building, citizen participation, innovative programs, litigation, networking, planning, training.
Types of support: Computer hardware, continuing support, general purposes, operating costs, pilot projects, projects, seed money, technical assistance.
Geography: Western United States: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming only.

Limitations. *Recipients:* Aquariums, botanical gardens, educational institutions, individuals, museums, public agencies, religious organizations, research institutions, zoos.
Activities: Audiovisual materials, exhibits, expeditions/tours, feasibility studies, land acquisition, political activities, symposia/ colloquia.
Types of support: Advertising campaigns, annual campaigns, capital campaigns/expenses, debt retirement, emergency funding, endowments, equipment, facilities, fellowships, indirect costs, internships, lectureships, leveraging funds, loans, maintenance, mortgage reduction, multi-year grants, professorships, program-related investments, scholarships, travel expenses.
Geography: Alaska, Hawaii and all other states not listed above.

The Max and Anna Levinson Foundation

1411 Paseo de Peralta
Santa Fe, New Mexico 87501-4326
Tel: 505-982-3662 Fax: 505-982-3665
E-mail: levinson@igc.apc.org
EIN: 236282844 Type: Independent
EGA member
Contact: Charlotte Talberth, Executive Director

History and philosophy. The Levinson Foundation is a family foundation incorporated in 1955. Its concern is the "development of a more humane and rewarding society in which people have a greater ability and opportunity to determine directions for the future." Funding is allocated equally among three categories: The Environment, Social, and Jewish/Israel. Most grants are in the $5,000-$10,000 range. Funding is rarely given to organizations with annual budgets in excess of $500,000.

Officers and directors. *Officers:* Carl A. Levinson, President; Carol Doroshow, Treasurer. *Directors:* Carol Doroshow, Helen L. Doroshow, Doug Levinson, Gordon R. Levinson, James Levinson, Julian A. Levinson, Lynda B. Levinson.

Financial data. Data for fiscal year ended September 30, 1996. *Assets:* $2,559,270 (M). *Total grants disbursed:* $402,727.

Environmental awards. *Program and interests:* Environmental interests include:
- Preservation of ecosystems and biological diversity.
- Protection of forests and coral reefs.
- Effects of the global economy.
- Alternative fibers and demand reduction.
- Natural resource and water conservation.

Issues.	*Cli*	*Bio*	*Lan*	*Agr*	*Wat*	*Oce*	*Ene*	*Was*	*Tox*	*Pop*	*Dev*
		•	•	•	•		•		•		

Activities.	*Adv*	*Dir*	*Edu*	*Lit*	*Med*	*Pol*	*Res*
	•			•	•	•	•

Funding analysis.*

Fiscal year:	1993	1996
Env grants disb:	$213,000	$150,000
Number:	30	15
Range:	$3,500-$10,000	$3,500-$10,000
Median:	$7,500	$7,500
Pct $ disb (env/total):	52	37

Recipients (1993 highest):	*Number:*	*Dollars:*
Reef Relief, Inc.	1	10,000
Rocky Mountain Institute	1	10,000
The Wildlands Project	1	10,000
Center for International Environmental Law	1	8,500
Arizona Rainforest Alliance	1	8,000
Environmental Law Alliance Worldwide (E-LAW)	1	8,000
Forest Guardians	1	8,000
Institute for Agriculture and Trade Policy	1	8,000
Nuclear Free America	1	8,000
Round River Conservation Studies	1	8,000
Western Environmental Law Center, Inc.	1	8,000

Activity regions (1993 highest):	*Number:*	*Dollars:*
U.S. South Central	9	60,500
U.S. not specified	4	29,000
U.S. Mountain	3	20,500
Mexico and Central America	2	16,500
Middle East and Western Asia	2	15,000
U.S. Southeast	2	15,000

*As reported by foundation.

Sample grants (1996).

Amigos Bravos. Taos, NM. $9,000. For a recovery plan for the Rio Grande silvery minnow, and for litigation to clean up pollution caused by hard-rock mining.

Biodiversity Legal Foundation. Boulder, CO. $9,000. Education to communicate scientific concepts about the biodiversity crisis to the public, integrating conservation principles and environmental law.

Forest Guardians. Santa Fe, NM. $9,000. General support for advocates of protection of Southwest forest and desert ecosystems.

International Forum on Globalization. San Francisco, CA. $7,500. To analyze the globalization process to environmental, human rights, and economic justice activists.

Israel Union for Environmental Defense. Tel Aviv, Israel. $10,000. To participate in Ecopeace, a regional NGO monitoring the development projects of the peace process for sustainability.

La Sierra Foundation of San Luis. San Luis, CO. $9,000. For traditional farmers and community groups opposing logging of their watershed.

Red Nacional de Accion Ecologia. Santiago, Chile. $9,000. Training for Chilean activists in the use of that country's new environmental laws.

Rocky Mountain Youth Corps. Taos, NM. $7,500. To provide people ages 16-24 with community service jobs in their own communities, specifically, fire restoration work in Taos County.

Southwest Center for Biological Diversity. Phoenix, AZ. $9,000. Endangered Species Act petitions, policy proposals, and technical support for biodiversity activists.

Western Environmental Law Center, Inc. Taos, NM. $9,000. Environmental litigation on behalf of Indian tribes and environmental organizations in the Southwest.

The Wildlands Project. Tucson, AZ. $9,000. Conservation activists designing a system of preserves to protect biological diversity in the Americas.

Application process. *Initial contact:* Write to request application form, guidelines, and grants list. If project seems consistent with Foundation interests, submit short proposal (2-6 pages) and attachments. Proposal to discuss:

1. Problem or opportunity you seek to address; scope, significance, impact, etc.
2. Changes to be brought about as a result of project.
3. Activities to be accomplished by project.
4. Why project efforts will achieve desired changes.
5. Evaluation criteria.

Attachments.

1. Completed application form (from Foundation).
2. Budget, including expenditures and income from current and anticipated sources.
3. Relevant information about the organization and its key individuals.
4. Copy of IRS tax-exempt status determination letter.

Facsimiles will not be accepted.

When to apply: 1997 deadline for proposals is June 15. Awards are given out in fall of 1997. The foundation will, however, accept proposals at any time.

Materials available: Information sheet, grants list, application form.

Emphases. *Recipients:* Nonprofit organizations.

Activities: Activism, advocacy, capacity building, education, innovative programs, litigation, workshops.

Types of support: Continuing support, general purposes, leveraging funds, operating costs, pilot projects, projects, seed money.

Geography: Primarily Southwestern U.S.; national and international programs.

Limitations. *Recipients:* Botanical gardens, individuals, museums, public agencies, zoos.

Activities: Exhibits, expeditions/tours, land acquisition, lobbying.

Types of support: Advertising campaigns, capital campaigns/ expenses, endowments, facilities, fellowships, lectureships, multi-year grants, professorships.

NATIONAL ENVIRONMENTAL EDUCATION AND TRAINING FOUNDATION
Challenge Grants

NEETF is not a government agency, but is funded primarily through federal congressional appropriations. NEETF awards one-year challenge grants requiring a cash match of at least two non-federal dollars for each NEETF dollar awarded. The Foundation will support only environmental education grants that explicitly connect environment, economy, and equity--the three E's of sustainable development. NEETF is most interested in projects that educate adults--decision makers at both a personal and professional level--through workplace programs, community initiatives, and in formal education settings.

NEETF will now award competitive grants in three program areas:

HEALTH AND ENVIRONMENT: projects that help people make the connection between health and environment, and that support informed action.

SAFE WATER: projects that help people make the connection between their water source and their water faucet. Programs that promote community-wide understanding of water--sources, quality treatments, protection strategies, costs--are a priority.

ENVIRONMENTAL EDUCATION INNOVATION: A very limited number of grants to support new or next-step environmental education approaches will be considered. Programs must be cost effective and partnership-based. National enhancement of environmental education is the goal

Application Forms:	National Environmental Education and Training Foundation 915 Fifteenth Street, NW, Suite 200 Washington, DC 20005 (202) 628-8200
Size of Grants:	up to $15,000
Preproposals Due:	June 2 (If accepted, a full proposal will be required)

National Fish and Wildlife Foundation

Bender Building, Suite 900
1120 Connecticut Avenue, N.W.
Washington, D.C. 20036
Tel: 202-857-0166 Fax: 202-857-0162
E-mail: info@nfwf.org
EIN: 521384139 Type: Independent
EGA member
Contact: Krishna K. Roy, Director, Development & Marketing

History and philosophy. The National Fish and Wildlife Foundation (NFWF) was established by Congress in 1984. It is a 501(c)(3) nonprofit organization dedicated to the conservation of natural resources fish, wildlife, and plants. NFWF awards challenge grants using its federally appropriated funds to match private sector funds. Its method is to forge partnerships between the public and private sectors and support conservation activities that pinpoint and solve the root causes of environmental problems. These combined resources fuel effective conservation projects; however, federal appropriations may not be used for NFWF's operating expenses.

NFWF has five initiatives through which challenge grants are awarded: conservation education, fisheries, neotropical migratory birds, wetlands & private lands, and wildlife & habitat management. Initiatives generally target habitat protection and restoration; species conservation applied conservation; applied research and policy development; and/or education and leadership training.

Thus far, NFWF has awarded 1,209 grants that have leveraged $168 million for conservation projects. NFWF's work is local, regional, national, and international in scope. To date, project locations include the 50 U.S. states, Puerto Rico, and 17 countries.

Officers and directors. *Officers:* Magalen O. Bryant, Chairman. *Directors:* Helen Campbell Alexander, Kay K. Arnold, Magalen O. Bryant, Max C. Chapman, William B. Dunavant, Jr., Noel L. Dunn, Caroline Getty, Kenneth H. Hofmann, Patsy Ishiyama, Paul Tudor Jones II, Neil L. Oldridge, Charles M. Parish, J.C. Perkins, Lindsay Thomas, Susan Busch Transou. *Ex officio:* Mollie H. Beattie, Douglas K. Hall, Brig. Gen. Charles E. Yeager. *Counsel:* Michael J. Brennan.

Financial data. Data for fiscal year ended September 30, 1995. *Assets:* $26,652,970 (M). *Revenues:* $35,550,791. *Total grants disbursed:* $23,823,106.

Environmental awards. *Program and interests:* The foundation awards the majority of its grants through six conservation programs:

- Conservation Education Initiative.
  Through this initiative, NFWF supports education projects about fish, wildlife, plants, and their habitats. Primary target audiences are K-12 teachers and students, institutions of higher learning, and natural resource professionals. In 1995 the foundation awarded 30 grants totaling $1.17 million.
- Fisheries Conservation and Management Initiative.
  This initiative supports innovative projects which benefit native aquatic and inland marine species and foster partnerships between the public and private sector. To date, 86 projects benefitting 54 species of fish have been initiated. In 1995 the foundation awarded 38 grants totaling $2.15 million.
- Neotropical Migratory Bird Conservation Initiative.
  Priority is given to projects that benefit conservation of neotropical birds through: on-the-ground habitat management and restoration; applied research with demonstrable conservation benefits; monitoring; training for natural resource professionals and public education. In 1995 the foundation awarded 42 grants totaling $1,583,576.
- Wetlands and Private Lands Initiative.
  NFWF supports projects that conserve the nation's wetland resources, in particular habitat for wetland-dependent fish and wildlife. In 1995 the foundation awarded 36 grants totaling $1.4 million.
- Wildlife and Habitat Management.
  This initiative encompasses a variety of on-the-ground wildlife conservation projects, including: predator management; invasive exotic species management; development and management of Rights-of-Way (ROW) as wildlife habitat; species of special concern such as black bears, mountain lions, and bats. In 1995 the foundation awarded 59 grants totaling $3.5 million.

Issues.	*Cli*	*Bio*	*Lan*	*Agr*	*Wat*	*Oce*	*Ene*	*Was*	*Tax*	*Pop*	*Dev*
		•	•	•	•	•					•

Activities.	*Adv*	*Dir*	*Edu*	*Lit*	*Med*	*Pol*	*Res*
	•	•	•			•	•

Funding analysis.*

Fiscal year:	1994	1995
Env grants auth:	$35,809,157	$9,875,107
Number:	237	204
Range:	$1,000-$2,779,148	$2,000-$1,000,000

Median:	$75,000	$30,000
Pct $ disb (env/total):	100	100

Recipients (1995 highest):	*Number:*	*Dollars:*
California Department of Fish and Game	1	1,000,000
Bureau of Land Management & USDA Forest Service	1	535,000
U.S. DOI, Fish and Wildlife Service, Region 1	1	509,000
U.S. DOI, Fish and Wildlife Service, Region 6	1	400,000
Quail Unlimited, Inc.	1	300,000

Activity regions (1995 highest):	*Number:*	*Dollars:*
U.S. West	19	2,494,276
U.S. not specified	24	1,238,525
U.S. Southeast	22	1,208,709
U.S. Northwest	18	831,100
U.S. Northeast	17	750,600

*Includes NFWF matching funds.

Sample grants (1995).*

Bureau of Land Management & USDA Forest Service. Washington, DC. $535,000. Restore and manage 31 riverine systems on public land to benefit native fish and mussel species through public-private collaboration. Fourth year of support adds ten new projects and one new state to the program.

Center for Natural Lands Management. Sacramento, CA. $20,000. Implement a series of seminars throughout California that will allow land conservation professionals more accurately to estimate and plan for the long-term stewardship costs of mitigation projects.

Cornell University. Ithaca, NY. $37,000. Complete analysis and publish results from three seasons of data collection to determine the habitat needs of four species of breeding tanagers in the U.S.

Hamline University, Center for Global Environmental Education. St. Paul, MN. $34,000. Distribute Journey North, an Internet-based conservation education program that follows annual wildlife migration, to approximately 1,000 classrooms throughout the U.S. and Mexico.

Institute for Bird Populations. Point Reyes Station, CA. $32,800. Analyze MAPS (Monitoring Avian Population Survivorship) bird population trend data collected from 350 sites across the country, evaluate program, and establish a continent-wide training program in bird banding.

The Nature Conservancy. Durham, NC. $63,000. Acquire and manage 200 acres of bottomland hardwood forest in the Lower Roanoke River basin of North Carolina.

Rene Dubos Center for Human Environments, Inc. New York, NY. $50,000. Develop an interactive, multimedia CD-ROM computer program on natural resource conservation for 7th-8th grade students.

Sustainable Northwest. Portland, OR. $15,000. Maximize marketplace incentives for forestland stewardship to conserve and enhance northeastern Oregon's forests, wildlife habitats, and communities.

Texas Parks and Wildlife Foundation. Austin, TX. $71,000. Acquire 5,000 acres of bottomland hardwoods adjacent to the Little Sandy National Wildlife Refuge in Texas to protect waterfowl and neotropical bird habitat.

*Sample grants are all matching grants.

Application process. *Initial contact:* Brief preproposal. If project meets guidelines, applicant will be invited to submit full proposal. Contacts (with e-mail addresses) for the five programs are as follows:

Conservation Education: Rebecca Brown - brown@nfwf.org & Kathleen Pickering - pickering@nfwf.org
Fisheries: Gris Batchelder - batchelder@nfwf.org
International Projects: Andy Romero - romero@nfwf.org
Neotropical Migratory Birds: Alison Dalsimer -dalsimer@nfwf.org
Wetland/Private Lands: Holly Quirk - quirk@nfwf.org
Wildlife and Habitat: Jonathan Davis - davis@nfwf.org

When to apply: Preproposal deadlines are March 30, July 31, and November 30. If requested by foundation, proposals are due April 15, August 15, and December 15.
Materials available: Annual report, brochure on project information, articles on initiatives, *Partners in Flight* (quarterly newsletter), "NFWF Grant Guidelines."

Emphases. *Recipients:* Aquariums, botanical gardens, educational institutions, museums, nonprofit organizations, public agencies, research institutions, zoos.
Activities: Citizen participation, collaborative efforts, demonstration programs, education, fieldwork, innovative programs, land acquisition, planning, symposia/colloquia, training.
Types of support: Leveraging funds, pilot projects, projects, seed money.
Geography: North and Central America.

Limitations. *Activities:* Advocacy, lobbying, political activities, research (including graduate).
Types of support: Annual campaigns, capital campaigns/expenses, debt retirement, fellowships, general purposes, indirect costs, loans, mortgage reduction, multi-year grants, operating costs, professorships.

The Wildlands Project. McMinnville, OR. $1,000.
Wildlife Damage Review. Tucson, AZ. $600.

Application process. *Initial contact:* Proposal (11 copies) to include:
1. Completed application form (from foundation).
2. Grant proposal (2-4 pages)
   - Organizational history and mission.
   - Project description and anticipated results.
   - Qualifications of personnel.
   - Plan of Action and timeframe.
   - Organizational and project budget, alternative sources of funding.
   - Method of evaluation.

. Project budget, including expenses and income projections with fundraising strategy.
4. Copy of IRS tax-exempt status determination letter.

No additional attachments will be accepted or considered.
When to apply: Deadlines are January 15, May 15, and September 15. Awards are made in March, July, and November.
Materials available: Application form, "Guidelines for Proposal Submission."

Emphases. *Recipients:* Nonprofit organizations.
Activities: Activism, advocacy, capacity building, citizen participation, collaborative efforts, education, feasibility studies, fieldwork, innovative programs, land acquisition, litigation, planning, political activities, policy analysis/development, publications, research, training.
Types of support: Equipment, general purposes, indirect costs, operating costs, pilot projects, seed money, single-year grants only.
Geography: Primarily Northern California and the Pacific Northwest.

Limitations. *Recipients:* Aquariums, botanical gardens, individuals, nonprofit organizations, political action committees, public agencies, zoos.
Activities: Conferences, lobbying, publications (continuing).
Types of support: Debt retirement, emergency funding, endowments, fellowships, lectureships, multi-year grants, professorships, scholarships.

The Tides Foundation

The Presidio Building 1014
P.O. Box 29903
San Francisco, California 94129-0903
Tel: 415-561-6401 Fax: 415-561-6401
E-mail: tides@igc.apc.org
EIN: 510198509 Type: Independent
EGA member
Contact: Jason Sanders, Proposal Coordinator

History and philosophy. "The Tides Foundation was established in 1976 to promote creative nonprofit and philanthropic activity, particularly in the western United States. Since that time, the scope of the foundation's work has widened beyond the western region to national and international dimensions."

"The foundation seeks to link diverse individuals seeking social justice, creative new approaches to economic enterprise, and an enlightened stewardship of our natural environment. It supports efforts in five areas: Environment & Natural Resources; International Affairs; Economic Public Policy & Enterprise Development; Social Justice; and Community Affairs. In each of these areas, Tides encourages the participation of Asian, African-American, Latino, and Native American organizations."

Tides is a public charity with 501(c)(3) and 509(a)(1) designations, and as such seeks contributions to support its grantmaking activities. As a grantmaker, it administers over 150 donor-advised funds and provides staff support to several independent grantmaking organizations. All grants are made on the recommendation of donor-advised funds. Tides implements its purposes through three separate, yet interrelated, programs: The Grantmaking Program, The Projects Program, and The Management Program.

Officers and directors. *Officers:* Wade Rathke, Chair; Drummond M. Pike, President; Michael Kieschnick, Treasurer; Lynda Palevsky, Corporate Secretary. *Directors:* Richard Boone, Susan Lehman Carmichael, Michael Kieschnick, Andrea Kydd, Mary Mountcastle, Lynda Palevsky, Drummond M. Pike, Wade Rathke, Charles Savitt.

Financial data. Data for fiscal year ended April 30, 1995. *Total grants disbursed:* $10,718,900.

Environmental awards. *Program and interests:* Tides has sponsored a variety of efforts to explore and develop new concepts of environmental harmony. General concerns are:

- Natural resource conservation, policy alternatives and solutions.
  - Global warming and the greenhouse effect.
  - Sustainable development.

- Land use, preservation, and stewardship.
  - Wildlands and rainforests.
  - Land rights of indigenous peoples.
  - Public lands.
  - Sustainable agriculture.

Tides also maintains interests in:
- Water issues in the Colorado River Basin, particularly citizen groups working to ensure a more balanced use of this important resource. Groups working on the challenges facing the Grand Canyon are of special interest.
  - Environmental issues such as toxins, preservation of temperate forests and rainforests, and recycling.
  - Social Justice groups organizing local constituencies and/or training young people as community leaders.
  - Small scale economic development projects run by and for the benefit of low-income women and people of color.
  - Organizations working to strengthen the spiritual and cultural traditions of indigenous peoples throughout the world.

Issues.	*Cli*	*Bio*	*Lan*	*Agr*	*Wat*	*Oce*	*Ene*	*Was*	*Tox*	*Pop*	*Dev*
	•	•	•	•	•	•	•	•	•	•	•

Activities.	*Adv*	*Dir*	*Edu*	*Lit*	*Med*	*Pol*	*Res*
	•					•	

Funding analysis.*

Fiscal year:	1993	1995
Env grants auth:	$1,236,555	$1,175,709
Number:	80	55
Range:	$3,250-$70,000	$100-$260,000
Median:	$10,000	$8,500
Pct $ auth (env/total):	19	11

Recipients (1995 highest):	*Number:*	*Dollars:*
Friends of the Earth/Environmental		

Policy Institute	1	260,000
Essential Information	1	149,300
Environmental Strategies	1	102,395
El Bosque Pumalin Foundation	1	98,500
Environmental Working Group	1	46,909

Activity regions (1995 highest):	*Number:*	*Dollars:*
U.S. not specified	23	747,176
U.S. West	9	215,644
U.S. Mountain	3	60,992
Canada	6	40,500
U.S. South Central	4	26,000

*1993 data do not include grants under $5,000.

Sample grants (1995).
ADESMO - Asociacion para el Desarrolo Ecologico de la Sierra Madre Occidental. Guadalajara, Mexico. $15,000. General support.
Animal Welfare Institute. Washington, DC. $19,106. General support.
Center for Neighborhood Technology. Chicago, IL. $18,397. General support.
Club Mouche Saumon Allier. Clermont-Ferrand, France. $1,000. To support efforts to protect Atlantic Salmon.
Dreamcatchers. Mill Valley, CA. $15,000. To support a film on the life of Reuben Snake.
Environmental and Economic Justice Project. Los Angeles, CA. $5,000. General support.
Forest Guardians. Santa Fe, NM. $5,000. To support an investigation into the death of activist Leroy Jackson.
Friends of the Earth. Washington, DC. $260,000. To support the Citizens Trade Campaign.
Institute for Agriculture and Trade Policy. Minneapolis, MN. $4,000. To support the Community Regeneration Project.

Application process. *Initial contact:* Proposal to include:
Summary (1 page).
1. Purpose of agency.
2. Grant purpose.
3. What outcomes are hoped for.
4. How grant funds will be spent.

Narrative (5 pages maximum).
1. Background. Describe organization.
   - Brief description of history and mission.
   - Need or problem that organization works to address.
   - Current programs and accomplishments. Emphasize achievements of the past year.
   - Population served, including geographic location, socioeconomic status, race, ethnicity, gender, sexual orientation, age, physical ability, and language.
   - Number of paid staff (differentiate full-time and part-time) and volunteers.
   - Organization's relationships with other organizations that work to meet the same needs or provide similar services. Explain how organization differs from others.
2. Funding request. Describe program for which funding is sought.
   - Statement of primary purpose and need or problem addressed.
   - Population served and how population will benefit from project.
   - Strategies used.
   - Names and qualifications of individuals who will direct project.
   - Anticipated project length.
   - How project contributes to organization's overall mission.
3. List of foundations, corporations, and other sources solicited for funds and the status of each solicitation.
4. Evaluation.
   - How program effectiveness will be measured.
   - Criteria for a successful program and results expected by end of funding period.

Financial information.
1. Most recent annual financial statement, audited if available. Statement should reflect actual expenditures of funds received during most recent fiscal year.
2. Operating budget for current fiscal year.
3. List of foundation and corporate supporters and other sources of income, with amounts, for current and most recent fiscal years.
4. If project funding is requested, provide current budget for project. List each staff line separately and include percent of time spent on project. Indicate specific uses of requested grant, if possible.

Other supporting materials.
1. List of directors, with their affiliations.
2. Copy of most recent IRS letter indicating agency's tax-exempt status or, if not available, an explanation.
3. One-paragraph resumes for key staff.
4. Most recent annual report, if available.
5. No more than three examples of recent articles about, or evaluations of, organization, if available. Newsletter, brochure, or other literature may be included.

When to apply: Anytime.

Materials available: Annual report (includes "How to Apply for a Grant from The Tides Foundation"), "Information for Grant Seekers," "Grant Proposal Format," *Tideline* (newsletter).

Emphases. *Recipients:* Nonprofit organizations.
Activities: Activism, advocacy, citizen participation, collaborative efforts, conflict resolution, innovative programs, networking, policy analysis/development, political activities, technical assistance, training, volunteerism, workshops, youth programs.
Types of support: Continuing support, general purposes, program-related investments, projects, single-year grants only, technical assistance.
Geography: National, international.

Limitations. *Types of support:* Capital campaigns/expenses, endowments, multi-year grants.

TROUT UNLIMITED

Trout Unlimited is an organization of conservation-minded anglers who promote quality trout and salmon fisheries both for their intrinsic value and as reminders of a river's health. The mission is to conserve, protect and restore North America's trout and salmon fisheries and their watersheds. Over 90,000 members pursue a variety of conservation activities through local chapters.

TU chapters can contribute dollars, volunteers, and/or supplies to local partnerships. The Big Blackfoot Chapter in Montana has donated several thousand dollars and has served as the funds administrator for the Blackfoot Challenge, enabling over half a million dollars to be used on habitat projects.

TU has a grant program, Embrace-a-Stream, which awarded $137,000 in 1997 to 33 grassroots stream projects. Grants of up to $10,000 care given to chapters for coldwater fishery resource, research and education projects. All projects must match EAS grants on a one-to-one basis, through volunteer labor, in-kind donations and/or cash. Projects must also involve a regionally or nationally significant coldwater fishery issue.

For information about Embrace-a-Stream or other partnership projects, contact your local chapter. The following state councils also have more information:

<u>Colorado Council, TU</u>
Anthony Kay, Chair
565 S. Harrison Lane
Denver, CO 80209-3516
(303) 377-2278 or 778-9322
/www.cotrout.org/

<u>Montana Council, TU</u>
Frank Cooper, Chair
1804 Beltview Drive
Helena, MT 59601-5801
(406) 443-6441
www.sechrest.com/flyfish/mtu/

<u>Utah Council, TU</u>
Bill Partner, Chair
906 West Brander Mill Cove
Murray, UT 84123
(801) 355-7571 or 268-3087
bpartner@aol.com

<u>Wyoming Council, TU</u>
Jay Buchner, Chair
P.O. Box 1022
Jackson, WY 83001
(307) 733-1530 or 733-4944
103062.442@compuserve.com

For national information, contact:

Trout Unlimited
1500 Wilson Blvd.; Suite 310
Arlington, VA 22209-2404
(703) 522-0200

Website: www.tu.org/trout

Natural Resources Conservation Matching Grants Program

Conservation grants to be given

DENVER — The state Soil Conservation Board is accepting applications for its Natural Resources Conservation Matching Grants Program.

The program assists soil conservation districts and the funds it provides make up the only cost-sharing program available for annual conservation practices in Colorado.

Funds must be used to implement conservation practices that preserve and protect natural resources through public/private partnerships.

In 1997, the board received 64 applications and awarded grants to 15 projects. This year, the board will hand out $500,000 in grants — double the amount from last year.

The application deadline is Aug. 31. For more information, call (303) 866-3351.

state organizing efforts to develop new alliances among people working against environmental destruction in their communities and workplaces.

*Sample grants represent disbursements made in 1995.

Application process. *Initial contact:* Letter of inquiry (3 pages) to include:

1. Brief statement of the issues to be addressed, history and goals of organization, and organization's involvement with these issues.
2. Brief summary of activities for which support is requested, including an outline of objectives, and anticipated outcomes and implications.
3. Approximate start date and duration of proposed activities.
4. Total amount of funding needed, amount requested from foundation, and information about other sources of support, both assured and requested.

When to apply: Anytime. The board of directors meets three times a year.
Materials available: Annual report (includes "Applying for a Grant").

Emphases. *Recipients:* Nonprofit organizations.
Activities: Activism, advocacy, capacity building, citizen participation, collaborative efforts, networking, policy analysis/ development.
Types of support: Continuing support, general purposes, multi-year grants, operating costs, projects.
Geography: United States. Especially Southeast, Southwest, and Rocky Mountain West (water and toxics; sustainable agriculture); United States (population/reproductive rights; sustainable communities); metropolitan New York (Metro New York).

Limitations. *Recipients:* Individuals.
Activities: Audiovisual materials, conferences, direct services, education, land acquisition, research, seminars, symposia/ colloquia.
Types of support: Advertising campaigns, capital campaigns/ expenses, debt retirement, endowments, fellowships, general purposes, lectureships, professorships, scholarships.

Outdoor-Industry Conservation Alliance

c/o Recreation Equipment, Inc. (REI)
P.O. Box 1938
Sumner, Washington 98390-0800
Tel: 707-961-0776
Website: http://www.outdoorlink.com/consall
Type: Independent
Contacts: Ron Nadeau, President
Kathleen Beamer, Grants Coordinator

Additional Information:
Jill Zilligen
Patagonia, Inc.
259 W. Santa Clara Street
Ventura, California 93001

History and philosophy. Founded in 1989, the alliance is a group of 56 outdoor businesses whose collective contributions support grassroots citizen-action groups and their efforts to protect wild and natural areas where outdoor enthusiasts recreate. The alliance funds projects that protect rivers, trails, wild lands natural areas where outdoor enthusiasts spend their time.

Membership is open to "businesses based on self-propelled or muscle-powered outdoor activities, whose livelihood depends on conserving our outdoor environment, from all aspects of the outdoor industry." Each member-business makes a minimum annual donation of $10,000. The alliance then seeks selected conservation groups that have developed programs to address important outdoor environmental issues.

Environmental awards. *Program and interests:* Criteria for funding include:
- Grassroots.
- Volunteer based.
- Citizen action orientation.
- Muscle-powered.
- Lobbying for specific projects.
- Protection of endangered species habitats.
- Projects that begin and end.

Recent grants: 1996 grants supported land conservation, wilderness protection, water use and coastal issues, and recreation.

Issues.	*Cli*	*Bio*	*Lan*	*Agr*	*Wat*	*Oce*	*Ene*	*Was*	*Tox*	*Pop*	*Dev*
		•	•		•	•					

Activities.	*Adv*	*Dir*	*Edu*	*Lit*	*Med*	*Pol*	*Res*
	•						

Funding analysis.

Fiscal year:	1996
Env grants auth:	$324,720
Number:	10
Range:	$20,000-$50,000
Median:	$34,485
Pct $ auth (env/total):	100

Recipients (1996 highest):	*Number:*	*Dollars:*
Headwaters Forest Coordinating Committee	1	50,000
Trustees for Alaska	1	35,000
Oregon Natural Desert Association	1	35,000
Northern Alaska Environmental Center	1	35,000
Access Fund	1	35,000

Activity regions (1996 highest):	*Number:*	*Dollars:*
U.S. West	2	82,250
Alaska	2	70,000
U.S. Northwest	2	59,500
U.S. Southeast	2	59,000
U.S. Mountain	1	33,970

Sample grants (1996).
The Access Fund. Boulder, CO. $35,000. To fund the purchase of an essential easement along Tennessee's Fiery Gizzard Trail

to allow climbers access to the Foster Falls climbing area, and to complete trail improvements for key sections of the trail.

Friends of the River Foundation. San Francisco, CA. $32,250. To build public and legislative opposition to California's Auburn Dam, and support efforts to secure long-term protection for the North and Middle forks of the American River.

The Northern Alaska Environmental Center. Anchorage, AK. $35,000. To strengthen citizen lobbying efforts through the Arctic Defense Lobby Project.

Oregon Natural Desert Association. Bend, OR. $35,000. To pursue the Oregon Clean Stream Campaign.

Puget Soundkeeper Alliance. Seattle, WA. $24,500. To support recreational users in launching a "block watch" program for Washington's Puget Sound.

RESTORE: The North Woods. Concord, ME. $20,000. To inform, organize, and activate public support for a national park study of the Maine North Woods.

Trustees for Alaska. Anchorage, AK. $35,000. To organize citizen participation to protect the Gulf of Alaska/Lower Cook Inlet marine region which faces pressure from offshore development, and to raise national awareness of the area.

Application process. *Initial contact:* Contact a member company and request its sponsorship of your proposal. Ask for nominating letter to be send to Jill Zilligan at Patagonia, Inc. She will contact the recommended group and request a proposal. Applicant will then received all necessary application information. Unsolicited proposals will not be reviewed. Member companies are listed on the alliance's website, or for more information contact Jill Zilligen at Patagonia, Inc.
When to apply: Send application by January for forwarding to alliance members. Decisions are made at the board meeting in August.
Materials available: Brochures, *Works in Progress* (newsletter).

Emphases. *Recipients:* Nonprofit organizations.
Activities: Activism, advocacy, citizen participation, lobbying, volunteerism.
Types of support: Projects.

Limitations. *Activities:* Education (traditional environmental projects such as the building of a nature center), media projects, research.

Patagonia, Inc.

259 West Santa Clara Street
Ventura, California 930001
Tel: 805-667-4660 Fax: 805-643-1648
E-mail: jil_zilligen@patagonia.com
EIN: 953526345 Type: Company-sponsored
EGA member
Contact: Jil Zilligen, Environmental Grants Director

Application address:
Patagonia, Inc. Grants Program
P.O. Box 150
Ventura, California 93002

History and philosophy. Patagonia, an outdoor-products manufacturer, commits 10 percent of its pre-tax profits or 1 percent of its sales, whichever is greater, to environmental causes. "Since 1984, our tithing program has distributed funds to over 500 different organizations. Rather than dilute the impact of our donations by spreading them thinly to a variety of causes, we have chosen to aim our dollars directly toward environmental issues. Patagonia products are designed for outdoor use and we feel a strong responsibility and commitment to keep the environment in its natural state for future generations. We are particularly interested in supporting environmental groups which operate at the most basic grassroots levels and which share our concern and sense of urgency about the state of the Earth."

Program areas are: Biodiversity; Forests; Media/Publications; Resource Extraction & Alternative Energy; Social Activism/Environmental Education; Sustainable Agriculture; Water; and International.

Officers and directors. *Owner:* Yvon Chouinard.

Financial data. Data for fiscal year ended April 30, 1996. *Total grants disbursed:* $1,100,313.

Environmental awards. *Program and interests:* Patagonia makes grants and donates clothing to organizations working to support environmental issues. The company's main priority is:

- Wildlands preservation.
  Biodiversity preservation.
  Habitat protection.

Patagonia also has a strong interest in:

- Wild river preservation.
  Efforts to block dam construction.

Other interests include issues that have an impact on habitat protection: toxic waste, acid rain, pesticide use, deforestation, ozone depletion, and air and water pollution.

Issues.	*Cli*	*Bio*	*Lan*	*Agr*	*Wat*	*Oce*	*Ene*	*Was*	*Tox*	*Pop*	*Dev*
	•	•	•	•	•	•	•	•	•		

Activities.	*Adv*	*Dir*	*Edu*	*Lit*	*Med*	*Pol*	*Res*
	•	•					

Funding analysis.

Fiscal year:	1995	1996
Env grants disb:	$1,311,332	$1,085,553
Number:	237	205
Range:	$50-$100,000	$200-$40,000
Median:	$3,000	$4,000
Pct $ disb (env/total):	94	98

Recipients (1996 highest):	*Number:*	*Dollars:*
Public Citizen	1	40,000
Pesticide Action Network	1	35,000
Steelhead Society of British Columbia	1	29,550
Oregon Natural Resources Council	1	25,500
Environmental Defense Center	1	20,900

Activity regions (1996 highest):	*Number:*	*Dollars:*

U.S. Mountain	48	220,350
U.S. West	31	200,700
U.S. Northwest	26	131,045
U.S. not specified	8	113,437
Canada	10	59,550

Sample grants (1996).
Alabama Wilderness Alliance. Montgomery, AL. $5,000. To support AWA's participation in revising the state's Land Resource Management Plan, which will determine the future of Alabama's national forests.
Amiq Institute. Anchorage, AK. $5,000. To protect fur seals from being entangled in discarded fishing nets by motivating Commander Island residents to scavenge nets from the water and use the scrap to make an array of consumer products.
Buckeye Forest Council. Athens, OH. $3,000. To restore Ohio's forest lands to their native state by establishing a network of core reserves surrounded by buffer zones and connected by wildlife corridors.
Ecological Services Centre. Narayangarh, Chitwan, Nepal. $1,905. To promote organic farming in Nepal through training about beneficial insects, composting, mulching, agroforestry, and alternative pest management.
Fund for Investigative Reporting. Asheville, NC. $3,000. For FIRE's proposal to investigate and report on the effect of urbanization on western North Carolina's black bear population.
InterTribal Sinkone Wilderness Council. Ukiah, CA. $5,000. For establishing the first InterTribal Indian Wilderness Park, and the purchase of a 3900-acre parcel of land for the park.
Nevada Nuclear Waste Task Force. Las Vegas, NV. $3,000. To increase citizen involvement in the process surrounding all nuclear waste issues.
Northern Alaska Environmental Center. Fairbanks, AK. $10,000. Support for distribution of video explaining the what the effects of oil exploration and drilling would be on the Arctic National Wildlife Refuge.
Pesticide Action Network - Germany. Hamburg, Germany. $5,000. For the group's campaign to encourage conversion to organically-grown cotton.
Puget Soundkeepers Alliance. Seattle, WA. $1,000. To train volunteers in water quality stewardship and industry watchdogging for the protection of Puget Sound.
Southern Utah Wilderness Alliance. Salt Lake City, UT. $10,150. To coordinate a grassroots project to educate the public on issues surrounding the future of Utah's Virgin River, which is threatened by 16 proposed dam projects.
Western Canada Wilderness Committee. Edmonton, AB. $7,000. Support for the Lubicon Campaign, which aims to protect the native Cree land from oil, gas, and forestry campaigns.
Women's Voices for the Earth. Missoula, MT. $3,000. For the group's campaign to pressure Stone Container Corporation to stop producing dioxin in its Missoula mill.

Application process. *Initial contact:* Proposal (4 typewritten pages maximum) that is direct, straightforward, and includes:
1. Who you are.
2. What your mission is.
3. What you've accomplished.
4. How you're going to achieve your goals.
5. How Patagonia might fit into your overall financial scheme.
6. Project budget.
7. Copy of IRS tax-exempt status determination letter.

No telephone inquiries, please. Standard mail or e-mail is acceptable. Proposals sent by resource-intensive express mail are not acceptable.
When to apply: April or August for disbursal of grants in September and January, respectively.
Materials available: Environmental Grants Program (includes "Guidelines for Proposals").

Emphases. *Recipients:* Nonprofit organizations.
Activities: Activism, advocacy, citizen participation, collaborative efforts.
Types of support: Clothing donations, single-year grants only.
Geography: National and international projects.

Limitations. *Activities:* Media projects, research (scientific).

Recreational Equipment, Inc.

P.O. Box 1938
Sumner, Washington 98390-0800
Tel: 206-395-3780 Fax: 206-395-4744
206-395-7100 (grants line)
EIN: 910656890 Type: Company-sponsored
EGA member
Contacts: Kathleen Beamer, Vice President, Public Affairs
Maria Groen, Grants Administrator
Judy Patrick, Public Affairs Secretary

History and philosophy. Recreational Equipment, Inc. (REI), the outdoor clothing and equipment manufacturer, began its corporate giving program in 1976. It supports grassroots efforts to protect public lands, rivers, and trails for muscle-powered outdoor recreation, specifically: climbing, camping & hiking, bicycling, paddling, and winter sports. Support may be in the form of monetary grants or donations of REI brand gear.

The company gives to (1) programs that increase access to outdoor activities and encourage involvement in muscle-powered sports, (2) programs that promote safe participation in outdoor muscle-powered sports, including education-based programs, (3) programs offering outdoor muscle-powered recreational opportunities for children ages 5-18 who would not otherwise have the opportunity, and (4) community organizations working on outdoor recreation public policy initiatives that are of strategic interest to REI's members, employees, and business.

Officers and directors. *Officer:* Kathleen Beamer, Vice President.

Financial data. Data for fiscal year ended December 31, 1995. *Assets:* $241,013,000 (M). *Revenue:* $447,688,000. *Total grants authorized:* $716,170.

Environmental awards. *Program and interests:* REI's primary interest is in protection and enhancement of natural resources needed for muscle-powered outdoor sports, through:

- Preservation of wildlands/open space.
- Advocacy-oriented education of the public on specific conservation issues.
- Building the membership base of conservation organizations.
- Direct citizen action (lobbying) on specific public land and water recreation issues.
- Working to organize a trails constituency and to advocate for trails at the state and local levels.
- Helping trails happen that are: mixed ownership, used for commuting, rail-to-trail conversion projects, mixed or diverse use, or used by road or mountain bicycles.
- The REI Rivers Campaign, which seeks to (1) add rivers for study in the National Wild and Scenic Rivers System or improve management of designated rivers, (2) protect and enhance natural resources and river recreation subject to hydropower dam activity, (3) improve state-level river programs, and (4) promote legislation for river protection or recreational access.

Issues.	*Cli*	*Bio*	*Lan*	*Agr*	*Wat*	*Oce*	*Ene*	*Was*	*Tox*	*Pop*	*Dev*
		•	•		•	•					

Activities.	*Adv*	*Dir*	*Edu*	*Lit*	*Med*	*Pol*	*Res*
	•	•	•				

Funding analysis.*

Fiscal year:	1994	1995
Env grants auth:	$439,642	$524,948
Number:	38	57
Range:	$940-$185,000	$500-$85,000
Median:	$3,533	$5,400
Pct $ auth (env/total):	100	73

Recipients (1995 highest):	*Number:*	*Dollars:*
American Rivers, Inc.	2	100,200
The Utah Wilderness Coalition	3	44,400
International Mountain Bicycling Association	2	31,370
The Wilderness Society	2	27,000
National Forest Coalition	1	25,000

Activity regions (1995 highest):	*Number:*	*Dollars:*
U.S. not specified	10	181,835
U.S. Mountain	12	110,640

U.S. West	9	70,000
U.S. Northwest	10	58,713
U.S. Mid-Atlantic	2	25,000

*Does not include company community recreation grants.

Sample grants (1995).
Adirondack Mountain Club. Lake George, NY. $4,960. Membership brochure for organization to preserve and enhance the natural and open space character of Adirondack Park.
American Rivers, Inc. Washington, DC. $85,000. To protect the country's outstanding free-flowing rivers through the funding of national, state, and local river protection work.
Campaign for Open Space, Parks, and Stream. Portland, OR. $2,500. Membership recruitment support.
Greater Yellowstone Coalition. Bozeman, MT. $5,000. To assist with a computer networking project.
Mineral Policy Center. Washington, DC. $10,000. To help bring grassroots activists to Washington, D.C. to testify and participate in lobbying efforts to repeal the 1872 Mining Law.
Northern Forest Alliance. Montpelier, VT. $16,000. Support for lobbying work, protection of Maine's woods, and a conservation mapping project.
Rails to Trails Conservancy. Washington, DC. $15,000. To assist with the "Show Congress" campaign, in the program to convert abandoned railroad corridors to multi-use trails.
Sierra Club, Southwest Regional Office. Boulder, CO. $10,520. For the Saving the Black Canyon of the Gunnison project.
Tualatin Riverkeepers. Tigard, OR. $4,600. To assist with the Tualatin River Discovery Summer Campaign, as part of the organization's effort to achieve direct citizen observation and awareness of the Tualatin River as a natural resource.
Utah Wilderness Coalition. Salt Lake City, UT. $20,000. To assist with the Save America's Red rock Wilderness project, as part of the organization's overall effort to protect public lands in Utah.

Application process. *Initial contact:* Telephone REI grants line (206-395-7100), for guidelines. Full application for Conservation (not Community Recreation) grant to include:
1. Application form (from company).
2. Detailed line-item budget.
3. Copy of IRS tax-exempt status determination letter.
4. Description of project goals, objectives, strategies, and methods of evaluation (3 pages maximum).
5. Program/project brochures (three pieces maximum).

Faxed proposals are not accepted. All materials to be submitted to REI Grants Administrator. Do not contact REI during the evaluation process.
When to apply: Proposals are accepted 10 times per year: January 10, February 10, March 10, April 10, May 9, June 10, July 10, August 8, September 10, and October 10 for decisions a month later.
Materials available: Corporate annual report, "Proposal Guide-lines," application form, grants list.

Emphases. *Recipients:* Nonprofit organizations.
Activities: Activism, advocacy, audiovisual materials, citizen participation, collaborative efforts, innovative programs, lobbying, networking, political activities, youth programs.
Types of support: Annual campaigns, emergency funding, lever-aging funds, membership campaigns, pilot projects, projects, seed money, single-year grants only.
Geography: United States only.

Limitations. *Recipients:* Botanical gardens, educational institutions, individuals, museums, public agencies, religious organizations, research institutions, zoos.
Activities: Conferences, direct services, education, fundraising, media projects, research.
Types of support: Advertising campaigns, capital campaigns/ expenses, continuing support, debt retirement, endowments, equipment, facilities, fellowships, general purposes, indirect costs, lectureships, loans, maintenance, mortgage reduction, multi-year grants, operating costs, professorships, program-related investments, scholarships.

The Strong Foundation for Environmental Values

116 New Montgomery Street, Suite 532
San Francisco, California 94105-3607
Tel: 415-543-2152
EIN: 941167412 Type: Independent
EGA member
Contact: Kimery Wiltshire, Executive Secretary

History and philosophy. Established in 1914 under another name, this grantmaker became The Strong Foundation for Environmental Values in 1982. Its mission is "to reflect a deep concern for our earthly environment and the people and animals that inhabit it." It makes grants primarily in Northern California and the West.

Officers and directors. *Officers:* Margaret Kelley, President; Tamra Peters, Vice President; Pat Bradley, Secretary; James T. Watters, Treasurer. *Directors:* Pat Bradley, Paul Grundland, John Huffnagle, Margaret Kelley, Tamra Peters, James T. Watters.

Financial data. Data for fiscal year ended August 31, 1994. *Assets:* $872,489 (M). *Total grants disbursed:* $60,500.

Environmental awards. *Program and interests:* The foundation's primary interests are:
- Toxic waste.
- Land use.
- Water resources.

Recent grants: 1994-95 grants included support for conservation (land acquisition, farmland preservation, parks, public lands, open space, greenbelts, wilderness); forests (ancient forests, sustainable forestry); coastal issues; freshwater (watershed and river protection); species preservation and restoration; and toxics (environmental health, hazardous waste).

Issues.	*Cli*	*Bio*	*Lan*	*Agr*	*Wat*	*Oce*	*Ene*	*Was*	*Tox*	*Pop*	*Dev*
		•	•	•	•	•			•		

Activities.	*Adv*	*Dir*	*Edu*	*Lit*	*Med*	*Pol*	*Res*
	•	•	•	•		•	•

Funding analysis.

Fiscal year:	1992	1994
Env grants disb:	$62,500	$60,500
Number:	39	45
Range:	$500-$5,000	$500-$5,000
Median:	$1,300	$1,000
Pct $ disb (env/total):	100	100

Recipients (1994 highest):	*Number:*	*Dollars:*
California Oak Foundation	1	5,000
Gwich'in Steering Committee	1	4,000
The Tuolumne River Preservation Trust	1	4,000
Klamath Forest Alliance	1	3,100
Golden Gate National Recreation Area	1	2,800

Activity regions (1994):	*Number:*	*Dollars:*
U.S. West	30	44,400
U.S. Northwest	9	8,400
Alaska	1	4,000
U.S. Mountain	3	2,600
U.S. not specified	2	1,100

Sample grants (1995).
Central Sierra Environmental Resource Center (CSERC). Twain Harte, CA. $2,000.
Friends of the Earth, Northwest. Seattle, WA. $1,900.
Great Bear Foundation. Missoula, MT. $500.
Local Earth Action Forum. Sonoma, CA. $3,000.
Marine Science Institute. Redwood City, CA. $800.
Oregon Coast Aquarium. Newport, OR. $500.
Public Forestry Foundation. Eugene, OR. $1,000.
The Tuolumne River Preservation Trust. Oakland, CA. $2,300.

Turner Foundation, Inc.

One CNN Center, South Tower, Suite 1090
Atlanta, Georgia 30303
Tel: 404-681-9900 Fax: 404-681-0172
E-mail: turnerfi@mindspring.com
Website: http://www.turnerfoundation.org/turner
EIN: 581924590 Type: Independent
EGA member
Contact: Peter Bahouth, Executive Director

History and philosophy. Turner Foundation, Inc. was founded in 1990. It supports activities to preserve the environment, conserve natural resources, protect wildlife, and develop and implement sound population policies.

Officers and directors. *Officers:* R. E. Turner, President; Rutherford Seydel, Secretary; Edward C. Harris, Treasurer; Peter Bahouth, Executive Director. *Trustees:* Jane Fonda, Jennie Turner Garlington, Laura Turner Seydel, R. Beauregard Turner, Rhett L. Turner, Robert Edward Turner IV.

Financial data.* Data for fiscal year ended December 31, 1995. *Assets:* $135,000,000 (M) (est.). *Total grants disbursed:* $6,000,000 (est.).

*As reported by foundation.

Environmental awards. *Program and interests:* The foundation will support activities pertaining to:

- Water and toxics.
  To protect rivers, bays, wetlands, and oceans from contamination, degradation, and other abuses.
- Energy efficiency and renewables.
  To protect the atmosphere by promoting energy efficiency and renewable energy.
- Protection of forests and other habitats.
  To defend biodiversity by protecting natural habitats.
- Population issues.
  To develop a global population policy addressing the relationships between population growth, access to reproductive health services, and global resources.

The foundation will also support:
- Education about the need for preservation activities.
- Efforts to instill a sense of common responsibility for the fate of life on earth to citizens of all nations.

Issues.	*Cli*	*Bio*	*Lan*	*Agr*	*Wat*	*Oce*	*Ene*	*Was*	*Tox*	*Pop*	*Dev*
	•	•	•	•	•	•	•	•	•	•	•

Activities.	*Adv*	*Dir*	*Edu*	*Lit*	*Med*	*Pol*	*Res*
	•	•	•			•	

Funding analysis.

Fiscal year:	1995
Env grants disb:	$2,895,200
Number:	161
Range:	$2,500-$112,000
Median:	$15,000
Pct $ disb (env/total):	48

Recipients (1995 highest):	*Number:*	*Dollars:*
Worldwatch Institute	1	112,000
Upper Chatahoochee Riverkeeper	1	85,000
Global Green USA	1	75,000
Pacific Environment and Resources Center	1	60,000
Third Millennium Foundation	1	60,000

Activity regions (1995 highest):	*Number:*	*Dollars:*
U.S. not specified	37	778,500
U.S. Southeast	35	603,000
U.S. Mountain	32	425,700

International*	13	372,000
U.S. South Central	12	207,000

*Multiple regions or not specified.

Sample grants (1995).
American Association for the Advancement of Science. Washington, DC. $20,000. To support a project that identifies and implements the scientific research necessary to understand and address sustainability as it relates to population, the environment, and consumption.
Coalition for Clean Air. Venice, CA. $10,000. To support activities aimed at mitigating air pollution by broadening the organizing base among groups traditionally underrepresented including children and community associations through outreach, organizing networks, conducting meetings, and canvassing.
Heartwood. Paoli, IN. $10,000. To support a project aimed at reducing wood consumption and the accompanying environmental degradation by educating people to reduce use, promoting alternative fibers, promoting plans to end dioxins in paper processing, and promoting recycling, while advocating for wood export restrictions and sustainable management of private forestlands.
Native American Fish and Wildlife Society. Broomfield, CO. $28,000. To protect and preserve Native American environmental resources by facilitating contact between tribes, monitoring enforcement and compliance activities of environmental regulatory agencies, and advocating for better environmental policies.
Pacific Environment and Resources Center. Sausalito, CA. $60,000. To support the Siberian Forest Protection Project designed to protect the Siberian tiger and its habitats by targeting the region's rural citizens with conservation strategies, focusing national attention in support of conservation projects, and initiating a campaign to address planned industrial development.
Prairie Island Coalition Against Nuclear Storage. Lake Elmo, MN. $5,000. To support the Stop the Dump Campaign designed to organize public pressure to stop nuclear waste storage while promoting renewable energy technologies and advocating elimination of nuclear generated power.
Safely Treating Our Pollution. Atlanta, GA. $20,000. To support efforts to increase protection of Georgia's water resources through public education and outreach, developing solutions, and designing and testing pollution remediation techniques.
Southface Energy Institute. Atlanta, GA. $5,000. To support the Earthwide Home project designed to develop and construct a home to serve as an environmentally sustainable, energy efficient model for other nonprofit housing providers.
Worldwatch Institute. Washington, DC. $112,000. To support research, publication, and dissemination of environmental analysis in books and working papers that address current environmental issues and a state-of-the world report on environmental indicators.

Application process. *Initial contact:* Full proposal (3 pages) to include:
Narrative.
1. Problem to be solved and issues it addresses.
2. Organization's history and accomplishments.
3. Organization's current programs and activities.
4. If other than general operating support, description of project, why project was chosen, and if it is new or ongoing.
5. Project goals, objectives, activities/strategies, and timeline.
6. Demographics and geographic area affected by the project.

Attachments.
1. Copy of IRS tax-exempt status determination letter.
2. Project budget.
3. List of other funding sources for project, amounts, and if received, committed, or projected/pending.
4. Current annual operating budget.
5. List of organization's top five major funders for past two years.
6. Recent newsletter, articles, newspaper clippings, evaluations, or reviews (5 pages maximum).
7. List of board of directors and affiliations.
8. Grant Application Coversheet and Grant Application Checklist (from foundation).

Send by regular mail only.
When to apply: Deadlines are April 1 and October 1. The board of trustees meet in July and December.
Materials available: Brochure, "Grant Application Coversheet," "Grant Application Checklist."

Emphases. *Recipients:* Nonprofit organizations.
Activities: Activism, advocacy, capacity building, citizen participation, collaborative efforts, policy analysis/development.
Types of support: Continuing support, general purposes, leveraging funds.
Geography: Water and Toxics: U.S. states of Florida, Georgia, Montana, New Mexico, South Carolina; Energy: domestic and international; Forests and Other Habitats: Florida, Georgia, Montana, New Mexico, South Carolina, national programs, and Russia; Population: domestic and international.

Limitations. *Activities:* Audiovisual materials, land acquisition, publications.
Types of support: Endowments, facilities, seed money.

EPA UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Catalog of Federal Funding Sources for Watershed Protection

Funding Source Descriptions
Contents

Funding Source Descriptions

(listed according to topic)

☐ **COASTAL WATERS**

U.S. Department of Commerce

- Coastal Services Center Cooperative Agreements (USDOC/NOAA)
- Coastal Zone Management Administration/Implementation Awards (USDOC/NOAA)
- Financial Assistance for Ocean Resources Conservation and Assessment Program (USDOC/NOAA)

U.S. Environmental Protection Agency

- Chesapeake Bay Program (EPA)
- National Estuary Program (EPA)

☐ **CONSERVATION**

Federal Emergency Management Agency

- Flood Mitigation Assistance Program (FEMA)
- Hazard Mitigation Grant Program (FEMA)

U.S. Department of Agriculture

- Conservation Reserve Program (USDA/FSA)
- Emergency Conservation Program (USDA/FSA)
- Resource Conservation and Development Program (USDA/NRCS)
- Wildlife Habitat Incentives Program (USDA/NRCS)

U.S. Department of the Interior

- Cooperative Endangered Species Conservation Fund-Grants to States (USDOI/FWS)
- Partners for Wildlife Habitat Restoration Program (USDOI/FWS)
- Wildlife Conservation and Appreciation Program (USDOI/FWS)

☐ **ECONOMIC DEVELOPMENT**

U.S. Department of Agriculture

- Water and Waste Disposal Systems for Rural Communities (USDA/RUS)

U.S. Department of the Housing and Urban Development

- Community Development Block Grant Program (HUD/CPD)

U.S. Environmental Protection Agency

- Brownfields Economic Redevelopment Initiative (EPA)
- Sustainable Development Challenge Grants (EPA)
- U.S.-Mexico Border XXI Grants Program (EPA)

☐ **EDUCATION**

U.S. Department of Agriculture

Sustainable Agriculture Research and Education (USDA/CSREES)
U.S. Environmental Protection Agency
Environmental Education Grants Program (EPA)

- **ENVIRONMENTAL JUSTICE**
  U.S. Environmental Protection Agency
  Environmental Justice Community/University Partnerships Grants Program (EPA)
  Environmental Justice Grants to Small Community Groups (EPA)
  Environmental Justice Through Pollution Prevention Grants Program (EPA)

- **FISHERIES**
  U.S. Department of Commerce
  Fisheries Development and Utilization Research and Development Grants and Cooperative Agreements Program (USDOC/NOAA)
  U.S. Department of the Interior
  Administrative Grants for Federal Aid in Sport Fish Restoration Program (USDOI/FWS)
  Sport Fish Restoration Program (USDOI/FWS)

- **FORESTRY**
  U.S. Department of Agriculture
  Cooperative Forestry Assistance (USDA/FS)
  Forestry Incentives Program (USDA/NRCS)

- **INDIAN TRIBES**
  U.S. Department of the Housing and Urban Development
  Indian Community Development Block Grant Program (HUD/PIH)
  U.S. Department of the Interior
  Agriculture on Indian Lands (USDOI/BIA)
  Fish, Wildlife, and Parks Programs on Indian Lands (USDOI/BIA)
  Forestry on Indian Lands (USDOI/BIA)
  Water Resources on Indian Lands (USDOI/BIA)
  U.S. Environmental Protection Agency
  Clean Water Act Indian Set-Aside Grant Program (EPA)
  Indian Environmental General Assistance Program (EPA)

- **MINING**
  U.S. Department of the Interior
  Abandoned Mine Land Reclamation Program (USDOI/OSM)

- **POLLUTION PREVENTION AND CONTROL**
  U.S. Department of Agriculture
  Environmental Quality Incentives Program (USDA/NRCS)
  Watershed Protection and Flood Prevention Program (USDA/NRCS)
  U.S. Department of the Interior
  Clean Vessel Act Grant Program (USDOI/FWS)
  U.S. Department of Transportation
  Surface Transportation Program (USDOT/FHWA)

U.S. Environmental Protection Agency
- Capitalization Grants for Clean Water State Revolving Fund (EPA)
- Capitalization Grants for Drinking Water State Revolving Fund (EPA)
- Great Lakes Program (EPA)
- Hardship Grants Program for Rural Communities (EPA)
- Nonpoint Source Implementation Grants (319 Program) (EPA)
- Pollution Prevention Grants Program (EPA)
- Superfund Technical Assistance Grants for Citizen Groups at Priority Sites (EPA)
- Water Quality Cooperative Agreements (EPA)

- **WETLANDS**

U.S. Department of Agriculture
- Wetland Reserve Program (USDA/NRCS)

U.S. Department of the Interior
- Coastal Wetlands Planning, Protection, and Restoration Act (USDOI/FWS)
- North American Wetlands Conservation Act Grant Program (USDOI/FWS)

U.S. Environmental Protection Agency
- Wetlands Protection Development Grants (EPA)

Contents **Foreword** **Preface** **Introduction**

List of Funding Source Descriptions

Funding Source Categories

Coastal Waters	*Forestry*
Conservation	*Indian Tribes*
Economic Development	*Mining*
Education	*Pollution Prevention and Control*
Environmental Justice	*Wetlands*
Fisheries	

Indices **Appendices**

HOME HOTLINES PUBLICATIONS COMMENTS SEARCH

OW-GENERAL@epamail.epa.gov

Revised October 8, 1997

OWOW **http://www.epa.gov/OWOW/watershed/wacademy/its/funddesc.html**

U.S. ENVIRONMENTAL PROTECTION AGENCY
EPA/NSF/NASA Joint Program on Water and Watersheds

The U.S. Environmental Protection Agency, the National Science Foundation and the National Aeronautics and Space Administration seek research proposals to address fundamental concepts of ecosystem restoration and rehabilitation in the context of the watershed system.

The goals of this community-based grant program are to enhance the community's understanding of environmental issues, build the capacity for communities to address these problems, develop tools, information and data to assist communities in addressing environmental problems, and ensure access to the most credible scientific information available. Proposals should have a specific geographic focus but the outcomes and outputs must be transferable.

The program will not support site-specific projects for the sole purpose of restoration. New restoration efforts may be implemented only if the primary purpose is research and development, such as developing or validating models.

Not-for-profit scientific research and educational institutions located in the U.S., and state or local governments are eligible to apply under this solicitation. Researchers in federal agencies may submit applications, but federal employees may not request salary reimbursement. Federal employees may cooperate or collaborate with other eligible applicants.

Application Forms:	U.S. EPA National Center for Environmental Research And Quality Assurance (8703) 401 M Street, SW Washington DC 20460 1-800-490-9194
Contact:	Barbara Levinson (202) 260-5983
Size of Grants:	$100,000 to $300,000 per year for 3 years
Proposals Due:	October 15
Website:	www.epa.gov/ncerqa

Financial Assistance

FINANCIAL SUPPORT AND FLEXIBILITY

As a leader in wastewater control, OWM is involved in many activities that promote improved wastewater treatment. The Office provides direction and assistance to national, State, and local programs for the abatement and prevention of municipal water pollution. The following pages provide an overview of some of these assistance efforts.

- Clean Water State Revolving Fund (SRF)
- Construction Grants Programs
- Public Private Partnerships (P3)
- Section 106 Water Pollution Control Program Grants
- Section 104(b)(3) Water Quality Cooperative Agreements
- Indian Set-Aside Grants
- Hardship Grants Program for Rural Communities

EPA and its partners... working together for cleaner water

The Clean Water State Revolving Fund (SRF) Program

With the passage of the Amendments to the Clean Water Act (CWA) in 1987, the U.S. Congress ushered in a new era in clean water funding. The new CWA called for the replacement of the long-running federal

Construction Grants program with an innovative State Revolving Fund (SRF program). Under the SRF program, each state (and Puerto Rico) would create revolving loan funds to provide independent and permanent sources of low-cost financing for a range of water quality infrastructure projects. Funds to establish or capitalize the SRF programs would be provided by the federal (83%) and state (17%) governments.

Currently, all fifty states and Puerto Rico are operating successful SRF programs. Capitalization began in 1988; today total assets of the SRF program stand at more than $20 billion. As payments are made on loans, funds are recycled to fund additional water protection projects. If capitalized as planned, the SRF will be available to play a key role in funding water quality infrastructure far into the future.

The SRF is a far more flexible program than its predecessor, the Construction Grants program. Under the SRF, States have a wide variety of options: States may choose from a variety of assistance options, including loan, refinancing, purchasing, or guaranteeing local debt, and purchasing bond insurance. States also set loans terms, including interest rates (from zero percent to market rate), repayment periods (up to twenty years), and many other loan features. SRFs are also available to fund a wide variety of water quality projects including all types of nonpoint source and estuary management projects, as well as more traditional municipal wastewater treatment projects. States may also customize loan terms to meet the needs of small and disadvantaged communities.

For more information, call EPA's National Center for Environmental Publications and Information at (800) 490-9198 and request a copy of "the Clean Water State Revolving Fund: Financing America's Environmental Infrastructure - A Report of Progress" (EPA publication number 832-95-R-001), or view fact sheets about the SRF program:

The Clean Water State Revolving Fund and the Clean Water Action Plan

Clean Water State Revolving Fund - General Information

Protecting Wetlands with the Clean Water State Revolving Fund [**PDF**]

Protecting Wetlands with the Clean Water State Revolving Fund [**HTML**]

CW-SRF Funded Wetlands Projects

Clean Water (SRF) Allotments to the States

Funding Framework Workshops

How to Fund Nonpoint Source & Estuary Enhancement Projects [PDF]

Cleaning Up Polluted runoff with the Clean Water State Revolving Fund [PDF]

Construction Grants Program

During the 1970s and 1980s, the *Construction Grants Program*was a major source of federal funds, providing more than $60 billion for the construction of public wastewater treatment projects. These projects, which constituted a significant contribution to the nation's water infrastructure, included sewage treatment plants, pumping stations, and collection and intercept sewers; rehabilitation of sewer systems; and the control of combined sewer overflows. EPA's effective management of construction grants led to the improvement of water quality in thousands of municipalities nationwide.

With the 1987 amendments to the Clean Water Act, Congress set 1990 as the last year that grants funds would be appropriated. By phasing out the construction grants program, EPA shifted the method of municipal financial assistance from grants to loans provided by *State revolving funds*.

Public-Private Partnerships (P3)

EPA's *Public-Private Partnerships (P3)*initiative seeks opportunities for municipalities to work with the private sector in financing public wastewater treatment operations. Local officials are in the best position to develop capital financing options that meet their particular needs. EPA is committed to supporting these communities and allowing them flexibility in financing the wastewater treatment infrastructure needed to achieve the highest possible level of environmental protection.

In 1992, EPA identified three wastewater systems as pilot projects for our P3 initiative: the City of Indianapolis, the City of Silverton, Oregon, and the Miami Conservancy District near Dayton, Ohio. OWM is working with local officials and private companies to assess and develop effective models for greater private-sector investment and management of wastewater facilities. These exciting projects will provide valuable information that EPA will share with local partners throughout the country.

Hardship Grants program for Rural Communities

The Hardship Grants Program helps small, disadvantaged rural communities address their wastewater treatment needs. Funding is provided for either planning, design, and construction of wastewater treatment facilities or technical assistance related to operation and maintenance. To qualify communities must be rural, have 3000 or fewer residents, lack centralized wastewater facilities, have a per capita income that is 80% or less than the national per capita income and an unemployment rate that is 1% or more above the national unemployment rate. EPA will make grants to states who will, in turn, provide either funding or echnical assistance to hardship communities.

Section 106 Water Pollution Control Program Grants

Section 106 of the Clean Water Act authorizes EPA to provide Federal assistance to States (including territories, the District of Columbia, Indian Tribes) and interstate agencies to establish and implement ongoing water pollution control programs.

Prevention and control measures supported by State Water Quality Management programs include permitting, pollution control activities, surveillance, monitoring, and enforcement; advice and assistance to local agencies; and the provision of training and public information.

Increasingly, EPA and States are working together to develop *basin-wide approaches*to water quality management. The Section 106 program is helping to foster a watershed protection approach at the State level by looking at States' water quality problems holistically, and targeting the use of limited finances available for effective program management. In the near term, the program is seeking ways to streamline the grants process to ease the administrative burden on States.

Section 104(b)(3) Water Quality Cooperative Agreements

Under authority of Section 104(b)(3) of the Clean Water Act, EPA makes grants to State water pollution control agencies, interstate agencies, and other nonprofit institutions, organizations, and individuals to promote the coordination of environmentally beneficial activities. These activities include storm water control, sludge management, and pretreatment.

Among the efforts that are eligible for funding under the Section 104(b)(3) program are research, investigations, experiments, training, environmental technology demonstrations, surveys, and studies related to the causes, effects, extent, and prevention of pollution.

EPA's Regional Offices select grant proposals that are most likely to advance the States' and EPA's ability to deal with water pollution problems. Headquarters also manages grants that address concerns of a national scope. Unlike the Section 106 program, Section 104(b)(3) grants may not be used to fund ongoing programs or administrative activity.

The FY 1999 proposal form will be loaded onto this site when it becomes available later this year.

The list of approved 104(b)(3) grantees will be loaded onto this site in the near future.

Additional Information on Water Quality Cooperative Agreements

Indian Grants Management

Section 518(c) of the Clean Water Act authorized EPA to create a grants program to help pay for the planning, design and construction of wastewater treatment systems to serve Indian Tribes and Alaska Native Villages.

Tribes and Native Alaskan Villages face significant human health, water quality and environmental problems because of the lack of adequate wastewater treatment. These problems--and the corresponding lack of existing environmental structure--exist because of many factors, including local economic conditions, disperse populations, political and cultural barriers, and the lack of significant environmental investment by federal and state agencies.

The Indian Set-Aside program seeks to help alleviate these problems and to focus attention on the needs of Native populations. Millions of dollars in grants funds have been made available for wastewater projects on Indian lands and in Alaska Native Villages. EPA will continue to work with Tribes, Alaska Native Villages and other federal agencies to achieve adequate wastewater systems.

The Indian Set-Aside (ISA) Program is administered by EPA through a cooperative effort with the Indian Health Service (IHS). Applicants can obtain a copy of the guidance document entitled "Guidelines and Requirements for Applying for Grants from the Indian Set-Aside Program"dated, April 1988, to determine how to apply for these grants. An Addendum to the guidance document was issued in March 1995. The guidance document can be obtained by contacting EPA's Regional Indian Set-Aside Coordinator for the area in which you are located:

Regional Office Indian Set-Aside Coordinators

Region 1	Region 6
Debbie Kerr	**Velma Smith**
Environmental Protection Agency	Environmental Protection Agency
Water Management Division	Water Management Division
JFK Federal Building	Fountain Place 12th Floor Suite 1200

One Congress Street
Boston, MA 02203-0001
(617) 565-4886
(CT,ME,MA,NH,RI,VT)

1445 Ross Avenue
Dallas, TX 75202-2733
(214) 665-7153
(AR,LA,NM,OK,TX)

Region 2

Muhammad Hatim
Environmental Protection Agency
Water Management Division
290 Broadway
New York, New York 10007-1866
(212) 637-3855
(NJ,NY,PR,VI)

Region 7

Gerald Gutekunst
Environmental Protection
Water Management Division
726 Minnesota Avenue
Kansas City, KS 66101
(913) 551-7484
(IA,KS,MO,NB)

Region 4

Mario Machado
Environmental Protection Agency
Water Management Division
345 Courtland Street, N.E.
Atlanta, GA 30365
(404) 347-3633 ext. 6533
(AL,FL,GA,KY,MS,NC,SC,TN)

Region 8

Terry Griffith
Environmental Protection Agency
Water Management Division
999 18th Street, Suite 500
Denver, CO 80203-2466
(303) 312-6155
(CO,MT,ND,SD,UT,WY)

Region 5

Charles Pyca
Environmental Protection Agency
77 West Jackson Boulevard
Chicago, IL 60604-3507
(312) 886-0259
(IL,IN,MI,MN,OH,WI)

Region 9

Loretta Vanegas
Environmental Protection Agency
Water Management Division
75 Hawthorne Street
San Francisco, CA
(415) 744-2125
(AZ,CA,HI,NV,TT)

Region 10

Judy Fey
Environmental Protection Agency
Water Management Division
1200 Sixth Avenue
Seattle, WA 98101
(206) 553-1302

(AK, ID, OR, WA)

Financial Assistance - Publications

Selected Financial Assistance Publications
Catalog of Publications for Financial Assistance
Ordering Information

Financial Assistance - Guidance

Interim Guidance Issued for the Drinking Water State Revolving Fund

The Clean Water State Revolving Fund Funding Framework Policy and Guidance Document

Financial Assistance - Contacts

State Revolving Fund State Contacts

Regional Office Indian Set Aside Coordinators

Hardship Grant Program for Rural Communities Program Contacts

Financial Assistance - Frequently Asked Questions

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This page last updated on May 26, 1998
http://www.epa.gov/owm/finan.htm

Weeden Foundation

747 Third Avenue, 34th Floor
New York, New York 10017
Tel: 212-888-1672 Fax: 212-888-1354
E-mail: weeden@igc.org
Website: http://www.weedenfdn.org
EIN: 946109313 Type: Independent
EGA member
Contact: James N. Sheldon, Executive Director

History and philosophy. The Weeden Foundation was established in 1963. The founder, Frank Weeden (d. 1984), was concerned about mankind's overuse and mindless destruction of the natural resource base and the population growth which helps fuel such abuse. He was particularly concerned about the consequences of increasing pressures on the biological diversity of the Earth through destruction of environmentally significant habitat. Almost all foundation grants are awarded for either environmental or population purposes. In 1996 the foundation announced the creation of the Coalition for United States Population Stabilization (C.U.S.P.S.), a joint effort with various other foundations and organizations to address U.S. overpopulation.

Officers and directors. *Officers:* Alan N. Weeden, President; William Weeden, M.D., Vice President; John Weeden, Secretary/Treasurer. *Directors:* Elizabeth Weeden Barek, David Davies, Alan N. Weeden, Donald E. Weeden, John D. Weeden, Leslie Weeden, Norman Weeden, William F. Weeden, M.D.

Financial data. Data for fiscal year ended June 30, 1996. *Assets:* $24,529,432 (M). *Total grants disbursed:* $1,466,100.

Environmental awards. *Program and interests:* Interests include:

- Population and environment.
- Biodiversity.
- Ecosystem protection.
- Natural resource conservation.
- Rainforest and habitat protection.
- Wilderness.

Issues.	*Cli*	*Bio*	*Lan*	*Agr*	*Wat*	*Oce*	*Ene*	*Was*	*Tax*	*Pop*	*Dev*
		•	•		•	•		•		•	•

Activities.	*Adv*	*Dir*	*Edu*	*Lit*	*Med*	*Pol*	*Res*
	•	•		•	•		

Funding analysis.*

Fiscal year:	1994	1995
Env grants disb:	$964,225	$734,500
Number:	64	51
Range:	$3,000-$100,000	$5,000-$50,000
Median:	$10,000	$10,000
Pct $ disb (env/total):	62	44

Recipients (1995 highest):	*Number:*	*Dollars:*
The Nature Conservancy California Regional Office	1	50,000
Worldwatch Institute	1	50,000
Ecologically Sustainable Development (ESD)	1	30,000
Population-Environment Balance, Inc.	1	30,000
American Bird Conservancy	1	25,000

Activity regions (1995 highest):	*Number:*	*Dollars:*
U.S. not specified	14	175,000
U.S. West	5	110,000
Andean Region and Southern Cone	8	85,000
International	2	65,000
International multiple regions	3	60,000

*Does not include trustee-initiated grants.

Sample grants (1995).
American Bird Conservancy. Washington, DC. $25,000. For conservation of wild birds and their habitats throughout the Americas.
Cheetah Conservation Fund. Elandsvreugde, Namibia. $10,000. To preserve and protect the cheetah in Namibia and other African habitats.
Environmental Information Center. Washington, DC. $15,000. For the Endangered Species Protection Public Education Campaign.
Fundacion Jatun Sacha. Quito, Ecuador. $10,000. For the Bilsa Biological Station Reserve and the conservation of the remaining unprotected Mache-Chindul forest in western Ecuador.
Idaho Sporting Congress. Boise, ID. $5,000. To respond to the destructive effects of the salvage logging rider in the 1995 Rescission Bill.
LightHawk. Santa Fe, NM. $10,000. For the Temperate Forest Conservation program in Chile.
National Forest Protection Campaign. Washington, DC. $20,000. To defend national forest protection laws and policies by enhancing and coordinating the existing efforts of conservation organizations.
The Nature Conservancy, California Regional Office. San Francisco, CA. $50,000. To assist with the acquisition of the Valensin Ranch, located a few miles north of the Cosumnes River Preserve.
Northwest Environment Watch. Seattle, WA. $10,000. Research and dissemination of a publication on the issue of population.
River Network. Portland, OR. $10,000. For the Watershed 2000 plan which seeks to initiate citizen watershed councils in each of the nation's 2,000 major watersheds by the year 2020.
Russian Conservation News. Dingman's Ferry, PA. $10,000. For publication of a quarterly, English-language journal intended to inform individuals and organizations in the West about conservation issues in Russia.
Save America's Forests. Washington, DC. $10,000. To influence the federal forest policy debate and to coalesce a movement of forest activists, businesses, and citizens.
Wood Reduction Clearinghouse. San Francisco, CA. $10,000. To promote a reduction in U.S. wood use as a demand-side strategy to protect remaining forests.
Worldwatch Institute. Washington, DC. $50,000. To raise awareness of pressing global environmental and population issues.

Application process. *Initial contact:* Written request describing grant purpose. Shorter descriptions are preferred. Include:
1. Annual report with financial statements (preferably audited).
2. List of board of directors and their affiliations.
3. IRS tax-exempt status determination letter or an equivalency form for non-U.S. based organizations.
4. Project and organizational budget.
5. Other sources of support (past, present, and anticipated).
6. Qualifications of key personnel.

Foundation will contact applicant if it is interested or needs more detailed information.
When to apply: Deadlines are generally in February, May, August, and November. The board of directors meet four times a year, in early March, June, September, and December. For consideration at a particular board meeting, proposal must be received six weeks in advance. Call or e-mail for specific deadlines.
Materials available: Annual report (includes "Guidelines for Grant Applications.")

Emphases. *Recipients:* Nonprofit organizations.
Activities: Advocacy, demonstration programs, innovative programs, land acquisition, litigation, media projects.
Types of support: General purposes, projects, seed money.
Geography: Central Siberia, Latin America, Western North America.

Limitations. *Recipients:* Individuals.
Activities: Audiovisual materials, conferences, exhibits, expeditions/tours, research, seminars, symposia/colloquia.
Types of support: Emergency funding, endowments, equipment, fellowships, internships, lectureships, professorships, scholarships.

WILDLIFE FOREVER
Research, Habitat and Education Grants

Wildlife Forever is a private, non-profit grant-making organization funded by the North American Outdoor Group, a multi-media association consisting of two of the largest groups of sportsmen and women: the North American Fishing Clubs and the North American Hunting Clubs, with a combined membership of about one million. The mission is to preserve America's wildlife heritage through preservation, conservation, and management of habitat, plant life, and wildlife. Funding is available to conservation groups, state game and fish departments and federal agencies.

Wildlife Forever favors supporting projects in the following areas:

- Enhancing wildlife and fish populations through acquisition, research and management
- Conserving and enhancing wildlife and aquatic habitat
- Promoting wildlife and fish habitat and quality
- Watchable Wildlife related projects

No salaries or overhead will be funded. At least a 50 percent match to the grant funds is expected.

Application Forms: Andrea Stoffregen
Wildlife Forever
12301 Whitewater Drive, Suite 210
Minnetonka, MN 55343
(612) 936-0605

Size of Grants: Average $5,000 to $10,000

Proposals Due: January 1, July 1

LAND MANAGEMENT RECOMMENDATIONS

- IMPLEMENT PRESCRIPTIVE GRAZING PRACTICES, INCLUDING FENCING FOR PROTECTION OF RIPARIAN CORRIDORS AND PRIME WETLANDS
- DEVELOP AND IMPLEMENT A WEED MANAGEMENT PLAN
- REMOVE RUSSIAN OLIVE TREES
- REVEGETATE AS NEEDED AND DIVERSIFY WITH NATIVE SPECIES
- ASSESS CREEK CORRIDORS FOR POTENTIAL DUMP SITES
- SURVEY FOR THREATENED AND ENDANGERED SPECIES
- MONITOR BEAVER ACTIVITY IMPACTS TO STREAM RESTORATION EFFORTS
- MONITOR STREAM RESTORATION AND OVERALL ECOLOGICAL VITALITY, DIVERSITY, AND SUCCESSION
- MAINTAIN AGRICULTURAL LAND USE AS FEASIBLE
- RESTRICT PUBLIC ACCESS AT EXISTING OIL & GAS FACILITY ACCESS ROADS, EXCEPT AS NOTED