

A Natural Heritage Assessment of Wetlands and Riparian Areas in Summit County, Colorado 1997 Final Report



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1997 Final Report**

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December 1997**

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USER'S GUIDE

The Summit County Conservation Inventory conducted by the Colorado Natural Heritage Program consists of two essentially distinct projects that are highly integrated with respect to methodology, field work, and coordination with Summit County government. This report reflects the separate nature of the projects by being organized in a two volume set. Both projects utilized the same Natural Heritage methodology that is used throughout North America, and both searched for and assessed the plants, animals, and plant communities on the Colorado Natural Heritage Program's List of rare and imperiled elements of biodiversity. Each volume prioritizes potential conservation sites based on the relative significance of the biodiversity they support and the urgency for protection of the site. All information explaining Natural Heritage methodology and ranks is repeated in each volume, so that each volume can stand alone and be used independently of the other.

Volume I presents *all* potential conservation sites identified in Summit County that support rare and imperiled plants, animals, and significant plant communities, including wetland and riparian areas. Volume II focuses exclusively on wetland and riparian areas. Volume II also presents "locally significant areas." These are sites that are among the most important wetlands in Summit County, but they are not unique from a national or statewide perspective, therefore these sites did not receive a Biodiversity Rank. Additionally, Volume II presents an assessment of the wetland functions performed by each site that was surveyed. These functional assessments are intended to provide the user with a more complete picture of the value wetlands and riparian areas provide to Summit County residents.

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TABLE OF CONTENTS

USER'S GUIDE	I
ACKNOWLEDGMENTS	II
TABLE OF CONTENTS	III
LIST OF FIGURES	VIII
EXECUTIVE SUMMARY	1
RECOMMENDATIONS.....	3
PROJECT BACKGROUND AND PURPOSE	4
Study Area	5
THE NATURAL HERITAGE NETWORK AND BIODIVERSITY	6
What is Biological Diversity?.....	7
Colorado's Natural Heritage Program	8
The Natural Heritage Ranking System	9
Protection Urgency Ranks	11
Management Urgency Ranks.....	11
Element Occurrence Ranking	12
Proposed Conservation Sites	13
Proposed Conservation Planning Boundaries.....	13
Off-Site Considerations	14
Ranking of Proposed Conservation Sites.....	15
Legal Designations	15
WETLAND DEFINITIONS AND REGULATIONS	17
Wetland Definitions.....	17
Wetland Function and Values.....	18
Wetland Regulation in Summit County and throughout Colorado.....	19
METHODS	21
Survey Site Selection	21
Site Assessment	21
Plant Communities.....	23

WETLAND FUNCTIONS AND VALUES	24
Ground Water Recharge and Discharge	24
Flood Storage	25
Shoreline Anchoring	25
Sediment Trapping	25
Long and Short Term Nutrient Removal	25
Production Export (Downstream and Within Food Chain Support)	26
Habitat	26
Recreation (Active and Passive)	27
Uniqueness/Heritage Value	27
HYDROGEOMORPHIC (HGM) APPROACH TO WETLAND FUNCTION	
ASSESSMENT	28
RESULTS SUMMIT COUNTY SITES OF BIODIVERSITY SIGNIFICANCE	30
UPPER BLUE RIVER BASIN	33
Blue Lakes	34
Cucumber Gulch	41
Blue River at McCullough Gulch	46
Goose Pasture Wetland	51
Muggins Gulch	56
Upper French Gulch	61
AREAS OF LOCAL SIGNIFICANCE	66
Blue River Arm at Dillon Reservoir	67
Braddock Flats	70
Hoosier Creek	73
Indiana Creek	76
Quandry Peak/Bemrose Subdivision	79
Whatley Ranch	82
LOWER BLUE RIVER BASIN	85
Horse Creek	86
Cataract Creek	91
Otter Creek	96
Pass Creek	101
Slate Creek	106
Spruce Creek	111
Blue River-North of Silverthorne	116
Bushee Creek	123
Triple Creek Ranch	128
AREAS OF LOCAL SIGNIFICANCE	133
Brush Creek	134
Columbine Wetland	137
Silverthorne Wetland	140

Willow Creek at Silverthorne	143
SNAKE RIVER BASIN.....	146
Dillon Bay	147
Montezuma	152
Peru Creek.....	159
Soda Springs	164
AREAS OF LOCAL SIGNIFICANCE.....	168
Caravail at Keystone	169
Soda Creek at Summit Cove	172
TENMILE BASIN	175
Meadow Creek	176
Clinton Creek	183
AREA OF LOCAL SIGNIFICANCE	188
Union Gulch at Copper Mountain	189
FUNCTION AND VALUE ASSESSMENT RESULTS	192
SIGNIFICANT KNOWN AND POTENTIAL WETLAND ELEMENTS IN SUMMIT COUNTY	207
Wetland and Riparian Plant Associations in Summit County	207
Rare or Imperiled Wetland Plants in Summit County Wetlands	209
Rare or Imperiled Amphibian Associated with Summit County Wetlands	210
Rare or Imperiled Fish Associated with Summit County Wetlands	211
Rare or Imperiled Birds Associated with Summit County Wetlands	212
Rare or Imperiled Mammals Associated with Summit County Wetlands	213
WETLAND PLANT ASSOCIATIONS	215
PALUSTRINE FORESTED COMMUNITIES--BROAD-LEAVED DECIDUOUS	216
Narrowleaf cottonwood/thinleaf alder (<i>Populus angustifolia/Alnus incana</i>) plant association.....	216
Narrowleaf cottonwood-Colorado blue spruce/thinleaf alder (<i>Populus angustifolia-Picea pungens/Alnus incana</i>) plant association.....	219
Quaking aspen/tall forb (<i>Populus tremuloides/tall forb</i>) plant association	224
PALUSTRINE SCRUB-SHRUB COMMUNITIES--BROAD-LEAVED DECIDUOUS ...	227
Bog birch/mesic forb-mesic graminoid (<i>Betula glandulosa/mesic forb-mesic graminoid</i>) plant association.....	227

Barrenground willow/mesic forb (<i>Salix brachycarpa</i> /mesic forb) plant association	230
Drummond willow-beaked sedge (<i>Salix drummondiana</i> / <i>Carex utriculata</i>) plant association	232
Drummond willow/mesic forb (<i>Salix drummondiana</i> /mesic forb) plant association	235
Geyer willow-mountain willow/bluejoint reedgrass (<i>Salix geyeriana</i> - <i>Salix monticola</i> / <i>Calamagrostis canadensis</i>) plant association	238
Geyer willow/aquatic sedge (<i>Salix geyeriana</i> / <i>Carex aquatilis</i>) plant association	242
Geyer's willow/beaked sedge (<i>Salix geyeriana</i> / <i>Carex utriculata</i>) plant association	246
Geyer's willow-mountain willow/mesic forb (<i>Salix geyeriana</i> - <i>Salix monticola</i> /mesic forb) plant association	250
Mountain willow/bluejoint reedgrass (<i>Salix monticola</i> / <i>Calamagrostis canadensis</i>) plant association	254
Mountain willow/mesic graminoid (<i>Salix monticola</i> /mesic graminoid) plant association	258
Planeleaf willow/bluejoint reedgrass (<i>Salix planifolia</i> / <i>Calamagrostis canadensis</i>) plant association	261
Planeleaf willow/marsh marigold (<i>Salix planifolia</i> / <i>Caltha leptosepala</i>) plant association	264
Planeleaf willow/aquatic sedge (<i>Salix planifolia</i> / <i>Carex aquatilis</i>) plant association	268
Wolf willow/aquatic sedge (<i>Salix wolfii</i> / <i>Carex aquatilis</i>) plant association	272
PALUSTRINE SCRUB-SHRUB COMMUNITY--DECIDUOUS	276
Shrubby cinquefoil/tufted hairgrass (<i>Pentaphylloides floribunda</i> / <i>Deschampsia cespitosa</i>) plant association	276
PALUSTRINE EMERGENT COMMUNITIES--PERSISTENT	278
Clustered sedge (<i>Carex praegracilis</i>) wetland	278
Tufted hairgrass (<i>Deschampsia cespitosa</i>) plant association	280
PALUSTRINE AQUATIC BED COMMUNITIES--ROOTED VASCULAR.....	283
American milfoil (<i>Myriophyllum exalbescens</i>) plant association	283
Rocky Mountain pond lily (<i>Nuphar luteum</i> ssp. <i>polysepalum</i>) plant association	285
Pondweed (<i>Potamogeton natans</i>) plant association	287
LITERATURE CITED	288
APPENDIX A—EXAMPLES OF FIELD FORMS.....	297

LIST OF TABLES

Table 1. Definition of Colorado Natural Heritage Imperilment Ranks.	10
Table 2. Federal and State Agency Special Designations.	16
Table 3. Hydrogeomorphic wetland classes in Summit County.	29
Table 4. Sites of Biodiversity Significance sites in Summit County, arranged by basin and biodiversity rank (B-rank).	30
Table 5. Summary of function and value assessment for the wet meadow mapping unit.	193
Table 6. Summary of function and value assessment for the mesic meadow mapping unit.	194
Table 7. Summary of function and value assessment for the irrigated meadow mapping unit.	195
Table 8. Summary of function and value assessment for the willow mapping unit.	196
Table 9. Summary of function and value assessment for the low willow mapping unit.	197
Table 10. Summary of function and value assessment for the willow/wet meadow mapping unit.	198
Table 11. Summary of functions and value assessment for the low willow/wet meadow mapping unit.	199
Table 12. Summary of functions and value assessment for the cottonwood mapping unit.	200
Table 13. Summary of function and value assessment for the spruce mapping unit.	201
Table 14. Summary of function and value assessment for the mixed riparian mapping unit.	202
Table 15. Summary of function and value assessment for alpine willow/rock complex mapping.	203
Table 16. Summary of function and value assessment for assessment for water mapping unit.	204
Table 17. Summit County wetlands that performed 3 or more functions to a high or very high degree.	205
Table 18. Summit County wetlands that performed at least 1 function to a high degree.	206
Table 19. Summit County wetlands that do not perform any function to a high degree.	206
Table 20. Riparian and wetland plant communities in Summit County.	208
Table 21. Rare or imperiled wetland plants associated with Summit County.	210
Table 22. Rare or imperiled amphibian associated with Summit County wetlands.	211
Table 23. Rare or imperiled fish associated with Summit County wetlands.	212
Table 24. Rare or imperiled birds associated with Summit County wetlands.	213
Table 25. Rare or imperiled mammal associated with Summit County wetlands.	214

LIST OF FIGURES

Figure 1. Map of Summit County's Sites of Biodiversity Significance.	31
Figure 2. Average of function ranks for wet meadow mapping unit.	193
Figure 3. Average of function ranks for mesic meadow mapping unit.	194
Figure 4. Average of function ranks for irrigated meadow mapping unit.	195
Figure 5. Average of function ranks for willow mapping unit.	196
Figure 6. Average of function ranks for low willow mapping unit.	197
Figure 7. Average of function ranks for the willow/wet meadow mapping unit.	198
Figure 8. Average of function ranks for the low willow/wet meadow mapping unit.	199
Figure 9. Average of function ranks for cottonwood mapping unit.	200
Figure 10. Average of function ranks for spruce mapping unit.	201
Figure 11. Average of function ranks for mixed riparian mapping unit.	202
Figure 12. Average of function ranks for alpine willow/rock complex mapping unit.	203
Figure 13. Average of function ranks for water mapping unit.	204

EXECUTIVE SUMMARY

Summit County contains a diverse array of wetlands which support a wide variety of plants, animals, and plant communities. At least 10 plants, 4 birds, 1 fish, 1 amphibian, 2 mammals, and 24 major wetland/riparian plant communities from the Colorado Natural Heritage Program's (CNHP's) list of rare and imperiled plants, animals, and plant communities are known to occur in or are associated with Summit County wetlands. In addition to their biological significance, these wetlands perform many functions that provide value to the residents of the county and the communities down river. Summit County wetlands maintain water quality, provide wildlife habitat, provide recreational opportunities, and add to the aesthetic quality of the county.

In 1996, CNHP received funding to inventory wetland areas within Summit County jurisdiction excluding federal and state lands. The funding for this project was provided by the U.S. Environmental Protection Agency to the Colorado Department of Natural Resources, which selects projects and administers funding. The purpose of the funding is to provide local planners, resource managers, and citizens with information on the status and value of their riparian and wetland areas.

This report presents the results of a comprehensive wetland survey designed to better understand the types of wetlands which occur in Summit County, along with their distribution and their natural heritage value. In 1996, Summit County hired White Horse Associates and Natural Resource Consulting to map wetland vegetation types on private lands using aerial photography. Thirteen mapping units were derived from the vegetation types. Mylar overlays which delineated each mapping unit type were produced for the 7.5 minute quadrangles covering Summit County. CNHP selected a representative number of the mapping units, within a range of elevations and locations, to survey during the 1997 field season. Each mapping unit was then characterized in terms of plant associations, hydrology, and wetland class. CNHP initially identified 85 wetlands which merited inventory. A low-altitude flight over the county and roadside assessments allowed CNHP to prioritize the number of sites that required actual on-site inventory. Wetlands heavily impacted by roads, buildings, weeds, agriculture, or grazing were eliminated from the inventory.

A function and value assessment was conducted to provide finer details for each mapping unit. The function and value assessment is based on Cooper (1988), which employs a modified version of the methodology known as Wetland Evaluation Technique (WET) (Adamus et al. 1991). This technique is a broad-brush approach to wetland evaluation, and is based on information derived from predictors of wetland functions which can be gathered relatively quickly. It can be used to compare ratings of a wetland for future uses in management and planning.

There were a total of 38 function and value assessments performed at 34 locations on private lands within Summit County. Twenty six of those wetlands performed three or more functions to a high degree, seven wetlands performed at least one function highly, and five wetlands did not perform any functions to a high degree.

Twenty one wetland and riparian sites are profiled in this report. Three of these sites support breeding occurrences for the globally imperiled southern Rocky Mountain boreal toad (*Bufo boreas boreas*). These sites also represent the best examples of 24 wetland and riparian communities observed on private lands. CNHP believes these sites include those wetlands that most merit conservation efforts, while emphasizing that protecting only these sites will, in no way, adequately protect all the values associated with Summit County wetlands. Additionally, 12 areas of local significance have been identified based on the local importance of their functions and values within Summit County.

Recommendations for a comprehensive approach to wetland conservation in Summit County are presented. Rapid growth throughout much of the county continues to pose a threat to wetlands through encroachment, fragmentation, altered hydrology, and weed introduction. Historically, one of the most profound impacts on Colorado's wetlands have been changes in hydrology imposed by reservoirs, diversion, irrigation ditches, canals, and ground water pumping. As water becomes an increasingly valuable commodity in north central Colorado, more changes of this type are anticipated.

In addition to providing important information for Summit County, this inventory will advance efforts to evaluate and manage wetlands on state and regional levels. Wetland plant community information gathered during this project is being assimilated into *A Preliminary Vegetation Classification of the Western United States* (Bourgeron and Engelking 1994) currently being compiled and updated by The Nature Conservancy and the Colorado Natural Heritage Program. Policy makers, land use planners, and resource managers can use information in the classification to make informed decisions governing the use and conservation of natural heritage resources.

Information from this effort will also be used to enhance the development of a program for hydrogeomorphic (HGM) wetland function assessment. This report can be used to help identify wetland subclasses in the area, and to better characterize the range of variation within a subclass. Several of the sites profiled in this report have the potential for use as reference sites, or to be part of the reference standard.

RECOMMENDATIONS

- 1 **Develop and implement a plan for protecting the proposed conservation sites profiled in this report.** Strong consideration should be given to protecting sites with global and state-wide significance as indicated by Biodiversity (B) Rank (B1=highest priority, B5=lowest priority) Protection priority should then be give to “locally significant areas”. These sites provide Summit County with the basic framework to implement a wetland conservation program.
2. **Treat all the sites included in this report as “red flags” when considering proposals for commercial and residential land use changes.** Wetlands with significant natural heritage elements generally require a buffer from development of at least 300 feet, extending up to 1,000 feet (in the case of the Colorado River cutthroat trout and the southern Rocky Mountain boreal toad).
3. **Consider the effects on wetlands, especially the significant wetlands identified in this report, when evaluating proposals for water diversions, extensive development within a watershed, ground water development, and other activities potentially affecting wetlands.** Hydrology defines wetlands, and wetlands can often be affected by changes in hydrology far from their boundaries. Changes in water quality and quantity must be considered in planning for protection of significant wetlands of Summit County.
4. **Develop and implement a county-wide wetland conservation program.** Use the U.S. Fish and Wildlife Service definition of wetlands, the White Horse Associates and Natural Resource Consulting inventory maps, and this report to guide this program. Develop a system of buffers, while recognizing that some wetlands, such as those with natural heritage significance, require buffers larger than most.
5. **Prohibit the introduction, sale, and planting of plants that are known to negatively and profoundly affect wetlands and riparian areas.** These include, but are not limited to; wild chamomile, crack willow, purple loosestrife, and Russian olive. Encourage land managers and others to remove these plants from their properties.
6. **Encourage and support statewide wetland protection efforts.** County government is encouraged to support research efforts on wetlands. County-wide education of the importance of wetlands could be implemented through the county extension service or other local agencies. Cultivate communication and cooperation with landowners regarding protection of wetlands in Summit County.

PROJECT BACKGROUND AND PURPOSE

Wetlands are places where soils are inundated or saturated with water long enough and frequently enough to significantly affect the plants and animals that live and grow there. Until recently, most people viewed wetlands as a hindrance to productive land use. As a result, many wetlands across North America were purposefully and unintentionally destroyed. Kelly et al. (1993) state that wetlands in the United States are being lost at a rate of 260,000 acres/year (105,218 ha/year). In Colorado an estimated 1 million acres of wetlands (50% of the total for the state) were lost prior to 1980 (Dahl 1990).

Although the rate of wetland loss in Summit County is difficult to quantify, it is clear that many of the county's wetlands, especially around urban area and along the Blue River, have been destroyed or profoundly altered from their pre-settlement state, especially from gold dredging operations. Agriculture, grazing, development, reservoirs, and water diversions have had tremendous impacts on wetlands throughout the county. Fertile soils and available water for irrigation attract agriculture to floodplains. Since the nineteenth century hydrological diversions developed for irrigation, recreation, and drinking water supplies, have removed water from some wetlands, and created other wetlands very different from those present prior to European settlement. For example, in the urban area, residential and commercial development has profoundly affected the large willow community associated with the Blue River and its tributaries. It is clear that with the current rate of land use conversion in the county and the lack of comprehensive wetland protection programs, wetlands will continue to be lost or dramatically altered.

Increasingly, local Colorado governments, particularly in rapidly growing parts of the state, are expressing a desire to better understand their natural heritage resources, including wetlands. The Colorado Natural Heritage Program (CNHP) approached this project with the intent of addressing this desire.

The primary goal of this project was to identify significant wetlands within Summit County (excluding state and federal lands). In order to do this, CNHP determined which wetlands in the county support rare and imperiled plants, animals, and significant plant communities. To supplement the biological information, CNHP also assessed all the other functions and values attributed to each wetland. The second goal of this project was to facilitate better understanding of the wetlands that occur in Summit County, and thus, extend overall knowledge of Colorado wetlands.

Study Area

Summit County straddles the west flank of the Continental Divide and is approximately 396,036 acres. Private lands comprise about 110,890 acres (28%) of Summit (Summit County Planning Department pers. comm. 1997). Most private lands are along the major stream corridors in the valleys. The majority of remaining lands is managed by the U.S. Forest Service. Elevations range from 2274 m (7,580 ft), where the Blue River leaves Summit County, to 4280 m (14,265 ft) on Quandary Peak. More than 85% of the county is above 9,000 feet (White Horse Associates and Natural Resource Consulting 1996). Summit County is located in the north central portion of Colorado and lies within the North-Central Highlands and Rocky Mountain section (Bailey et al. 1994). Summit County is bordered to the northwest by the Gore Range, the Tenmile to the west, Hoosier Pass and Loveland Pass lie on the continental divide which forms the county line to the south and east, and the Williams Fork Mountains border to the northeast. The Blue River and its major tributaries (Swan River, Snake River, and Tenmile Creek) drain the majority of Summit County. Three major reservoirs (Blue Lakes, Dillon Lake, and Green Mountain) influence the Blue River and its associated wetlands.

The climate is generally characterized by long, cold, moist winters, and short, cool, dry summers. Dillon, where climate data are recorded, receives approximately 41.58 cm (16.37 in.) of precipitation each year. Average minimum and maximum temperatures are, respectively, -7.9⁰ C (17.7⁰ F) and 11.0⁰ C (51.8⁰ F). The average total snow fall is 334.8 cm (131.8 in.) (Western Regional Climate Center 1997). The geology of Summit County is complex, as evidenced by the Geological Map of Colorado (Tweto 1979). The Williams Fork Mountains, Gore Range and the Tenmile Range consist of Precambrian granitic rocks with several faults (Tweto 1979). The lower Blue Valley at the base of the Williams Fork Mountains consists of Pierre Shale. There are outcrops of Dakota sandstone near the Dillon Dam. The Blue River Valley was glacially created as evidenced by the numerous boulder-strewn moraines (Chronic 1980).

Typical southern Rocky Mountain flora is prevalent in Summit County. Elevations at 2274 m (7,580 ft) are dominated by *Amelanchier alnifolia* (service berry), *Artemisia tridentata* ssp. *vaseyana* (mountain sagebrush) and *Symphoricarpos rotundifolius* (snowberry). At these elevations, wetlands occur in riparian areas on floodplains and in beaver ponds. These wetlands are dominated by *Salix* spp. (willows), *Populus angustifolia* (narrowleaf cottonwood), *Picea pungens* (Colorado blue spruce) and *Alnus incana* (thinleaf alder). Other wetlands within this elevation range include seeps supported by groundwater discharge. These wetlands are dominated by beaked sedge (*Carex utriculata*) and clustered sedge (*Carex praegracilis*).

Above 2400 m (8,000 ft), *Populus tremuloides* (quaking aspen), *Pinus contorta* (lodgepole pine), *Pseudotsuga menziesii* (Douglas fir), and *Picea engelmannii* (Engelmann spruce) dominate. In the elevational zone between 3000 m to 4200 m (10,000 to 12,000 ft) *Picea engelmannii* (Engelmann spruce), *Abies lasiocarpa* (subalpine fir), *Salix brachycarpa* (short-fruit willow), and *Salix planifolia* (planeleaf willow) occur.

THE NATURAL HERITAGE NETWORK AND BIODIVERSITY

Colorado is well known for its rich diversity of geography, wildlife, plants, and plant communities. However, like many other states, it is experiencing a loss of much of its flora and fauna. This decline in biodiversity is a global trend resulting from human population growth, land development, and subsequent habitat loss. Globally, the loss in species diversity has become so rapid and severe that Wilson (1988) has compared the phenomenon to the great natural catastrophes at the end of the Paleozoic and Mesozoic eras.

The need to address this loss in biodiversity has been recognized for decades in the scientific community. However, many conservation efforts made in this country were not based upon preserving biodiversity; instead, they primarily focused on preserving game animals, striking scenery, and locally favorite open spaces. To address the absence of a methodical, scientifically-based approach to preserving biodiversity, Robert Jenkins, in association with The Nature Conservancy, developed the Natural Heritage Methodology in 1978.

Recognizing that rare and imperiled species are more likely to become extinct than common ones, the Natural Heritage Methodology ranks species according to their rarity or degree of imperilment. The ranking system is scientifically based upon the number of known locations of the species as well as its biology and known threats. By ranking the relative rareness or imperilment of a species, the quality of its populations, and the importance of associated proposed conservation sites, the methodology can facilitate in prioritizing conservation efforts so the most rare and imperiled species may be preserved first. As the scientific community began to realize that plant communities are equally important as individual species, this methodology has also been applied to ranking and preserving rare plant communities as well as the best examples of common communities.

The Natural Heritage Methodology is used by Natural Heritage Programs throughout North, Central, and South America, forming an international database network. Natural Heritage Network data centers are located in each of the 50 U.S. states, five provinces of Canada, and 13 countries in South and Central America and the Caribbean. This network enables scientists to monitor the status of species from a state, national, and global perspective. It also enables conservationists and natural resource managers to make informed, objective decisions in prioritizing and focusing conservation efforts.

What is Biological Diversity?

Protecting biological diversity has become an important management issue for many natural resource professionals. Biological diversity at its most basic level includes the full range of species on Earth, from species such as bacteria and protists, through multicellular kingdoms of plants, animals, and fungi. At finer levels of organization, biological diversity includes the genetic variation within species, both among geographically separated populations and among individuals within a single population. On a wider scale, diversity includes variations in the biological communities in which species live, the ecosystems in which communities exist, and the interactions among these levels. All levels are necessary for the continued survival of species and plant communities, and all are important for the well-being of humans. It stands to reason that biological diversity should be of concern to all people.

The biological diversity of an area can be described at four levels:

1. **Genetic Diversity** -- the genetic variation within a population and among populations of a plant or animal species. The genetic makeup of a species is variable between populations within its geographic range. Loss of a population results in a loss of genetic diversity for that species and a reduction of total biological diversity for the region. This unique genetic information cannot be reclaimed.
2. **Species Diversity** -- the total number and abundance of plant and animal species and subspecies in an area.
3. **Community Diversity** -- the variety of natural communities within an area that represent the range of species relationships and inter-dependence. These communities may be diagnostic or even endemic to an area. It is within communities that all life dwells.
4. **Landscape Diversity** -- the type, condition, pattern, and connectedness of natural communities. A landscape consisting of a mosaic of natural communities may contain one multifaceted ecosystem, such as a wetland ecosystem. A landscape also may contain several distinct ecosystems, such as a riparian corridor meandering through shortgrass prairie. Fragmentation of landscapes, loss of connections and migratory corridors, and loss of natural communities all result in a loss of biological diversity for a region. Humans and the results of their activities are integral parts of most landscapes.

The conservation of biological diversity must include all levels of diversity: genetic, species, community, and landscape. Each level is dependent on the other levels and inextricably linked. In addition, and all too often omitted, humans are also linked to all levels of this hierarchy. We at the Colorado Natural Heritage Program believe that a healthy natural environment and human environment go hand in hand, and that recognition of the most imperiled elements is an important step in comprehensive conservation planning.

Colorado's Natural Heritage Program

To place this document in context, it is useful to understand the history and functions of the Colorado Natural Heritage Program (CNHP). CNHP is the state's primary comprehensive biological diversity data center, gathering information and field observations to help develop statewide conservation priorities. After operating in Colorado for 14 years, the Program was relocated from the State Division of Parks and Outdoor Recreation to the University of Colorado Museum in 1992, and more recently to the College of Natural Resources at Colorado State University.

The multi-disciplinary team of scientists and information managers gathers comprehensive information on rare, threatened, and endangered species and significant plant communities of Colorado. Life history, status, and locational data are incorporated into a continually updated data system. Sources include published and unpublished literature, museum and herbaria labels, and field surveys conducted by knowledgeable naturalists, experts, agency personnel, and our own staff of botanists, ecologists, and zoologists. Information management staff carefully plot the data on 1:24,000 scale USGS maps and enter it into the Biological and Conservation Data System. The Element Occurrence database can be accessed from a variety of angles, including taxonomic group, global and state rarity rank, federal and state legal status, source, observation date, county, quadrangle map, watershed, management area, township, range, and section, precision, and conservation unit.

CNHP is part of an international network of conservation data centers that use the Biological and Conservation Data System developed by The Nature Conservancy. CNHP has effective relationships with several state and federal agencies, including the Colorado Natural Areas Program, Colorado Department of Natural Resources and the Colorado Division of Wildlife, the U.S. Environmental Protection Agency, and the U.S. Forest Service. Numerous local governments and private entities also work closely with CNHP. Use of the data by many different individuals and organizations, including Great Outdoors! Colorado, encourages a proactive approach to development and conservation thereby reducing the potential for conflict. Information collected by the Natural Heritage Programs around the globe provides a means to protect species before the need for legal endangerment status arises.

Concentrating on site-specific data for each element of natural diversity allows us to evaluate the significance of each location to the conservation of Colorado's, and indeed the nation's, natural biological diversity. By using species imperilment ranks and quality ratings for each location, priorities can be established for the protection of the most sensitive or imperiled sites. A continually updated locational database and priority-setting system such as that maintained by CNHP provides an effective, proactive land-planning tool.

The Natural Heritage Ranking System

Information is gathered by CNHP on Colorado's plants, animals, and plant communities. Each of these species and plant communities is considered an **element of natural diversity**, or simply an **element**. Each element is assigned a rank that indicates its relative degree of imperilment on a five-point scale (e.g., 1 = extremely rare/imperiled, 5 = abundant/secure). The primary criterion for ranking elements is the number of occurrences, i.e., the number of known distinct localities or populations. This factor is weighted more heavily because an element found in one place is more imperiled than something found in twenty-one places. Also of importance are the size of the geographic range, the number of individuals, trends in both population and distribution, identifiable threats, and the number of already protected occurrences.

Element imperilment ranks are assigned both in terms of the element's degree of imperilment within Colorado (its State or S-rank) and the element's imperilment over its entire range (its Global or G-rank). Taken together, these two ranks give an instant picture of the degree of imperilment of an element. CNHP actively collects, maps, and electronically processes specific occurrence information for elements considered extremely imperiled to vulnerable (S1 - S3). Those with a ranking of S3S4 are "watchlisted," meaning that specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted. A complete description of each of the Natural Heritage ranks is provided in Table 1.

This single rank system works readily for all species except those that are migratory. Those animals that migrate may spend only a portion of their life cycles within the state. In these cases, it is necessary to distinguish between breeding, non-breeding, and resident species. As noted in Table 1, ranks followed by a "B", e.g., S1B, indicate that the rank applies only to the status of breeding occurrences. Similarly, ranks followed by an "N", e.g., S4N, refer to nonbreeding status, typically during migration and winter. Elements without this notation are believed to be year-round residents within the state.

Table 1. Definition of Colorado Natural Heritage Imperilment Ranks.

Global imperilment ranks are based on the range-wide status of a species. State imperilment ranks are based on the status of a species in an individual state. State and Global ranks are denoted, respectively, with an "S" or a "G" followed by a character. These ranks should not be interpreted as legal designations.	
G/S1	Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction.
G/S2	Imperiled globally/state because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction throughout its range.
G/S3	Vulnerable through its range or found locally in a restricted range (21 to 100 occurrences).
G/S4	Apparently secure globally/state, though it might be quite rare in parts of its range, especially at the periphery.
G/S5	Demonstrably secure globally/state, 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.
G/SU	Unable to assign rank due to lack of available information.
GQ	Indicates uncertainty about taxonomic status.
G/SH	Historically known, but not verified for an extended period, usually.
G#T#	Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.
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 reliable identified, mapped, and protected.
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.
Notes: Where two numbers appear in a state or global rank (e.g., S2S3), the actual rank of the element falls between the two numbers.	

Protection Urgency Ranks

Protection urgency ranks (P-ranks) refer to the time frame in which conservation protection must occur. In most cases, this rank refers to the need for a major change of protective status (e.g., agency special area designations or ownership). The urgency for protection rating reflects the need to take legal, political, or other administrative measures to alleviate threats that are related to land ownership or designation. The following codes are used to indicate the rating which best describes the urgency to **protect** the area:

- P1 Immediately threatened by severely destructive forces, within 1 year of rank date; protect now or never!
- P2 Threat expected within 5 years.
- P3 Definable threat but not in the next 5 years.
- P4 No threat known for foreseeable future.
- P5 Land protection complete or adequate reasons exists not to protect the site; do not act on this site.

A protection action involves increasing the current level of legal protection accorded one or more tracts at a potential conservation area. It may also include activities such as educational or public relations campaigns or collaborative planning efforts with public or private entities to minimize adverse impacts to element occurrences at a site. It does not include management actions, i.e., any action requiring stewardship intervention. Threats that may require a protection action are as follows:

- 1) Anthropogenic forces that threaten the existence of one or more element occurrences at a site; e.g., development that would destroy, degrade or seriously compromise the long-term viability of an element occurrence and timber, range, recreational, or hydrologic management that is incompatible with an element occurrence's existence;
- 2) The inability to undertake a management action in the absence of a protection action; e.g., obtaining a management agreement;
- 3) In extraordinary circumstances, a prospective change in ownership management that will make future protection actions more difficult.

Management Urgency Ranks

Management urgency ranks (M-ranks) indicate the time frame in which a change in management of the element or site must occur. Using best scientific estimates, this rank refers to the need for management in contrast to protection (e.g., increased fire frequency, decreased herbivory, weed control, etc.). The urgency for management rating focuses on land use management or land stewardship action required to maintain element occurrences at the potential conservation area.

A management action may include biological management (prescribed burning, removal of exotics, mowing, etc.) or people and site management (building barriers, rerouting trails, patrolling for collectors, hunters, or trespassers, etc.). Management action does not include

legal, political, or administrative measures taken to protect a potential conservation area. The following codes are used to indicate the action needed to be taken at the area:

- M1 Management action required immediately or element occurrences could be lost or irretrievably degraded within one year.
- M2 New management action will be needed within 5 years to prevent the loss of element occurrences.
- M3 New management action will be needed within 5 years to maintain current quality of element occurrences.
- M4 Although not currently threatened, management may be needed in the future to maintain the current quality of element occurrences.
- M5 No serious management needs known or anticipated at the site.

Element Occurrence Ranking

Actual locations of elements, whether they be single organisms, populations, or plant communities, are referred to as element occurrences. The element occurrence is considered the most fundamental unit of conservation interest and is at the heart of the Natural Heritage Methodology. In order to prioritize element occurrences for a given species, an element occurrence rank (EO-Rank) is assigned according to their ecological quality whenever sufficient information is available. This ranking system is designed to indicate which occurrences are the healthiest and ecologically the most viable, thus focusing conservation efforts where they will be most successful. The EO-Rank is based on 4 factors:

- Quality** -- the representativeness of the occurrence as compared to element occurrence (EO) specifications including maturity, size, and numbers. The element occurrence specifications are set by a consensus of experts regarding the element in question;
- Condition** -- how much has the site and EO been damaged or altered from its optimal condition and character;
- Viability** -- the long-term prospects for continued existence of this occurrence;
- Defensibility** -- the extent to which the occurrence can be protected from extrinsic human factors that might otherwise degrade or destroy it.

Each of these factors are rated on a scale of A through D, with A representing an excellent grade and D representing a poor grade. These grades are then averaged to determine an appropriate EO-Rank for the occurrence. If there is insufficient information available to rank an element occurrence, an EO-Rank is not assigned. Possible EO-Ranks and their appropriate definitions are as follows:

- A** The occurrence is relatively large, pristine, defensible, and viable.
- B** The occurrence is small but in good condition, or large but removed from its natural condition and/or not viable and defensible.
- C** The occurrence is small, in poor condition, and possibly of questionable viability.
- D** The occurrence does not merit conservation efforts because it is too degraded or not viable.
- H** Historically known, but not verified for an extended period.

Proposed Conservation Sites

In order to successfully protect populations or occurrences, it is necessary to recognize proposed conservation sites. These proposed conservation sites focus on capturing the ecological processes that are necessary to support the continued existence of a particular element occurrence of natural heritage significance. Proposed conservation sites may include a single occurrence of a rare element or a suite of rare element occurrences or significant features.

The goal of the process is to identify a land area that can provide the habitat and ecological processes upon which a particular element occurrence or suite of elements occurrences depends for their continued existence. The best available knowledge of each species' life history is used in conjunction with information about topographic, geomorphic, and hydrologic features, vegetative cover, as well as current and potential land uses. The proposed boundary does not automatically exclude all activity. It is a hypothesis that some activities will prove degrading to the element or the process on which they depend, while others will not. Consideration of specific activities or land use changes proposed within or adjacent to the proposed conservation planning boundary should be carefully considered and evaluated for their consequences to the element on which the conservation unit is based.

Proposed Conservation Planning Boundaries

Once the presence of rare or imperiled species or significant natural communities has been confirmed, the first step towards their protection is the delineation of a proposed conservation planning boundary. In general, the proposed conservation planning boundary is an estimate of the landscape that supports the rare elements as well as the ecological processes that allow them

to persist. In developing such boundaries, CNHP staff considered a number of factors that include, but are not limited to:

- the extent of current and potential habitat for the elements present, considering the ecological processes necessary to maintain or improve existing conditions;
- species movement and migration corridors;
- maintenance of surface water quality within the site and the surrounding watershed;
- maintenance of the hydrologic integrity of the groundwater, e.g., by protecting recharge zones;
- land intended to buffer the site against future changes in the use of surrounding lands;
- exclusion or control of invasive exotic species;
- land necessary for management or monitoring activities.

As the label "conservation planning" indicates, the boundaries presented here are for planning purposes. They delineate ecologically sensitive areas where land-use practices should be carefully planned and managed to ensure that they are compatible with protection goals for natural heritage resources and sensitive species. All land within the conservation planning boundary should be considered an integral part of a complex economic, social, and ecological landscape that requires wise land-use planning at all levels.

Off-Site Considerations

Furthermore, it is often the case that all relevant ecological processes cannot be contained within a site of reasonable size. Taken to the extreme, the threat of ozone depletion could expand every site to include the whole globe. The boundaries illustrated in this report signify the immediate, and therefore most important, area in need of protection. Continued landscape level conservation efforts are needed. This will involve county-wide efforts as well as coordination and cooperation with private landowners, neighboring land planners, and state and federal agencies.

Ranking of Proposed Conservation Sites

One of the strongest ways that the CNHP uses element and element occurrence ranks is to assess the overall biodiversity significance of a site, which may include one or many element occurrences. Based on these ranks, each site is assigned a **biodiversity** (or B-) **rank**:

B1 Outstanding Significance: only site known for an element or an excellent occurrence of a G1 species.

B2 Very High Significance: one of the best examples of a community type, good occurrence of a G1 species, or excellent occurrence of a G2 or G3 species.

B3 High Significance: excellent example of any community type, good occurrence of a G3 species, or a large concentration of good occurrences of state rare species.

B4 Moderate or Regional Significance: good example of a community type, excellent or good occurrence of state-rare species.

B5 General or Local Biodiversity Significance: good or marginal occurrence of a community type, S1, or S2 species.

Legal Designations

Natural Heritage imperilment ranks should not be interpreted as legal designations.

Although most species protected under state or federal endangered species laws are extremely rare, not all rare species receive legal protection. Legal status is designated by either the U.S. Fish and Wildlife Service under the Endangered Species Act or by the Colorado Division of Wildlife under Colorado Statutes 33-2-105 Article 2. In addition, the U.S. Forest Service recognizes some species as "Sensitive," as does the Bureau of Land Management. Table 2 defines the special status assigned by these agencies and provides a key to the abbreviations used by CNHP.

Please note that the U.S. Fish and Wildlife Service has issued a Notice of Review in the February 28, 1996 Federal Register for plants and animal species that are "candidates" for listing as endangered or threatened under the Endangered Species Act. The revised candidate list replaces an old system that listed many more species under three categories: Category 1 (C1), Category 2 (C2), and Category 3 (including 3A, 3B, 3C). Beginning with the February 28, 1996 notice, the Service will recognize as candidates for listing only species that would have been included in the former Category 1. This includes those species for which the Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act. Candidate species listed in the February 28, 1996 Federal Register are indicated with a "C". While obsolete legal status codes (Category 2 and 3)

are no longer used, CNHP will continue to maintain them in its Biological and Conservation Data system for reference.

Table 2. Federal and State Agency Special Designations.

Federal Status:	
1. U.S. Fish and Wildlife Service (58 Federal Register 51147, 1993) and (61 Federal Register 7598, 1996)	
LE	Endangered; species formally listed as endangered.
E(S/A)	Endangered due to similarity of appearance with listed species.
LT	Threatened; taxa formally listed as threatened.
P	Proposed endangered or threatened; species formally proposed for listing as endangered or threatened.
C	Candidate: species for which the Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened.
2. U.S. Forest Service (Forest Service Manual 2670.5) (noted by the Forest Service as “S”)	
FS	Sensitive: those plant and animal species identified by the Regional Forester for which population viability is a concern as evidenced by:
a.	Significant current or predicted downward trends in population numbers or density.
b.	Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.
3. Bureau of Land Management (BLM Manual 6840.06D) (noted by BLM as “S”)	
BLM	Sensitive: those species found on public lands, designated by a State Director, that could easily become endangered or extinct in a state. The protection provided for sensitive species is the same as that provided for C (candidate) species.
State Status:	
1. Colorado Division of Wildlife	
E	Endangered
T	Threatened
SC	Special Concern

WETLAND DEFINITIONS AND REGULATIONS

Wetland Definitions

Wetlands are places where soils are inundated or saturated with water often and long enough to significantly affect the plants and animals that live and grow there. This type of general definition suffices for most ecologists, but wetland regulators and the judicial system require a more precise definition.

The U.S. Army Corps of Engineers (the Corps) has primary responsibility for regulating activities in wetlands. According to the Corps, wetlands are “those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstance do support, a prevalence of vegetation typically adapted for life in saturated soil condition.” For Corps’ programs, the wetlands’ boundary must be determined according to the mandatory technical criteria described in the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987). In order for an area to be classified as a jurisdictional wetlands (i.e., a wetland subject to federal regulations), it must have *all* three of the following:

- (1) wetland plants (plants that tolerate flooded soils);
- (2) wetland hydrology (flooded or saturated soils for a significant part of the growing season); and
- (3) hydric soils (soils that show evidence of regular or sustained saturation e.g., low chroma matrices, gleyed matrices, histic epipedons, and iron and manganese concretions.).

The U.S. Fish and Wildlife Service defines wetlands from an ecological point of view. In *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979) the definition states that “wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water”. Wetlands must have *one or more* of the following three attributes:

- (1) at least periodically, the land supports predominantly hydrophytes (wetland plants);
- (2) the substrate is predominantly undrained hydric soil; and
- (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

This definition only requires that an area meet one of the three criteria (vegetation, soils, and hydrology) in order to be classified as a wetland.

The Colorado Natural Heritage Program prefers the wetland definition used by the U.S. Fish and Wildlife Service, because it recognizes that some areas display many of the attributes of wetlands without exhibiting all three characteristics required to fulfill the Corps’ criteria. Additionally, riparian areas, while often technically not wetlands, should be included in a wetland conservation program. Riparian areas perform many of the same functions as do

wetlands, including maintenance of water quality, storage of floodwaters, and enhancement of biodiversity, especially in the western United States (National Research Council 1995).

Wetland Function and Values

Many physical and biological functions and values associated with wetlands provide benefits to society. CNHP ranks natural communities, plants, animals according to their relative degree of imperilment within a global and state context and is most interested in the contribution of wetlands in maintenance of Colorado's natural diversity. The southern Rocky Mountain population of the boreal toad (*Bufo boreas boreas*), for example, only three to four healthy populations remain, comprised of less than 20 high priority breeding sites (S. Corn and L. Livo pers. comm. as cited in Pague et al. 1997). The Colorado Division of Wildlife lists the boreal toad as an endangered species, while the U.S. Fish and Wildlife Service has designated it as a candidate for listing under the Endangered Species Act.

Wetlands perform many functions beyond simply providing habitat for plants and animals. It is commonly known that wetlands act as natural filters, helping to protect water quality, but it is less well known that wetlands perform other important functions. Adamus et al. (1991) list the following functions performed by wetlands (detailed definitions for each function are located on page 24):

- Ground water recharge--the replenishing of below-ground aquifers.
- Ground water discharge--the movement of ground water to the surface e.g., springs.
- Floodflow alteration--the temporary storage of potential flood waters.
- Sediment stabilization--the protection of stream banks and lake shores from erosion.
- Sediment/toxicant retention--the removal of suspended soil particles from the water, along with toxic substances that may be attached to these particles.
- Nutrient removal/transformation--the removal of excess nutrients from the water, in particular nitrogen and phosphorous.
- Production export--supply organic material (dead leaves, etc.) to the base of the food chain.
- Aquatic diversity/abundance--wetlands support fisheries.
- Wildlife diversity/abundance--wetlands provide habitat for wildlife.

Adamus and Stockwell (1983) include two items they call "values" which also provide benefits to society:

- Recreation--wetlands provide areas for fishing, birdwatching, etc.
- Uniqueness/heritage value--wetlands support rare and unique plants, animals, and plant communities.

"Values" are subject to societal perceptions, whereas "functions" are all biological and physical processes and manifestations of processes which occur in wetlands, regardless of the value placed on them by society (National Research Council 1995). The actual value attached to any given function or value listed above depends on the needs and perceptions of society.

It is important to recognize that not all wetlands provide all functions. For instance, many subalpine willow carrs, especially small ones, do not have significant amounts of open water. They are supported by seeps and springs on the mountain sides and thus cannot provide habitat for fish (the aquatic diversity/abundance function). The lack of certain functions at a wetland does not necessarily decrease the importance of that wetland.

Wetland Regulation in Summit County and throughout Colorado

In 1994, Summit County adopted the Countywide Comprehensive Plan after extensive public involvement. The Plan calls for the protection and preservation of natural features such as wetlands, riparian areas and other sensitive areas, as well as the maintenance and enhancement of wildlife habitat diversity. The Board of County Commissioners in 1997 adopted a public policy goal to identify and protect sensitive lands. In 1995, Summit County adopted wetland regulations that established 25 ft. setbacks from delineated wetlands for multi-family, commercial, and industrial buildings.

Wetlands in Summit County are currently regulated under the authority of the federal Clean Water Act. A permit issued by the Corps is required before placing fill in a wetland (e.g., building up a site before constructing a home), and before dredging, ditching, or channelizing a wetland. The Clean Water Act exempts certain filling activities, such as normal agricultural activities.

The 404(b)(1) guidelines, prepared by the Environmental Protection Agency in consultation with the Corps, are the federal environmental regulations for evaluating projects that will impact wetlands. Under these guidelines, the Corps is required to determine if alternatives exist for minimizing or eliminating impacts to wetlands. When unavoidable impacts occur, the Corps requires mitigation of the impacts. Mitigation may involve creation or restoration of similar wetlands in order to achieve an overall goal of no net loss of wetland area.

It is important to understand that the Corps wetlands program is not a wetlands *protection* program, even though in fact many wetlands are protected through implementation of these regulations (B. Clairain, U.S.F.W.S., pers. comm.). Rather, the Corps wetlands permit review process is a means to insure that the societal value of wetlands (i.e., the value of flood control, water quality maintenance, etc.) is considered whenever wetlands will be impacted by development activities. Under the Corps program, most wetland permit applications are approved, after impacts have been minimized or mitigated. Many wetlands eventually are impacted by permitted activities.

The U.S. Fish and Wildlife Service has conducted inventories of the extent and types of our nation's wetlands. The Cowardin et al. (1979) classification system provides the basic mapping units for the U.S. National Wetlands Inventory (NWI). The NWI drew maps for Summit County, west of the 106th meridian, based on 1:58,000 scale color infrared aerial photography taken in September 1983. The NWI maps east of the 106th meridian were completed in the 1970s using black and white photos. Photointerpretation and field reconnaissance were used to

refine wetland boundaries according to the wetland classification system. The information is summarized on 1:24,000 and 1:100,000 maps.

The NWI maps provide important and accurate information regarding the location of wetlands. They can be used to gain an understanding of the general types of wetlands in the county and their distribution. The NWI maps cannot be used for federal regulatory programs that govern wetlands for two reasons. First, the U.S. Fish and Wildlife Service uses a definition of wetland that differs slightly from Corps, the agency responsible for executing federal wetland regulations. Secondly, there is a limit to the resolution of the 1:24,000 scale maps. For example, at this scale, the width of a fine line on a map represents about 5 m (17 ft) on the ground (Mitsch and Gosselink 1993). For this reason, precise wetland boundaries must be determined on a project by project basis. Colorado's state government has developed no guidelines or regulations concerning the management, conservation, and protection of wetlands, but a few county and municipal governments have, including the City of Boulder, Boulder County, and San Miguel County.

METHODS

Survey Site Selection

Site selection was based on targeting a representative samples of each mapping unit from the Wetland Vegetation Type Inventory (White Horse Associates and Natural Resource Consulting 1996). Site selection was executed based on the goal of visiting every wetland type (mapping unit), at various locations and elevations within in Summit County, excluding public lands. Within the full spectrum of wetland types, the highest quality occurrence of each type was targeted during the field season. CNHP classifies wetland and riparian plant associations or communities, not wetlands. Plant communities reflect the broader nature of the wetlands in the study area (i.e., willow carr, sedge meadow, etc.), while also mirroring the local nature of the wetlands in Summit County. Most other classifications applied to wetlands in Colorado and across the nation (including the U.S.F.W.S. classification used for mapping purposes in Summit County) classify wetlands based mainly on the physiognomy (structure) of the vegetation. Unfortunately, these structural classes can be applied across virtually all wetlands, and they generally do not reflect the importance or singularity of Summit County's wetlands.

Potential wetlands or target inventory areas (TIAs) were initially identified using Whitehorse Associates and Natural Resource Consultants' mapping units, color infrared aerial photographs, 7.5 minute topographic quadrangles, in conjunction with a review of CNHP's Biological and Conservation Data (BCD) system for known occurrences. A low-altitude flight over the county provided an opportunity to view the county as a whole, to exclude inferior sites included during the photo interpretation, and to include high quality sites that were missed. The TIAs were prioritized for surveying in such a manner that each type of wetland in Summit County would be visited.

The majority of these sites are on private lands, so field personnel requested permission to access the TIAs. Each land owner was contacted either by telephone or in person at their residence. For various reasons permission to access some TIAs was not obtained.

Site Assessment

Site assessments included assessments of the natural heritage elements at the site and a wetland function evaluation. Site visits and assessments were conducted on the following three levels:

- 1) **Roadside or adjacent land assessments.** Many of the sites could be viewed at a distance from a public road or from adjacent public land. While on the ground the field scientist can see, even from a distance, many features not apparent on maps and aerial photos. The majority of the sites selected during the TIA analysis were rejected during this phase from consideration as potential conservation sites. The road assessments determined the extent of human and livestock impacts on the TIA, which included ditching, adventive plant species, indicator plant species of

intensive livestock use, stream bank destabilization, establishment of saplings on point bars, major hydrologic alterations, excessive weed cover (especially noxious weeds), or new construction. Sites with these characteristics were immediately rejected as potential high significance conservation sites. No extensive data were gathered at these sites.

2) **On-site assessments.** On-site assessment was the preferred method, as it was the only assessment technique that can yield high-confidence statements concerning the known or potential presence of rare and imperiled elements or excellent examples of common communities. On-site assessments are also the most resource intensive because of the required landowner contact and comprehensive field efforts. In several cases where on-site assessments were desired, they could not be conducted either because the field crews were denied access to the property by the landowner, or CNHP was unable to contact the landowner in the available time.

3) **Off-site assessments.** Off-site assessment was the least preferred method because of the low confidence in the results. In cases where access to a property was not possible, off-site assessments are made when there are indications that the site contains a good example of a natural community or a rare or imperiled species. Off-site assessments generally included intensive analysis of aerial photos, surveys of the property from the nearest publicly accessible point, flyovers, survey of similar sites on nearby public land, and assessment of existing data in BCD.

For the sites that were visited, the following information was noted (Example of field forms are located at the end of the report):

General Field Information

- sketch of the site layout, with distribution of community types indicated (this was generally done on the 7.5' USGS topographic map, but occasionally for clarity a separate map was drawn on the site survey form)
- elevation (from 7.5 min. USGS topographic maps)
- current and historic land use (e.g., grazing, logging, recreational use) when apparent
- notes on geology and geomorphology
- reference photos of the site
- signs of disturbance such as logging, grazing, flooding, etc.

Natural Heritage Information

- list of elements present or expected at the site
- element occurrence (EO) ranks, or information that will lead to EO Rank
- proposed site boundaries

General Wetland Information

- wetland class according to HGM
- water source
- hydroperiod
- flooding and inundation frequency
- general soils description, i.e., texture, color, cobble size, percent mottling

Qualitative Function and Value Assessment

- hydrological functions, i.e., groundwater recharge/discharge, flood storage, shoreline anchoring
- biogeochemical functions, i.e., sediment trapping, long and short term nutrient retention
- biological functions, i.e., downstream foodchain support, within food chain support, fish and wildlife habitat, passive recreation

Plant Communities

Plant communities are very useful indicators of site conditions, therefore, our TIA analysis attempted to identify potential sites for the full range of plant communities present in the study area. The following information about plant communities was gathered when visiting a site. For every site where an element occurrence was located, the following information was entered into BCD:

- List of all plant associations in the wetland complex, including the amount of wetland area covered by that community. In almost all cases, plant associations were immediately placed in existing classifications. However, on rare occasion a plant association was encountered which could not be easily classified based on stands sampled previously.
- Vegetation data for each major plant association in the wetland were collected using rough ocular estimates of species cover in a representative portion of the plant association.
- Hydrologic information, including water source and hydroperiod (i.e., perennially flooded, seasonally saturated, etc.).
- Soil descriptions based on a shallow pit or an augered sample within each plot. Thickness, texture (via hand-texturing), color, mottling/gleying, structure, matrix color, coarse fragments, and parent material when possible were noted for each soil horizon.
- Notes on unusual features, alkali deposits, unusual microtopography, beaver activity, etc.

WETLAND FUNCTIONS AND VALUES

A function and value assessment was conducted to provide finer details for each mapping unit. The function and value assessment is based on Cooper (1988), which employs a modified version of the methodology known as Wetland Evaluation Technique (WET) (Adamus et al. 1991). This technique is a broad-brush approach to wetland evaluation, and is based on information derived from predictors of wetland functions which can be gathered relatively quickly. It can be used to compare ratings of a wetland for future uses in management and planning. The technique developed by Adamus et al. (1991) has not been adequately regionalized to local conditions in the western United States, but the method does provide an accurate framework for evaluating wetland functions. The ratings, however, are based on the “Best Professional Judgment” of CNHP’s wetland ecologists.

The ratings for each function are not based on quantitative data, and only a limited amount of data on these functions are available. Some of the functions (e.g., groundwater recharge and nutrient retention) are very difficult to assess accurately in a rapid manner. Also, the scientific understanding of many of these functions as performed in the Rocky Mountains is based on sparse and disparate data from many sources, often for eastern or Pacific Coast wetlands. CNHP was aware of these limitations, but CNHP is confident that the function and value assessments, as presented, provide a solid foundation on which to base wetland protection efforts.

Absolute assessments of the functions of Summit County wetlands can be known only after extensive (generally multi-year) data have been collected at a site. County government is encouraged to support such research efforts. Such research will generate potential reference sites for the hydrogeomorphic (HGM) approach to wetland function assessment. The following is a discussion of each function and value evaluated for the assessment.

Ground Water Recharge and Discharge

Ground water recharge occurs when the water level in a wetland is higher than the water table of its surroundings resulting in the movement (usually downward) of surface water (e.g., flood water retention). Ground water discharge results when the groundwater level of a wetland is lower than the water table of its surroundings, resulting in the movement (usually laterally or upward) of surface water (e.g., springs, seeps). Neither of these functions is exclusionary for a wetland can perform both functions simultaneously. Ground water movement can greatly influence some wetlands, whereas in others it may have minimal effect (Carter and Novitzki

1988). There are three processes that directly affect ground water movement:

- 1) ground water flow rates and storage capacity;
- 2) direction and location (within the wetland) of ground water movement; and
- 3) evapotranspiration

Both groundwater discharge and recharge are difficult to estimate without intensive data collection. Wetland characteristics that may indicate groundwater recharge are: porous underlying strata, irregularly shaped wetland, dense vegetation, and presence of a constricted outlet. Indicators of groundwater discharge are: a dam upstream and wet slopes with no obvious source.

Flood Storage

Wetlands are excellent in their ability to store or delay flood waters that occur from peak flow, gradually recharging the adjacent groundwater table. Indicators of flood storage include: debris along streambank and in vegetation, low gradient, formation of sand and gravel bars, high density of small and large depressions, and dense vegetation.

Shoreline Anchoring

Shoreline anchoring is the stabilization of soil at the water's edge by roots and other plant parts. The vegetation dissipates the energy caused by fluctuations of water and prevents streambank erosion. The presence of woody vegetation and sedges in the understory are the best indicator of good shoreline anchoring.

Sediment Trapping

Sediment and toxicant trapping is the process by which suspended solids and chemical contaminants are retained and deposited within the wetland. Deposition of sediments can ultimately lead to removal of toxicants through burial, chemical break down, or temporary assimilation into plant tissues (Boto and Patrick 1979). Most vegetated wetlands are excellent sediment traps, at least in the short term. Riverine wetlands tend to have relatively short retention times, because of the typical seasonal flooding that occurs. Wetland characteristics indicating this function include: dense vegetation, deposits of mud or organic matter, gentle sloping gradient, and location next to beaver dams or human-made detention ponds/lakes.

Long and Short Term Nutrient Removal

Nutrient retention is the storing of nutrients within the sediment or vegetation. Inorganic nutrients are transformed into the organic form, resulting in the transformation and subsequent removal of one nutrient (e.g., nitrogen) as a gas. Nutrient removal/transformation involves trapping of nutrients before they reach deep water, are carried downstream, or are transported to

underlying aquifers. Particular attention is focused on processes involving nitrogen and phosphorus, as these nutrients are usually of greatest importance to wetland systems (Kadlec and Kadlec 1979). Nutrient storage in wetlands may be for long-term (greater than 5 years) for example peatlands or short-term (30 days to 5 years) as in riverine wetlands. A densely vegetated cattail or bulrush community would be an example of a wetland that performs this function for the short-term. A wetland that would not perform this function would be sparsely vegetated and located on a steep slope.

Processes involving nitrogen removal and conversion to gas are pertinent to wetlands. Denitrification is frequently a critical process because it results in nutrient removal rather than retention. Denitrification is the microbial conversion of nitrate to gaseous nitrogen, resulting in a permanent loss of nitrogen from a wetland. This process must occur under anaerobic or near anaerobic conditions. There are two sources of nitrate for denitrification: diffusion from water and nitrification. Nitrification, the microbial conversion of ammonia to nitrate, occurs only under aerobic conditions.

Nitrogen fixation is the opposite process of nitrification in that gaseous nitrogen is converted or fixed, usually into organic forms of nitrogen, by bacteria and blue-green algae. Also, several wetland vascular plant genera (e.g., *Lemna* spp. and *Juncus* spp.) host nitrogen-fixing bacteria. In most wetlands, denitrification exceeds nitrogen fixation (Seitzinger 1988), which results in a net loss of nitrogen. However, reviews of mass balance studies show that wetlands do generally act as sinks for nitrogen and phosphorus both under nutrient-enriched and natural conditions (Nichols 1983; Nixon and Lee 1986). Some indicators of nutrient retention include: high sediment trapping, organic matter accumulation, presence of free-floating, emergent, and submerged vegetation, and permanently or semi-permanently flooded areas.

Production Export (Downstream and Within Food Chain Support)

Production export refers to the flushing of relatively large amounts of organic material (carbon) from the wetland downstream. Production export emphasizes the production of organic foods within the wetland and the utilization of the exported production by fish and aquatic invertebrates. Food chain support is the direct or indirect use of nutrients, in any form, of animals inhabiting aquatic environments. Indicators of wetlands that perform downstream food chain support are: an outlet, seasonally flooded, overhanging vegetation, and dense and diverse vegetation. Wetlands that perform within food chain support do not have stagnant water and contain productive vegetation.

Habitat

Habitat includes those physical and chemical factors which affect the metabolism, attachment, and predator avoidance of the adult or larval forms of fish, and the food and cover needs of wildlife in the place where they reside. Wetland characteristics indicating good fish habitat include: deep, open, non-acidic water, no barriers to migration, well-mixed (high oxygen

content) water, and highly vegetated. Wetland characteristics indicating good wildlife habitat are: good edge ratio, islands, high plant diversity, and a sinuous and irregular basin.

Recreation (Active and Passive)

Active recreation refers to recreational activities which are water-dependent. This includes the following activities: swimming, boating, canoeing, and kayaking. Passive recreation refers to the use of wetlands for aesthetic enjoyment e.g., nature study, picnicking, open space, or research.

Uniqueness/Heritage Value

Heritage value refers to the biological diversity of the wetland. This function is based on the ranking of imperiled plant, animal, and natural communities according to CNHP.

HYDROGEOMORPHIC (HGM) APPROACH TO WETLAND FUNCTION ASSESSMENT

Few people argue about the value of wetlands for water quality maintenance, flood regulation, and wildlife habitat, but when wetlands occur on private land their regulation for public good provokes controversy. In an effort to provide a more consistent and logical basis for regulatory decisions about wetlands, a new approach to assessing wetland functions--the *hydrogeomorphic* approach is rapidly being developed. In Colorado, the hydrogeomorphic, or HGM, approach to wetland function assessment is being developed by the Colorado Geological Survey, with help from the U.S. Army Corps of Engineers, other government agencies, academic institutions, the Colorado Natural Heritage Program, and representatives from private consulting firms.

This approach is based on a classification of wetlands according to their hydrology (water source and direction of flow) and geomorphology (landscape position and shape of the wetland) called "hydrogeomorphic" classification (Brinson 1993). There are four hydrogeomorphic classes present in Summit County: riverine, slope, depression, and lacustrine (Table 3). Within a geographic region, HGM wetland classes are further subdivided into subclasses. A subclass includes all those wetlands that have essentially the same characteristics and perform the same functions. CNHP tentatively proposes eight subclasses for Summit County, based on field experience. Their descriptions and characterizations may have to change as the definition of each subclass is extended to the entire area.

Using the HGM method, wetlands functions are evaluated only with respect to other wetlands in the same subclass, because different subclasses often perform very different functions. For example, a montane kettle pond may provide habitat for rare plant communities never found on a large river, but it has little flood control value. While on the other hand, the wetlands along the Blue River perform important flood control functions.

One of the fundamental goals of the HGM approach is to create a system whereby every wetland is evaluated according to the same standard. In the past wetland function assessments typically were on a site by site basis, with little ability to compare functions or assessments between sites. The HGM approach allows for consistency first through the use of a widely applicable classification, then through the use of *reference wetlands*. Reference wetlands are chosen to encompass the known variation of a subclass of wetlands. A subset of the reference wetlands are *reference standards*, wetlands that correspond to the highest level of functioning of the ecosystem across a suite of functions (Brinson and Rheinhardt 1996).

The hydrogeomorphic approach to wetland function assessment assumes that highest, sustainable functional capacity is achieved in wetland ecosystems and landscapes that have not been subject to long-term anthropogenic disturbance. Under these conditions, the structural components and physical, chemical, and biological processes in the wetland and surrounding landscape reach the dynamic equilibrium necessary to achieve highest, sustainable functional capacity (Smith et al. 1995). In general reference standards, against which all other wetlands in a subclass will be compared, meet this condition. The need to find reference standards overlaps with CNHP's

efforts to identify those wetlands with the highest biological significance, in that the least disturbed wetlands will often be those with the highest significance. Several of the wetland sites profiled in this report can probably serve as reference wetlands.

Table 3. Hydrogeomorphic wetland classes in Summit County.

Class	Geomorphic setting	Water Source	Water Movement	Subclass	Examples
Riverine	In riparian areas along rivers and streams	Overbank flow from channel	One-directional and horizontal (downstream)	1. High-order, meandering river, broad flood plain; forested wetlands 2. Low-order stream, willow carr wetlands	Cottonwood forests wetland along the lower Blue River; Willow shrublands along Indiana Creek
Slope	At the base of slopes, e.g., along the base of the foothills; also, places where a porous bedrock overlying a non-porous bedrock intercepts the ground surface.	Groundwater	One-directional, horizontal (to the surface from groundwater)	3. Low-elevation, often alkaline, springs on sedimentary rock 4. Montane and subalpine fens	Horse Creek fen and Dillon Bay fen Montane and subalpine sedge meadows e.g., Webster pass
Depressional	In depressions cause by glacial action (in the mountains) and oxbow ponds within floodplains.	Shallow ground water	Generally two-directional, vertical: flowing into and out of the wetland in the bottom and sides of the depression	5. Low-elevation wet meadows, oxbow ponds 6. Montane and subalpine kettle ponds	Goose Pasture wetland Frisco Duck, Spruce Creek subdivision
Lacustrine	Along the edges of reservoirs	Flow between deep water and shallow water areas	Two-directional, horizontal: flowing into/out of shallow water wetlands as reservoirs rise/fall	7. Seasonally saturated forested wetlands 8. Permanently flooded marshes	Willow carrs along reservoirs Sedge meadows on edges of reservoirs

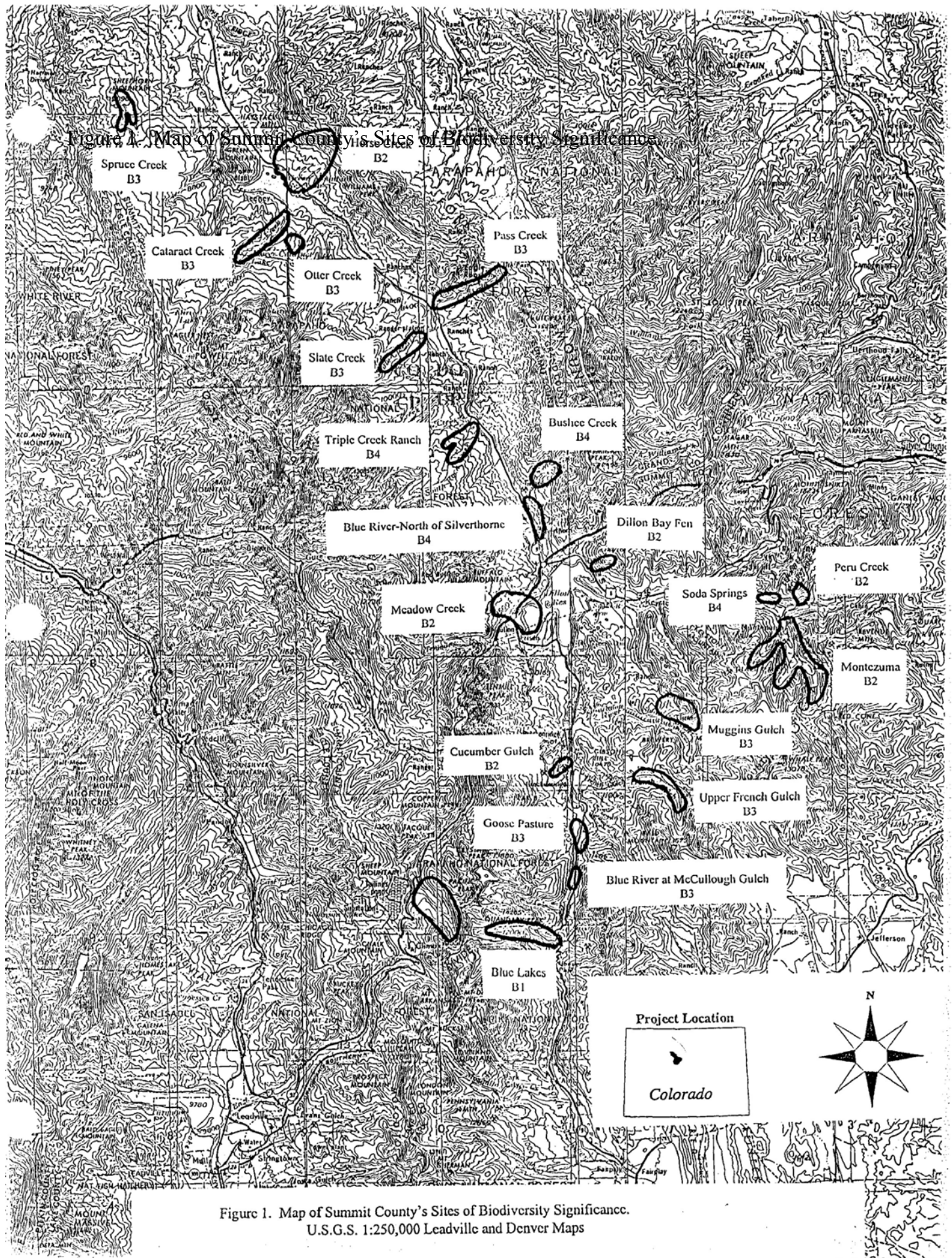
RESULTS

SUMMIT COUNTY SITES OF BIODIVERSITY SIGNIFICANCE

Conservation resources should be directed to the following sites first, in order of their biodiversity rank. The 21 most important wetland sites in Summit County are profiled in this section, alphabetically according to basin (Figure 1). These sites include the wetlands with the highest biodiversity significance as well as the best examples of all wetland types present in Summit County. Table 3 lists all 21 sites in order of their significance. All of these sites merit protection, but any available resources should be directed first toward the B1 sites, then the B2, the B3, and finally the B4 and B5 sites. These sites alone do not represent a complete wetland conservation program; they only represent the rare and imperiled elements.

Table 4. Sites of Biodiversity Significance sites in Summit County, arranged by basin and biodiversity rank (B-rank).

Site Name	Biodiversity Rank
Upper Blue River Basin	
Blue Lakes	B1
Cucumber Gulch	B2
Blue River at McCullough Gulch	B3
Goose Pasture	B3
Muggins Gulch	B3
Upper French Gulch	B3
Lower Blue River Basin	
Horse Creek	B2
Cataract Creek	B3
Otter Creek	B3
Pass Creek	B3
Slate Creek	B3
Spruce Creek	B3
Blue River-North of Silverthorne	B4
Bushee Creek	B4
Triple Creek Ranch	B4
Snake River Basin	
Dillon Bay	B2
Montezuma	B2
Peru Creek	B2
Soda Springs	B4
Tenmile Creek Basin	
Meadow Creek	B2
Clinton Creek	B3



Each site is described in a standard site report which reflects data fields in CNHP's Biological and Conservation Data System (BCD), used to track rare and imperiled elements. The sections of this report and the contents are outlined and explained below.

BIODIVERSITY RANK: The overall significance of the conservation site in terms of imperilment of the natural heritage resources and the quality (health, abundance, etc.) of their occurrences. As discussed in Section 2, these ranks range from B1 (Outstanding Significance) to B5 (General Biodiversity Significance). See page 15 for complete rank definition.

PROTECTION URGENCY RANK: The time frame in which conservation protection must occur. In most cases, this rank refers to the need for a major change of protective status (e.g., agency special area designations or ownership). The ranks range from P1 (immediate urgency; within a one year time frame) to P5 (no known urgency). See page 11 for complete rank definition.

MANAGEMENT URGENCY RANK: The time frame in which a change in management of the element or site must occur. Using best scientific estimates, this rank refers to the need for management in contrast to protection (e.g., increased fire frequency, decreased herbivory, weed control, etc.). The ranks range from M1 (immediate urgency, within one year) to M5 (no known urgency). See page 12 for complete rank definition.

LOCATION: General location, followed by the U.S.G.S. 7.5' quadrangle name(s) and the township, range, and section that include the proposed conservation site.

GENERAL DESCRIPTION: A brief narrative picture of the topography, general location, vegetation, and current use of the site. Common names are used along with the scientific names.

BIODIVERSITY RANK JUSTIFICATION: A synopsis of the rare species and significant natural communities that occur in the site. The Natural Heritage elements are listed alphabetically according to genera. The species or community that is the primary element is bolded within the table. See Table 1 for explanations of ranks.

BOUNDARY JUSTIFICATION: The proposed conservation planning boundary delineated in this report, which includes all known occurrences of natural heritage resources and, in some cases, adjacent lands required for their protection.

PROTECTION AND MANAGEMENT RANK JUSTIFICATION: A summary of the major issues and factors that are known or likely to affect the protection and management of the site.

WETLAND FUNCTIONAL EVALUATION. A summary of the functions and values and the confidence with which each was ranked that are occurring on each conservation site. Each function is ranked (i.e., no, low, medium, high, or very high rank) according to how well the wetland is performing that function. A confidence level rank of low, medium, or high accompanies each rank. A graph is included to visually illustrate the function and value for each site. Also included is a general soils description.

UPPER BLUE RIVER BASIN

Blue Lakes

Biodiversity Rank: B1 (Outstanding significance)

The Blue Lakes site supports ten CNHP elements of concern. Specifically, this site supports the only known occurrence of Weber whitlow-grass. Additionally, Weber saussurea and Porter feathergrass, both globally rare are located next to the Blue Lake Reservoir spillway. The following state rare plants also occur within the site: Kotzebue grass-of-parnassus, northern rockcress, thick-leaf whitlow-grass, arctic draba, moonwort, stiff clubmoss, and mountain bladder fern.

Protection Urgency Rank: P3

The majority of this site is privately owned with adjacent public lands. A conservation easement is recommended to ensure protection for elements. Increased mining, expansion of the reservoir, and recreational activities could threaten current and potential rare plant habitat.

Management Urgency Rank: M3

Although current management appears to be adequate, actions may be needed in the future to maintain the current quality of element occurrences. Actions could include restoration of social trails to prevent further erosion and destruction of rare plant habitat.

Location: 1 air mile south of Quandary Peak: 6.5 miles south of Breckenridge on Highway 9 to Blue Lakes Road, west on road to reservoir

U.S.G.S. 7.5 min. quadrangle: Breckenridge

Legal Description: T8S R78W Sections 4, 3, 2, 1, 34

General Description: The Blue Lakes site is a glacial valley located between Quandary Peak and North Star Mountain. The Tenmile range consists of Leadville limestone, providing the specific substrate for several rare plants species. The steep, talus slopes also support a subalpine willow scrub community (*Salix brachycarpa*/mesic forb). A subalpine riparian willow carr (*Salix planifolia*/*Carex aquatilis*) is located adjacent to Monte Cristo creek that flows through the site. The site is approximately 1,100 acres in size and ranges in elevation from 3180 m (10,600 ft.) to 3600 m (12,000 ft.).

The Blue Lakes are reservoirs that have been created by the city of Colorado Springs. There are several mining claims scattered throughout the site. A road bisects the site allowing access for recreational and sight-seeing trips. There is a small residential development within the eastern portion of the site.

Biodiversity Rank Justification: The Blue Lakes site supports ten CNHP elements of concern. Specifically, this site supports the only known occurrence of the Colorado endemic, Weber whitlow grass (*Draba weberi*). There are a total of 18 known Colorado occurrences of the globally rare Weber saussurea (*Saussurea weberi*), seven of those occurrences are within Summit County. Porter feathergrass (*Ptilagrostis mongholica* ssp. *porteri*), a globally rare plant species, is known from 24 other locations all in Colorado. The Blue Lakes occurrence of this

subspecies is the only known location for Summit County. The following state rare plants also occur within the site: Kotzebue grass-of-parnassus (*Parnassia kotzebuei*), northern rockcress (*Draba borealis*), thick-leaf whitlow-grass (*Draba crassa*), arctic draba (*Draba fladnizensis*), moonwort (*Botrychium lunaria*), stiff clubmoss (*Lycopodium annotinum* var. *pungens*), and mountain bladder fern (*Cystopteris montana*).

Natural Heritage elements at the Blue Lakes site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Botrychium lunaria</i>	moonwort	G5	S1				B
<i>Cystopteris montana</i>	mountain bladder fern	G5	S1				B
<i>Draba borealis</i>	northern rockcress	G4	S2				unranked
<i>Draba crassa</i>	thick-leaf whitlow-grass	G3	S2				D
<i>Draba fladnizensis</i>	arctic draba	G4	S2S3				unranked
<i>Draba weberi</i>	Weber whitlow-grass	G1	S1				unranked
<i>Lycopodium annotinum</i> var. <i>pungens</i>	stiff clubmoss	G5TU	SU				unranked
<i>Parnassia kotzebuei</i>	Kotzebue grass-of-parnassus	G4	S1				unranked
<i>Ptilagrostis mongholica</i> ssp. <i>porteri</i>	Porter feathergrass	G3G5T2	S2				B
<i>Saussurea weberi</i>	Weber saussurea	G3Q	S2				unranked

*EO=Element Occurrence

Boundary Justification: The boundary encompasses the elements and provides a 1,000 ft. buffer zone along the talus slopes to limit direct disturbance e.g., trampling and indirect disturbances e.g., unnatural erosion. The site also includes the spillway, which is vital to the survival of the elements. The boundary is drawn to encompass the willow communities and the rare plants. A much larger area should be considered in any long-term management or protection plan to protect from negative impacts on the hydrology. Boundary provides suitable habitat where additional individuals can become established over time.

Protection Rank Justification: The site is privately owned with adjacent publicly owned lands. The status of the mining claims should be considered. A conservation easement is recommended due the high concentration of rare plants and potential rare plant habitat.

Management Rank Justification: There is some recreational use of the area but it is concentrated on the road. Although this site does not appear to be threatened at this time, this rank could change if recreational or mining impacts increase in the future. Should mining become active, management plans should be developed prior to on-ground activities. Monitoring activities should occur every 5-10 years unless there is a significant change in on-site activity. The hydrology of this site is important to the ecological processes which support the rare plants and the riparian communities. The water quality, quantity, and timing should be maintained at its current status.

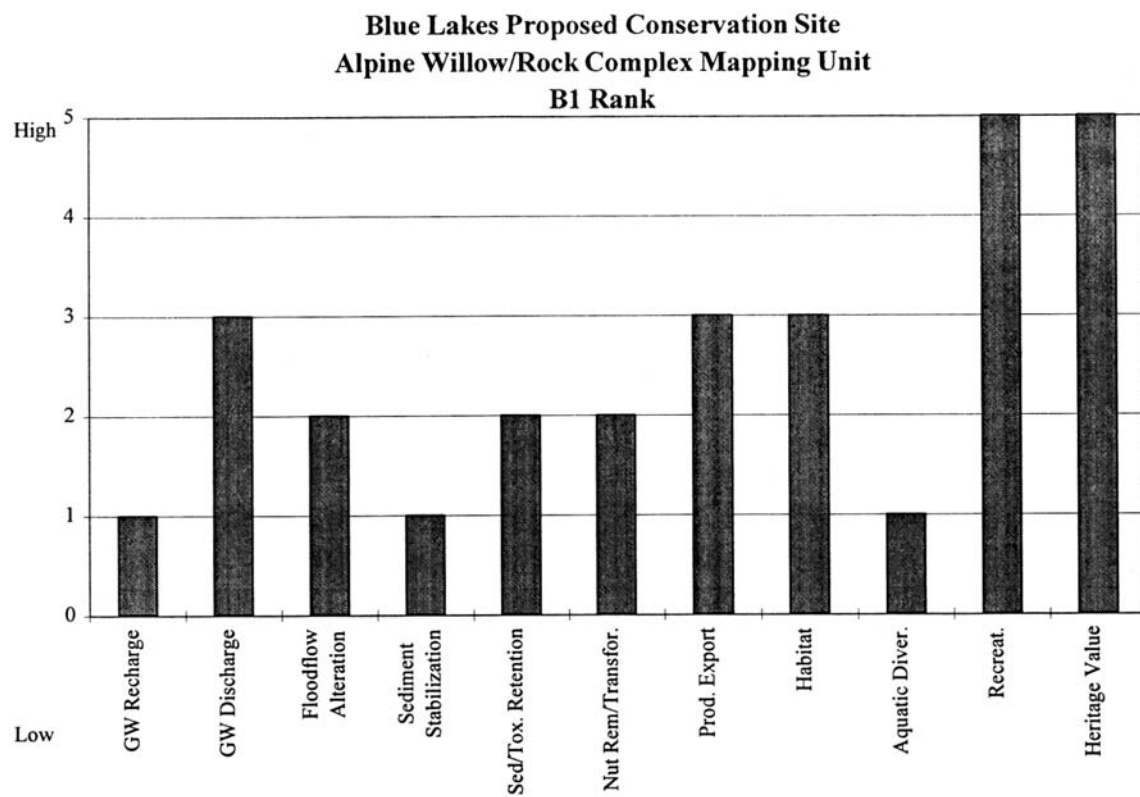
Wetland Functional Evaluation for the Blue Lakes site (alpine willow/rock complex):
Proposed HGM wetland class: Slope wetland with seasonal saturation and continuous inundation

Wetland functional evaluation for the Blue Lakes site (alpine willow/rock complex).

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	no	high	shallow to bedrock, enceptisols
Groundwater Discharge	medium	high	springs observed
Floodflow Alteration	low	high	some temporary storage of snowmelt
Sediment Stabilization	no	high	no adjacent water
Biogeochemical Functions			
Sediment/Toxicant Retention	low	medium	minimal sediment from upslope
Nutrient Removal/Transformation	low	medium	may remove some atmospheric deposition from snowmelt and sediments from mining activities
Biological Functions			
Production Export	medium	medium	densely vegetated, no flushing flow
Habitat	medium	high	pikas, marmots
Aquatic Diversity/Abundance	no	high	no open water
Recreation	very high	high	many visitors to this valley
Uniqueness/Heritage Value	very high	high	occurrence of G1S1 species within site

General Soil Description

Texture	range from shallow layer of litter or rock to about 25 cm of high-organic loam, peat accumulation in some areas where springs discharge
Color	dark
Cobble Size	glacial till
Percent Mottling	1-5%



Graph of function and value assessment for Blue Lakes site.

Wetland Functional Evaluation for the Blue Lakes site (Monte Cristo Creek):

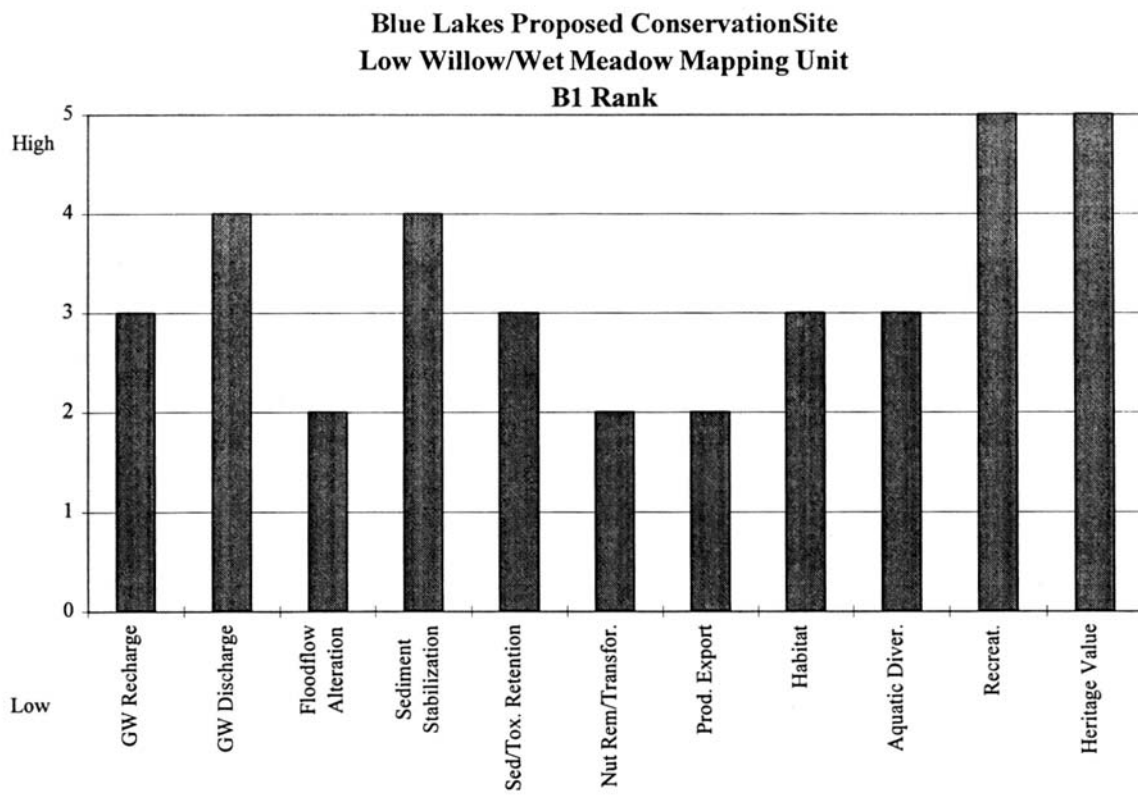
Proposed HGM wetland class: Riverine wetland with seasonal saturation and rare flooding.

Wetland functional evaluation for the Blue Lakes site (low willow/wet meadow mapping unit).

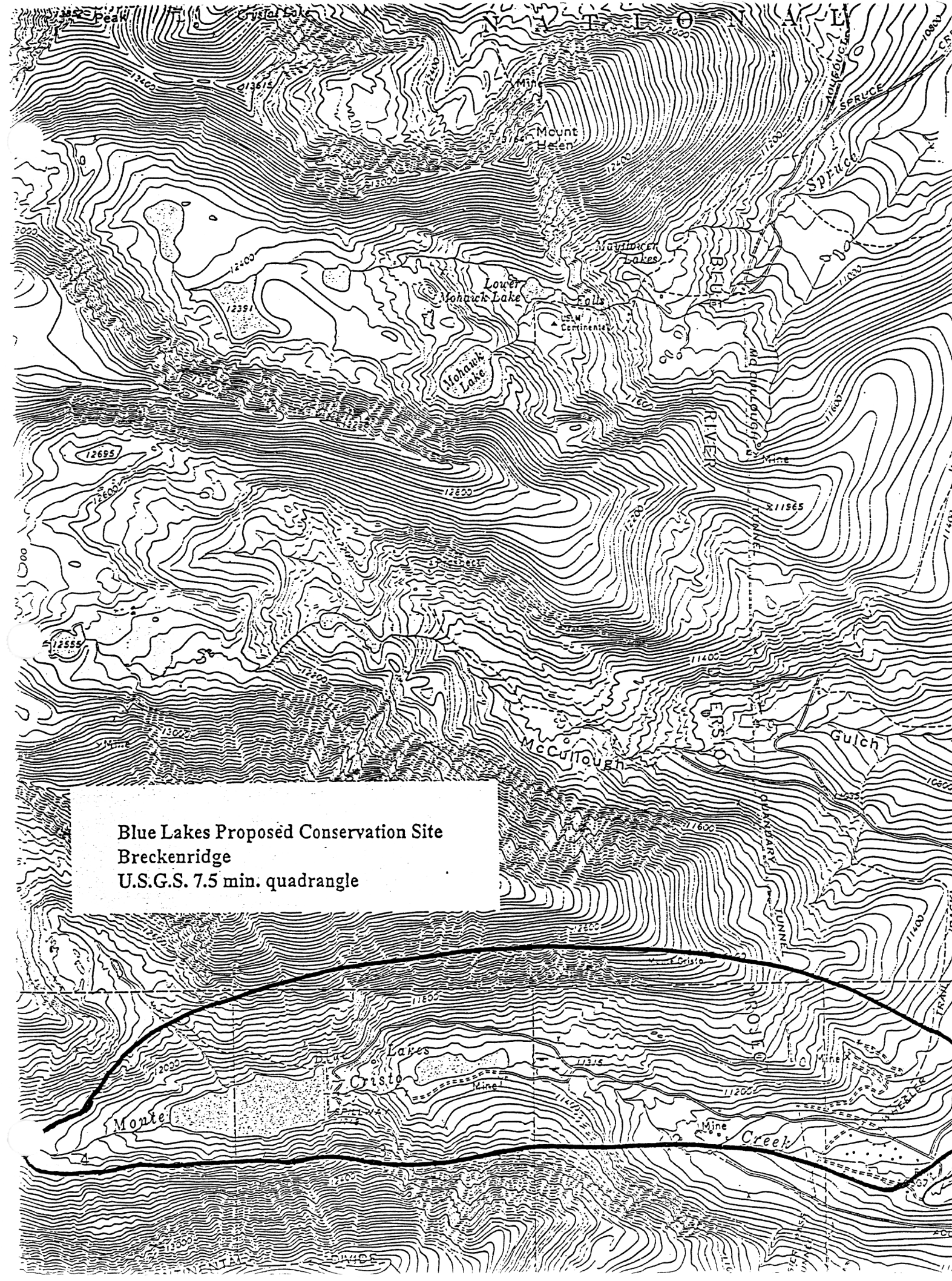
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	several ponds, rocky soils
Groundwater Discharge	high	high	numerous springs along both slopes that feed the ponds
Floodflow Alteration	low	high	some retention of snowmelt
Sediment Stabilization	high	high	dense vegetation
Biogeochemical Functions			
Sediment/Toxicant Retention	medium	medium	wetland catches sediments from steep slopes and several mine tailings
Nutrient Removal/Transformation	low	high	some peaty soils
Biological Functions			
Production Export	low	high	no flushing flows, but dense vegetation
Habitat	medium	high	pikas, marmots
Aquatic Diversity/Abundance	medium	high	no fish observed, clear, well-mixed water
Recreation	very high	high	sight-seeing, fishing, hiking
Uniqueness/Heritage Value	very high	high	occurrence of GIS1 plant

General Soil Description

Texture	soils are skeletal
Color	dark peaty soils near springs
Cobble Size	glacial till
Percent Mottling	1-5%



Graph of function and value assessment for Blue Lakes site (riverine).



Cucumber Gulch

Biodiversity Rank: B2 (Very high significance)

The Cucumber Gulch site supports a breeding population of the globally imperiled southern Rocky Mountain boreal toad.

Protection Urgency Rank: P1

This site is immediately threatened by residential development, road maintenance, and activities associated with the Breckenridge Ski Area and the Keystone Nordic Ski Area. The site is privately owned and there are specific plans for development (e.g., homes, access roads, etc.) of the area. The breeding population of the southern Rocky Mountain boreal toad population is located within the trail system of the nordic center. Recreational uses, including skiing and mountain biking, pose threats to this site. The ski trails are mowed in the summer spreading exotic plant species, fragmenting the willow carr, affecting the hydrology, and creating erosion problems. A conservation easement or open space designation is recommended.

Management Urgency Rank: M1

Management actions must be taken immediately to prevent the further fragmentation of the willow communities and further degradation of the southern Rocky Mountain boreal toad. Actions could include: limiting access of mountain bikes and hikers during post-breeding, due to juvenile and adult dispersal, monitoring the effects of snowmaking on water quality, and management of beaver to provide optimal water levels and habitat for southern Rocky Mountain boreal toad viability.

Location: Cucumber Gulch is 0.5 miles west of the confluence of the Blue River and French Gulch. From Breckenridge, follow signs to Breckenridge Ski Area, Peak 8 on Ski Hill Road. About one and a half miles up the road, before reaching the ski area parking lot, turn right into the Nordic Center Parking lot. From the Nordic Center head north and west, about 1/4 mile walk along an old road to Cucumber Gulch.

U.S.G.S. 7.5 min. quadrangle: Breckenridge

Legal Description: T6S R78W Sections 25, 36

General Description: Cucumber Gulch is a north to northeast-facing drainage in the Blue River watershed. It is dominated by a montane willow carr (*Salix planifolia*/*Carex aquatilis*) and an alpine willow scrub (*Salix brachycarpa*-mesic forb) with bog birch (*Betula glauca*). There are numerous beaver ponds located throughout the willow carr. The open valley is about 0.3 miles wide at its widest point with Engelmann spruce (*Picea engelmannii*) and lodgepole pine (*Pinus contorta*) scattered throughout. Mudflats around the margins of the beaver ponds provide important habitat for the boreal toad. The upland areas in the site are dominated by Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*) and lodgepole pine (*Pinus contorta*). The site is approximately 500 acres with an elevation range from 2850 m (9,500 ft.) to 2950 m (9,900 ft.).

Biodiversity Rank Justification: The Cucumber Gulch site contains one of three breeding populations of the southern Rocky Mountain boreal toad (*Bufo boreas boreas*) located on private lands in Summit County. This population of breeding toads was first documented in 1995. There was no breeding observed during the summer of 1996 (Horstman 1996). During the 1997 survey only two adults and 150-200 tadpoles were observed on June 18. There was no evidence of recruitment or survival of young in 1997 (Horstman 1997).

The southern Rocky Mountain population of boreal toads is likely distinct from other populations (A. Goebel unpubl. data as cited in Pague et al. 1997). There are approximately 206 historical localities for the southern Rocky Mountain boreal toad in Colorado. Presently, only three to four healthy populations remain, comprised of less than 20 high priority breeding sites (S. Corn and L. Livo, pers. comm. as cited in Pague et al. 1997). Populations have declined precipitously or disappeared over the past 20 years and continue to do so (Goettl 1997). The reasons for the decline are unknown and the factors important to the perseverance of this species are not well understood (Pague et al. 1997). The southern Rocky Mountain boreal toad is currently a candidate for federal listing, a state endangered and U.S. Forest Service sensitive species.

Natural Heritage elements at the Cucumber Gulch site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Bufo boreas boreas</i>	southern Rocky Mountain boreal toad	G4T1Q	S1	C	E	FS	B

*EO=Element Occurrence

Boundary Justifications: The boundary includes the southern Rocky Mountain boreal toad occurrence and adjacent contiguous habitat. A buffer of 1,000 ft. is provided to prevent direct disturbance such as, development, access roads, trampling, mowing, trails, to the southern Rocky Mountain boreal toad and riparian habitats. A much larger area, including the full watershed, and post-breeding dispersal area for the toad should be considered in any conservation plan.

Protection Rank Justification: The Cucumber Gulch is immediately threatened by a proposed residential development for site. A conservation easement or open space designation is recommended to protect the southern Rocky Mountain boreal toad and its habitat.

Management Rank Justification: Management actions must be taken immediately due to the high threat of residential development, road improvements, and continual recreational use. Hydrological processes originating outside of the planning boundary, including water quality, quantity, and timing, must be managed to maintain boreal toad population and community viability. These processes may be affected by the Breckenridge Ski Area Peak 8 snowmaking operations which are located at the top of the Cucumber Gulch site.

Wetland Functional Evaluation for the Cucumber Gulch site:

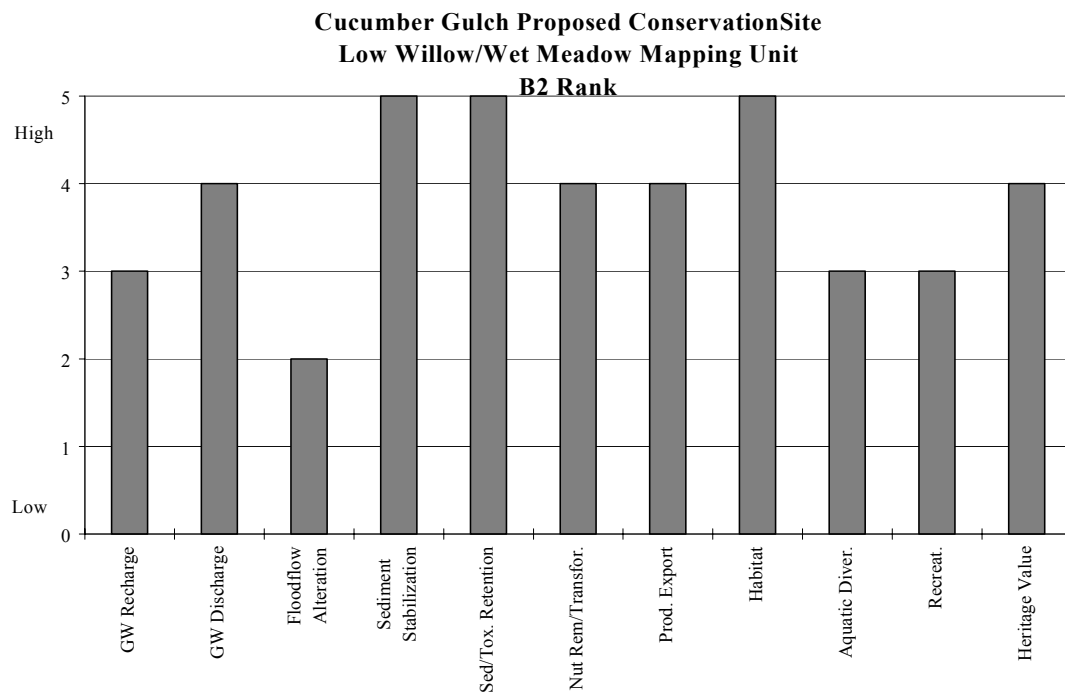
Proposed HGM wetland class: Riverine and slope wetland with permanent to seasonal saturation and continuous inundation.

Wetland functional evaluation for the Cucumber Gulch site (low willow/wet meadow mapping unit).

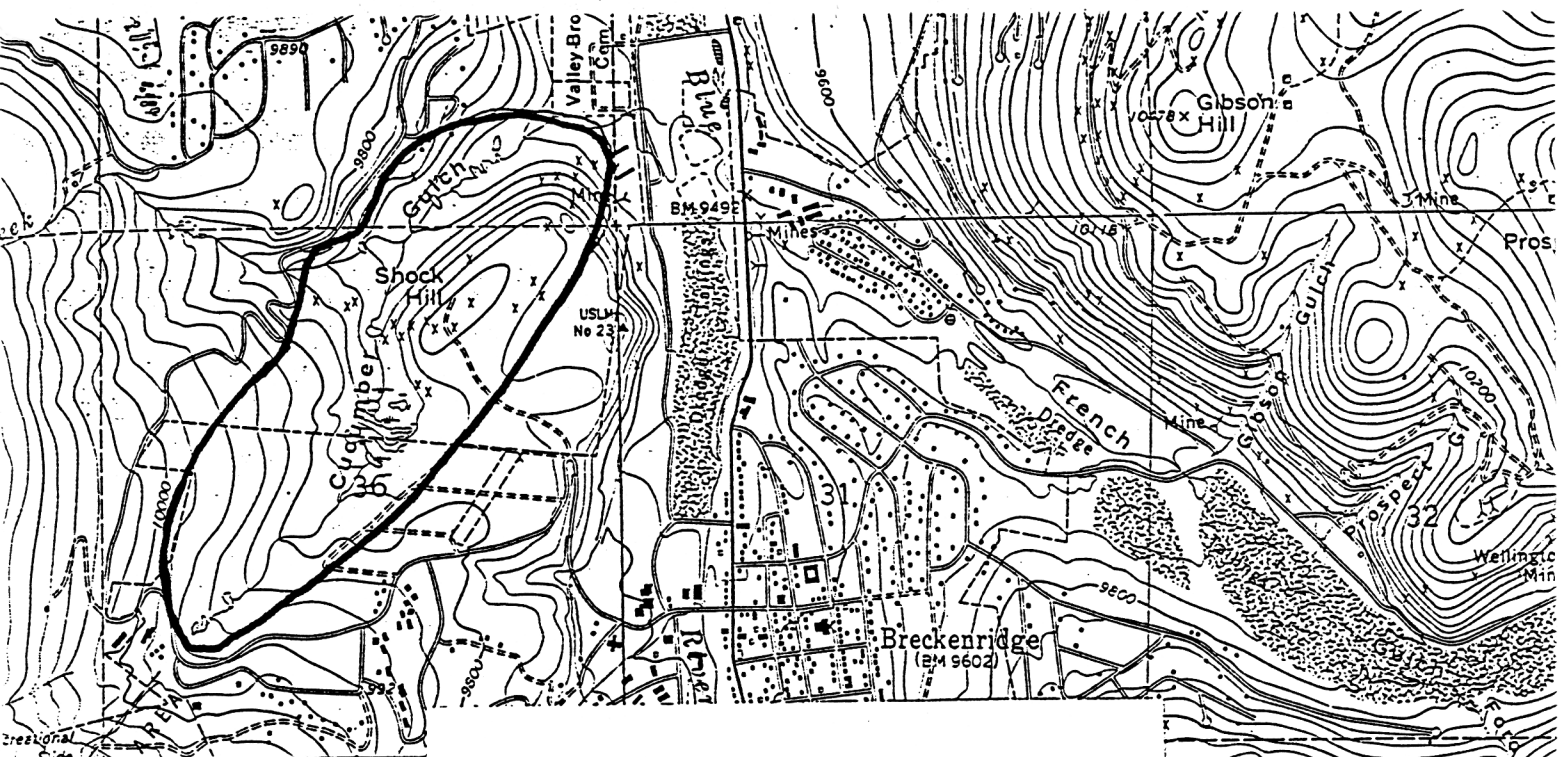
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	soils are not porous, but there are constrictions within the wetland, densely vegetated and located high in basin.
Groundwater Discharge	high	high	wetland is located at base of Tenmile Range, no obvious source of water except from spring discharge
Floodflow Alteration	low	high	dense vegetation, clayey soils, no debris or high water marks, wetland has been filled on north and south ends.
Sediment Stabilization	very high	high	high vegetation density of willows, located at edge of ponds with sedge understory
Biogeochemical Functions			
Sediment/Toxicant Retention	very high	medium	constricted outlets, low gradient, organic matter deposits, construction and road improvements surround wetland
Nutrient Removal/Transformation	high	medium	flooded permanently, nearby anthropogenic activities, organic matter accumulation
Biological Functions			
Production Export	high	medium	no severe scouring, clayey soils, vegetation overhanging water
Habitat	very high	medium	boreal toad, beaver, elk, likely fish
Aquatic Diversity/Abundance	medium	high	ponds with open water, well-mixed, no barriers
Recreation	medium	high	ski trail in winter, mountain bike in summer
Uniqueness/Heritage Value	high	high	breeding population of boreal toad

General Soil Description

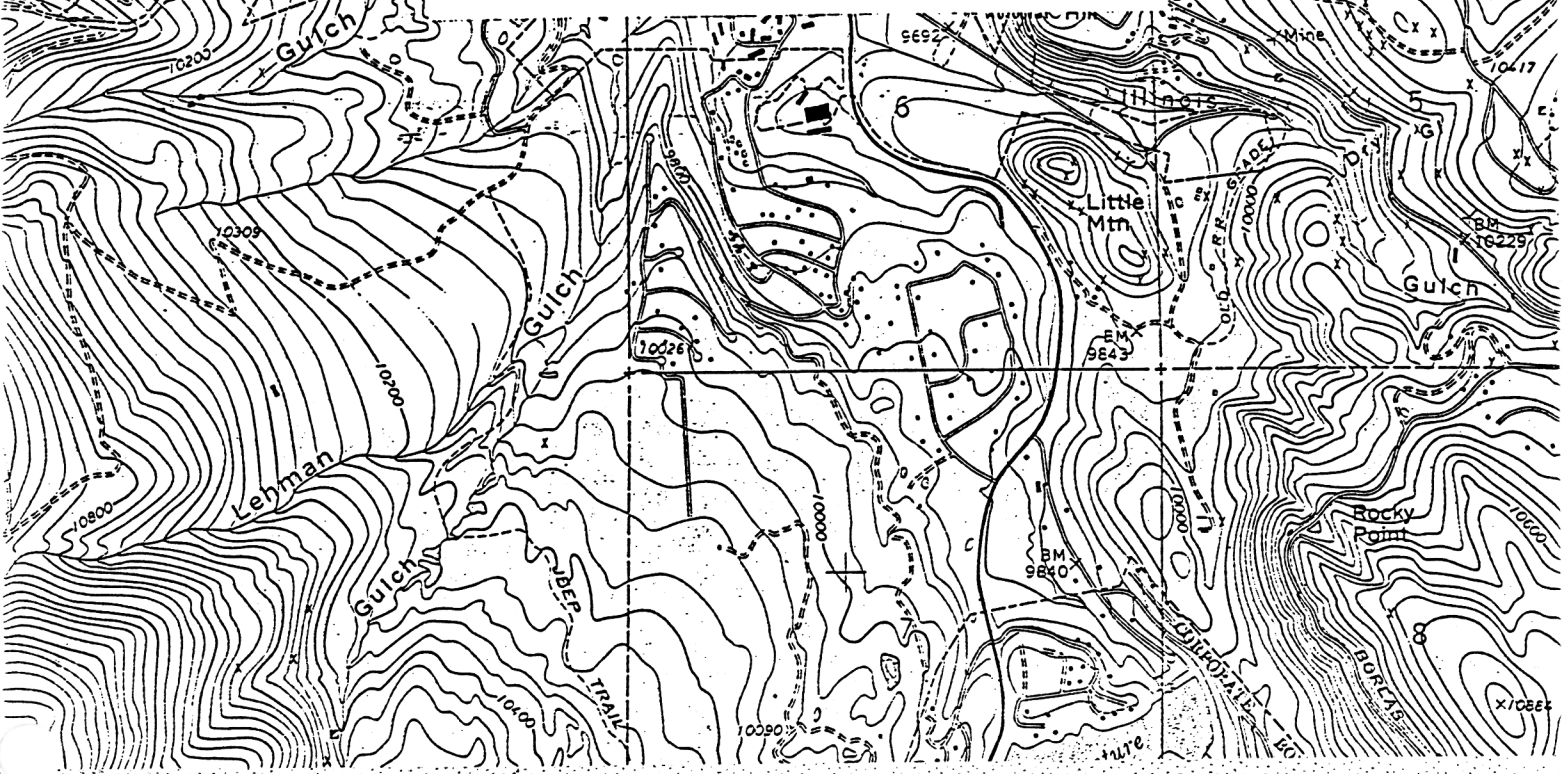
Texture	clayey with little sand
Color	dark with sulfur smell, some redox along wetland edge, 2.5Y 4/4 in lower area and 10YR 3/1 in upper area
Cobble Size	small
Percent Mottling	none



Graph of function and value assessment for Cucumber Gulch site.



Cucumber Gulch Proposed Conservation Site
Breckenridge
U.S.G.S. 7.5 min. quadrangle



Blue River at McCullough Gulch

Biodiversity Rank: B3 (High significance)

The Blue River at McCullough Gulch site contains excellent examples of globally common alpine willow and montane riparian scrub communities. The state rare Preble's shrew was documented within the site. It is one of the best examples of a riverine wetland observed on private lands in Summit County.

Protection Urgency Rank: P2

This site is privately owned with adjacent public lands. Plans for private lands are unknown; however, the site is located in an area that is being developed rapidly with residences. Seven acres on the southeastern portion of the site are owned by Summit County. This portion is managed as open space and has a conservation easement to limit future development. A conservation easement or open space designation is recommended to protect the entire site.

Management Urgency Rank: M3

The site is bordered by Highway 9, which impacts the wetland with road maintenance and improvement projects. Beaver are enhancing the wetland and their continued success relies on proper management.

Location: 5 miles south of Breckenridge, west of Highway 9.

U.S.G.S. 7.5 min. quadrangle: Breckenridge

Legal Description: T7S R77W Sections 36, 30, 25

General Description: The Blue River at McCullough Gulch site is a riparian wetland located between the Tenmile Range and the western base of Red Mountain. The wetland supports a two mile long alpine willow scrub (*Salix brachycarpa*/mesic forb) that is fed by the Blue River as it meanders through the site, as well as several springs that flow from the base of the Tenmile Range. The site includes a pristine wetland that is adjacent to several subdivisions. There is no evidence of grazing from domestic animals, but the site is heavily used by wildlife, e.g., beaver, deer, elk. There are few weeds or hay grasses present. The site is approximately 300 acres and ranges in elevation from 3060 m (10,200 ft.) to 3079 m (10,263 ft.).

Biodiversity Rank Justification: The Blue River at McCullough Gulch site is one of the best remaining wetlands in the upper Blue River Basin. This site supports excellent examples of an alpine willow scrub (*Salix brachycarpa*/mesic forb) and a montane riparian shrubland (*Pentaphylloides floribunda*/*Deschampsia cespitosa*). The site provides excellent potential habitat for the southern Rocky Mountain boreal toad. The site was searched for toads in 1997 with negative results. Between July 16 and August 27, 1997 seven Preble's shrews (*Sorex c.f. preblei*) were documented. The Preble's shrew is a state rare species recently documented for Colorado.

Natural Heritage elements at the Blue River at McCullough Gulch site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Pentaphylloides floribunda/ Deschampsia cespitosa</i>	montane riparian shrubland	G4	SU				A
<i>Sorex c.f. preblei</i>	Preble's shrew	G5	S1				unranked
<i>Salix brachycarpa/ mesic forb</i>	alpine willow scrub	GUQ	S4				A

*EO=Element Occurrence

Boundary Justification: The boundary encompasses the willow carr and provides a 1,000 ft. buffer to protect the site from immediate impacts (e.g., road improvements, development) to the elements and the hydrology. A much larger area, including the full watershed of the Blue River, needs to be considered when developing a plan for long-term viability of the plant communities and Preble's shrew.

Protection Rank Justification: The site is privately owned by two parties (the southern portion of site was not visited). The boundary includes portions of the seven acre McCullough Gulch trailhead property acquired by Summit County as open space in 1995. This portion is managed as open space and has a conservation easement to limit future development. A conservation easement or open space designation is recommended to protect the entire site. The private landowners need to be aware of importance of this remaining wetland in a rapidly developing area of Summit County. The wetlands of the upper Blue River are being rapidly developed and this site is still in relative pristine condition.

Management Rank Justification: Presently, the site is being well managed. But there are future threats to the sites in particular residential development and road enhancement projects. Management for beaver viability should be a priority. This occurrence of the Preble's shrew should be periodically sampled (approximately every 5 years) to determine changes in viability and overall quality of the occurrence as well as the riparian habitat. Further searches for the southern Rocky Mountain boreal toad are recommended. Alterations in hydrology above this site could have profoundly negative impacts on the elements. The hydrology of this site is important to the ecological processes which support the southern Rocky Mountain boreal toad and the riparian communities. The water quality, quantity, and timing should be maintained at its current status.

Wetland Functional Evaluation for the Blue River at McCullough Gulch site:

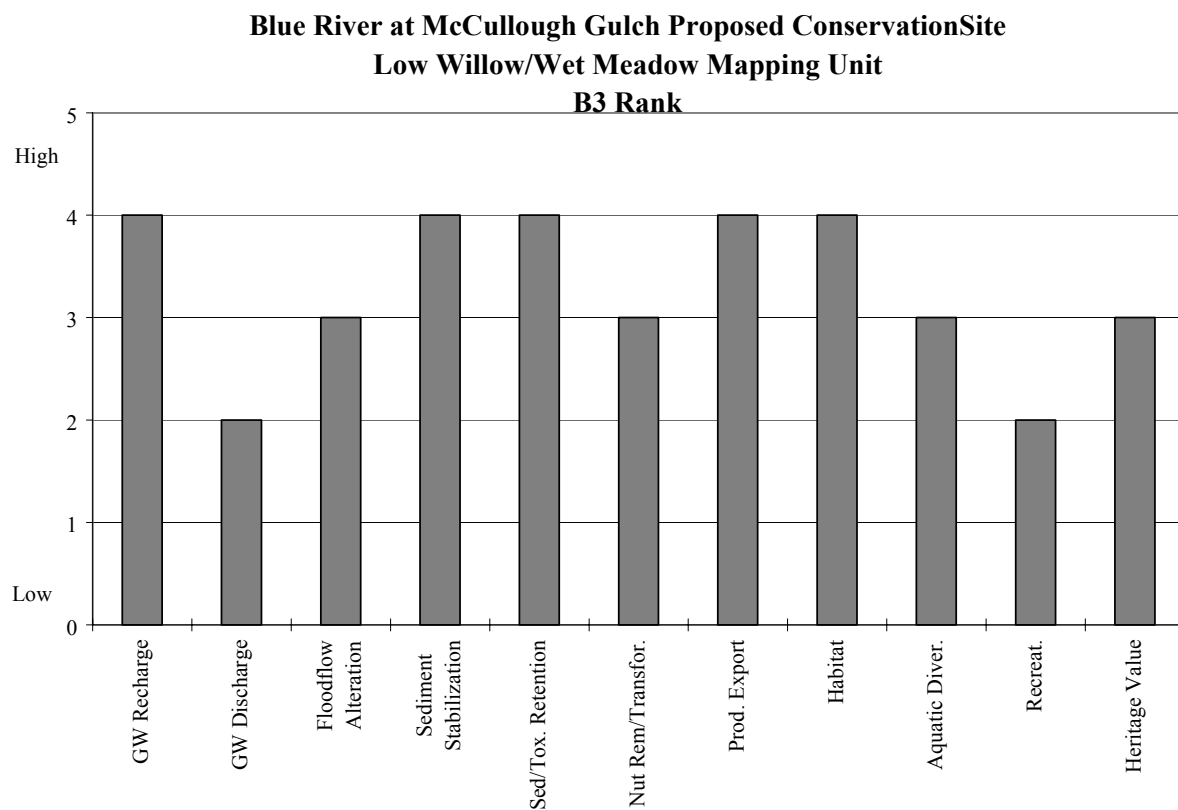
Proposed HGM wetland class: Riverine wetland with a seasonal saturation and occasional flooding

Wetland functional evaluation for the Blue River at McCullough Gulch site (low willow/wet meadow mapping unit).

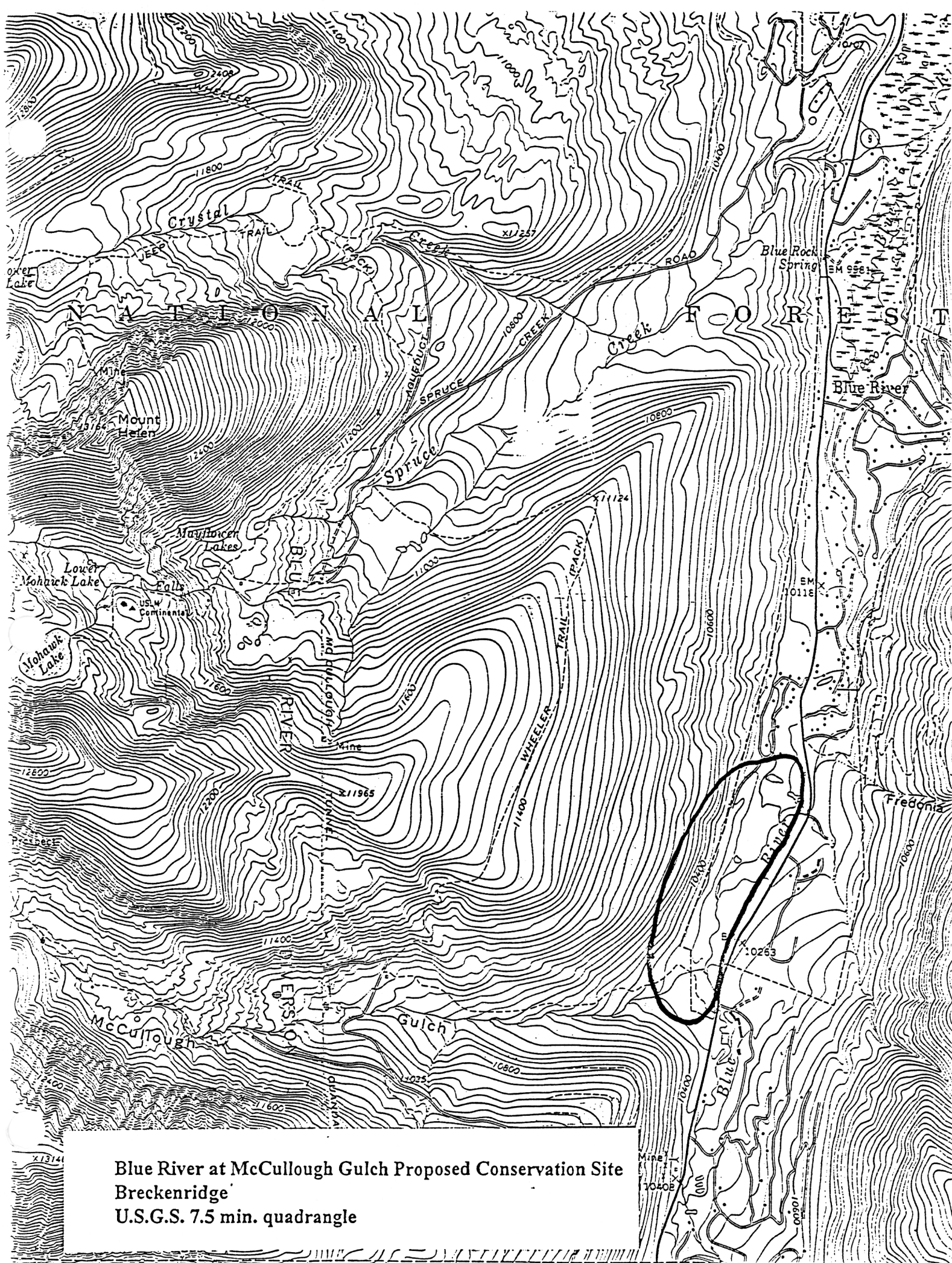
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	high	high	sandy soils in underlying strata, very dense vegetation, beaver ponds, irregular shape
Groundwater Discharge	low	high	observed water from slopes
Floodflow Alteration	medium	high	observed debris and sediment deposits; several depressions next to river.
Sediment Stabilization	high	high	densely vegetated with willows, grasses, forbs
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	beaver ponds constrict flow, organic matter, sediments trapped from road maintenance and mining activities above wetland
Nutrient Removal/Transformation	medium	medium	no aquatic vegetation, high sediment trapping
Biological Functions			
Production Export	high	medium	flushing flows, vegetation overhanging water
Habitat	high	high	observed brook trout, mule deer
Aquatic Diversity/Abundance	medium	high	ponds do barricade stream, clear, cool water, irregular shape, low gradient
Recreation	low	high	only passive, fishing, hiking
Uniqueness/Heritage Value	medium	high	A rank of globally common communities

General Soil Description

Texture	clayey soils with some sand
Color	red 7.5 YR 4/1
Cobble Size	small
Percent Mottling	15% in first 50 cm



Graph of function and value assessment Blue River at McCullough Gulch site.



Blue River at McCullough Gulch Proposed Conservation Site
Breckenridge
U.S.G.S. 7.5 min. quadrangle

Goose Pasture Wetland

Biodiversity Rank: B3 (High significance)

The Goose Pasture wetland supports excellent examples of a common montane riparian willow carr and a common alpine willow scrub. It is the most extensive willow carr observed on private lands in Summit County. Several kettle ponds (glaciated depressions) with submerged vegetation are located in the adjacent uplands. There is also a historical record for the southern Rocky Mountain boreal toad from 1961.

Protection Urgency Rank: P4

This wetland is privately owned by several owners and the Town of Blue River. The tarn (mountain lake) is owned by the Town of Breckenridge. It is considered open space, but no official designation has been made. The site is located in a rapidly growing area of Summit County. A conservation easement or open space designation is recommended to protect this wetland for the future.

Management Urgency Rank: M3

New management will be needed within 5 years to maintain current quality of element occurrences. Management actions could include: monitor water quality due to road maintenance and construction and control spread of exotic plant species. The Town of Breckenridge should limit access to the tarn and adjacent property in order to prevent degradation of the wetland. Future searches for the southern Rocky Mountain boreal toad are recommended.

Location: 2 miles south of Breckenridge

U.S.G.S. 7.5 min. quadrangle: Breckenridge

Legal Description: T7S R77W Sections 7, 18, 19

General Description: The Goose Pasture wetland is located directly south (upstream) of Goose Pasture Tarn. The site is located in a glaciated valley between the Tenmile Range to the west and Boreas Pass to the east. The Blue River meanders through the wetland creating several riverlets and ponds. There are numerous, active beaver ponds within the wetland, as well as natural depressions. There are several kettle ponds interspersed in the spruce/fir uplands that support submerged vegetation. The site is approximately 700 acres and ranges in elevation from 2964 m (9,880 ft.) to 3000 m (10,000 ft.).

The main portion of the site is bordered to the west by Highway 9 and to the east by subdivisions. The kettle ponds (glacial ice depressions) are located west above Goose Pasture Tarn within the Spruce Creek subdivision. The Town of Blue River is located adjacent to the wetland. There is no grazing within the site. There is little pedestrian traffic or fishing within the wetland.

Biodiversity Rank Justification: The Goose Pasture wetland supports excellent examples of a montane riparian willow carr (*Salix drummondiana*/mesic forb) and an alpine willow scrub

(*Salix brachycarpa*/mesic forb). It is the most extensive willow carr observed on private lands in Summit County. A good example of a floating/submergent palustrine (freshwater marsh) wetland (*Nuphar luteum* ssp. *polysepalum*) is located upslope of the riverine wetland. A historical record (1961) for the state endangered southern Rocky Mountain boreal toad (*Bufo boreas boreas*) is located within the site. The site was searched for the boreal toad in 1997, but none were observed.

Natural Heritage elements at the Goose Pasture Wetland site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Bufo boreas boreas</i>	southern Rocky Mountain boreal toad	G4T1Q	S1	C	E	FS	Historical
<i>Nuphar luteum</i> ssp. <i>polysepalum</i>	floating/submerged palustrine wetland	GU	SU				B
<i>Salix brachycarpa</i> /mesic forb	alpine willow scrub	GUQ	S4				A
<i>Salix drummondiana</i> /mesic forb	montane riparian willow carr	GU	S4				A

*EO=Element Occurrence

Boundary Justification: The boundary is drawn to encompass the elements and provide a buffer of at least 1,000 ft. The boundary includes the wetlands and the kettle ponds located to the west upslope of the wetland. A buffer zone is intended to protect the elements from immediate impacts such as development and road expansion operations. A much larger area should be considered in any long-term management or protection plan to protect the hydrology.

Protection Rank Justification: This wetland is both privately and publically owned. It is considered open space, but no official designation has been made. The kettle ponds are located on private lands within the Spruce Creek subdivision. The site is located in a rapidly growing area of Summit County and it needs a conservation easement or county open space designation.

Management Rank Justification: New management will be needed within 5 years to maintain current quality of element occurrences. Management actions could include: monitor water quality due to road maintenance and construction and control spread of exotic plant species. The Town of Breckenridge should limit access to the tarn and adjacent property in order to prevent degradation of the wetland. Future searches for the southern Rocky Mountain boreal toad are recommended. Alterations in hydrology above this site would have profoundly negative impacts on the elements.

Wetland Functional Evaluation for the Goose Pasture Wetland site:

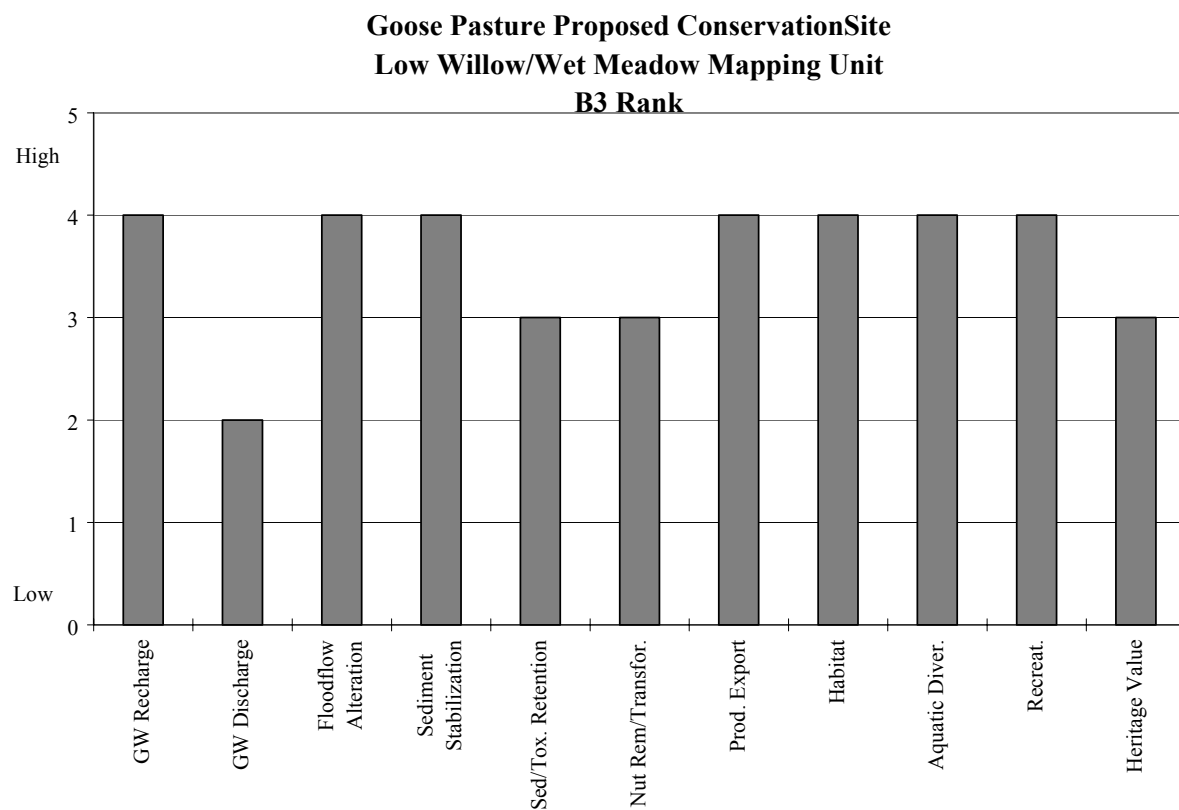
Proposed HGM wetland class: Riverine wetland with seasonal to permanent saturation that is occasionally flooded.

Wetland functional evaluation for the Goose Pasture Wetland site (low willow/wet meadow mapping unit).

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	high	high	sandy soils, dense vegetation, obvious flooding, several ponds, wetland above river, irregular shape
Groundwater Discharge	low	low	no obvious springs
Floodflow Alteration	high	high	debris and sediment evident, low gradient, sandy soils, not permanently saturated, several ponds
Sediment Stabilization	high	high	high vegetation density, located next to open water
Biogeochemical Functions			
Sediment/Toxicant Retention	medium	medium	constricted outlets due to beaver ponds, dense vegetation, low gradient, low to moderate accumulation of organic matter, located downstream of numerous mines
Nutrient Removal/Transformation	medium	medium	some areas permanently saturated, moderate sediment retention
Biological Functions			
Production Export	high	medium	flushing flows, vegetation overhanging water, seasonally flooded
Habitat	high	high	beaver, elk, deer, moose ?
Aquatic Diversity/Abundance	high	high	observed fish, clear water, mixed, high edge ratio, high plant diversity
Recreation	high	high	fishing, scenic
Uniqueness/Heritage Value	medium	high	A rank of G4 communities

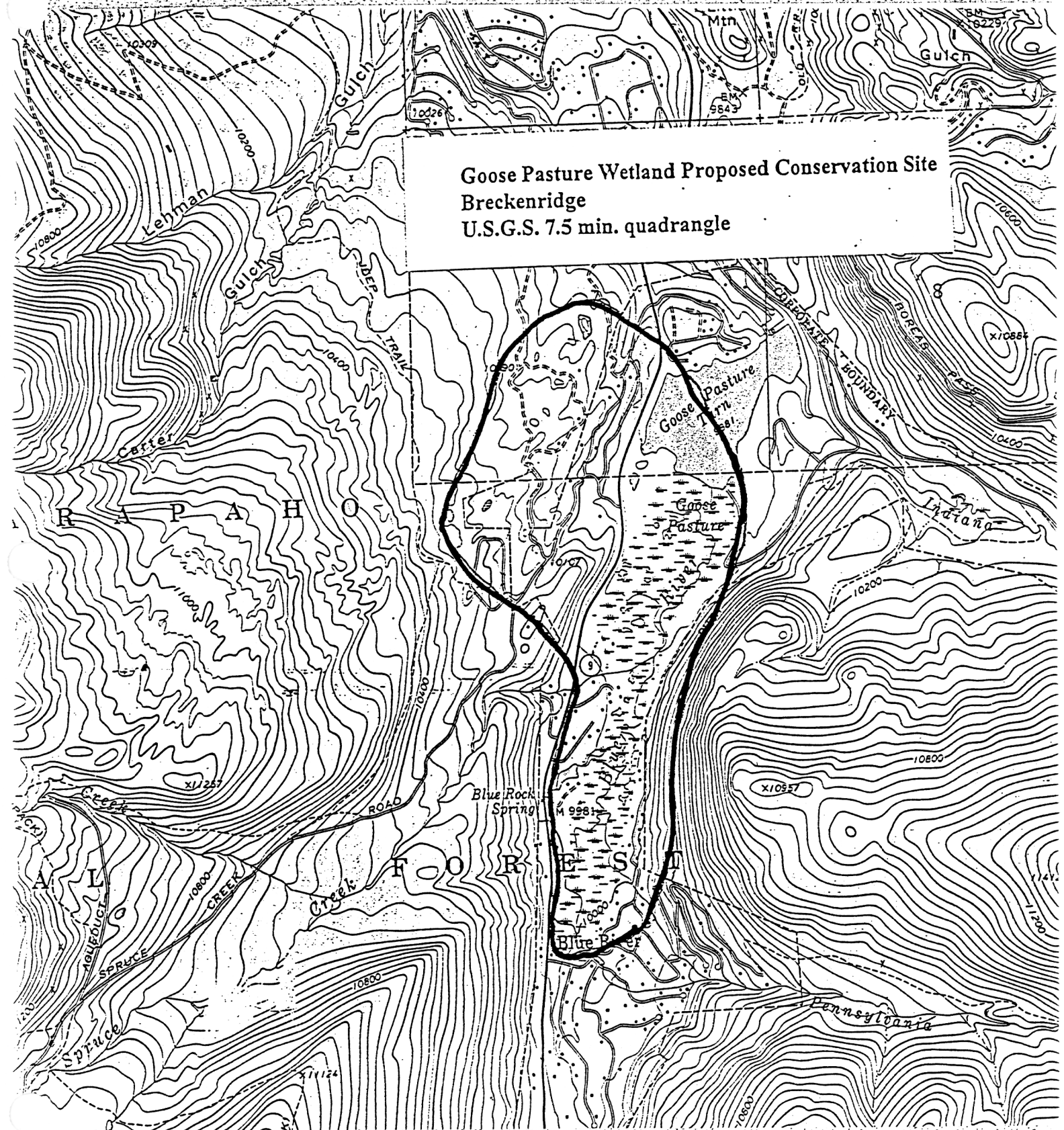
General Soil Description

Texture	alluvium, sandy, glacial till
Color	red 10YR 4/4
Cobble Size	small to medium
Percent Mottling	1-5% at 10 cm



Graph of function and value assessment for Goose Pasture site.

Goose Pasture Wetland Proposed Conservation Site
Breckenridge
U.S.G.S. 7.5 min. quadrangle



Muggins Gulch

Biodiversity Rank: B3 (Moderate significance)

The Muggins Gulch site supports a good occurrence of a globally rare lower montane woodland and an excellent occurrence of a state rare alpine willow carr. There is also a good occurrence of a state rare subalpine riparian shrubland.

Protection Urgency Rank: P1

The majority of the Muggins Gulch site is privately owned with adjacent public lands. This site is located in a rapidly developing area and the threats from residential development and road improvements are high. Additionally, the current owners are considering the creation of a fishing pond within the willow carr for their bed and breakfast clients. This site is an excellent candidate for either a conservation easement or open space designation.

Management Urgency Rank: M1

Management actions are required immediately or the riparian areas will be lost or degraded. Actions should also consider reintroducing beaver to maintain the viability of the occurrences. Additional research is needed to determine the hydrological impacts from the planned pond creation. This site would be a good place to promote the importance of wetlands through interpretive displays for the bed and breakfast patrons.

Location: 9 air miles southeast of Frisco, along the Swan River

U.S.G.S. 7.5 min. quadrangle: Keystone

Legal description: T6S R77W Sec 11, 12, 14, 13, 24

General Description: Muggins Gulch site is located north of the Swan River at the southwest base of Keystone Ski Area. The site extends from Muggins Gulch east to the North Fork of the Swan River. There is one residence within the site that currently operates as a bed and breakfast. The site has historically been logged and burned. The site supports a mosaic of natural communities ranging from wet meadows (*Deschampsia cespitosa*) to sagebrush shrubland (*Artemisia cana/Festuca thurberi*) to bristlecone pine (*Pinus aristata*) forests. The site is approximately 1,600 acres and ranges in elevation from 2910 m (9,700 ft.) to 2976 m (9,920 ft.).

The wetlands around Muggins Gulch are supported by three streams and numerous springs. The riparian areas support dense willow carrs that contain abandoned beaver dams. Upslope of the riparian areas are numerous springs that support slope wetlands with peaty soils. In the wetter areas near the springs there are wet meadows and bog birch (*Betula glandulosa*) communities. Engelmann spruce (*Picea engelmannii*) and quaking aspen (*Populus tremuloides*) communities occur on adjacent slopes. The bristlecone pine (*Pinus aristata*) community exists on the south-southwest facing slopes east of Muggins Gulch.

Biodiversity Rank Justification: The Muggins Gulch site is a relatively undisturbed area that supports a mosaic of plant communities. The site supports an excellent example of a subalpine willow carr (*Salix wolfii/Carex aquatilis*). There is a good occurrence of a globally rare lower

montane woodland (*Pinus aristata/Festuca thurberi*) and a state rare riparian shrubland (*Betula glandulosa*/mesic forb-mesic graminoid). There is a good occurrence of a western slope sagebrush shrubland (*Artemisia cana/Festuca idahoensis*) also documented for this site. The site is also good potential habitat for the state endangered southern Rocky Mountain boreal toad (*Bufo boreas boreas*). The site was surveyed for the boreal toad in 1997, but none were found.

Natural Heritage elements at the Muggins Gulch site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Artemisia cana/Festuca idahoensis</i>	western slope sagebrush shrublands	G4	SU				B
<i>Betula glandulosa</i> /mesic forb and graminoid	subalpine riparian shrubland	GU	S2S3				B
<i>Pinus aristata/Festuca thurberi</i>	lower montane woodlands	G3	S2				B
<i>Salix wolfii/Carex aquatilis</i>	subalpine willow carr	G4	S3				A

*EO=Element Occurrence

Boundary Justifications: The boundary drawn includes the drainages and adjacent upslope areas. There is a 1,000 ft buffer drawn to provide protection from immediate impacts, such as development. A much larger area should be considered in any long-term management or protection plan to protect the hydrology.

Protection Rank Justification: The site is owned privately with adjacent public lands. The private owners are interested in keeping area as open space. The U.S. Forest Service plans are unknown. The area is surrounded by residential development. The Keystone Ski Area and the Keystone Ranch are located to the north of site. There is a residential development next to the Swan River along the western border of the site. There is the threat that Keystone Ski Area will expand and eventually be linked with Breckenridge Ski Area.

Management Rank Justification: Management actions must be taken immediately to prevent loss of the elements. The private landowners are considering construction of a 5 acre pond which would negatively impact the willow communities (e.g., introduction of non-native fish and plants) and alter the hydrology of the site, possibly diminishing boreal toad habitat. Beaver should be reintroduced to the site to improve the viability of the riparian areas. Monitoring of water quality should be considered, especially with the proposed pond creation. The hydrology of this site is important to the ecological processes which support the riparian communities. The water quality, quantity, and timing should be maintained at its current status. The Forest Service should monitor the bristlecone pine occurrence due to the observed dying branches, perhaps from pine bark beetle activity. This site would be a good place to promote the importance of wetlands through interpretive displays for the bed and breakfast patrons.

Wetland Functional Evaluation for the Muggins Gulch site:

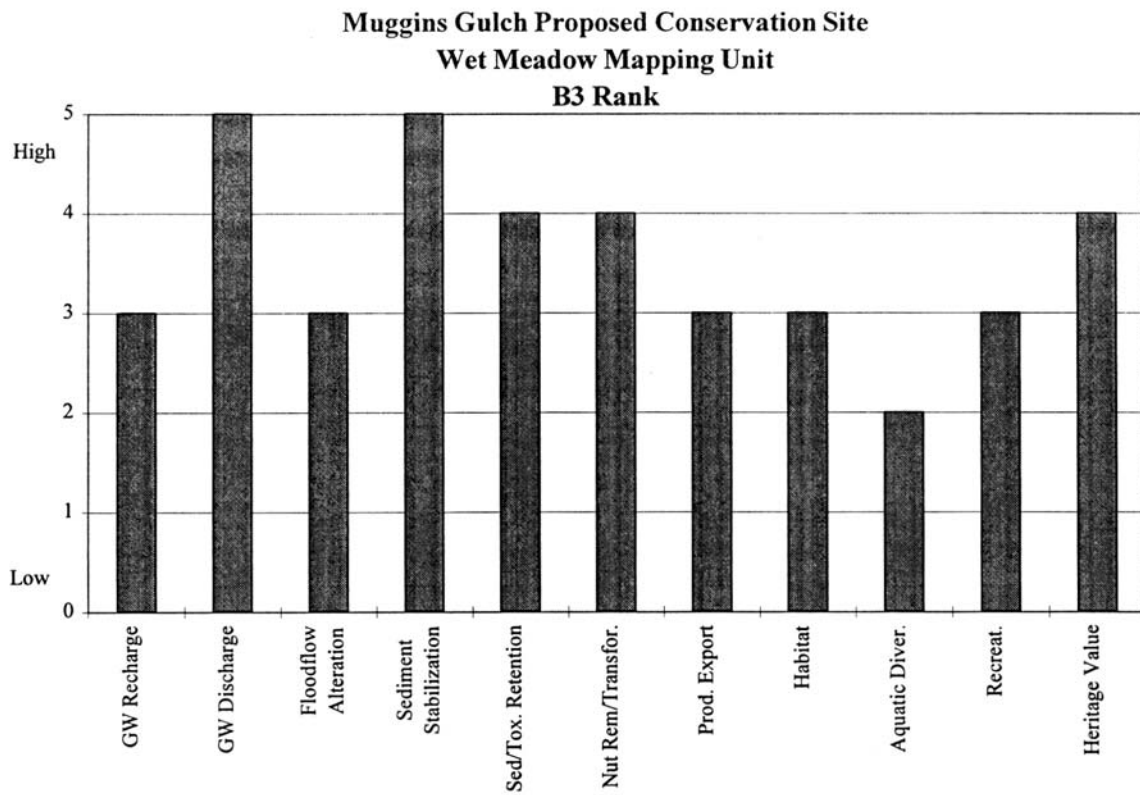
Proposed HGM wetland class: Riverine and slope wetlands with permanent to seasonal saturation and evidence of continuous to occasional inundation

Wetland functional evaluation for the Muggins Gulch site (wet meadow mapping unit).

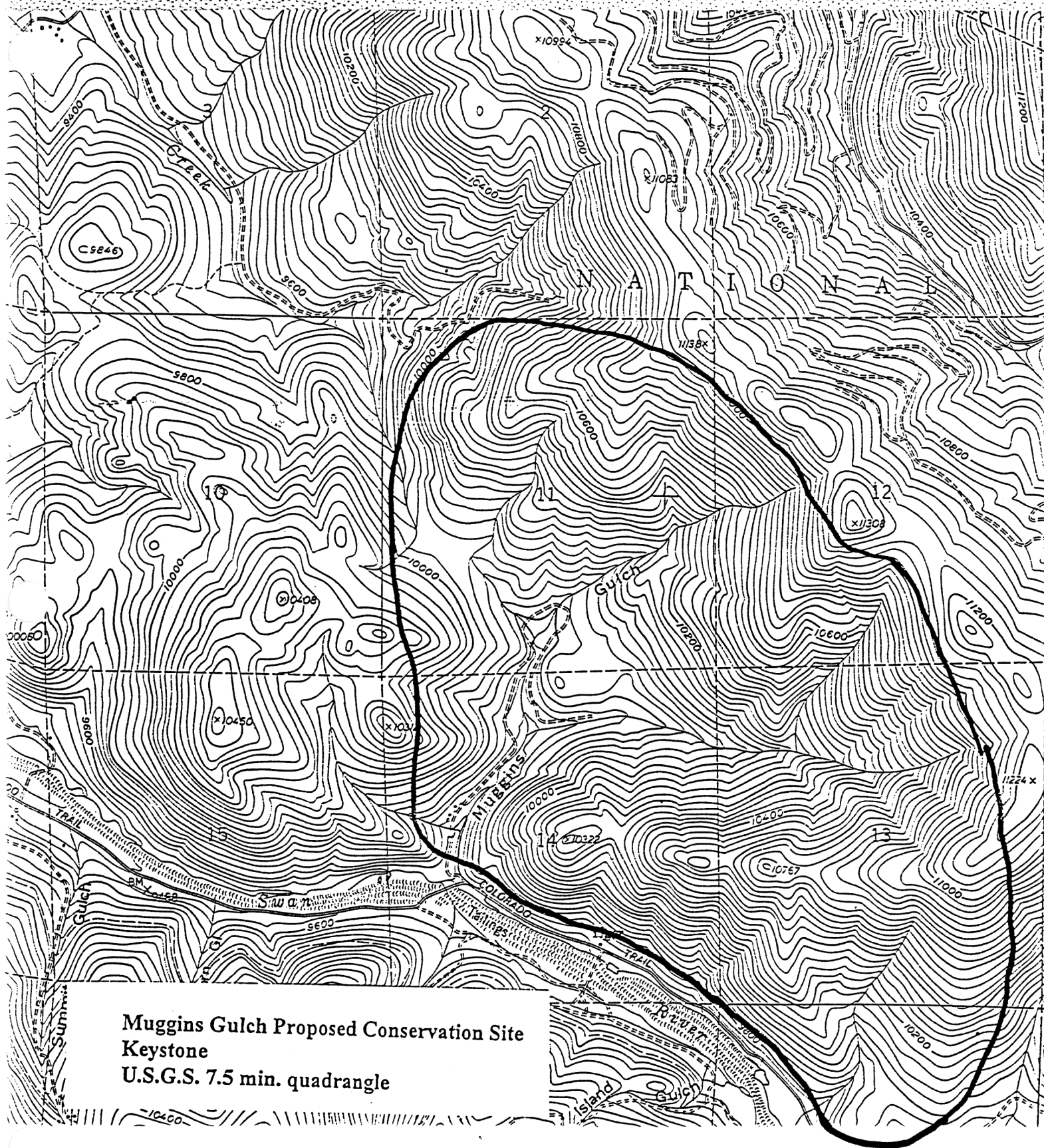
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	low flood water retention, clayey soils, dense vegetation, several constricted outlets due to old beaver dams
Groundwater Discharge	very high	high	numerous springs along slopes
Floodflow Alteration	medium	high	no flooding evident, but observed seasonally saturation from snow and springs
Sediment Stabilization	very high	high	very high vegetation density
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	constricted outlet, sediment built-up behind dams
Nutrient Removal/Transformation	high	medium	peaty soils, permanently saturated soils within the slope wetlands
Biological Functions			
Production Export	medium	medium	diverse vegetation, irregular shape
Habitat	medium	medium	observed many insects, fairy shrimp and fingerling trout (likely brook)
Aquatic Diversity/Abundance	low	medium	small wetland basin with not many area of open water
Recreation	medium	high	no active, scenic open space
Uniqueness/Heritage Value	high	high	A and B ranked globally rare communities

General Soil Description

Texture	sapric soils (up to 60 cm) within slope wetlands; Glacial till along riparian areas
Color	gleyed soils within slope wetlands 3/5 PB; Dark soils next to riparian areas
Cobble Size	small
Percent Mottling	1-3% next to riparian



Graph of function and value assessment for Muggins Gulch site.



Upper French Gulch

Biodiversity Rank: B3 (High significance)

The Upper French Gulch site supports an excellent example of a Colorado River cutthroat trout occurrence.

Protection Urgency Rank: P3

The Upper French Gulch site is owned both privately and publicly. It is threatened by residential development, road improvements, and mining activities.

Management Urgency Rank: M2

New management actions will be needed within 5 years to prevent the loss of the elements.

Location: Approximately 4 miles east of Breckenridge

U.S.G.S. 7.5 min. quadrangle: Boreas Pass

Legal Description: T6S R77 W Sections 34, 35

T7S R77 W Sections 2, 1

General Description: The Upper French Gulch site is a narrow, subalpine riparian willow carr located in a glacially carved valley between Bald Mountain and Mt. Guyot. French Gulch, Black Gulch, and Little French Gulch drain the site. There is an extensive montane riparian willow carr (*Salix planifolia*/*Carex aquatilis*) that supports several beaver ponds. The site is approximately 400 acres ranging in elevations from 3066 m (10,220 ft.) to 3264 m (10,800 ft.). The lower portion of the drainage was destroyed by dredging operations and is not included in the site. There is a 4WD road that parallels French Gulch that is currently closed to motorized use by the public. Motorized access is allowed for homeowners in the Mountain Meadows subdivision.

Biodiversity Rank Justification: The Upper French Gulch site supports an A-purity rank for a 1993 occurrence of the Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*). The Colorado River cutthroat trout is a U.S. Forest sensitive and a state special concern species. The introduction of non-native trout species, dating to 1872 in Colorado, is considered a primary cause for the decline in numbers and genetic purity of the Colorado River cutthroat trout. The population in Upper French Gulch in 1993 was determined to be genetically intact.

Natural Heritage elements at the Upper French Gulch site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Oncorhynchus clarki pleuriticus</i>	Colorado River cutthroat trout	G5T3	S3		SC	FS	A-purity rank

*EO=Element Occurrence

Boundary Justification: The boundary is drawn to encompass the riparian community and a 1,000 ft. buffer from each side of the river to protect the trout from direct disturbances, e.g.,

development, water diversions. A much larger area should be considered in any long-term management or protection plan to protect the hydrology.

Protection Rank Justification: The site is owned both publicly and privately. There are a number of potential threats to the site which include: residential/commercial development, road improvement or creation, and increase in mining/dredging operations.

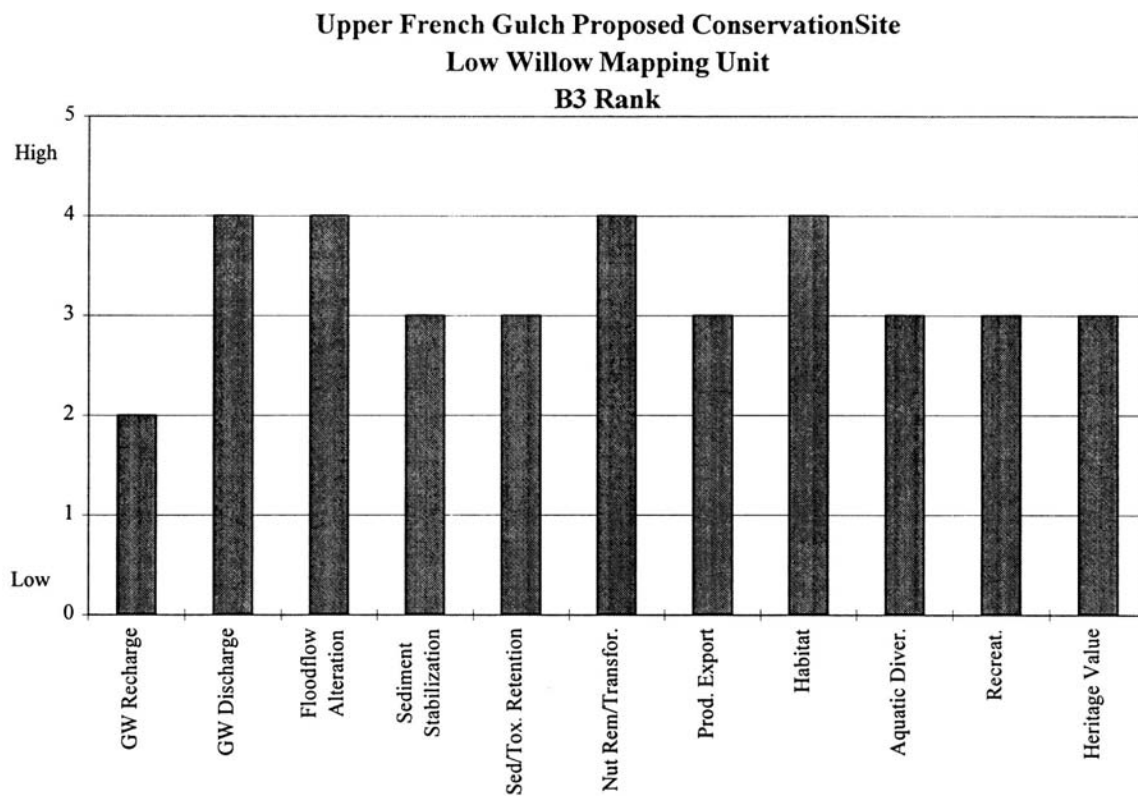
Management Rank Justification: New management actions will be required within the next 5 years. These actions could include: a management plan for cutthroat trout and beaver viability. The hydrology of this site is important to the ecological processes which support the trout and the riparian communities. The water quality, quantity, and timing should be maintained at its current status. Management should consider designating trails for winter and summer use to encourage users to stay on roads and trails to prevent erosion and trampling.

Wetland Functional Evaluation for the Upper French Gulch site:

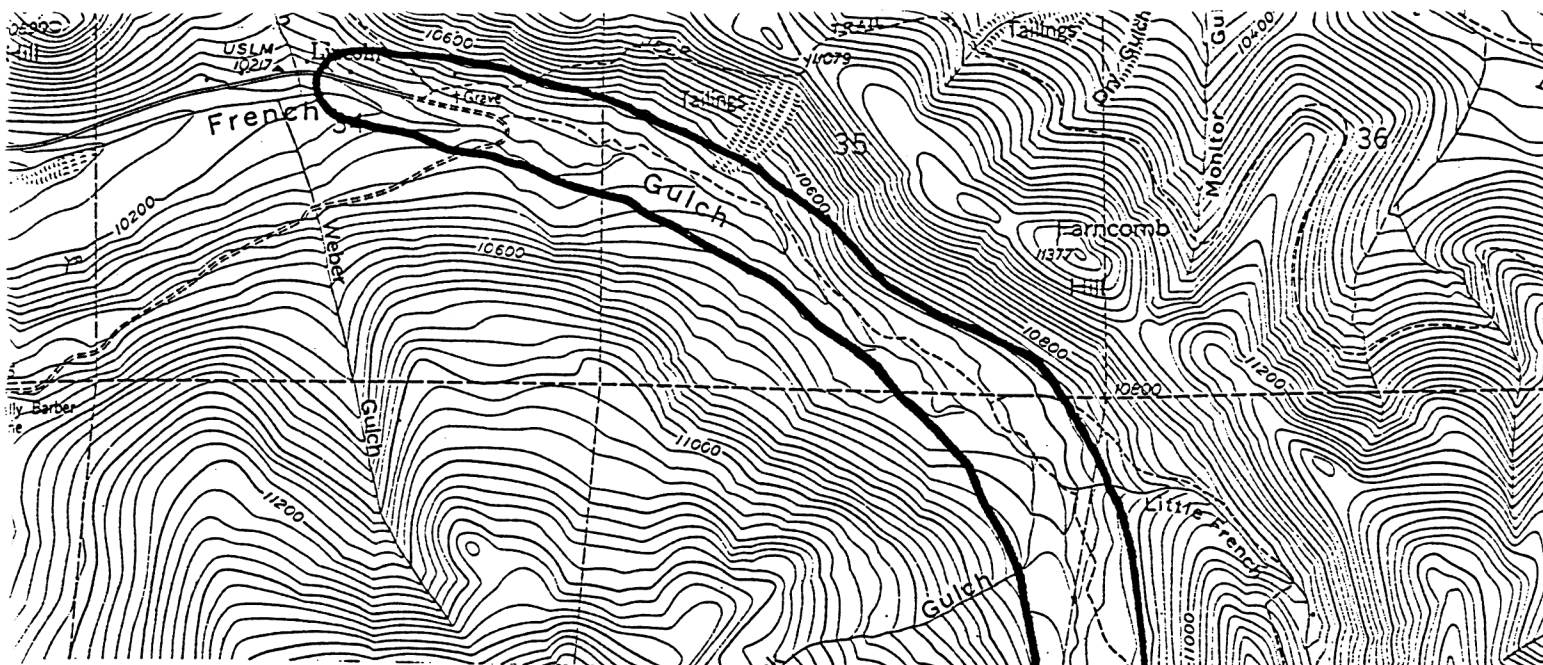
Proposed HGM wetland class: Riverine wetland with some springs with permanent to seasonal saturation

Wetland functional evaluation for the Upper French Gulch site (low willow mapping unit).

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	low	medium	beaver ponding and constrictions in channel may cause some recharge
Groundwater Discharge	high	high	numerous seeps/slopes along edges
Floodflow Alteration	high	high	low order stream, beaver, good microtopography
Sediment Stabilization	medium	medium	moderated vegetation density
Biogeochemical Functions			
Sediment/Toxicant Retention	medium	medium	moderate vegetation
Nutrient Removal/Transformation	high	medium	vigorous woody growth, some sediment trapping, complex mosaic of toxic/anoxic soils
Biological Functions			
Production Export	medium	medium	moderate productivity, dead wetlands downstream
Habitat	high	medium	sign of abundant beaver, some elk
Recreation	medium	medium	nice view, little hiking
Uniqueness/Heritage Value	medium	medium	A rank of Colorado River cutthroat trout
General Soil Description			
Texture	alluvial soils, considerable loam, moderate to coarse sand in some areas		
Color	gleyed in several areas		
Cobble Size	small to moderate		
Percent Mottling	redox features at 10 inches in areas		



Graph of function and value assessment for Upper French Gulch site.



Upper French Gulch Proposed Conservation Site
Boreas Pass
U.S.G.S. 7.5 min. quadrangle



AREAS OF LOCAL SIGNIFICANCE

Blue River Arm at Dillon Reservoir

Location: 2 miles east of Frisco on Highway 9

U.S.G.S. quadrangle name (s): Frisco

Legal Description: T5S R77W Section 31

General Description: The Blue River Arm at Dillon Reservoir area is a lacustrine wetland located at the south end of the Dillon Reservoir. The montane riparian willow carr (*Salix monticola*-*Salix geyeriana*/mesic forb) is located between the gravel access road and the Keystone Road. There is a small occurrence of a subalpine riparian willow carr (*Salix planifolia*/*Carex aquatilis*) located in the boggy areas of the Blue River. A beaked sedge (*Carex utriculata*) wetland is located west of the gravel access road. There is a small occurrence of mare's tail (*Hippuris vulgaris*) located in the littoral zone. The area is approximately 30 acres at an elevation of 2700 m (9,000 ft.).

The wetland does receive some fluctuation of water levels, but no more than 30-40 cm. It appears that the middle of the willow carr is drier than surrounding area, probably due to the slight rise in elevation. This part of the willow carr appears that it was filled, perhaps during dam construction. A sewage treatment plant is located adjacent to the Blue River in the southern portion of the area. There is a gravel boat ramp and road that bisects the area.

Protection Considerations: This area is privately owned with access points open to the public. Threats to the site could include filling of the wetland for residential/ commercial expansion or an increase in water level in Dillon Reservoir.

Management Considerations: Although not currently threatened, management may be needed in the future to maintain the current quality the riparian and wetland communities.

Wetland Functional Evaluation for the Blue River Arm at Dillon Reservoir area:

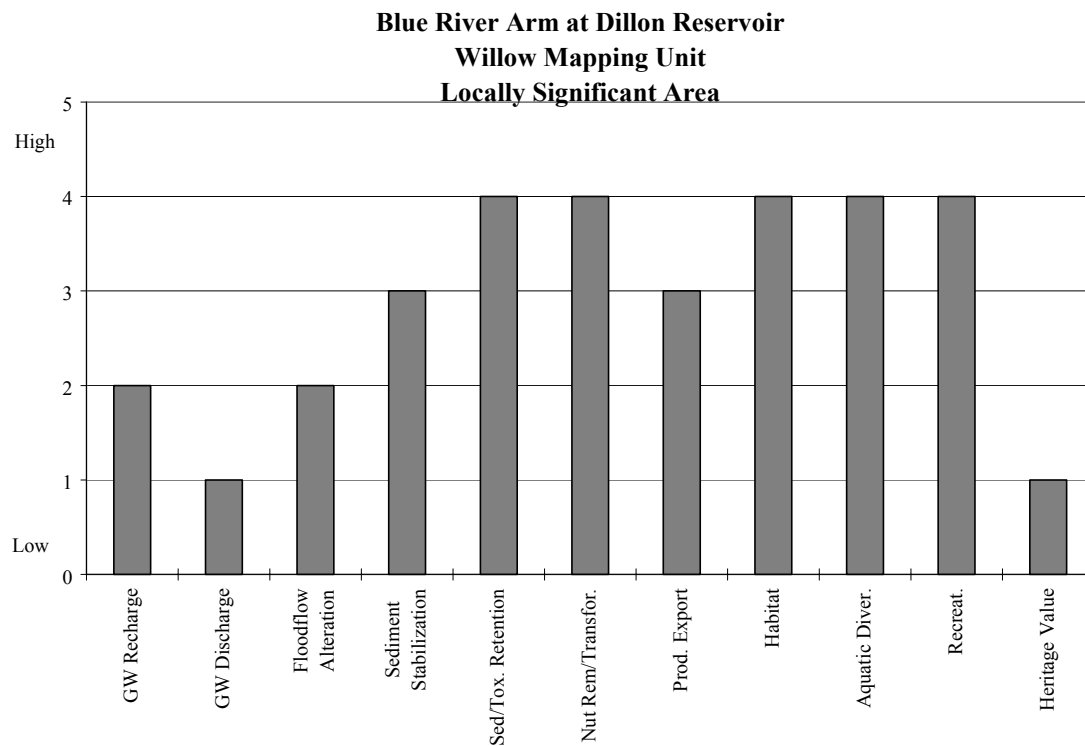
Proposed HGM wetland class: Lacustrine wetland with intermittent saturation and rare flooding

Wetland functional evaluation for the Blue River Arm at Dillon Reservoir area.

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	low	high	some recharge from storage of water during storm events and flooding of Blue River
Groundwater Discharge	no	high	no evidence of springs
Floodflow Alteration	low	high	area has been filled from dam construction, but sedge wetland does retain some water
Sediment Stabilization	medium	high	dense vegetation along edge of reservoir that can trap sediments from above construction activities and gravel mining operations
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	located below water treatment plant, dense vegetation
Nutrient Removal/Transformation	high	medium	high sediment retention, some peat accumulation, located below construction, mining, and water treatment activities
Biological Functions			
Production Export	medium	high	Blue River does flush area to a small degree, dense vegetation located next to river
Habitat	high	high	Blue River is good fishing habitat “gold medal”
Aquatic Diversity/Abundance	high	high	observed fish and several anglers
Recreation	high	high	heavily used fishing and boat access
Uniqueness/Heritage Value	no	high	not an area of biodiversity significance

General Soil Description

Texture	soils peaty in the sedge wetland, some sane
Color	dark 10YR 3/1
Cobble Size	small
Percent Mottling	1-5% in sedge wetland, no redox in middle of carr



Graph of function and value assessment for Blue River Arm at Dillon Reservoir area.

Braddock Flats

Location: 3.2 miles north of Breckenridge; west of Highway 9; next to Blue River

U.S.G.S. quadrangle name (s): Frisco

Legal Description: T6S R78W Section 13; T6S R77W Section 18, 7

General Description: The Braddock Flats area is dominated by an alpine willow scrub (*Salix brachycarpa*/mesic forb) located west of the Blue River. East of the Blue River has been completely altered by dredging operations. The Blue River borders the area, but has been channelized. The remaining willow carr is a remnant of a much more extensive carr. There are beaver ponds within the area that are active. Mainly native grasses and sedges occupy the understory. Upslope of the carr are numerous springs within the western slope sagebrush shrublands (*Artemisia cana*/*Festuca thurberi*). The area is approximately 40 acres ranging in elevation from 2738 m (9127 ft.) to 2880 m (9600 ft.)

Protection Considerations: The area is privately owned with adjacent public lands. The area has been totally altered by dredging operations and there exists the high probability that these operations could be extended.

Management Considerations: Management actions for the Braddock Flats area should consider management for the remaining willow carr that would include restoration of streambank and beaver viability.

Wetland Functional Evaluation for the Braddock Flats area:

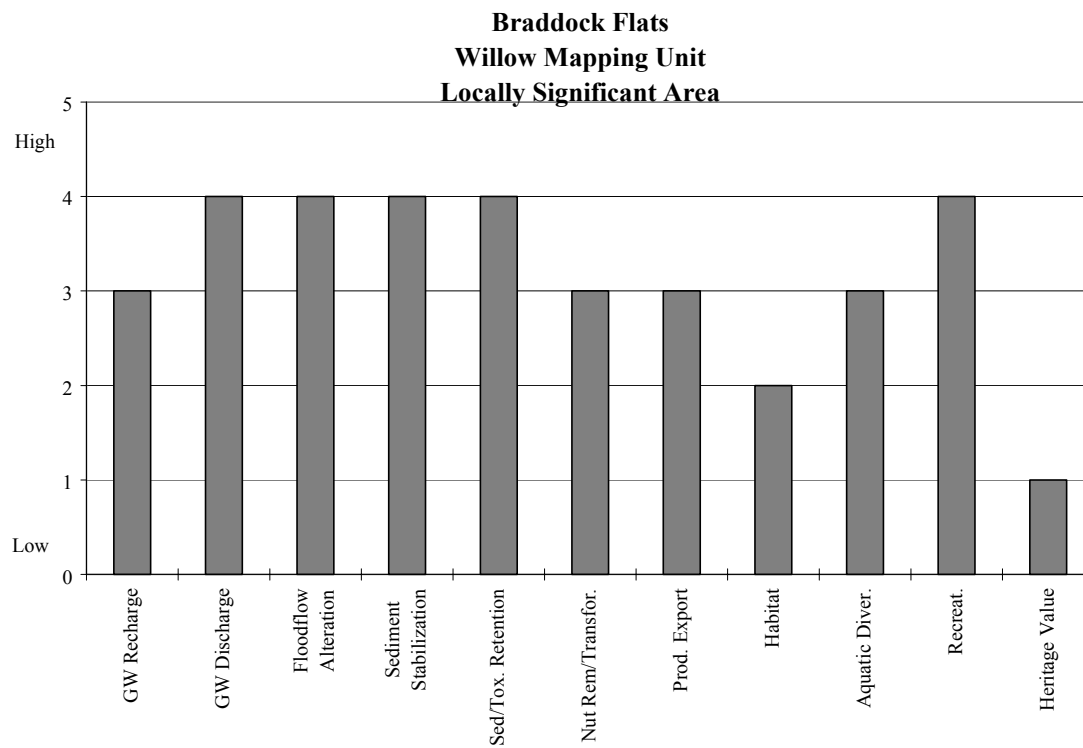
Proposed HGM wetland class: Riparian wetland with seasonal saturation and frequent flooding

Wetland functional evaluation for the Braddock Flats area.

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	clayey soils, dense vegetation, located above river
Groundwater Discharge	high	high	no springs next to river, but several upslope
Floodflow Alteration	high	high	mottling, debris, sediment deposits
Sediment Stabilization	high	high	heavily vegetated shoreline, but river is channelized from gravel extraction
Biogeochemical Functions			
Sediment/Toxicant Retention	high	high	several beaver ponds, dense vegetation, deposits of sediment, likely from construction upslope of river
Nutrient Removal/Transformation	medium	medium	construction above wetland, beaver ponds
Biological Functions			
Production Export	medium	medium	flushing flows, outlet, vegetation overhanging water
Habitat	low	high	fragmented by road, bike path, and dredging operations
Aquatic Diversity/Abundance	medium	medium	likely good fishing
Recreation	high	high	fishing, bicycling, hiking
Uniqueness/Heritage Value	no	high	degraded wetland

General Soil Description

Texture	clayey soils gleying at 50cm
Color	matrix 10YR 3/2; gleyed at 4/N
Cobble Size	small
Percent Mottling	7%: color 5YR 4/6



Graph of function and value assessment for Braddock Flats area.

Hoosier Creek

Location: 0.5 miles north of Hoosier Pass along Highway 9

U.S.G.S. quadrangle name (s): Breckenridge

Legal Description: T8S R78W Section 12

General Description: The Hoosier Creek area supports a subalpine riparian willow carr (*Salix brachycarpa*/mesic forb). The area is and is in the process of being subdivided into residential homes. Access roads and human-made ponds are located throughout the area. The area extends from Hoosier Pass to the confluence of Hoosier Creek and Blue Rive.

Protection Considerations: The Hoosier Creek area is immediately threatened by severely destructive forces, e.g., construction, roads, within the next year.

Management Considerations: Management actions are required immediately to prevent further fragmentation and destruction of the wetlands.

Wetland Functional Evaluation for the Hoosier Creek area:

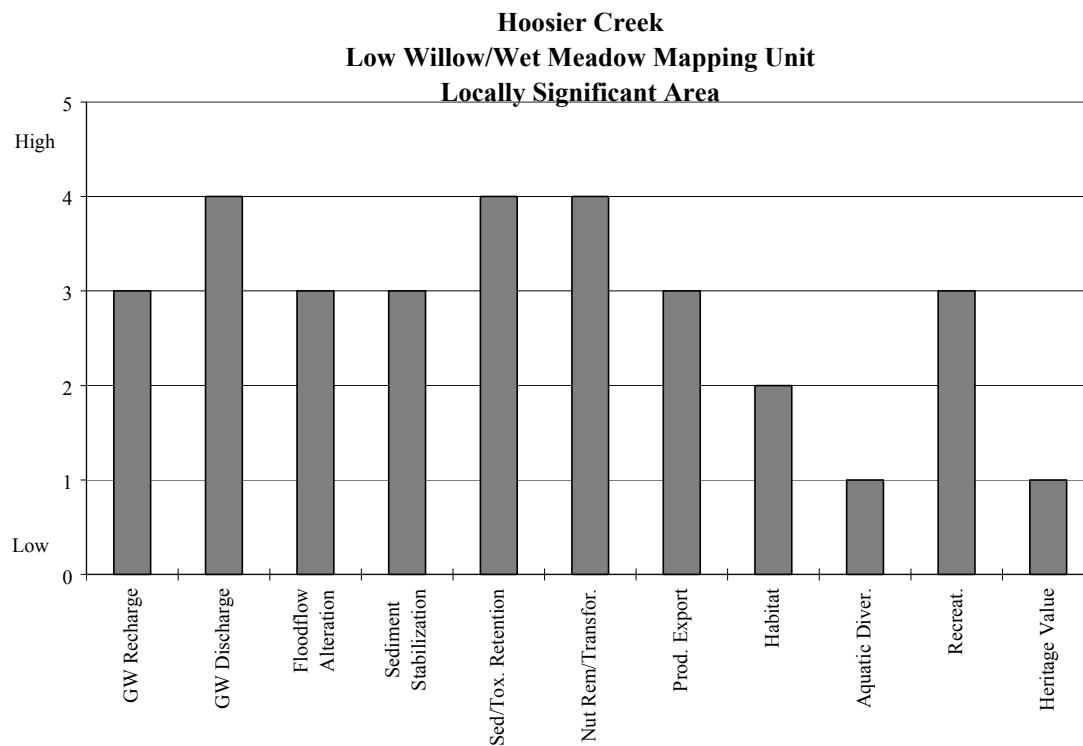
Proposed HGM wetland class: Riverine wetland with seasonal saturation and continuous to seasonal inundation

Wetland functional evaluation for the Hoosier Creek area.

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	peaty soils, dense vegetation in some places, fragmented willow carr, first order stream
Groundwater Discharge	high	high	observed several springs
Floodflow Alteration	medium	high	no redox, permanently saturated soils in some places
Sediment Stabilization	medium	high	dense vegetation in some areas, carr is fragmented by homes and roads
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	road maintenance activities, construction throughout the area
Nutrient Removal/Transformation	high	medium	high sediment retention, peaty soils in many places
Biological Functions			
Production Export	medium	medium	no flushing flows, permanently flooded
Habitat	low	high	fragmented carr
Aquatic Diversity/Abundance	no	high	on fish observed
Recreation	medium	high	passive only
Uniqueness/Heritage Value	no	high	degraded wetland

General Soil Description

Texture	peaty in many areas, glacial till
Color	dark, 10YR 3/1 gleying in several places
Cobble Size	none or small
Percent Mottling	1-5%



Graph of function and value assessment for Hoosier Creek area.

Indiana Creek

Location: 2 miles north of Breckenridge; east of Highway 9

U.S.G.S. quadrangle name (s): Breckenridge

Legal Description: T7S R 77 W Sections 17,16, 8

General Description: The Indiana Creek area is a riparian wetland located within the Spruce Valley Ranch subdivision. The montane riparian willow carr and alpine willow scrub (*Salix drummondiana*/mesic forb and *Salix brachycarpa*/mesic forb) is approximately 80 acres, ranging in elevation from 3036 m (10,120 ft.) to 3048 m (10,160 ft.). There are diversion ditches near homes, likely to prevent flooding. There are two access roads, one to the south and one that bisects the willow carr. There are active beaver within the site.

The Indiana Creek area supports a 1994 occurrence of Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*), a U.S. Forest Service sensitive and state special concern species. The occurrence documents a mixed population brooks trout and cutthroat trout due to the lack of a barrier

Protection Considerations: The area is privately owned and appears to be designated open space.

Management Considerations: Management actions could include a management plan to ensure beaver viability.

Wetland Functional Evaluation for the Indiana Creek area:

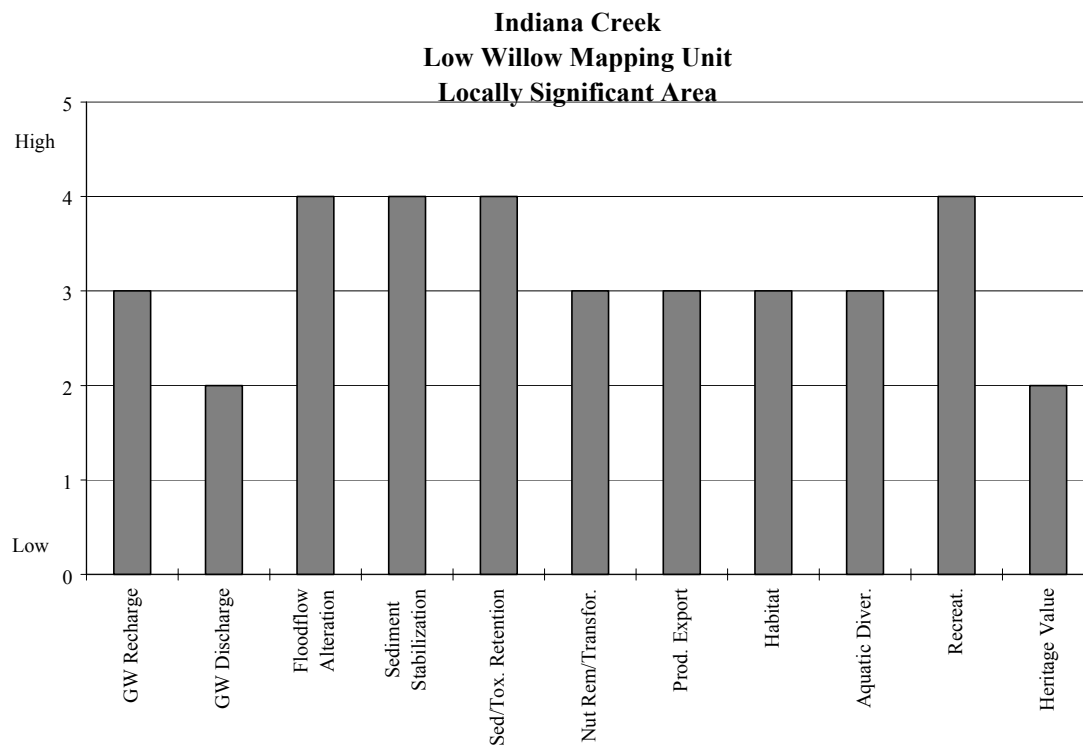
Proposed HGM wetland class: Riverine wetland with seasonal saturation and continuous to frequent flooding periods

Wetland functional evaluation for the Indiana Creek area.

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	somewhat porous soils, dense vegetation, beaver ponds, irregular shape
Groundwater Discharge	low	medium	no obvious springs or seeps
Floodflow Alteration	high	high	low gradient, dense vegetation, debris and sediment accumulation
Sediment Stabilization	high	high	densely vegetated along open water and streams
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	constricted outlets due to beaver ponds, low gradients, sediment and mud accumulation, several mines located upstream
Nutrient Removal/Transformation	medium	medium	constricted outlets, flooded permanently in areas, no aquatic vegetation
Biological Functions			
Production Export	medium	medium	vegetation overhanging, there is an outlet, but presence of ponds restricts flow
Habitat	medium	medium	elk, deer, moose
Aquatic Diversity/Abundance	medium	medium	observed fish, likely brook
Recreation	high	high	open space for residential area
Uniqueness/Heritage Value	low	high	B rank of GUS4

General Soil Description

Texture	moderately clayey with some sand
Color	red 7YR 3/2
Cobble Size	small to medium
Percent Mottling	mottling-difficult to get a soil sample due to the glacial till



Graph of function and value assessment for Indiana Creek area.

Quandry Peak/Bemrose Subdivision

Location: 5 miles south of Breckenridge; east of Highway 9

U.S.G.S. quadrangle name (s): Breckenridge

Legal Description: T8S R78W Section 1

T8S R77W Section 6

T7S R77W Sections 31, 30

General Description: The Quandry Peak/Bemrose Subdivision area is a riparian/slope wetland that is fragmented by homes, access roads, and human-made ponds. Several areas of the willow carr and wetland have been filled for homes and roads. The subalpine riparian willow carr (*Salix planifolia*/*Carex aquatilis*) with short-beaked willow (*Salix brachycarpa*) dominate the wetland. Englemann spruce (*Picea engelmannii*) and lodgepole pine (*Pinus contorta*) dominate the slopes above the willow carr.

Protection Considerations: This area is immediately threatened by destructive forces such as residential homes, roads, and filling of wetlands within the next year.

Management Considerations: Management actions are required immediately to prevent further fragmentation and destruction of the wetlands

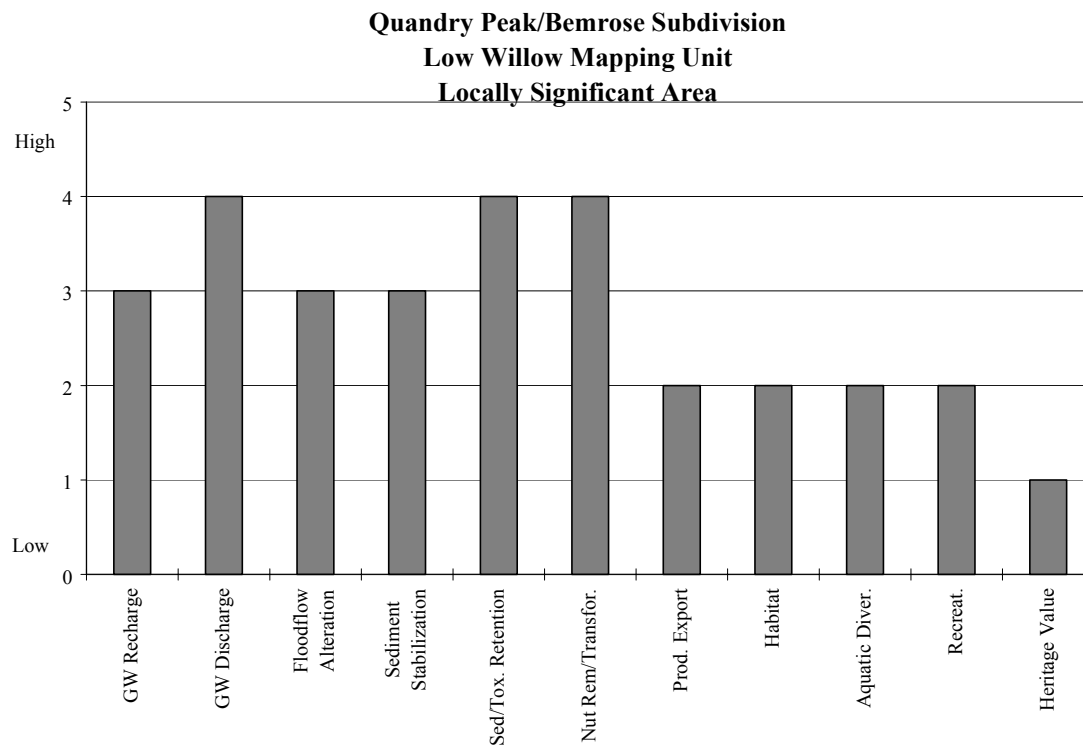
Wetland Functional Evaluation for the Quandry Peak/Bemrose Subdivision area:
Proposed HGM wetland class: Riparian and slope wetland with a seasonal to permanent saturation

Wetland functional evaluation for the Quandry Peak/Bemrose Subdivision area.

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	sandy to peaty soils, dense vegetation in some areas, wetland highly fragmented
Groundwater Discharge	high	high	several springs observed
Floodflow Alteration	medium	high	low redox, no sediment/debris trapping observed
Sediment Stabilization	medium	high	moderately vegetated in some area
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	construction, road improvement and maintenance within wetland
Nutrient Removal/Transformation	high	medium	high sediment retention, peaty soils
Biological Functions			
Production Export	low	medium	no flushing flows, fragmented
Habitat	low	medium	highly fragmented, no corridors
Aquatic Diversity/Abundance	low	medium	no fish observed, probably fish stocked in ponds
Recreation	low	high	mainly passive
Uniqueness/Heritage Value	no	high	degraded wetland

General Soil Description

Texture	peaty with some sand/glacial till
Color	dark 10YR 3/2
Cobble Size	small
Percent Mottling	1-5%



Graph of function and value assessment for Quandry Peak/Bemrose subdivision area.

Whatley Ranch

Location: 2.2 miles north of Breckenridge

U.S.G.S. quadrangle name (s): Frisco

Legal Description: T6S R78W Sections 13, 14

General Description: The Whatley Ranch is a riparian wetland located along North Barton Gulch. The area is located on the east side of Tenmile Peak. It contains irrigation ditches throughout. Prior to 1978, the ranch was platted for homes and golf course. Currently, there are 4-6 structures, several roads, hay meadows, and several human-made ponds. There is evidence of recent beaver activity, especially along the irrigation ditches. The subalpine riparian willow carr (*Salix planifolia*/*Caltha leptosepala*) is a remnant of a much more extensive carr. Drier areas are dominated by hay grasses and exotic plants. Uplands consist of lodgepole pine and Engelmann spruce.

Protection Considerations: The Whatley Ranch is privately owned with adjacent public lands. The area has is not in agriculture production presently, but there are plans to place the hay meadows back in to full production.

Management Considerations: Management actions should include reintroduction of beaver to certain areas, cessation of pond building, and control of exotic plants.

Wetland Functional Evaluation for the Whatley Ranch area:

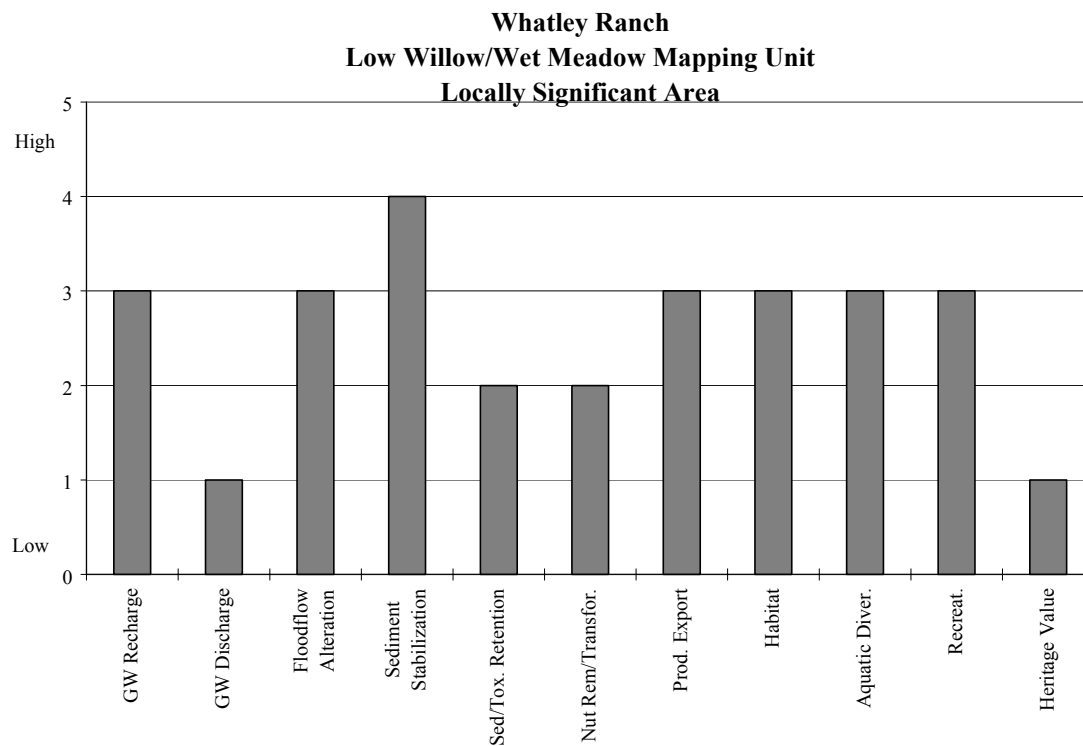
Proposed HGM wetland class: Riparian/slope wetland with a permanent to seasonal saturation

Wetland functional evaluation for the Whatley Ranch area.

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	clayey soils, but dense vegetation, creek has several ditches, flooding not as intense as it was historically
Groundwater Discharge	no	high	no springs on property, perhaps on USFS lands above
Floodflow Alteration	medium	high	floodflow has been altered by ditches and ponds
Sediment Stabilization	high	high	dense vegetation by natural water course
Biogeochemical Functions			
Sediment/Toxicant Retention	low	medium	dense vegetation, but low flooding
Nutrient Removal/Transformation	low	medium	no or low flushing flows, some peat accumulation
Biological Functions			
Production Export	medium	medium	seasonally flooded, moderate-dense vegetation, clayey soils
Habitat	medium	high	riverine system fragmented, as well as willow carr by hay meadows and ditches
Aquatic Diversity/Abundance	medium	high	ponds stocked with brook trout
Recreation	medium	high	fishing
Uniqueness/Heritage Value	no	high	degraded common willow community

General Soil Description

Texture	clayey with some sand
Color	10 YR 3/2
Cobble Size	small
Percent Mottling	2% in first 10cm



Graph of function and value assessment for Whatley Ranch area.

LOWER BLUE RIVER BASIN

Horse Creek

Biodiversity Rank: B2 (Very high significance)

The Horse Creek site supports good examples of the globally rare clustered sedge wetland and a state rare xeric sagebrush shrubland. The site also supports a fair example of a globally rare montane willow carr and a 1994 occurrence of the state rare boreal owl.

Protection Urgency Rank: P3

The majority of this site is privately owned. Threats to the site include increased fragmentation and altered hydrology due to agricultural activities. The potential of residential development is high due to the close proximity of Green Mountain Reservoir. This site would be an excellent candidate for a conservation easement.

Management Urgency Rank: M2

New management actions will be needed within five years to prevent the loss of element occurrences. Actions could include fencing off the fen and riparian areas and grazing during late fall.

Location: 23 miles north of Silverthorne, next to Highway 9; one mile north of Cow Creek campground

U.S.G.S. 7.5 min. quadrangle: King Creek; Battle Mountain

Legal Description: T2S R79W Sections 7, 6, 8, 17, 18, 5

T2S R80W Sections 1, 12

General Description: The Horse Creek site is located at the base of the Williams Fork Mountains and on the northeastern side of Green Mountain Reservoir. Mumford Gulch, Horse Gulch, and Horse Creek flow through the site. The site supports a fen (peat-accumulating wetland that is supported by ground water discharge) dominated by clustered sedge (*Carex praegracilis*), beaked sedge (*Carex utriculata*), and water hemlock (*Cicuta douglasii*). The fen is located at the confluence of several springs that emerge from deposits of Pierre Shale. The montane willow carr (*Salix geyeriana*-*Salix monticola*/*Calamagrostis canadensis*) extends northwest up the intermittent streams. The uplands are dominated by xeric sagebrush shrublands (*Artemisia tridentata* ssp. *wyomingensis*/*Pseudoroegneria spicata*). The site is approximately 3,000 acres ranging in elevation from 2400 m (8,000 ft.) to 2700 m (9,000 ft.).

The entire site, except for the boggy areas, receives moderate to heavy grazing. A two-track road borders the site to the north. A hay meadow fragments the willow carr in the southern portion of the site.

Biodiversity Rank Justification: The Horse Creek site is unique in that it contains one of the few relatively intact fens observed on private lands in Summit County. The fen supports a good example of a globally rare clustered sedge (*Carex praegracilis*) wetland. There are only five occurrences of clustered sedge wetlands known in Colorado; three of these are located in Summit County (CNHP 1997). There is a good example of a xeric sagebrush shrubland

(*Artemisia tridentata* ssp. *wyomingensis*/ *Pseudoroegneria spicata*). There are 13 known Colorado occurrences of this community type and only two of these are found in Summit County. The site also supports a fair example of a globally rare montane riparian willow carr (*Salix geyeriana*-*Salix monticola*/ *Calamagrostis canadensis*). The boreal owl (*Aegolius funereus*), a U.S. Forest Service sensitive species, has been located within the Horse Creek site.

Natural Heritage elements at the Horse Creek site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Aegolius funereus</i>	boreal owl	G5	S2			FS	unranked
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> / <i>Pseudoroegneria spicata</i>	xeric sagebrush shrublands	G5	S3?				B
<i>Carex praegracilis</i>	clustered sedge wetland	G2G3	S2				B
<i>Salix geyeriana</i> - <i>Salix monticola</i> / <i>Calamagrostis canadensis</i>	montane riparian willow carr	G3	S3				C

*EO=Element Occurrence

Boundary Justification: The boundaries drawn encompass the fen, the willow carr, and the intermittent streams to provide a buffer from direct impacts (e.g., water diversions, increased agriculture production) to the hydrology. The site boundaries extend west to the county line to include the sagebrush community and north to include spruce/fir habitat for the boreal owl.

Protection Rank Justification: The majority of this site is entirely privately owned. There are several anthropogenic threats that include: fragmentation, altered hydrology, increased agricultural activities, and residential development. This site would be an excellent opportunity for a conservation easement.

Management Rank Justification: New management for the site must take place within 5 years or the element occurrences could be lost. Actions could include: fencing off the willow carr and fen and monitoring the water. The hydrology of this site is important to the ecological processes which support the riparian communities. The water quality, quantity, and timing should be maintained at current levels.

Wetland Functional Evaluation for the Horse Creek site:

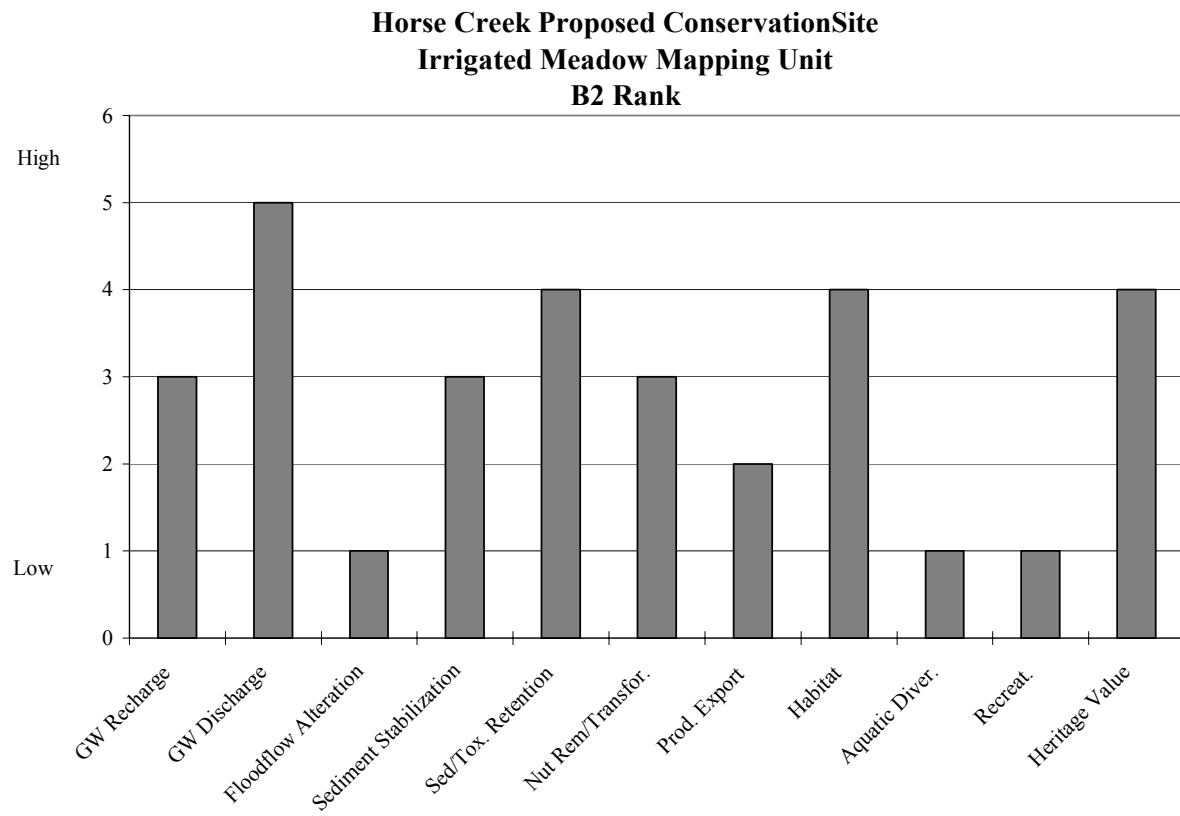
Proposed HGM wetland class: Slope wetland with permanent saturation and continuous inundation

Wetland functional evaluation for the Horse Creek site (irrigated meadow mapping unit).

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	densely vegetated, but clayey soils, constricted outlet
Groundwater Discharge	very high	high	located at confluence of several springs and intermittent streams
Floodflow Alteration	low	high	no evidence of flooding
Sediment Stabilization	medium	high	high vegetation density with sedge understory, but little open water
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	constricted outlet, low gradient, organic matter, agricultural activities present
Nutrient Removal/Transformation	low	medium	saturated soils, organic matter accumulation, peaty soils
Biological Functions			
Production Export	low	medium	not seasonally flushed by floods, no outlet
Habitat	high	high	elk, snipe, birds
Aquatic Diversity/Abundance	low	high	no open water
Recreation	low	high	none
Uniqueness/Heritage Value	high	high	B rank of G2G3 sedge community

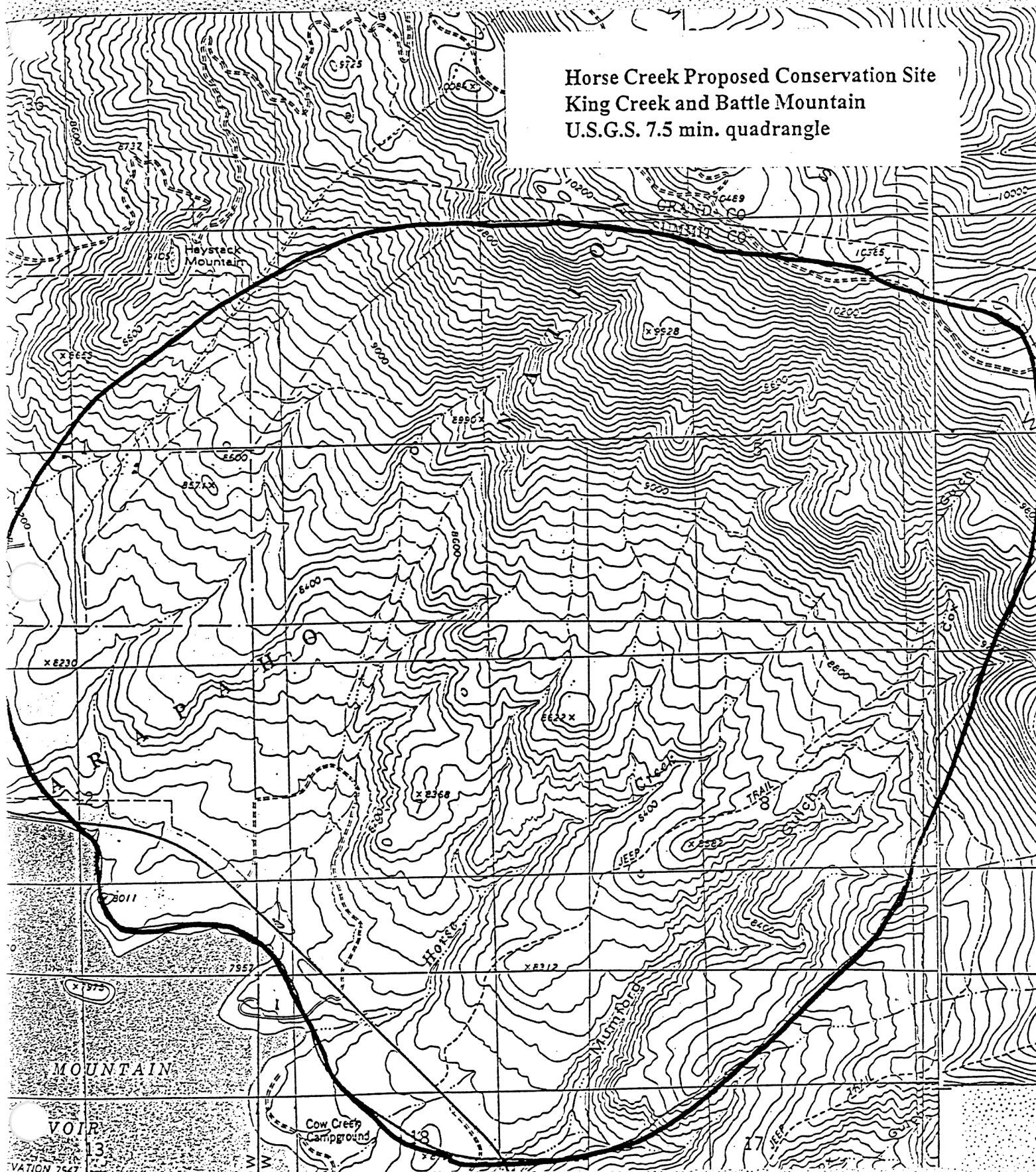
General Soil Description

Texture	peaty with gleying at 10 cm
Color	very black, sapric 5 YR 2.5/1, sulfur smell
Cobble Size	none
Percent Mottling	none



Graph of function and value assessment for Horse Creek site.

Horse Creek Proposed Conservation Site
King Creek and Battle Mountain
U.S.G.S. 7.5 min. quadrangle



Cataract Creek

Biodiversity Rank: B3 (High significance)

The Cataract Creek site supports a fair example of a globally rare clustered sedge wetland. Located on U.S. Forest Service lands within the site are occurrences of state rare low northern sedge, the Colorado River cutthroat trout, and a 1993 occurrence of the state endangered lynx.

Protection Urgency Rank: P3

The site is privately owned from Lower Cataract Lake downstream to Green Mountain Reservoir. Lower Cataract Lake is publicly owned. Threats to the site include: hydrological alterations, increased agricultural activities, or development.

Management Urgency Rank: M2

New management actions will be needed within five years to prevent the loss of element occurrences.

Location: 22 miles north of Silverthorne; southwest of Green Mountain Reservoir

U.S.G.S. 7.5 min. quadrangle: Mount Powell

Legal Description: T2S R79W Section 19;
T2S R80W Sections 25, 36, 35, 34, 36

General Description: The Cataract Creek site is located between the eastern side of the Gore Range and Green Mountain Reservoir. Cataract Creek is fed by several intermittent streams and numerous springs. The Cataract Creek site supports several riparian and wetland communities which include ponds with broad-leaf cattail marsh (*Typha latifolia*) and riparian areas that are dominated by thinleaf alder/Geyer willow (*Alnus incana*/*Salix geyeriana*). The site includes a U.S. Forest Service campground, hay fields, irrigation ditches, homes, and several access roads. The site is approximately 600 acres, ranging in elevation from 2508 m (8,360 ft.) to 2526 m (8,420 ft.).

Biodiversity Rank Justification: The Cataract Creek site supports a fair example of the globally rare clustered sedge wetland (*Carex praegracilis*). There are only five occurrences of clustered sedge wetlands known in Colorado; three of these are located in Summit County (CNHP 1997). There are also occurrences of the state rare low northern sedge (*Carex concinna*) and the Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*), a U.S. Forest Service sensitive and state special concern species. This occurrence was documented in 1992. It was observed that there was a mixed population of brook and native trout below a 75 ft. waterfall, however, above the barrier there were only native trout. There is a 1993 occurrence of lynx (*Felis lynx canadensis*), a U.S. Forest Service sensitive and state endangered species, documented in the site.

Natural Heritage elements at the Cataract Creek site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Carex concinna</i>	low northern sedge	G4G5	S1				unranked
<i>Carex praegracilis</i>	clustered sedge wetland	G2G3	S2				C
<i>Felis lynx canadensis</i>	lynx	G5	S1		E	FS	unranked
<i>Oncorhynchus clarki pleuriticus</i>	Colorado River cutthroat trout	G5T3	S3		SC	FS	unranked
<i>Populus tremuloides/Alnus incana</i>	montane riparian forest	GU	S3				A

*EO=Element Occurrence

Boundary Justification: The boundary drawn encompass all the elements and provides a buffer of 1,000 ft. to protect the hydrology and waterway from direct impacts such as, water diversion or development.

Protection Rank Justification: The site is owned both privately and publicly. Currently, there are no definable threats within the next five years for this site. Potential threats include: increased agricultural activities, altered hydrology, or development. A conservation easement for the slope wetlands/clustered sedge meadow is recommended.

Management Rank Justification: New management actions will be needed within five years to prevent the loss of the element occurrences. These actions should include a plan to maintain or increase beaver activity below the waterfall. Overall, the hydrology of this site is important to the ecological processes which support the cutthroat and riparian communities. The water quality, quantity, and timing should be maintained at current levels.

Wetland Functional Evaluation for the Cataract Creek site:

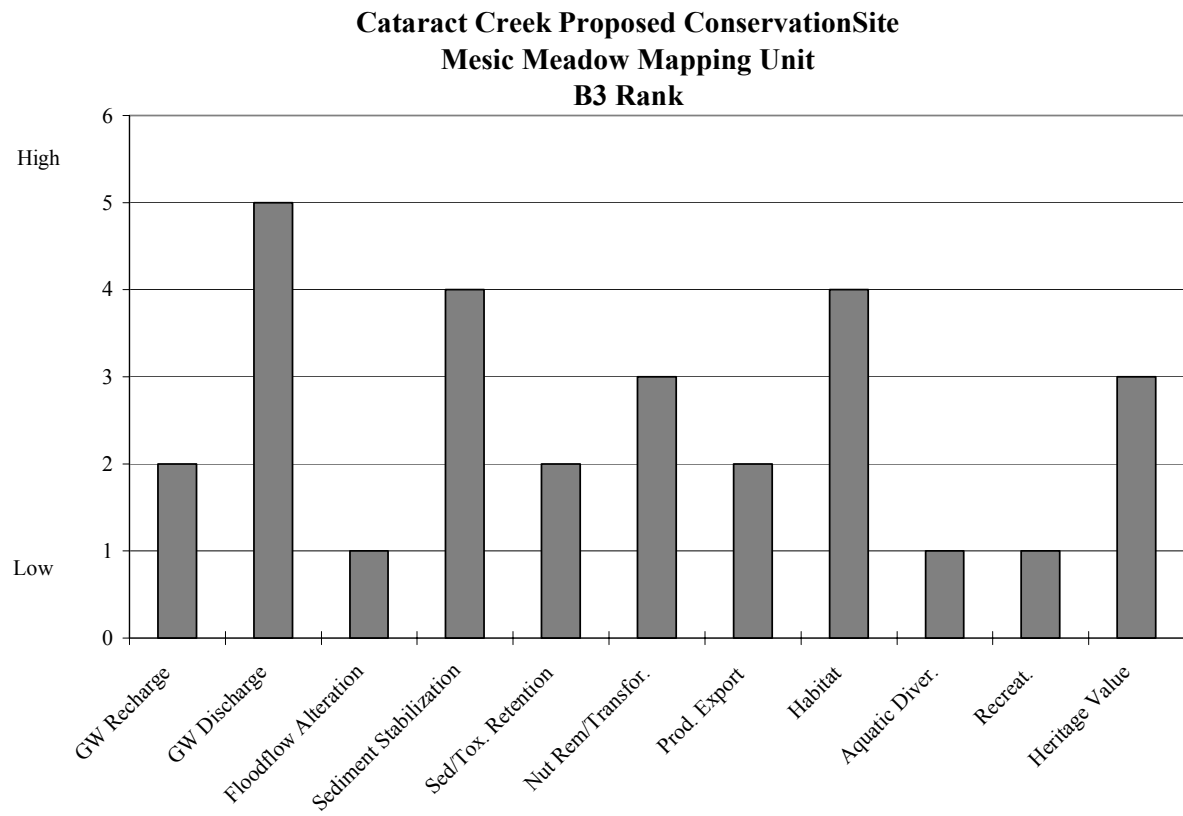
Proposed HGM wetland class: Depressional and slope wetland with permanent saturation and continuous inundation

Wetland functional evaluation for the Cataract Creek site (mesic meadow mapping unit).

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	low	high	clayey, peaty soils
Groundwater Discharge	very high	high	numerous springs
Floodflow Alteration	low	high	no evidence
Sediment Stabilization	high	high	dense vegetation
Biogeochemical Functions			
Sediment/Toxicant Retention	low	medium	no flooding
Nutrient Removal/Transformation	medium	medium	flooded permanently, pond weeds, organic matter accumulation
Biological Functions			
Production Export	low	medium	permanently flooded, no flushing flows
Habitat	high	high	observed 2 snipes and several red winged blackbirds, lots of insects
Aquatic Diversity/Abundance	low	high	no fish
Recreation	low	high	none
Uniqueness/Heritage Value	medium	high	C rank of G2G3 community

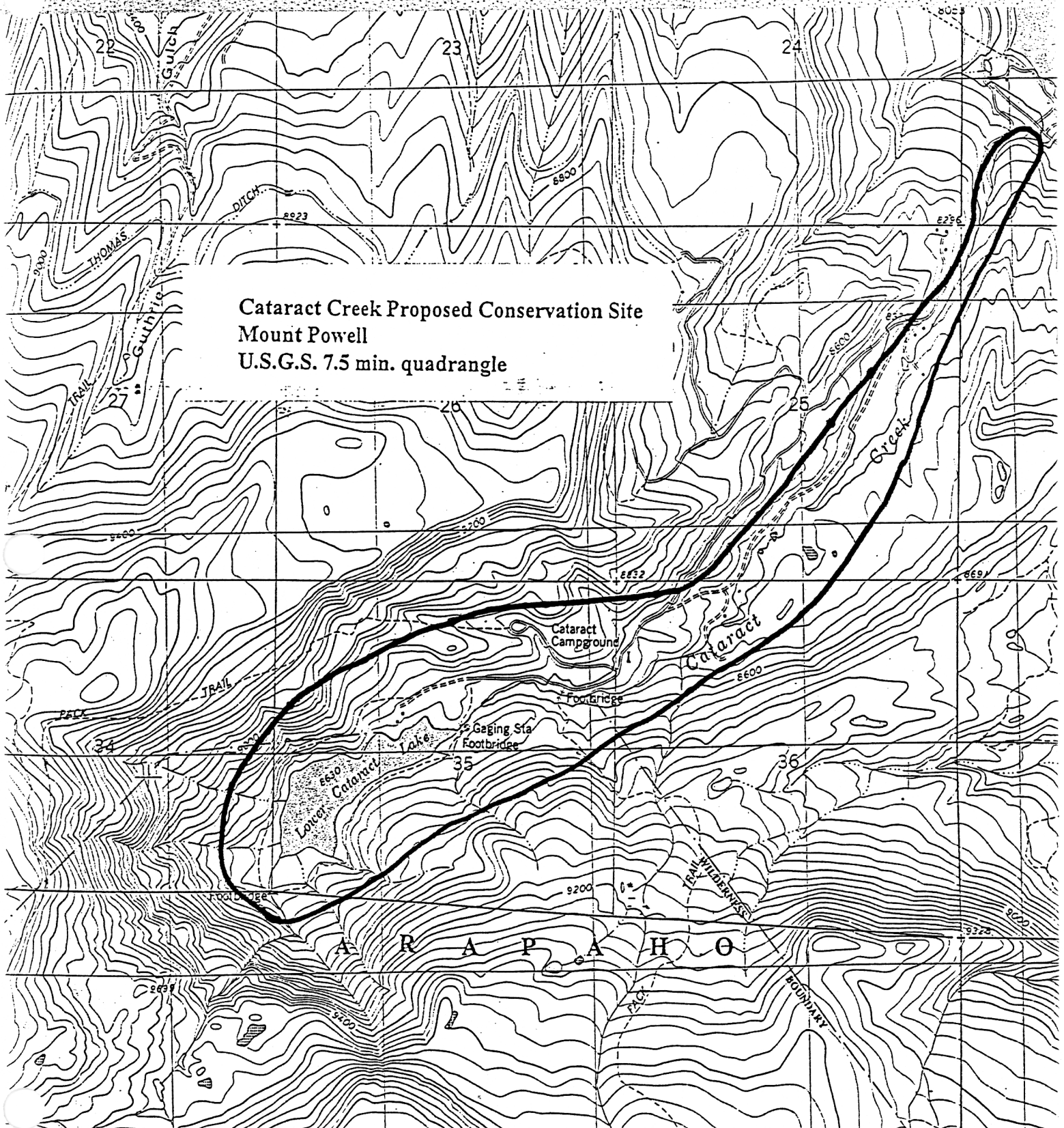
General Soil Description

Texture	peaty soils up to 20 cm, clayed gleyed soils > 20 cm
Color	Gley 1 5/GY
Cobble Size	none
Percent Mottling	none



Graph of function and value assessment for Cataract Creek site.

Cataract Creek Proposed Conservation Site
Mount Powell
U.S.G.S. 7.5 min. quadrangle



Otter Creek

Biodiversity Rank: B3 (High significance)

The Otter Creek site supports an excellent example of a state rare montane riparian willow carr and a good example of a submerged palustrine wetland. This site is one of the best wetlands observed on private lands in the lower Blue River Basin.

Protection Urgency Rank: P4

The Otter Creek site is privately owned with adjacent U.S. Forest Service lands. There is a conservation easement already in place. Hydrological concerns need to be considered.

Management Urgency Rank: M4

The water rights for this site are owned by three parties. The hydrology of the site could ultimately be threatened. Adjacent hay fields present a management concern of exotic plant species and hydrological alterations.

Location: 21 miles north of Silverthorne; southwest Green Mountain Reservoir

U.S.G.S. 7.5 min. quadrangle: Mount Powell

Legal Description: T2S R79W Sections 29, 30, 31, 32

General Description: The Otter Creek site consists of a series of beaver ponds that are fed by Otter Creek and several intermittent streams. The ponds support beaver, muskrat, brook trout and aquatic vegetation e.g., water milfoil (*Myriophyllum sibiricum*) and bladderwort (*Utricularia macrorhiza*). The montane riparian willow carr (*Salix monticola*-*Salix geyeriana*/ mesic forb) extends throughout the site. The site is approximately 500 acres and ranges in elevation from 2490 m (8,300 ft.) to 2520 m (8,400 ft.).

There are two-track roads and hay fields adjacent to the site. The understory in the drier areas consist of hay grasses. Uplands support communities of quaking aspen-Engelmann spruce (*Populus tremuloides*-*Picea engelmannii*) to the south and sagebrush (*Artemisia tridentata vaseyana*) shrublands to the west.

Biodiversity Rank Justification: The Otter Creek site supports an excellent example of a montane riparian forest (*Salix monticola*-*Salix geyeriana*/mesic forb) and a good example of a submerged palustrine community (*Myriophyllum exalbescens*). This site is one of the best wetlands observed in the Lower Blue River Basin for private lands.

Natural Heritage elements at the Otter Creek site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Myriophyllum sibiricum</i>	submerged palustrine wetland	GU	SU				B
<i>Salix monticola-Salix geyeriana/mesic forb</i>	montane riparian forest	GU	S3				A

*EO=Element Occurrence

Boundary Justification: The boundary drawn encompasses the riparian and wetland communities and the intermittent streams on U.S. Forest Service lands. A much larger area including the full watershed of Otter Creek needs to be considered when developing a plan for the long-term viability of this site.

Protection Rank Justification: The water rights for this site are owned by three other parties. The only anticipated threat to the site would be hydrological alterations.

Management Rank Justification: Management actions could include monitoring of water quality and amount fluctuations due to agricultural practices. Control weeds and hay grasses needs to be addresses in a management plan.

Wetland Functional Evaluation for the Otter Creek site:

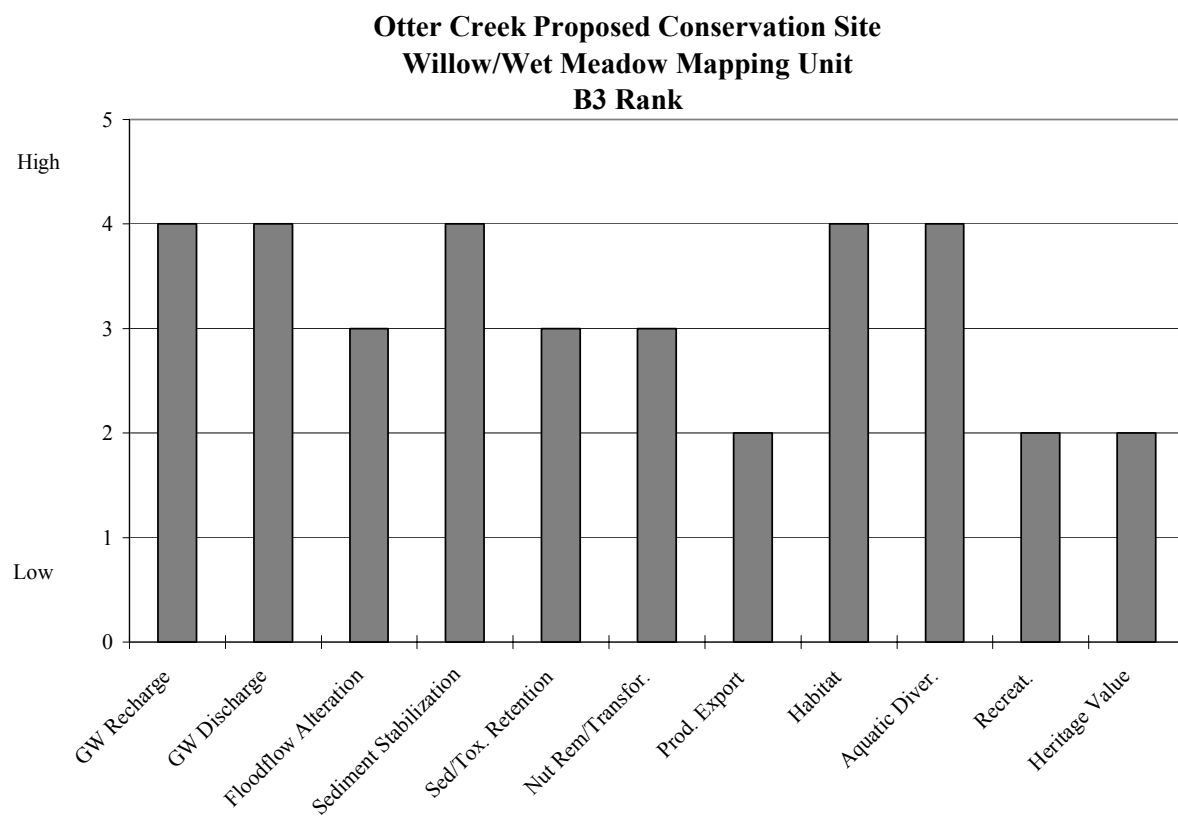
Proposed HGM wetland class: Riverine wetland with seasonal to permanent saturation and frequent flooding

Wetland functional evaluation for the Otter Creek site (willow/wet meadow).

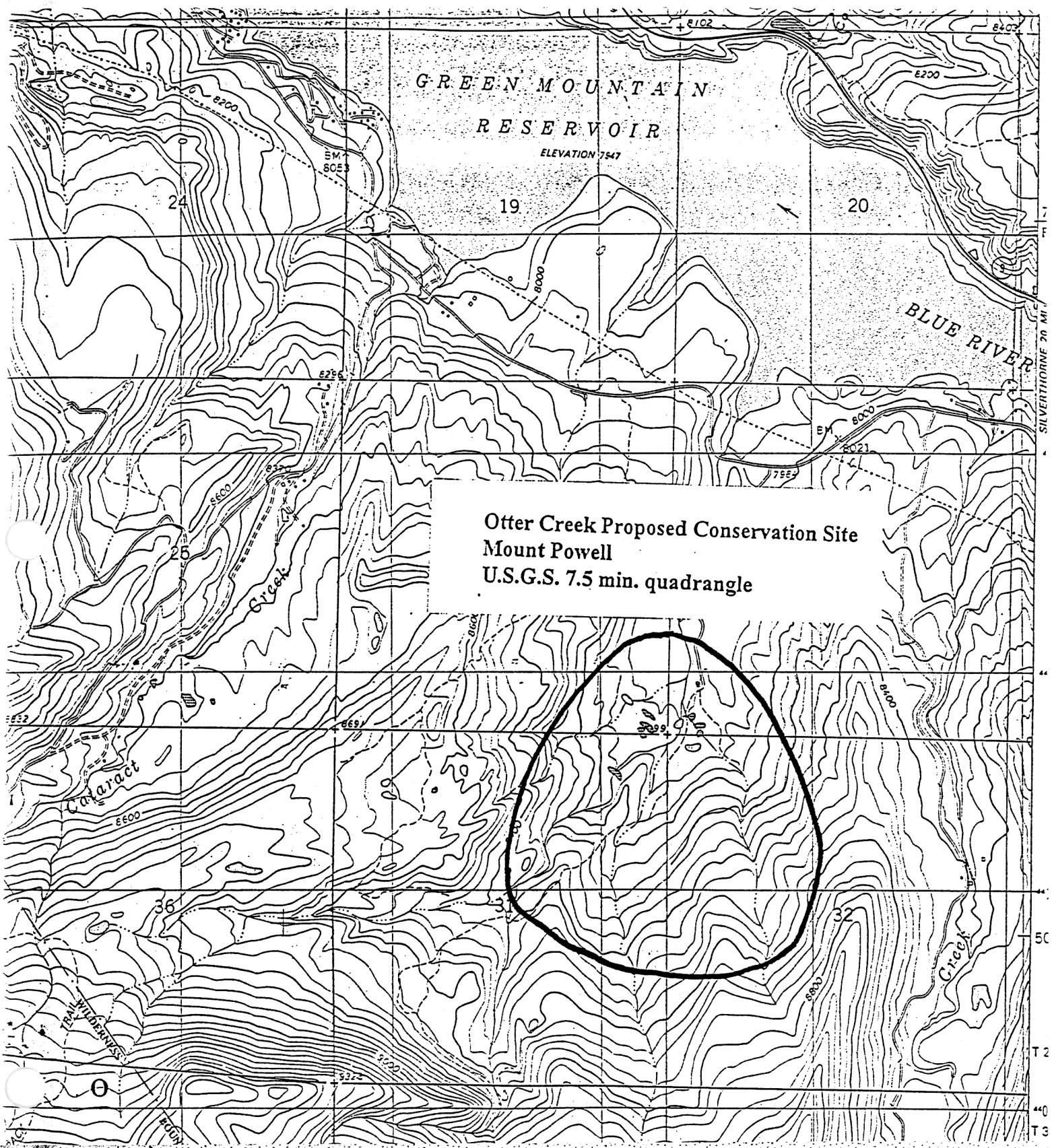
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	high	medium	porous soils, dense vegetation, constricted outlet, irregular shaped wetland
Groundwater Discharge	high	medium	numerous springs located along the slope
Floodflow Alteration	medium	medium	some debris and sediment deposits, small % of mottling
Sediment Stabilization	high	high	dense vegetation, open water, no good flushing flows
Biogeochemical Functions			
Sediment/Toxicant Retention	medium	medium	constricted outlet, low gradient
Nutrient Removal/Transformation	medium	medium	organic matter accumulation > 40-50 cm, presence of aquatic vegetation
Biological Functions			
Production Export	low	medium	sandy soils, constricted outlet, but no flushing flows
Habitat	high	high	beaver, muskrat, elk, deer, fish, aquatic vegetation
Aquatic Diversity/Abundance	high	high	overhanging vegetation, low gradient, cool, clear water
Recreation	low	high	no public access, private fishing
Uniqueness/Heritage Value	low	high	A rank of common riparian

General Soil Description

Texture	sandy, depositional soils
Color	dark 10YR 3/1
Cobble Size	small
Percent Mottling	1-5%



Graph of function and value assessment for Otter Creek site.



GREEN MOUNTAIN
RESERVOIR
ELEVATION 7547

BLUE RIVER

Otter Creek Proposed Conservation Site
Mount Powell
U.S.G.S. 7.5 min. quadrangle

SILVERTHORNE 20 MI

50
T2
T3

Pass Creek

Biodiversity Rank: B3 (High significance)

The Pass Creek site supports a good example of globally rare montane riparian forest. Additionally, there is a good occurrence of the state rare lower montane forest. There is a historical record of the globally rare Williams bishop's cap located in the spruce-fir uplands.

Protection Urgency Rank: P2

The majority of the site is privately owned with adjacent public lands. Currently, the site is moderately to heavily grazed, especially in the adjacent uplands. The site contains weeds and hay grasses in the understory. There is also a human-made pond located within the site.

Management Urgency Rank: M2

Management actions need to be taken within five years to prevent the loss of the occurrences. Management actions could include: weed control, fencing of the riparian area, and a management plan to ensure beaver viability.

Location: 13 miles north of Silverthorne on Highway 9 to Pass Creek Ranch

U.S.G.S. 7.5 min. quadrangle: Squaw Creek, Ute Pass

Legal Description: T3S R78W Sections 3, 4, 8, 9

General Description: The Pass Creek site is located at the southern base of Flat Top and Eagle Roost mountains. Pasture Creek, Hole Creek, and Pass Creek drain the site. Ute Pass borders the site to the east and Highway 9 forms the west border. The site consists of visible outcrops of Pierre Shale, common within the Williams Fork Mountains. The headwaters of Pass Creek are contained within the site. Pass Creek flows through a riparian area that is moderately to heavily grazed. There are several intact and active beaver ponds within the willow carr (*Salix monticola*-*Salix geyeriana*/mesic forb). The site is approximately 1,300 acres and ranges in elevation from 2444 m (8,146 ft.) to 2870 m (9,568 ft.).

There is a human-made pond located between a two-track road and Pass Creek. Ditches flow adjacent on both sides of Pass Creek. There is a pipeline and powerline that bisect the site.

Biodiversity Rank Justification: The Pass Creek site includes good examples of the globally rare riparian forest (*Populus angustifolia*-*Picea pungens*/*Alnus incana*) and the state rare lower montane forest (*Pseudotsuga menziesii*/*Acer glabrum*) communities. There is an imprecise location of the globally rare Williams bishop cap (*Conimitella williamsii*) that was not relocated during the 1997 survey. There are only two known occurrences in Colorado for the Williams bishop cap; both are from the Ute Pass area (CNHP 1997). Additionally, there is a historical record (1876) for wolverine (*Gulo gulo*) from the Ute Pass area. The site was searched for Southern Rocky Mountain boreal toad (*Bufo boreas boreas*) in 1997; but none were found.

Natural Heritage elements at the Pass Creek site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Conimitella williamsii</i>	Williams bishop's cap	G3	SH				B-
<i>Gulo gulo</i>	wolverine	G4	S1		E	FS	Historical
<i>Populus angustifolia-Picea pungens/ Alnus incana</i>	montane riparian forest	G3	S3				B
<i>Pseudotsuga menziesii/ Acer glabrum</i>	lower montane forest	G4	S1				B

*EO=Element Occurrence

Boundary Justification: The boundary drawn encompasses the elements found within the site. The boundary includes the Pass Creek watershed west of Ute Pass and extends south to the Ute Pass Road and west to Highway 9. A much larger area should be considered in any long-term management plan to protect the hydrology.

Protection Rank Justification: The majority of the site is privately owned. The northeastern portion is publicly owned. The site is currently in agricultural use and has sustained alterations which include weeds, hay grasses, and fragmentation of the willow carr.

Management Rank Justification: Management for the site needs to include limited grazing practices, especially within the riparian areas. Beaver are active along Pass Creek and need to be managed to ensure the longevity and viability of the willow carr. The hydrology needs to be closely monitored so not to adversely ly impact the riparian communities and the beaver population. The hydrology of this site is important to the ecological processes which support the riparian communities. The water quality, quantity, and timing should be maintained at current levels. Additional searches are required to relocate the Williams bishop's cap.

Wetland Functional Evaluation for the Pass Creek site:

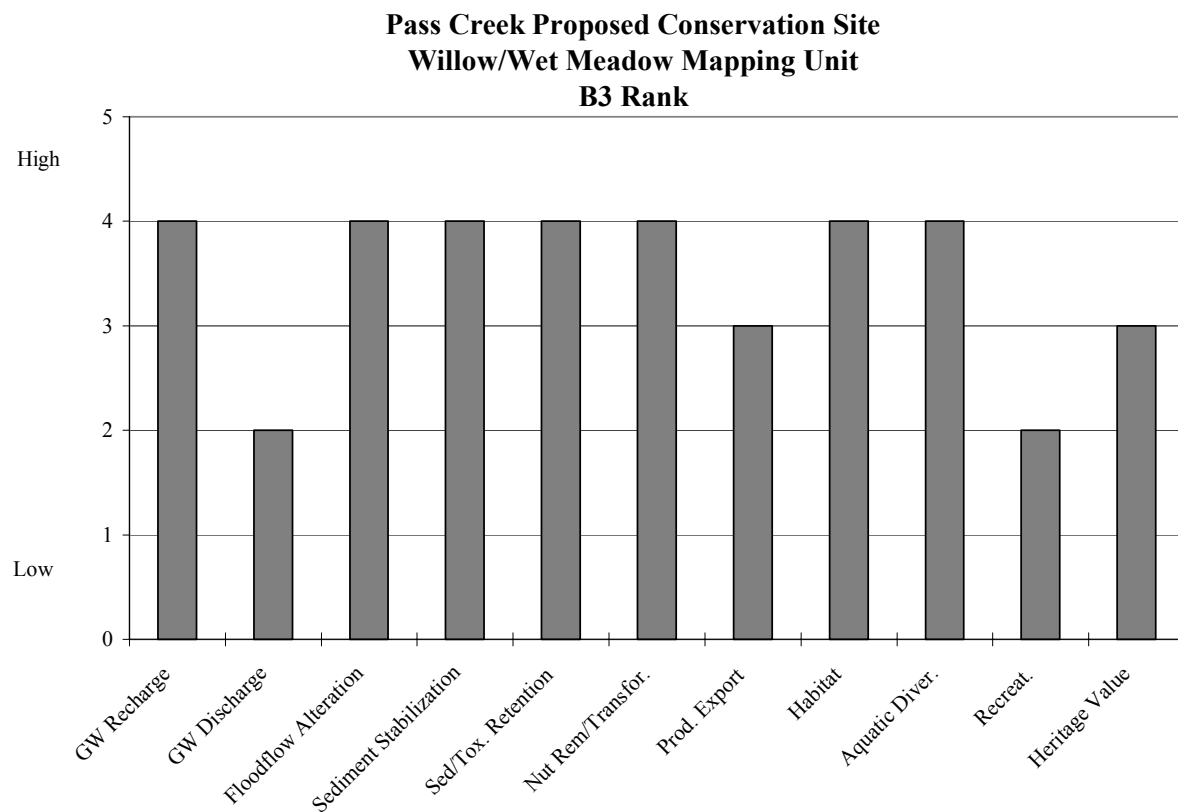
Proposed HGM wetland class: Riverine wetland with a seasonal to permanent saturation with occasional flooding

Wetland functional evaluation for the Pass Creek site (willow/wet meadow mapping unit).

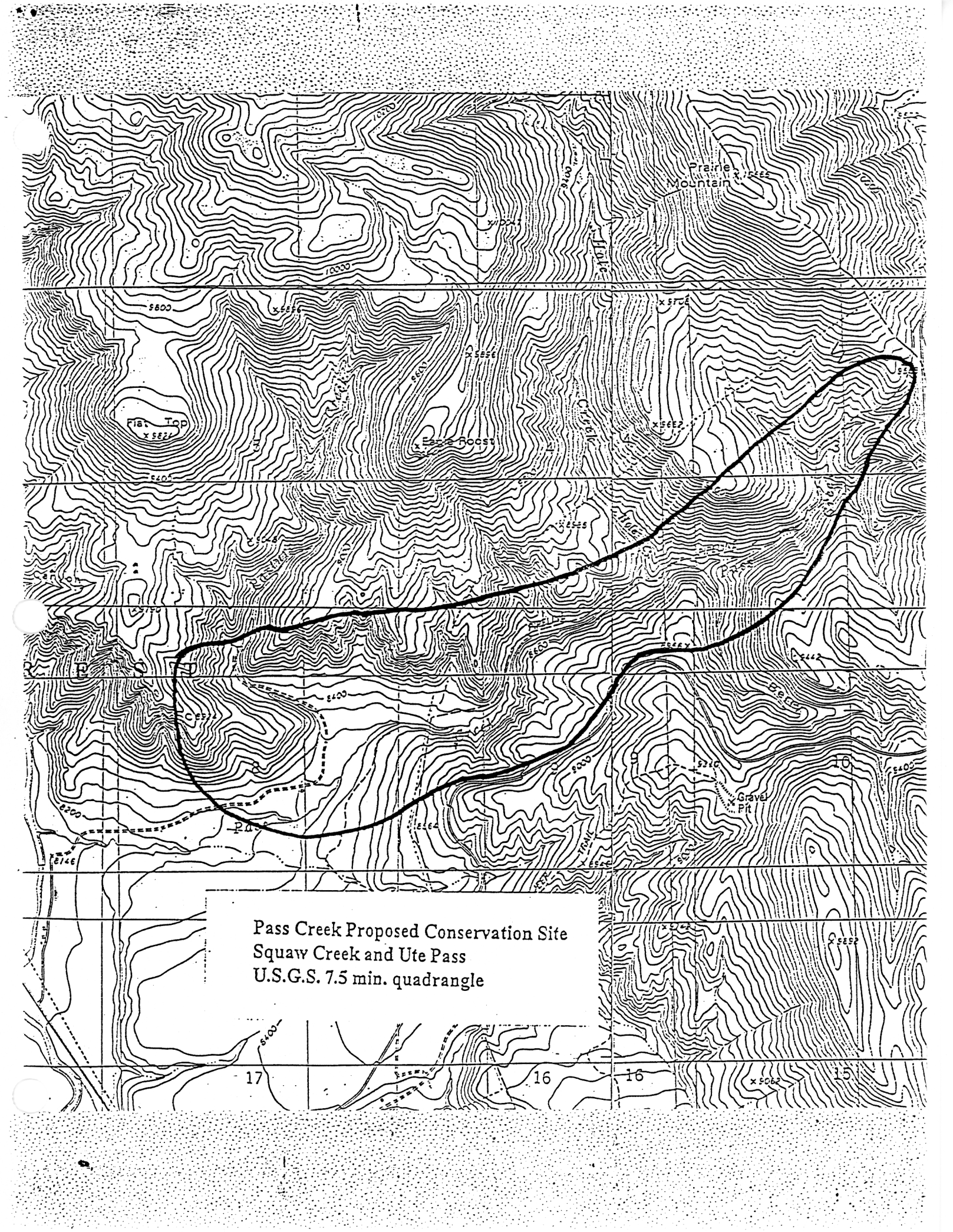
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	high	medium	porous soils, dense vegetation, beaver ponds
Groundwater Discharge	low	medium	no obvious springs, but springs have been observed within in this geological formation
Floodflow Alteration	high	high	woody debris, low gradient, sandy soils
Sediment Stabilization	high	medium	high vegetation density, located along open water
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	restricted outlets, low gradient, deposits of organic matter
Nutrient Removal/Transformation	high	medium	permanently saturated soils in some areas, beaver ponds, presence of aquatic vegetation
Biological Functions			
Production Export	medium	medium	permanently saturated soils, no severe scouring or flushing
Habitat	high	high	beaver, muskrat, deer, elk
Aquatic Diversity/Abundance	high	high	observed fish in human-made pond, likely within the beaver ponds
Recreation	low	high	only private fishing access
Uniqueness/Heritage Value	medium	high	B and C ranked occurrences of state rare plant communities

General Soil Description

Texture	sandy with some organic in first 10 cm
Color	Dark, 10 YR 2/1
Cobble Size	small to medium
Percent Mottling	15% in first 10 cm



Graph of function and value assessment for Pass Creek site.



This is a topographic map of a mountainous region, likely in the western United States, based on the text. The map features dense contour lines indicating steep terrain. A prominent, thick black line is drawn across the map, starting from the left edge, curving upwards in the center, and then curving downwards towards the right edge. This line appears to define a boundary or a specific route. Various geographical features are labeled, including 'Prairie Mountain' in the upper right, 'Flat Top' in the upper left, 'Essex Rock' in the center, and 'Gravel Pit' in the lower right. Elevation markers such as 8000, 8200, 8400, 8600, 8800, and 9000 are visible. The map is overlaid with a grid of horizontal and vertical lines. At the bottom, there is a text box with the title 'Pass Creek Proposed Conservation Site' and 'Squaw Creek and Ute Pass'. Below this, the text 'U.S.G.S. 7.5 min. quadrangle' is present. The bottom edge of the map shows section numbers 17, 16, 16, and 15 from left to right.

Pass Creek Proposed Conservation Site
Squaw Creek and Ute Pass
U.S.G.S. 7.5 min. quadrangle

Slate Creek

Biodiversity Rank: B3 (High significance)

The Slate Creek site supports an excellent example of a state rare montane floating/submerged wetland, a good example of a state rare montane riparian willow carr, and a fair example of a northern goshawk nesting occurrence, a state rare raptor.

Protection Urgency Rank: P4

The upper portion of this site has been purchased by the U.S. Forest Service and is now part of the Eagles Nest Wilderness. The lower portion is privately owned. A conservation easement would extend protection to compliment to the wilderness area.

Management Urgency Rank: M3

New management actions should be considered within five years to maintain current quality of the riparian and aquatic communities. These actions could include fencing off the riparian area and the kettle pond.

Location: 11 miles north of Silverthorne on Highway 9

U.S.G.S. 7.5 min. quadrangle: Squaw Creek

Legal Description: T3S R78W Sections 35, 26, 25, 24, 19

General Description: The Slate Creek site is located at the eastern base of the Gore Range. This site supports an extensive montane willow carr (*Salix monticola*-*Salix geyeriana*/mesic forb) with a series of beaver ponds. The sagebrush/grass uplands grade into aspen/lodgepole pine forests. There are two irrigation ditches that run adjacent to Slate Creek with several headgates located along the creek. The Gore Range trail bisects the site to the west and there is an access trail to the Gore Range trail beginning at the ranch house. There are no other roads or trails within the site. The site is approximately 1,700 acres and ranges in elevation from 2640 m (8,800 ft.) to 2790 m (9,300 ft.).

A kettle pond is located above Slate Creek and supports a viable population of pond weed (*Potamogeton natans*) and beaked sedge (*Carex utriculata*). A Northern goshawk (*Accipiter gentilis*) nest is located in the lodgepole pine forest north of Slate Creek.

Biodiversity Rank Justification: This site consists of an excellent example of a state rare montane floating/submerged wetland (*Potamogeton natans*) and a good example of a state rare montane riparian willow carr (*Salix monticola*-*Salix geyeriana*/mesic forb). There is a 1994 occurrence of the state rare Northern goshawk (*Accipiter gentilis*), a U.S. Forest Service sensitive species. The nest was not active in 1995. There were no observations of northern goshawk made during the 1997 field season. The willow carr and beaver ponds are good potential habitat for the Southern Rocky Mountain boreal toad (*Bufo boreas boreas*). The site was searched in 1997 for the boreal toad; but none were observed.

Natural Heritage elements at the Slate Creek site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Accipiter gentilis</i>	Northern goshawk	G5	S3B, S4N			FS	unranked
<i>Potamogeton natans</i>	montane floating/ submerged wetland	G5?	S1				A
<i>Salix monticola</i> - <i>Salix geyeriana</i> /mesic forb	montane riparian willow carr	GU	S3				B

*EO=Element Occurrence

Boundary Justification: The boundary drawn includes the entire riparian area along Slate Creek where the creek enters the broad valley down to the ranch house. The boundary encompasses all the elements including the goshawk nest and the immediate view-shed up to 0.5 mile radius. A larger area may need to be considered to protect the hydrological setting required by the riparian communities.

Protection Rank Justification: A portion of the site is within the Eagles Nest Wilderness. However the remaining portion remains threatened by incompatible grazing practices, residential development, and increased hydrological alterations from irrigation.

Management Rank Justification: Actions may need to be taken within the next five to protect the elements from the above mentioned threats. The hydrology of this site is important to the ecological processes which support the riparian communities. The water quality, quantity, and timing should be maintained at current levels.

Wetland Functional Evaluation for the Slate Creek site:

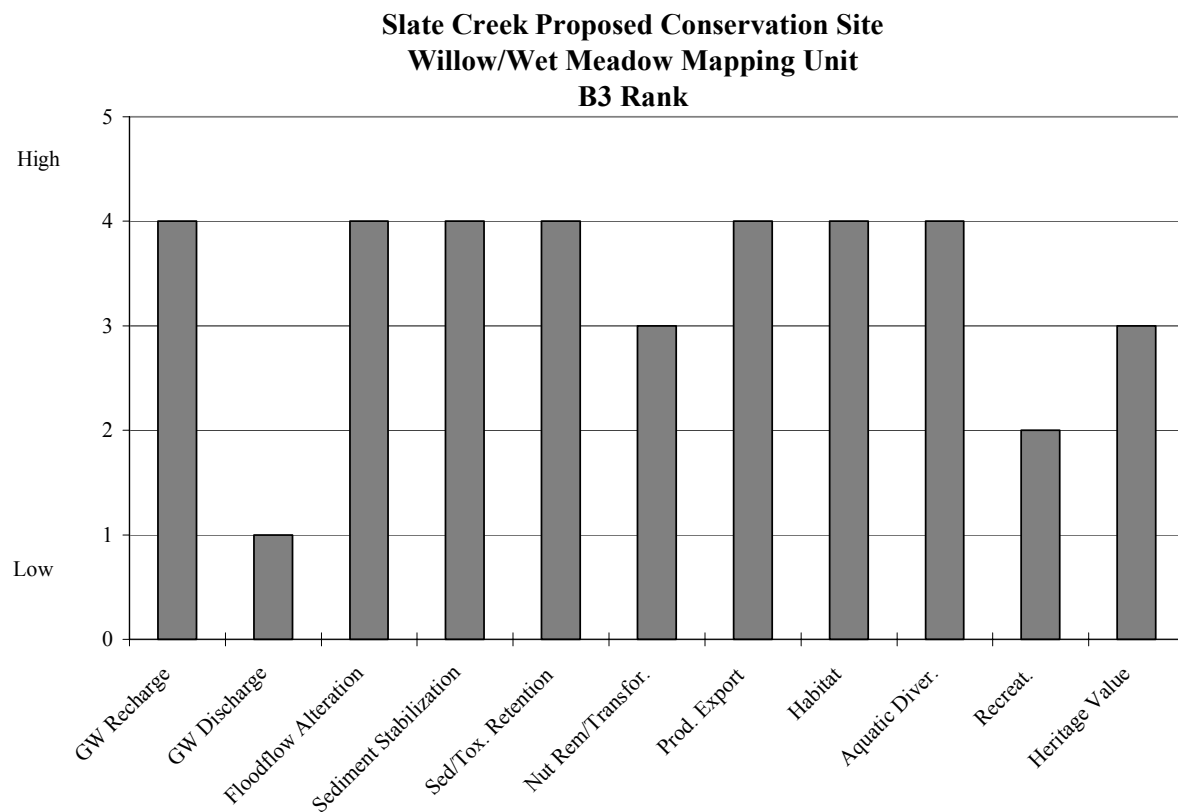
Proposed HGM wetland class: Riverine wetland with seasonal saturation and frequent flooding

Wetland functional evaluation for the Slate Creek site (willow/wet meadow mapping unit).

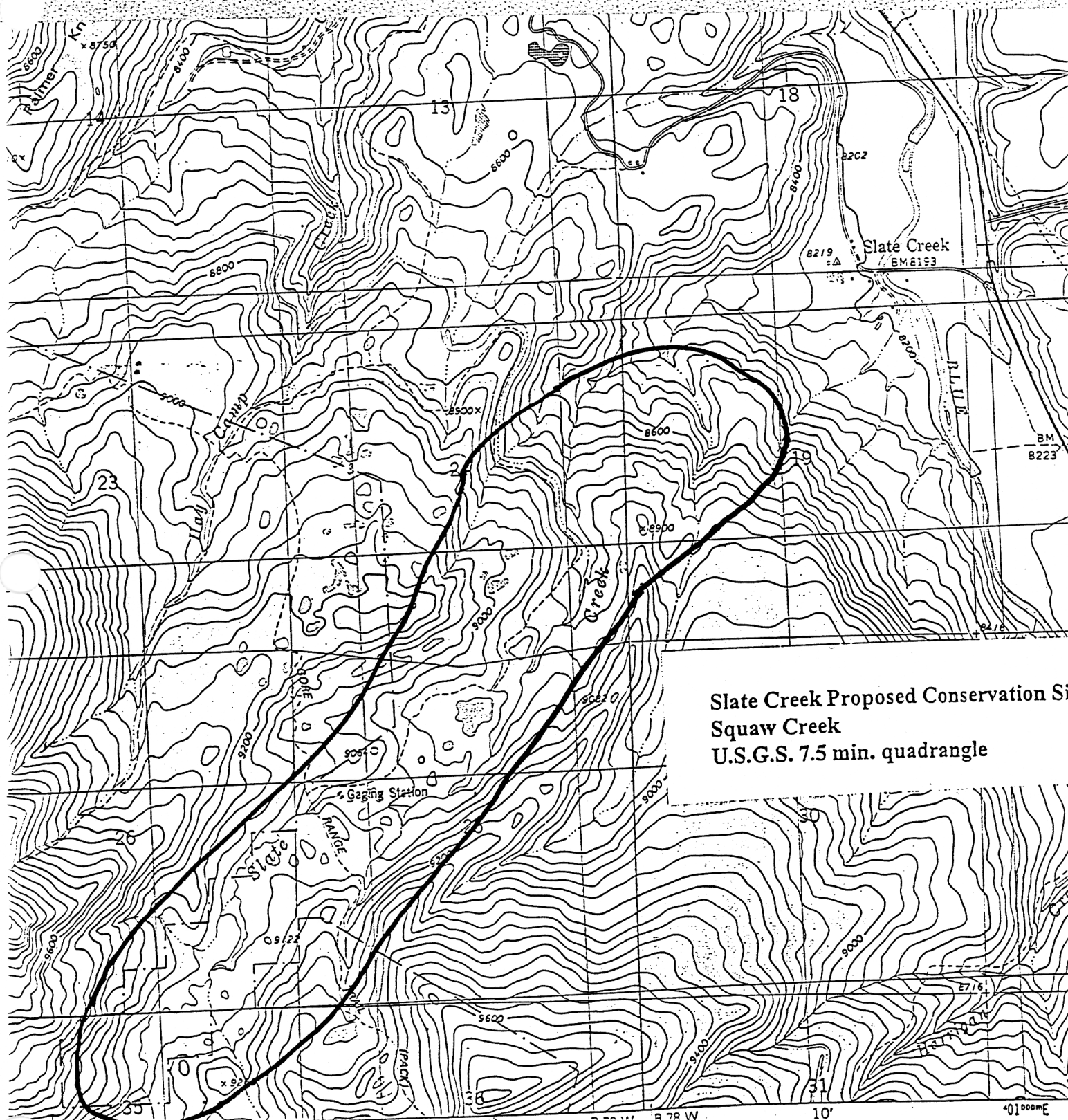
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	high	high	porous substrate, dense vegetation, several beaver dams, creek is located high in basin, high edge ration
Groundwater Discharge	low	high	no obvious springs
Floodflow Alteration	high	high	low gradient, restricted outlet from beaver dams, dense vegetation, porous soils
Sediment Stabilization	high	high	dense willow with birch anchoring shores
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	constriction of water flow, organic matter and debris deposits
Nutrient Removal/Transformation	medium	medium	some peat accumulation
Biological Functions			
Production Export	high	high	seasonally flooded, vegetation overhangs creek, productive vegetation
Habitat	high	high	provides habitat for fish, beaver, elk and black bear
Aquatic Diversity/Abundance	high	high	good edge ratio, irregular and sinuous basin, beaver provide fish habitat
Recreation	low	high	remote location, excellent views of Gore Range
Uniqueness/Heritage Value	medium	high	B rank of a G4 and an A rank of S1 communities

General Soil Description

Texture	sandy to peaty in low lying areas
Color	dark red 10R 3/1
Cobble Size	small
Percent Mottling	5-15% mottling, oxidized root channels



Graph of function and value assessment for Slate Creek site.



Spruce Creek

Biodiversity Rank: B3 (High significance)

The Spruce Creek site contains an excellent example of a globally rare montane riparian willow community and a B+ strain of a Colorado River cutthroat trout. This site supports one of the best examples of a montane willow carr observed on private lands in this portion of the county.

Protection Urgency Rank: P4

The site is privately and publicly owned. Plans for private lands are unknown, however there were no observable threats. The site is located in a very scenic area of Summit County, therefore there is a threat of increased residential development that would lead to the alteration of hydrology.

Management Urgency Rank: M4

Management actions may need to be taken within the next five years to protect the riparian community from an increase in agricultural activities. Actions could include control of weeds and fencing off the riparian area.

Location: Two air miles northeast of Sheephorn Mountain in northwestern Summit County

U.S.G.S. 7.5 min. quadrangle: Sheephorn Mountain

Legal Description: T1S R81W Sections 1, 2, 11, 12

General Description: The Spruce Creek site is located in the northwestern portion of Summit County northeast of Sheephorn Mountain. Spruce Creek enters the willow carr from the south and meanders through the extensive willow carr (*Salix monticola-Calamagrostis canadensis*) and series of beaver ponds for approximately one mile where it enters a narrow canyon. The majority of the beaver ponds are located on private lands.

The private lands appear to be in very good condition with a viable willow population and little grazing, although there was no on site visit of the private lands. The area located on public land is not grazed heavily by domestic stock, but there is evidence of wildlife utilizing the willow carr e.g., beaver, moose, mule deer, and elk. There are irrigated hay meadows upslope of the riparian area, but they do not appear to be in production or heavily grazed. The uplands consist of Engelmann spruce-Douglas fir (*Picea engelmannii-Pseudotsuga menziesii*) montane forest with quaking aspen (*Populus tremuloides*). This site is approximately 800 acres and ranges in elevation from 2612 m (8,720 ft.) to 2676 m (8,920 ft.).

Biodiversity Rank Justification: The Spruce Creek site supports an excellent occurrence of a globally rare montane willow carr (*Salix monticola-Calamagrostis canadensis*) community. There is a location of a B+ strain of the Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*), a U.S. Forest Service sensitive and state special concern species. This site supports the best example of a montane willow carr observed on private lands in the northwestern portion of Summit County. The site was searched for Southern Rocky Mountain boreal toad (*Bufo boreas boreas*), but none were observed.

Natural Heritage elements at the Spruce Creek site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Oncorhynchus clarki pleuriticus</i>	Colorado River cutthroat trout	G5T3	S3		SC	FS	unranked
<i>Salix monticola-Calamagrostis canadensis</i>	montane willow carr	G3	S3				A

*EO=Element Occurrence

Boundary Justifications: The boundary encompasses the low gradient wetlands that are adjacent to Spruce Creek and two intermittent streams to the north and west. A 1,000 ft buffer is drawn from each side of the river to protect from direct disturbances e.g., grazing. A much larger area, including the full watershed of Spruce Creek, needs to be considered when developing a long-term protection or management plan for the cutthroat trout and riparian community.

Protection Rank Justification: The Spruce Creek site is both privately and publicly owned. Currently, there is a public access road to the south and one residence located within the site. There are hay fields adjacent to the riparian area. Future plans for use of the site are unknown. A private landowner did not allow access to a portion of the site. This portion of Summit County is very scenic and there is good likelihood that eventually this area will receive development pressure.

Management Rank Justification: Management actions will need to be undertaken within five years to prevent the degradation of the riparian area. Altered hydrology, increased grazing and agricultural practices would increase sedimentation within the wetland, thereby affecting the viability of the cutthroat trout, beaver and eventually the longevity of the willow carr.

Wetland Functional Evaluation for the Spruce Creek site:

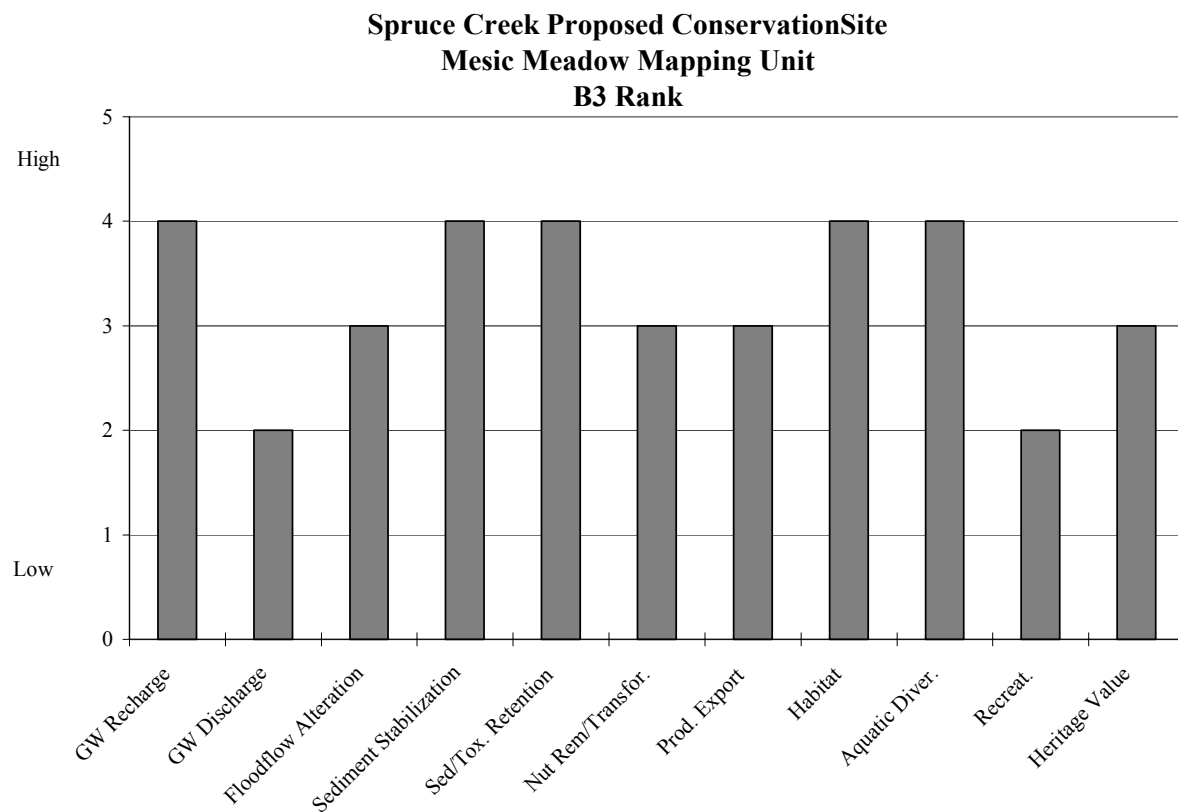
Proposed HGM wetland class: Riverine wetland with intermittent saturation and occasional flooding

Wetland functional evaluation for the Spruce Creek site (willow/wet meadow mapping unit).

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	high	high	porous soils, dense vegetation, low gradient, presence of beaver ponds
Groundwater Discharge	low	medium	no springs evident, but there are several springs within the same geographically setting in nearby sites
Floodflow Alteration	medium	high	some debris and sediment deposits observed, dense vegetation, presence of beaver ponds
Sediment Stabilization	high	high	dense vegetation along beaver ponds
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	presence of beaver ponds, organic matter accumulation
Nutrient Removal/Transformation	medium	medium	high sediment retention, flooding is intermittent
Biological Functions			
Production Export	medium	medium	seasonally flooded, vegetation overhanging water
Habitat	high	medium	observed elk, deer, and beaver sign
Aquatic Diversity/Abundance	high	medium	observed brook trout, sinuous basin
Recreation	low	high	no active recreation, likely fishing on public lands
Uniqueness/Heritage Value	medium	high	A rank of a globally rare willow community

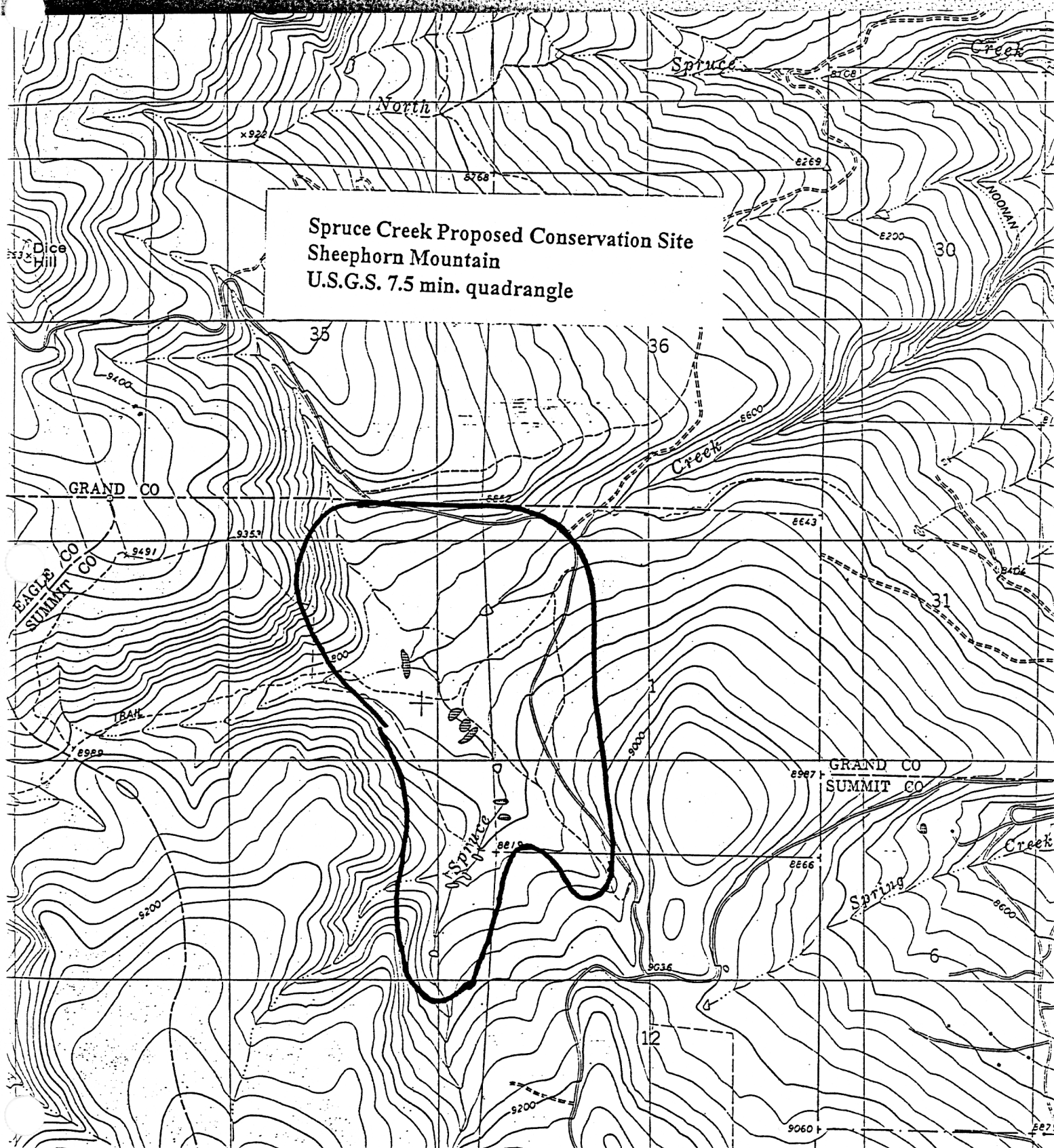
General Soil Description

Texture	sandy with cobbles
Color	very dark: 10YR 2/1
Cobble Size	small to medium
Percent Mottling	0-5%



Graph of function and value assessment for Spruce Creek site.

Spruce Creek Proposed Conservation Site
Sheephorn Mountain
U.S.G.S. 7.5 min. quadrangle



Blue River-North of Silverthorne

Biodiversity Rank: B4 (Moderate significance)

The Blue River-North of Silverthorne site supports fair occurrences of globally rare montane riparian forests and a montane willow carr. The site also contains a series of ponds (human-made) that provide nesting habitat for the state rare osprey and several common waterfowl species.

Protection Urgency Rank: P1

This site is immediately threatened by development pressures from residential and commercial enterprises. The majority of the site is privately owned, but there are public fishing access points along the river. The hydrology, in particular, is most threatened by development, fragmentation, and sedimentation.

Management Urgency Rank: M1

New management of this site is required immediately or the riparian communities will be lost or irretrievably degraded.

Location: Approximately two miles north of Silverthorne exit off of I 70, east of Highway 9 along a 2 miles stretch of the Blue River

U.S.G.S. 7.5 min. quadrangle: Dillon

Legal Description: T4S R78W Sections 36, 26, 35
T5S R78W Section 1

General Description: The Blue River-North of Silverthorne site is located 1.5 miles north of the I-70/Silverthorne interchange. Several intermittent and perennial streams, including Hamilton and Bushee Creeks drain into the Blue River within the site. There are several intact, vigorous stands of two montane riparian communities (*Populus angustifolia*/*Picea pungens*/*Alder incana* and *Picea pungens*/*Alder incana*). The Blue River Ranch Lakes are located adjacent to the Blue River at the north end of Silverthorne. The Blue River does receive some flooding, but the floodflow is controlled by Dillon Reservoir. The site is approximately 600 acres ranging in elevation from 2560 m (8,534 ft.) to 2610 m (8,700 ft.).

The site consists of several ponds, created by a gravel mining operation. It supports a fair example of a montane riparian willow carr (*Salix geyeriana*-*Salix monticola*/*Calamagrostis canadensis*) and a fair example of a subalpine riparian shrubland (*Betula glandulosa*/mesic forb-mesic graminoid). There are nesting osprey (*Pandion haliaetus*) within the site. There is a housing subdivision to the east that utilizes the area for open space. The site contains several housing developments, a sewage treatment plant, gravel mines, and hay fields.

Biodiversity Rank Justification: The Blue River-North of Silverthorne site supports fair examples of two montane riparian communities (*Populus angustifolia*-*Picea pungens*/*Alder incana* and *Populus angustifolia*/*Alder incana*). The Blue River Ranch Lakes contain of fair examples of a globally rare montane willow carr (*Salix geyeriana*-*Salix*

monticola/Calamagrostis canadensis) and a state rare subalpine riparian shrubland (*Betula glandulosa*/mesic forb-mesic graminoid). The site also contains a series of ponds (human-made) that provide habitat for osprey (*Pandion haliaetus*), a U.S. Forest Service sensitive species, and several common waterfowl. Eight migrating white-faced ibises (*Plegadis chihi*) were observed on the lakes on the date of the survey (June 8, 1997).

Natural Heritage elements at the Blue River-North of Silverthorne site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Betula glandulosa</i> /mesic forb-mesic graminoid	subalpine riparian shrubland	GU	S2S3				C
<i>Pandion haliaetus</i>	osprey	G5	S1B, SZN			FS	B
<i>Populus angustifolia-Picea pungens/Alder incana</i>	montane riparian forest	G3	S3				C
<i>Populus angustifolia/Alder incana</i>	montane riparian forest	G3	S3				C
<i>Salix geyeriana-Salix monticola/Calamagrostis canadensis</i>	montane willow carr	G3	S3				C

*EO=Element Occurrence

Boundary Justification: The boundary drawn encompasses the riparian communities which includes a portion within residential and commercial developments. Lower portions near the Town of Silverthorne are included within the site to provide a buffer. The boundary includes all four ponds, the area between the ponds and the Blue River, and a buffer of 1,000 ft. to protect the site from direct impacts e.g., development, water diversions.

Protection Rank Justification: The majority of this site is privately owned. There are several public fishing access points to the Blue River. The site is immediately threatened by development (e.g., golf courses, agricultural activities, subdivisions, and gravel mining).

Management Rank Justification: New management for this site is required immediately. Actions could include a plan that protects the riparian corridor from development or other types of exploitation. Control of exotic plants and hay grasses, as well as monitoring hydrologic fluctuations should be considered in a management plan.

Wetland Functional Evaluation for the Blue River-North of Silverthorne site:

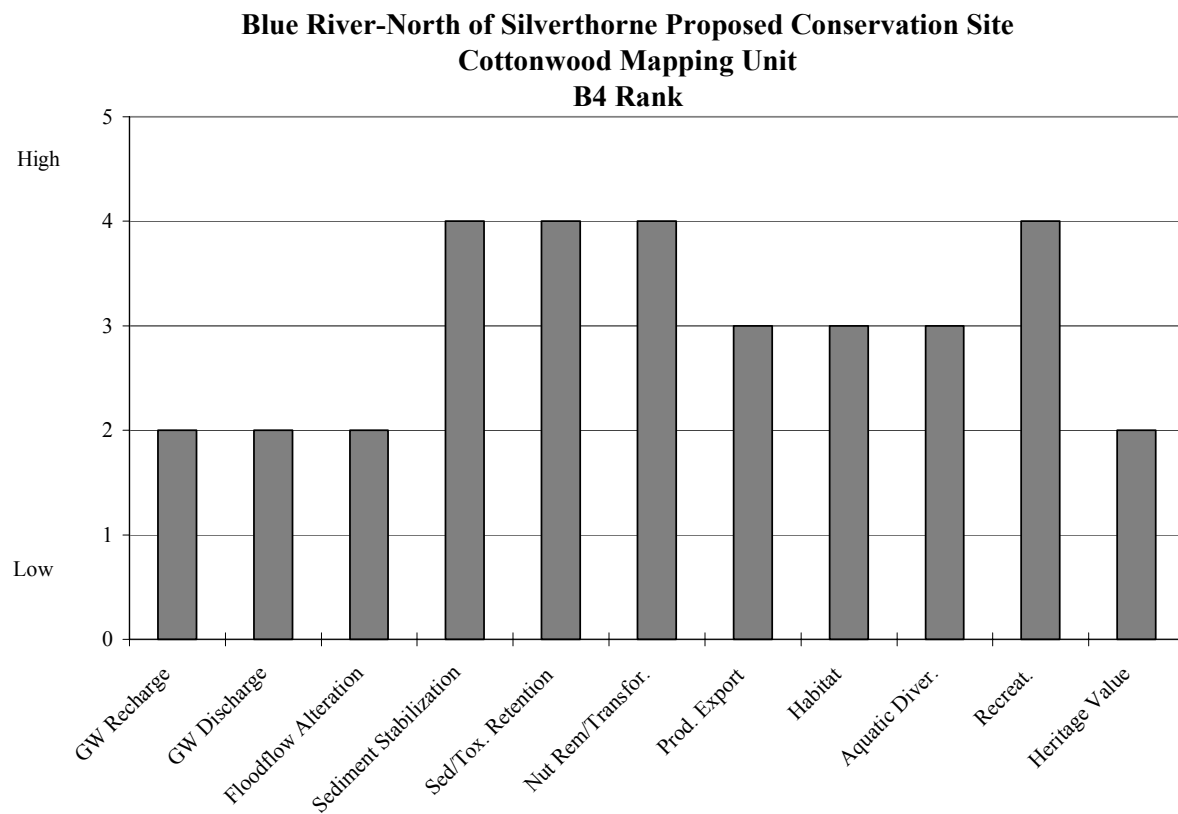
Proposed HGM wetland class: Riverine wetland with seasonal saturation and occasional flooding

Wetland functional evaluation for the Blue River-North of Silverthorne site (cottonwood).

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	low	high	porous strata, but little actually flooding, moderately vegetated, low gradient
Groundwater Discharge	low	medium	no obvious springs, but upslope intermittent streams could have a spring source
Floodflow Alteration	low	high	porous soils, little flooding, small amounts of debris and sediment on shores
Sediment Stabilization	high	high	moderate vegetation density, located adjacent to construction activities
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	moderate vegetation density, downstream of water treatment plants, road and home construction
Nutrient Removal/Transformation	high	medium	some organic matter accumulation within 1-10 cm, flooded seasonally, high sediment/toxicant retention
Biological Functions			
Production Export	medium	medium	seasonally flooded, flushing flow, vegetation overhangs water
Habitat	medium	medium	deer, elk, and trout
Aquatic Diversity/Abundance	medium	medium	Colorado cutthroat trout
Recreation	high	high	fishing, kayaking, scenic
Uniqueness/Heritage Value	medium	high	C ranked of G3 montane riparian forests

General Soil Description

Texture	sandy, organic matter within first 10 cm
Color	red 5YR 4/4
Cobble Size	small to medium
Percent Mottling	1-5% within first 50 cm



Graph of function and value assessment for Blue River-North of Silverthorne site.

Wetland Functional Evaluation for the Blue River Ranch Lakes:

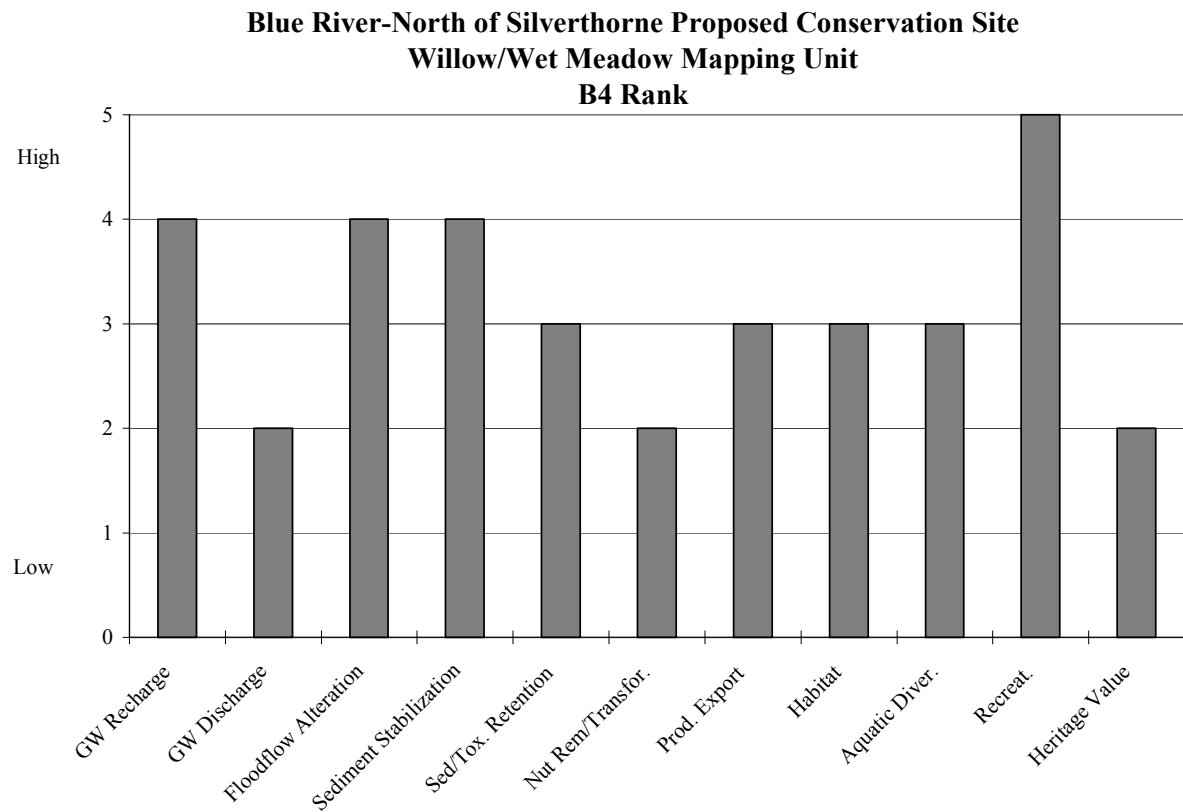
Proposed HGM wetland class: Riverine/depressional wetland with seasonal saturation and occasional flooding

Wetland functional evaluation for the Blue River Lakes Ranch (willow/wet meadow mapping unit).

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	high	high	porous soils, constricted outlets, dense vegetation
Groundwater Discharge	low	medium	no obvious springs
Floodflow Alteration	high	high	located next to Blue River, low gradient, porous soils, not permanently saturated, restricted outlets
Sediment Stabilization	high	high	high vegetation density, woody vegetation, open water
Biogeochemical Functions			
Sediment/Toxicant Retention	medium	medium	constricted outlets, some organic matter accumulation, located downstream of I-70-influx of sediments from interstate
Nutrient Removal/Transformation	low	medium	some organic matter, not flooded permanently, no aquatic vegetation observed
Biological Functions			
Production Export	medium	medium	constricted outlet, vegetation hanging over water, seasonally flooded
Habitat	medium	medium	open water, clear, barriers for migration, stocked with brook trout, slightly eutrophic
Aquatic Diversity/Abundance	medium	medium	stocked with trout
Recreation	high	high	passive, some fishing, no boating
Uniqueness/Heritage Value	low	high	C rank of G3S3 and C rank of GUS2S3

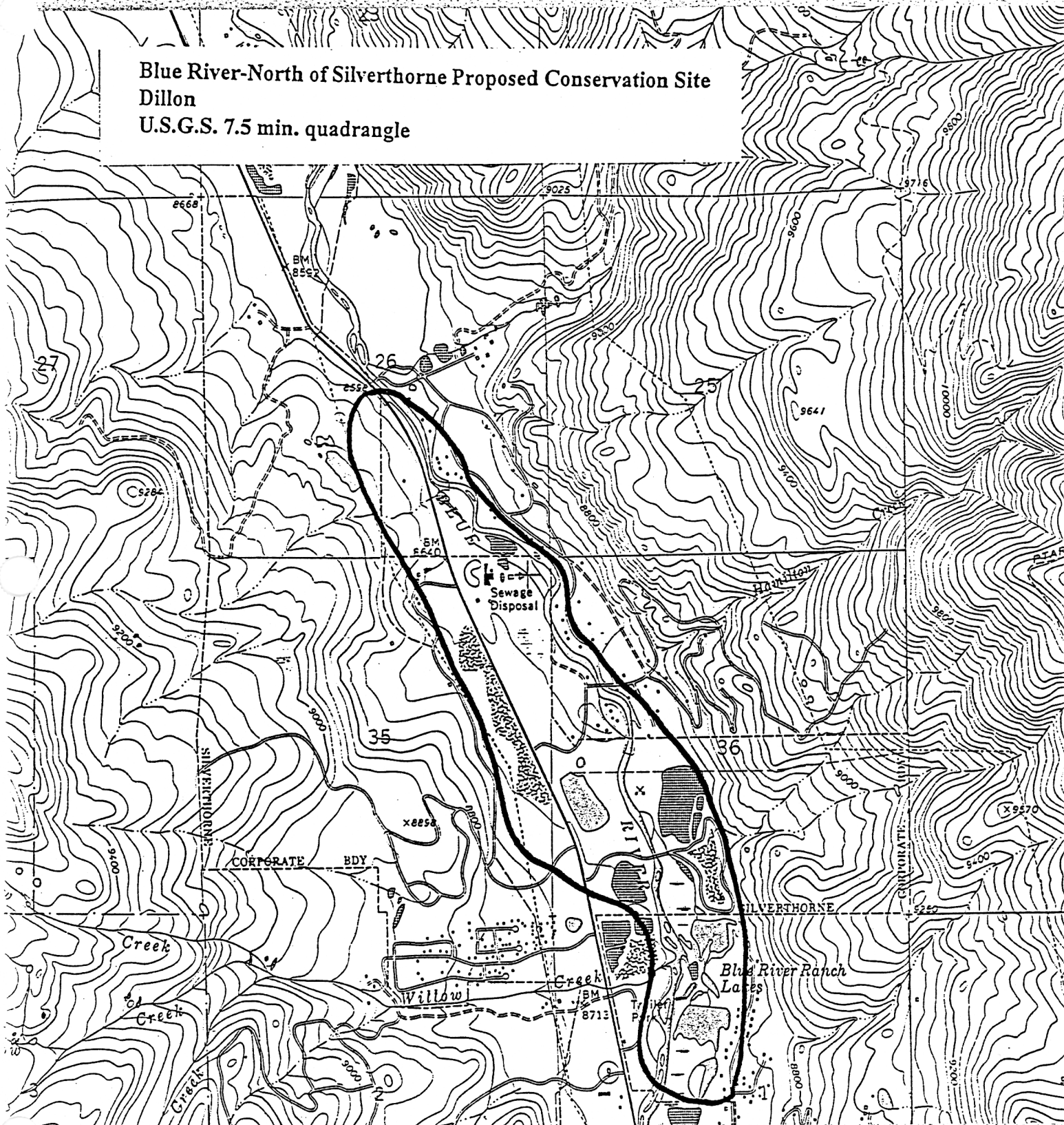
General Soil Description

Texture	sandy alluvium
Color	dark 10YR 3/2
Cobble Size	medium
Percent Mottling	5% at 10 cm



Graph of function and value assessment for Blue River-North of Silverthorne (Blue River Ranch Lakes).

Blue River-North of Silverthorne Proposed Conservation Site
Dillon
U.S.G.S. 7.5 min. quadrangle



Bushee Creek

Biodiversity Rank: B4 (Moderate significance)

The Bushee Creek site consists of good examples of state rare western slope sagebrush shrubland and montane riparian willow carr.

Protection Urgency Rank: P4

This site is privately owned and primarily used as a dude ranch. Currently the site is not being heavily impacted by agricultural practices or grazing, but historically the site was in agricultural production. There are no known threats for the foreseeable future.

Management Urgency Rank: M4

Presently the owners want to maintain the area in its current state. Management actions could include: control of noxious weeds and management of wetland for beaver viability.

Location: 3 miles north of Silverthorne; 0.5 miles north of water treatment plant

U.S.G.S. 7.5 min. quadrangle: Dillon

Legal Description: T4S R78W Sections 23, 24, 25

General Description: The Bushee Creek site is located on the west side of the Williams Fork Mountains. Bushee Creek and two intermittent streams flow through the site. The site supports several slope wetlands with springs. The common montane wet meadow (*Carex aquatilis-Pedicularis groenlandica*) is prominent within the slope wetlands. The montane riparian forest (*Abies lasiocarpa-Picea engelmannii/ Mertensia ciliata*) is located at the mouth of the canyon where North Bushee Creek enters the valley. The uplands are dominated by a western slope sagebrush shrubland (*Artemisia tridentata vaseyana/Festuca thurberi*). The montane riparian willow carr (*Salix monticola*/mesic graminoid) dominates the riparian area in the lower portion of the site. There are a series of active beaver ponds along the two main streams. The site is approximately 640 acres ranging in elevation from 2592 m (8,640 ft.) to 2880 m (9,600 ft.).

U.S. Forest Service lands surround the site on three sides. There are two 2-track roads that dissect the site. A cabin is located within the upper portion of the site. The open meadows consist of hay grasses, but no recent agricultural activities are evident.

Biodiversity Rank Justification: The Bushee Creek site consists of good examples of the state rare montane riparian willow carr (*Salix monticola*/mesic graminoid) and the state rare western slope sagebrush shrubland (*Artemisia tridentatata vaseyana/Festuca thurberi*). The site was searched in 1997 for the Southern Rocky Mountain boreal toad (*Bufo boreas boreas*) by a CDOW volunteer, but none were found.

Natural Heritage elements at the Bushee Creek site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Artemisia tridentata vaseyana/Festuca thurberi</i>	western slope sagebrush shrublands	GU	S1S2				B
<i>Salix geyeriana/Salix monticola</i> /mesic graminoid	montane riparian willow carr	GU	S3				B

*EO=Element Occurrence

Boundary Justification: The boundary includes the headwaters of Bushee Creek and the riparian areas adjacent to Bushee Creek and South Bushee Creek. The sagebrush uplands and lodgepole pine forests located above the creeks are included as a buffer to protect the riparian and wetlands from immediate impacts.

Protection Rank Justification: The site is entirely privately owned and is surrounded by U.S. Forest Service lands. The area was historically used for domestic stock and haying operations. The specific plans for the property are not known, but there were no obvious threats observed.

Management Rank Justification: Currently, the riparian areas are in relatively pristine condition. There are active beaver within the willow carr. Although not currently threatened, management may be needed in the future to maintain the current quality of the occurrences, (e.g., maintaining the beaver population) if conditions change. Water diversions should be minimized. Control of hay grasses and weeds needs to be addressed.

Wetland Functional Evaluation for the Bushee Creek site:

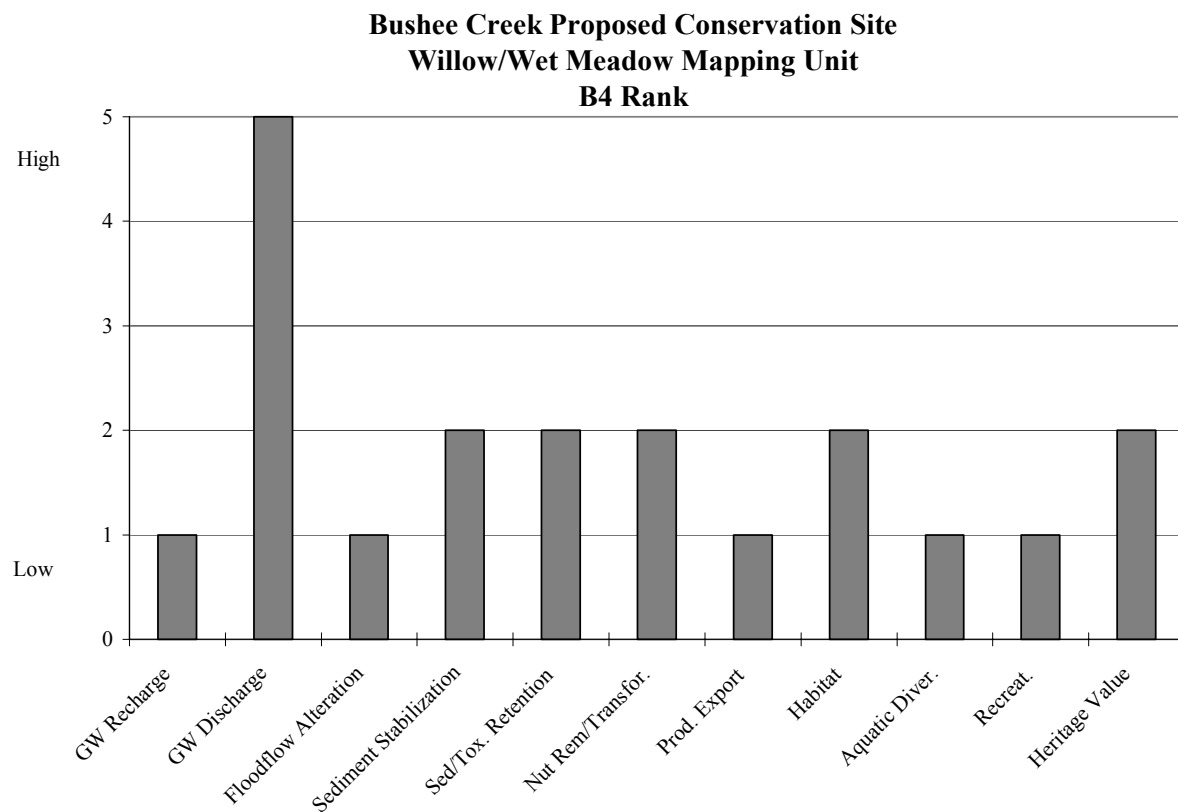
Proposed HGM wetland class: Slope wetland with permanent saturation from springs

Wetland functional evaluation for the Bushee Creek site (willow/wet meadow mapping unit).

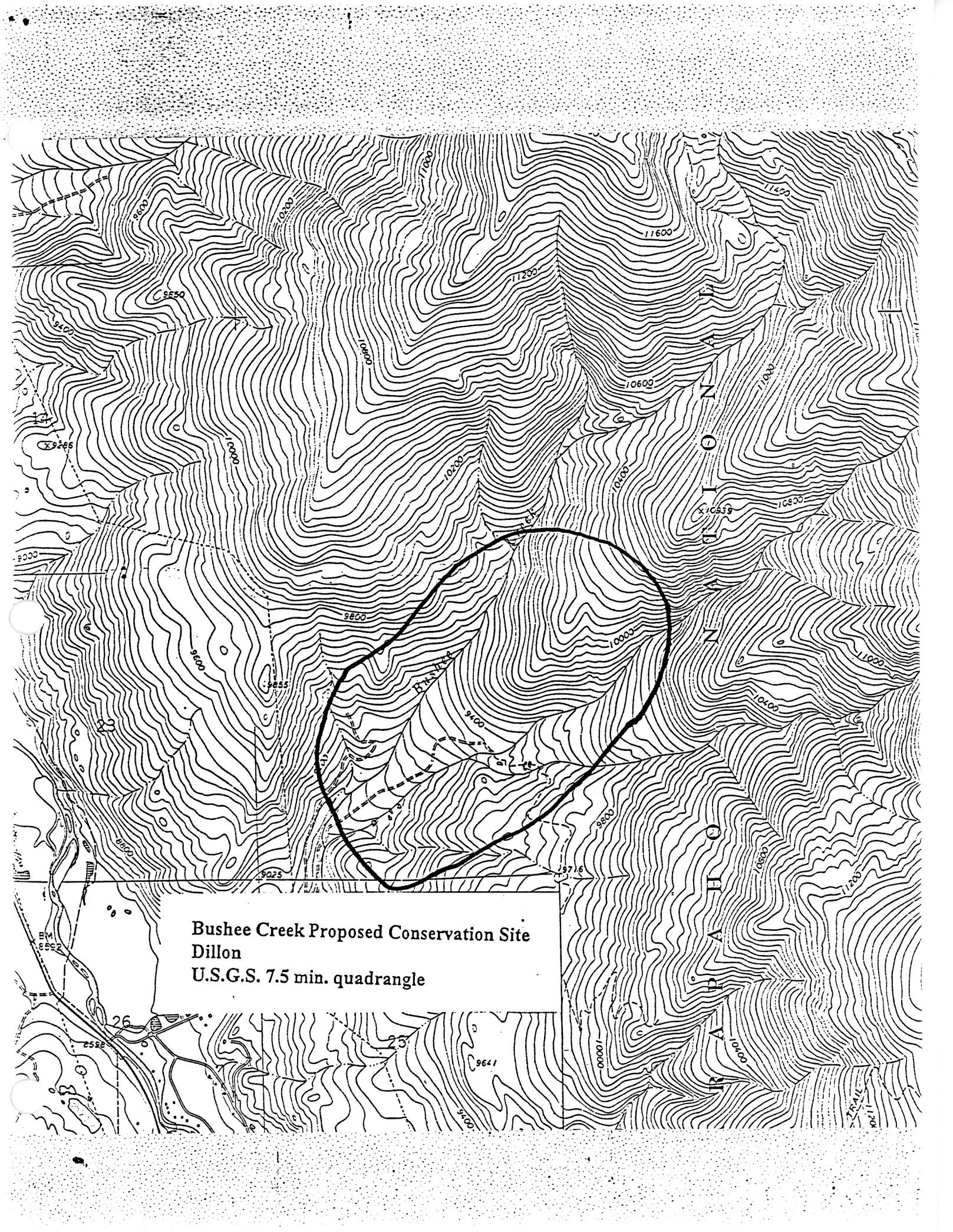
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	no	high	peaty soils
Groundwater Discharge	very high	high	springs and seeps evident
Floodflow Alteration	no	high	no flooding evident
Sediment Stabilization	low	high	no open water, but highly vegetated
Biogeochemical Functions			
Sediment/Toxicant Retention	low	medium	pristine setting, no mines upslope, no flooding
Nutrient Removal/Transformation	low	medium	low sediment and toxicant retention value, but does have some peaty soil
Biological Functions			
Production Export	no	high	
Habitat	low	high	good forage provide to deer and elk
Aquatic Diversity/Abundance	no	high	no open water
Recreation	low	high	not accessible to public, but used by owners as a dude ranch
Uniqueness/Heritage Value	low	high	B ranked G5S4 community

General Soil Description

Texture	peaty sapric soils up to 100 cm
Color	very dark
Cobble Size	none
Percent Mottling	none



Graph of function and value assessment for Bushee Creek site (slope).



A detailed topographic map showing contour lines and elevation. A thick black line outlines a proposed conservation site. The map includes various labels such as 'Bushee Creek', 'Dillon', and 'U.S.G.S. 7.5 min. quadrangle'. The terrain is rugged with many peaks and valleys. The proposed site is located in a valley area, roughly in the center of the map. The map is oriented with North at the top. The contour lines are closely spaced, indicating steep slopes. The overall shape of the proposed site is somewhat irregular, following the natural contours of the land. The map is a black and white reproduction of a physical map, showing some wear and tear at the edges.

Bushee Creek Proposed Conservation Site
Dillon
U.S.G.S. 7.5 min. quadrangle

Triple Creek Ranch

Biodiversity Rank: B4 (Moderate significance)

The Triple Creek Ranch site supports an excellent example of a state rare montane willow carr. A 1972 occurrence of the globally rare mountain whitlow-grass is located within the sagebrush uplands.

Protection Urgency Rank: P4

The site is privately owned with adjacent public lands. The owners want to conserve the area and have not grazed domestic livestock since 1990.

Management Urgency Rank: M4

The only management action needed for this site is to reintroduce and maintain a viable population of beaver.

Location: seven miles north of Silverthorne; four air miles northeast of Keller Mountain

U.S.G.S. 7.5 min. quadrangle: Willow Creek

Legal Description: T4S R78W Sections 8, 9, 16, 17

General Description: The Triple Creek Ranch is located on the eastern base of the Gore Range. It is located at the confluence of three forks of Rock Creek. The site consists of two areas of beaver ponds. The upper ponds consist of three-four abandoned ponds. The wetland is fed by several springs. One pond contains water and supported aquatic vegetation e.g., water starwort (*Callitriche verna*), burreed (*Sparganium emersum*), beaked sedge (*Carex utriculata*), and manna grass (*Glyceria striata*). The lower ponds contains water and peaty soils. There is evidence of moose, elk, and deer. The upslope community supports an aspen/lodgepole forest (*Populus tremuloides*, *Pinus contorta*). The river corridor is dominated by a montane riparian willow carr (*Salix geeyeriana*/*Carex utriculata*) with alder (*Alnus incana*), Colorado blue spruce (*Picea pungens*), and Rocky Mountain willow (*Salix monticola*). The site is approximately 640 acres ranging in elevation from 2640 m (8,800 ft.) to 2784 m (9,280 ft.).

Biodiversity Rank Justification: The Triple Creek Ranch site supports an excellent example of a state rare montane riparian willow carr (*Salix geeyeriana*/*Carex utriculata*). There is also an imprecise location (1972) occurrence of mountain whitlow-grass (*Draba rectifruta*) on Rock Creek. This occurrence was not relocated during the 1997 field season. There are 14 known occurrences in Colorado for mountain whitlow-grass (CNHP 1997).

Natural Heritage elements at the Triple Creek Ranch site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Draba rectifructa</i>	mountain whitlow-grass	G3	S2				unranked
<i>Salix geyeriana/ Carex utriculata</i>	montane riparian willow carr	G5	S3				A

*EO=Element Occurrence

Boundary Justification: The boundary drawn encompasses the headwaters of Rock Creek and the riparian community and the rare plant. A 1,000 ft. buffer is drawn to protect the hydrology from immediate impacts e.g., water diversions, development.

Protection Rank Justification: The site is privately owned with adjacent public lands. The owners want to conserve the area and have not grazed domestic livestock since 1990. A conservation easement would permanently protect this site and its elements.

Management Rank Justification: Management actions could include reintroduction of beaver and manage for their viability. Control of weeds and hay grasses needs to be addressed.

Wetland Functional Evaluation for the Triple Creek Ranch site:

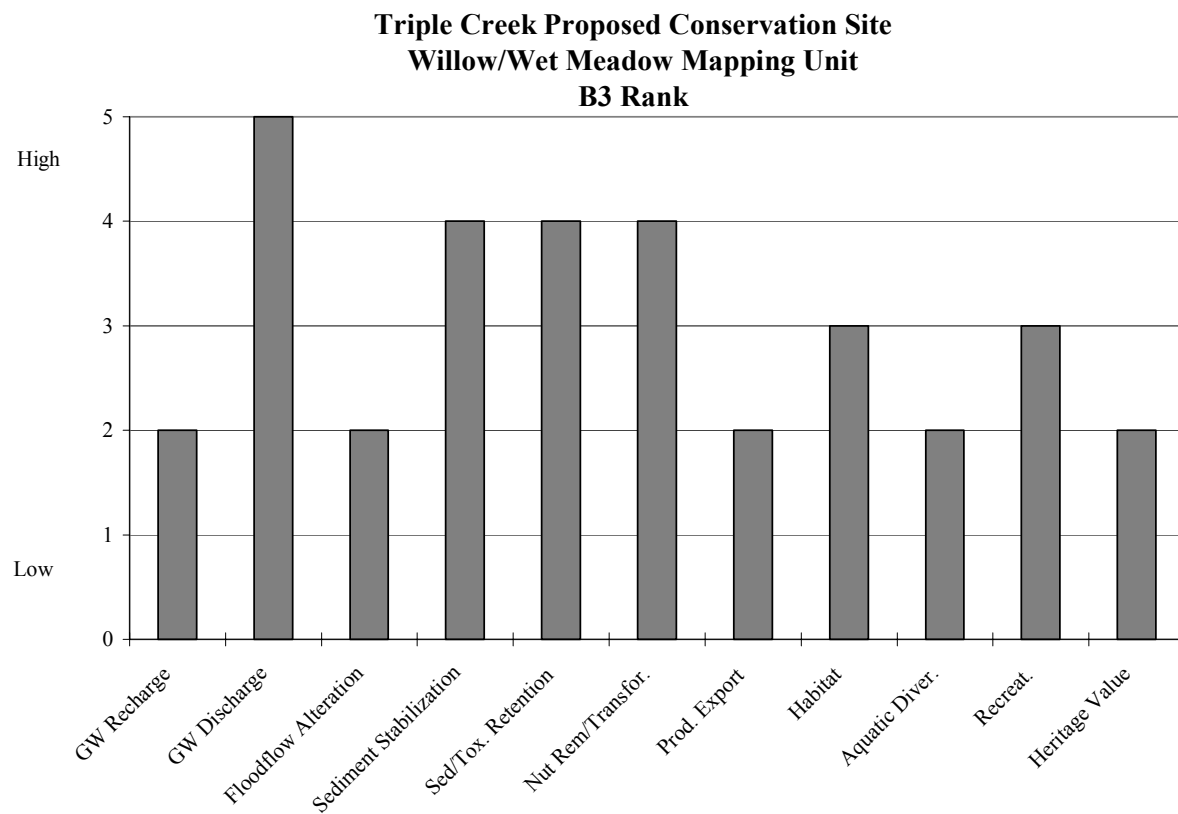
Proposed HGM wetland class: Riverine/slope wetland with permanent to seasonal saturation and continuous inundation

Wetland functional evaluation for the Triple Creek Ranch site (willow/wet meadow mapping unit).

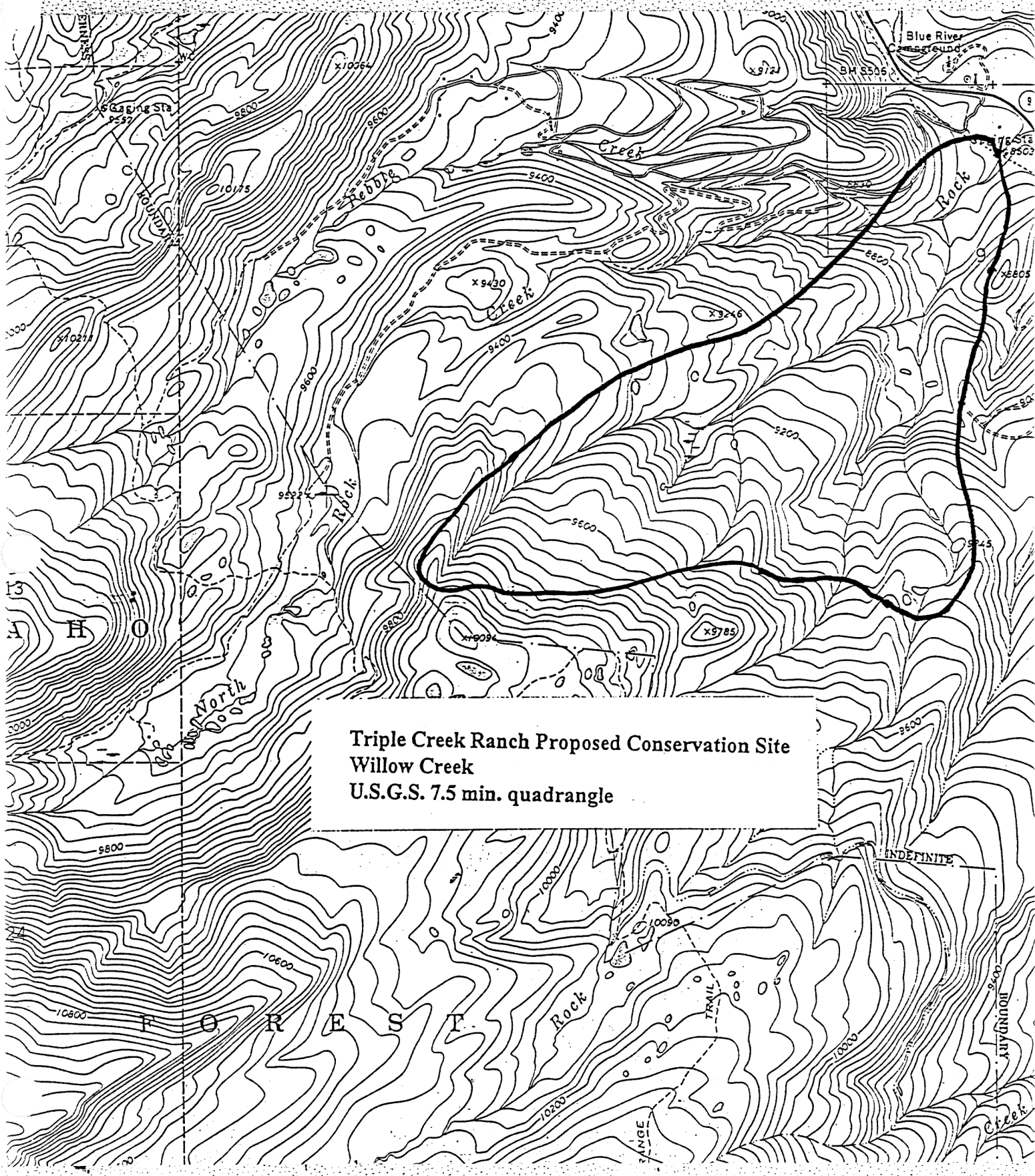
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	low	high	no porous soils, high sediment trapping
Groundwater Discharge	very high	high	numerous springs
Floodflow Alteration	low	high	no flooding apparent
Sediment Stabilization	high	high	densely vegetation
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	peaty soils, located high in watershed, mud deposits
Nutrient Removal/Transformation	high	medium	high sediment retention, flooded permanently, ponds constrict flow
Biological Functions			
Production Export	low	medium	permanently flooded, no flushing, not diverse vegetation
Habitat	medium	high	moose, elk, deer
Aquatic Diversity/Abundance	low	high	no native fish, constructed ponds near residence are stocked with brook trout
Recreation	medium	high	passive only
Uniqueness/Heritage Value	low	high	A ranked G5/S3

General Soil Description

Texture	peaty soils > 40 cm, glacial till between 45-55 cm
Color	dark, sapric
Cobble Size	fine
Percent Mottling	none



Graph of function and value assessment for Triple Creek Ranch site.



Triple Creek Ranch Proposed Conservation Site
Willow Creek
U.S.G.S. 7.5 min. quadrangle

AREAS OF LOCAL SIGNIFICANCE

Brush Creek

Location: 15 miles north of Silverthorne

U.S.G.S. quadrangle name (s): Squaw Creek

Legal Description: T3S R79W Sections 11, 14, 16

General Description: The Brush Creek area is located on the eastern slope of the Gore Range. The area is approximately 100 acres and ranges in elevation from 2460 m (8200 ft) to 2592 m (8640 ft). The riparian wetland is fed by three streams. The willow carr has been fragmented by hay fields and access roads. The sedge meadows are enhanced by the irrigation ditches. There are remnant beaver ponds, but no active beaver sign was observed. The willow carr understory is dominated by hay grasses e.g., timothy (*Phleum pratense*), smooth brome (*Bromus inermis*), and Kentucky blue grass (*Poa pratensis*).

Protection Considerations: This area is privately owned. A conservation easement already exists on portions of the property.

Management Considerations: Although not currently threatened, management may be needed in the future. Specific concerns are impacts from agricultural activities e.g., altered hydrology, weeds, and fragmentation.

Wetland Functional Evaluation for the Brush Creek area:

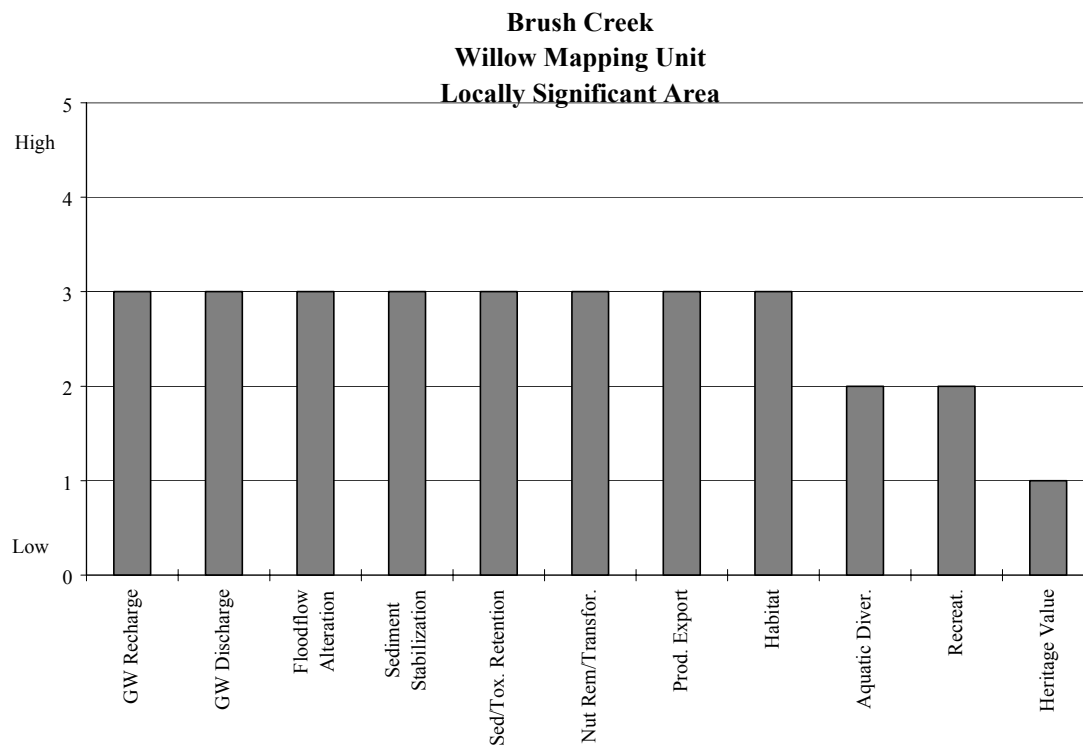
Proposed HGM wetland class: Riverine wetland with intermittent saturation and rare flooding events

Wetland functional evaluation for the Brush Creek area.

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	sandy soils, moderately vegetated, low-lying areas that do constrict flow, no active beaver
Groundwater Discharge	medium	high	discharge from irrigation ditches, probably numerous natural springs
Floodflow Alteration	medium	high	observed some debris and sediment, but only moderate amounts, presence of headgates and human-made ponds
Sediment Stabilization	medium	medium	moderate shoreline anchoring with some sedges
Biogeochemical Functions			
Sediment/Toxicant Retention	medium	medium	moderate amounts of mud and organic matter, but appears some of the riverlets have been ditched, therefore channelized
Nutrient Removal/Transformation	medium	medium	wetland probably filters out herbicides from agricultural activities
Biological Functions			
Production Export	medium	medium	moderate vegetation, controlled flooding
Habitat	medium	high	habitat for beaver (none currently), moose, elk, muskrat?
Aquatic Diversity/Abundance	low	high	no open water
Recreation	low	high	no active, scenic vistas
Uniqueness/Heritage Value	no	high	D rank of common community

General Soil Description

Texture	clayey with some sand
Color	some gleying
Cobble Size	small
Percent Mottling	40% mottling up to 50 cm



Graph of function and value assessment for Brush Creek area.

Columbine Wetland

Location: 10 miles north of Silverthorne on Highway 9.

U.S.G.S. quadrangle name (s): Squaw Creek

Legal Description: T3S R78W Section 29

General Description: The Columbine Wetland is located at the western base of the Gore Range. It is a slope/depressional wetland located above the Blue River. Harrigan Creek and Bordoux Gulch flow into the pond and wetland. The wetland is also fed by numerous springs flowing from the base of Gore Range. There are two upwellings of groundwater that appear to be the major sources of water for the sedge wetland and the pond located to the north. The beaked sedge montane wet meadow (*Carex utriculata*) is extensive, approximately 30 acres at an elevation of 2480 m (8266 ft) and is floating or quaking in several places.

The pond is impounded by a dike. There is a privately owned hay field north of the pond. There is no grazing or haying within the area. There is an access road that bisects the area and a private residence is located north of the wetland.

Protection Considerations: The area is located on public lands, with adjacent private property. Agricultural activities occur on the private property, however these activities do not seem to impact the wetland.

Management Considerations: Although this area is not currently threatened, new actions (e.g., fencing off the wetland) may be needed in the future to prevent loss of the element.

Wetland Functional Evaluation for the Columbine Wetland area:

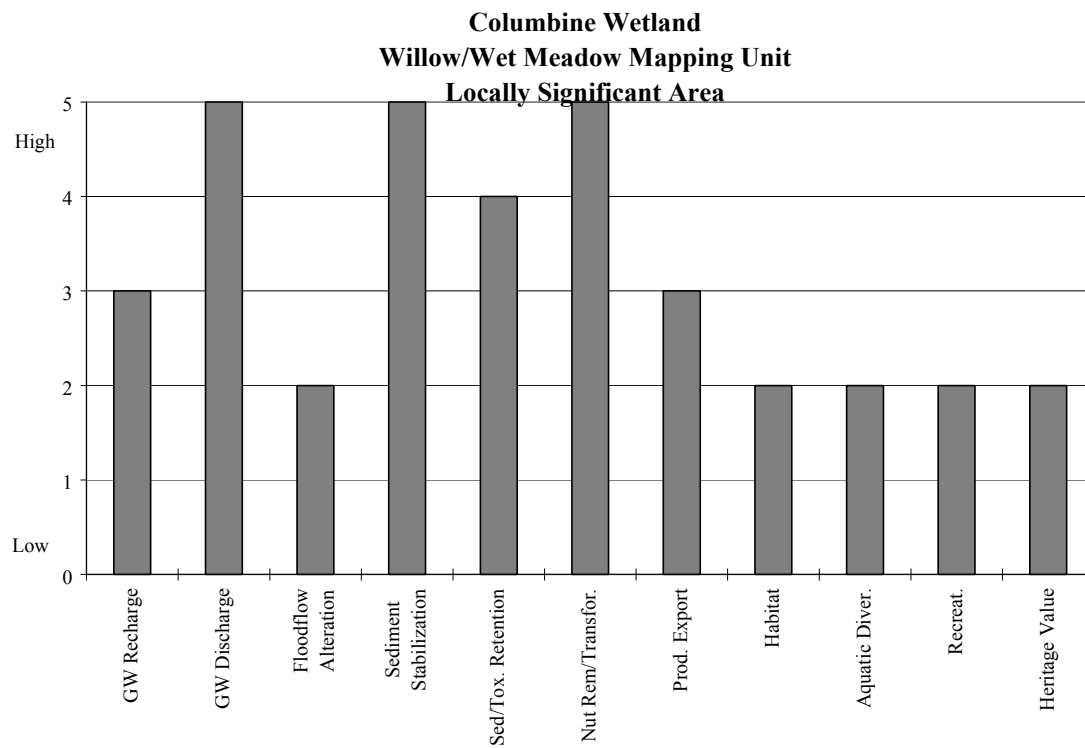
Proposed HGM wetland class: Slope wetland with permanent saturation and continuous inundation

Wetland functional evaluation for the Columbine Wetland area.

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	sandy soils with gravel in some areas, constricted outlet, surface water inflow > outflow
Groundwater Discharge	very high	high	numerous springs and free-flowing wells
Floodflow Alteration	low	high	no evidence of flooding, but wetland is located to Blue River
Sediment Stabilization	very high	high	peat accumulation, heavily vegetated
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	constricted outlet, accumulation of organic matter
Nutrient Removal/Transformation	very high	medium	organic matter accumulation, constricted outlet, presence of aquatic vegetation, permanently flooded
Biological Functions			
Production Export	medium	medium	no outlet, densely vegetated
Habitat	low	medium	open water, but not well mixed
Aquatic Diversity/Abundance	low	medium	did not observed fish, only aquatic insects
Recreation	low	high	not easily accessible
Uniqueness/Heritage Value	low	high	only free-flowing well observed on private lands

General Soil Description

Texture	peaty, histosols within sedge meadow, peat accumulation up to 50 cm, sandy on edges of wetland
Color	very dark 2.5 Y 2.5/1
Cobble Size	small
Percent Mottling	no mottling



Graph of function and value assessment for Columbine Wetland area.

Silverthorne Wetland

Location: northeast corner of Silverthorne and I-70 exchange

U.S.G.S. quadrangle name (s): Dillon

Legal Description: T5S R78W Section 12 and T5S R77W Section 7

General Description: The Silverthorne Wetland is located along Straight Creek between Interstate 70 and Highway 6. There is evidence of active beavers using the area creating ponds along the creek. The ponds contain a large amount of sediment due to the close proximity of Interstate 70 and Highway 6. There is commercial and residential development located adjacent to the wetland. Parts of the wetland have been filled and road placement has channelized Straight Creek. The area is approximately 20 acres ranging in elevation from 2655 m (8850 ft) to 2640 m (8800 ft)

Protection Considerations: The Silverthorne wetland is immediately threatened by severely destructive forces such as: development, filling, continued sedimentation from road maintenance.

Management Considerations: The Silverthorne wetland is very degraded. However, there are active beaver remaining. Management should consider actions to ensure the continued viability of the beaver.

Wetland Functional Evaluation for the Silverthorne wetland area:

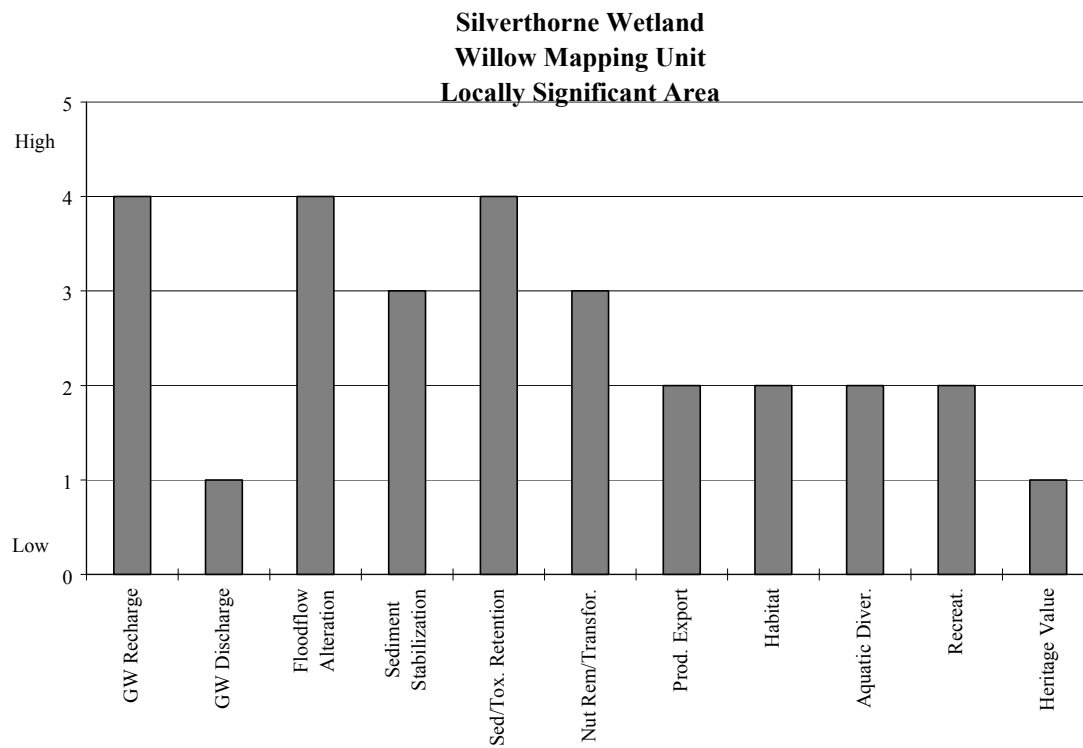
Proposed HGM wetland class: Riverine wetland with seasonal hydroperiod and frequent flooding events

Wetland functional evaluation for the Silverthorne area.

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	high	high	sandy soils, moderately dense vegetation, beaver dams provided recharge opportunities
Groundwater Discharge	no	high	no obvious springs
Floodflow Alteration	high	high	low gradient, porous substrate, several beaver dams, woody debris
Sediment Stabilization	medium	medium	willows and alders located adjacent to Straight Creek
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	dams slow or stop water, moderate vegetation, deposits of sediment on dam surfaces, road maintenance and activities contribute to sediment load
Nutrient Removal/Transformation	medium	medium	dams trap water, presence of some aquatic vegetation, ponds do appear to dry out by late summer
Biological Functions			
Production Export	low	medium	beaver ponds keep wetland permanently flooded (except for late summer), some flushing flows, water is eutrophic in ponds
Habitat	low	high	beaver
Aquatic Diversity/Abundance	low	high	stagnant water, barriers
Recreation	low	high	open space only
Uniqueness/ Heritage Value	no	high	degraded wetland

General Soil Description

Texture	sandy, no organic matter accumulation
Color	matrix 2.5Y 3/1
Cobble Size	small
Percent Mottling	15% mottle color 10YR 3/3



Graph of function and value assessment for Silverthorne Wetland area.

Willow Creek at Silverthorne

Location: 2 miles north of Interstate 70 and Silverthorne interchange; south on Highway 9

U.S.G.S. quadrangle name (s): Dillon

Legal Description: T5S R78W Section 2

General Description: The Willow Creek at Silverthorne area is a riparian wetland located along Willow Creek within the Willowbrook subdivision. The montane riparian willow carr (*Salix geyeriana*-*Salix monticola*/mesic graminoid) has been fragmented and is restricted to a very narrow corridor. The hydrology of the area has been completely altered, with dams and fill. There was no evidence of beaver within the wetland.

Protection Considerations: The area is privately owned. The hydrology has been altered and the willow carr has been fragmented by road and homes.

Management Considerations: Management could consider keeping the willow carr intact at least for open space purposes.

Wetland Functional Evaluation for the Willow Creek at Silverthorne area:

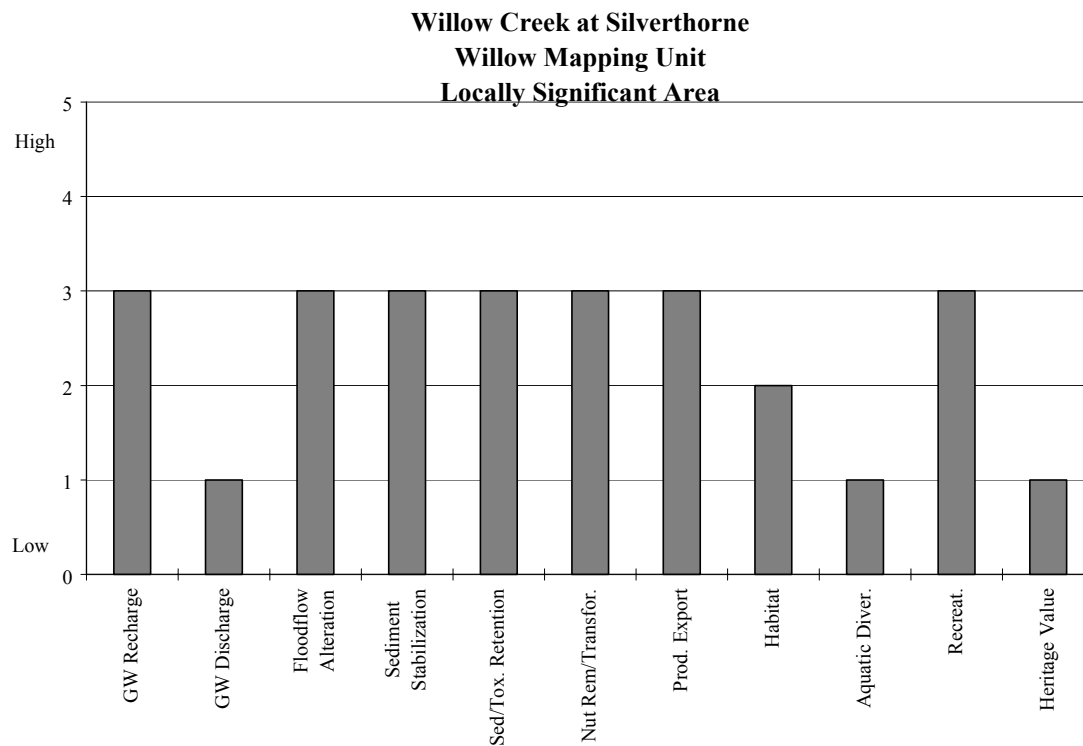
Proposed HGM wetland class: Riverine wetland with seasonal hydroperiod and occasional flooding

Wetland functional evaluation for the Willow Creek at Silverthorne area

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	sandy soils, dense vegetation where there is no homes, irregular shape, but due to homes and yards, creek has become channelized
Groundwater Discharge	no	high	no springs evident
Floodflow Alteration	medium	high	debris and sediment deposits observed, several depressions with water next to stream, much of historic carr has been filled
Sediment Stabilization	medium	high	high vegetation density, sedges in understory
Biogeochemical Functions			
Sediment/Toxicant Retention	medium	medium	no constricted outlets, except creek is dammed at Highway 9, mud and organic matter accumulation, wetland probably receives a fair amt. of fertilizer and pesticides from lawns
Nutrient Removal/Transformation	medium	medium	removal of chemicals from roads, construction, and lawn maintenance
Biological Functions			
Production Export	medium	medium	outlet has been altered due to hwy. 9, area is seasonally flooded
Habitat	low	medium	habitat for finches and sparrows
Aquatic Diversity/Abundance	no	medium	none observed
Recreation	medium	high	mainly passive
Uniqueness/Heritage Value	no	high	degraded occurrence

General Soil Description

Texture	sandy
Color	10 YR 3/1
Cobble Size	small
Percent Mottling	10-30%



Graph of function and value assessment for Willow Creek at Silverthorne area.

SNAKE RIVER BASIN

Dillon Bay

Biodiversity Rank: B2 (Very high significance)

The Dillon Bay site consists of a good example of the globally rare clustered sedge meadow.

Protection Urgency Rank: P2

The Dillon Bay site is entirely privately owned with adjacent public lands. This site is located adjacent to Highway 6 and the Dillon Reservoir where there is the high probability of alteration due to residential development and/or road improvements. A conservation easement or open space designation should be considered to prevent development or negative impact to the fen.

Management Urgency Rank: M2

Management of site should be taken within 5 years to prevent the loss of the wetland.

Location: 2 miles east of Dillon on Highway 6

U.S.G.S. 7.5 min. quadrangle: Frisco; Dillon; Keystone; Loveland Pass

Legal Description: T5S R77W Sections 16, 9, 10, 15

General Description: The Dillon Bay site is located at the southeastern tip of Dillon Bay, north of Highway 6 on the southwest side of Tenderfoot Mountain. It is a fen (peat-accumulating wetland that is supported by ground water discharge) supported by groundwater discharging from the Pierre Shale. The fen is dominated by cluster sedge (*Carex praegracilis*), aquatic sedge (*Carex aquatilis*), beaked sedge (*Carex utriculata*), Geyer willow (*Salix geyeriana*), Rocky Mountain willow (*Salix monticola*), shortfruit willow (*Salix brachycarpa*), shrubby cinquefoil (*Pentaphylloides floribunda*) and Englemman spruce (*Picea engelmannii*). Upslope of the wetland, aspen (*Populus tremuloides*) and lodgepole pine (*Pinus contorta*) dominate. The drier areas are dominated by sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and rabbitbrush (*Chrysothamnus parryi*).

The site is bordered to the south by Highway 6 and to the north by Tenderfoot Mountain. The Oro Grande bicycle trail bisects the site. The site is a total of 500 acres ranging in elevation from 2721 m (9,070 ft.) to 2880 m (9,600 ft.).

Biodiversity Rank Justification: This site contains a globally imperiled clustered sedge (*Carex praegracilis*) wetland community. There are only 5 occurrences of clustered sedge wetlands known in Colorado, three of these are located in Summit County (CNHP 1997). It is a significant site due to the relative rarity of fens observed on private lands in Summit County.

Natural Heritage elements at the Dillon Bay Fen site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Carex praeegracilis</i>	clustered sedge wetland	G2G3	S2				B

*EO=Element Occurrence

Boundary Justification: The boundary drawn encompasses the fen, adjacent uplands, and montane forest. This boundary includes property owned both privately and publicly. A much larger area should be considered in any long-term management or protection plan to protect the hydrology of this site.

Protection Rank Justification: The site is located in a quickly growing area of Summit County. Residential development is encroaching from the Town of Dillon which could attempt to fill and build on this site. The site is located very close to Highway 6 therefore, there is the threat of road widening activities.

Management Rank Justification: The private landowners need to be notified of the importance of this site both as a unique wetland and the location of the globally rare sedge wetland so that a management plan can be in place to protect this site. The hydrology of this site is important to the ecological processes which support these riparian communities. The water quality, quantity, and timing should be maintained at its current status.

Wetland Functional Evaluation for the Dillon Bay Fen site:

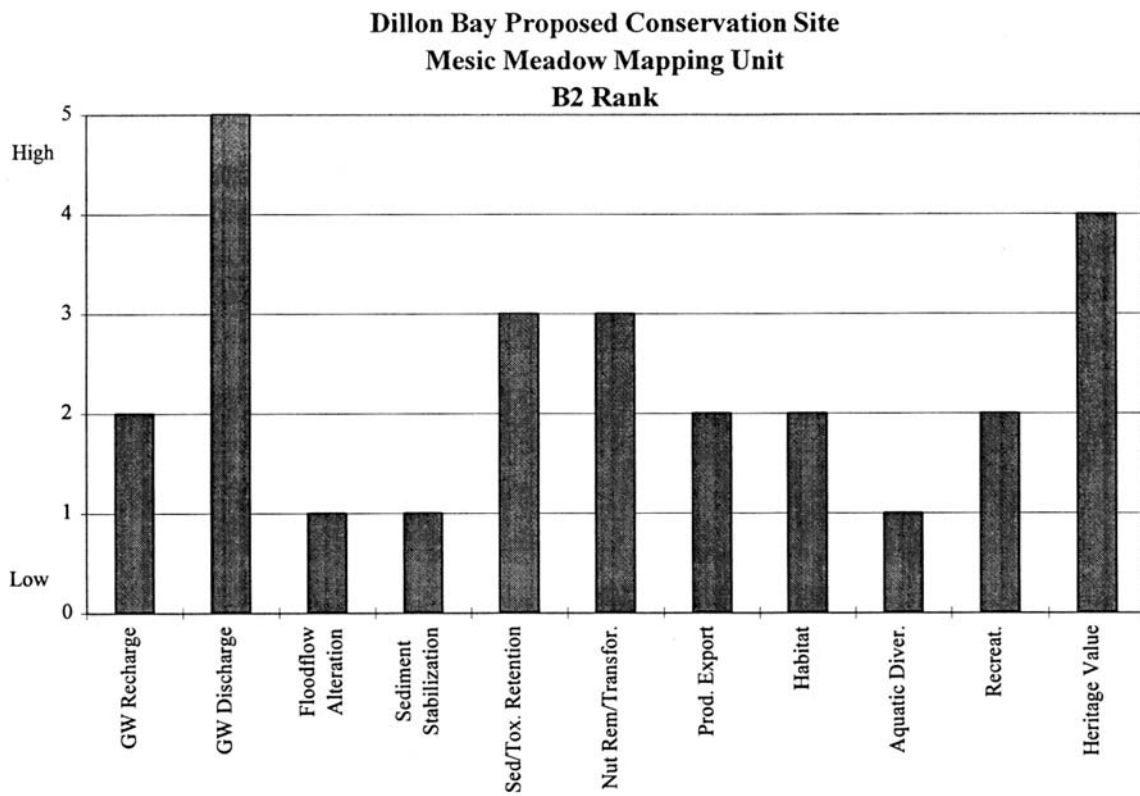
Proposed HGM wetland class: Slope wetland with permanent saturation and continuous inundation

Wetland functional evaluation for the Dillon Bay Fen site (mesic meadow mapping unit).

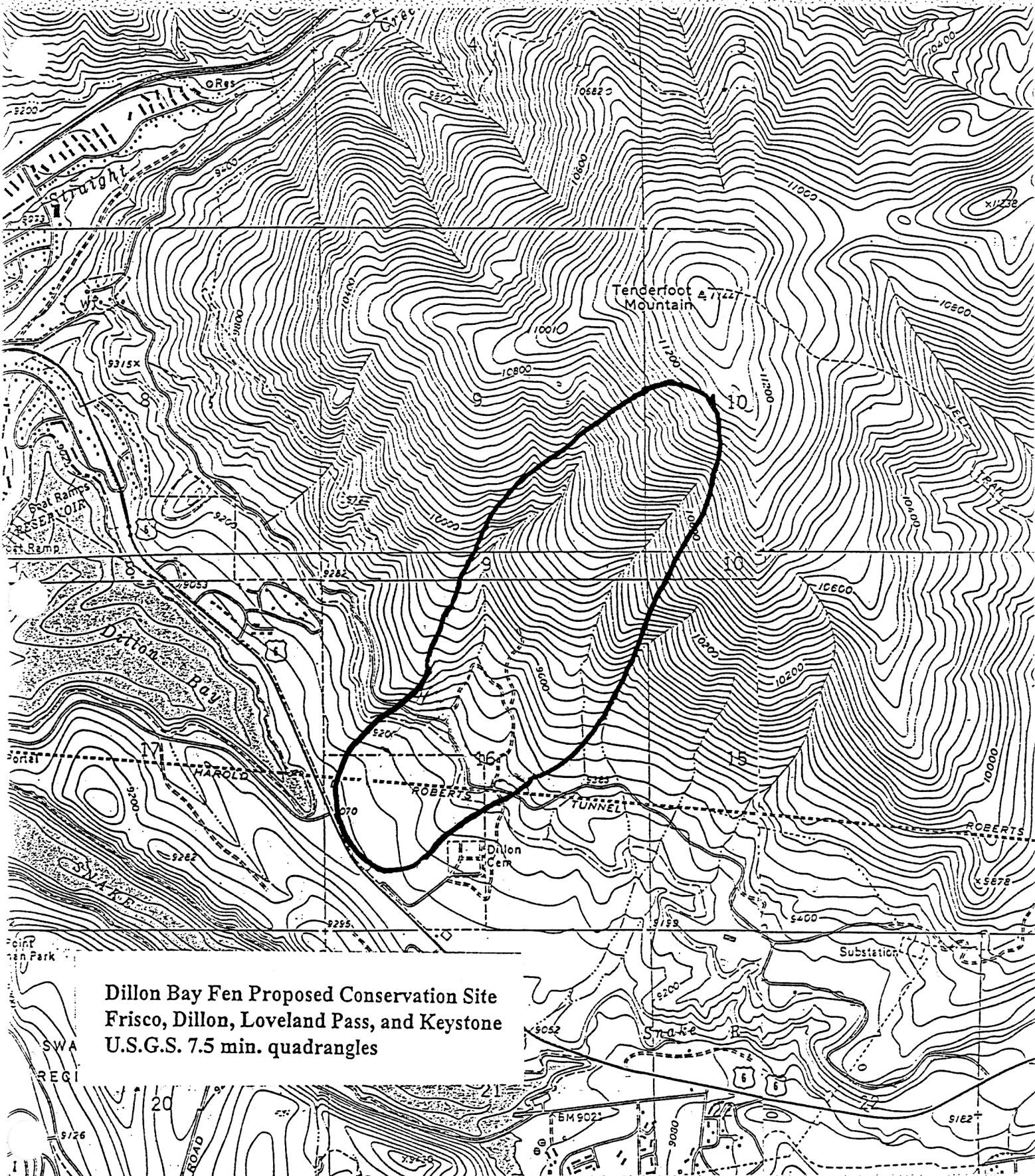
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	low	high	peaty soils, excess water is diverted into an adjacent ditch next to hwy 6
Groundwater Discharge	very high	high	numerous obvious springs
Floodflow Alteration	no	high	no flooding evident
Sediment Stabilization	no	high	no open water
Biogeochemical Functions			
Sediment/Toxicant Retention	medium	high	gentle gradient, long-term retention due to the peaty soils
Nutrient Removal/Transformation	medium	high	peaty soils, flooded permanently
Biological Functions			
Production Export	low	high	no outlet, no flushing, no open water
Habitat	low	high	observed 2 snipes
Aquatic Diversity/Abundance	no	high	no fish, no open water
Recreation	low	high	scenic, bike path
Uniqueness/Heritage Value	high	high	B rank of G2G3 community

General Soil Description

Texture	peaty, sapric
Color	dark brown
Cobble Size	none
Percent Mottling	none



Graph of function and value assessment for Dillon Bay Fen site.



Dillon Bay Fen Proposed Conservation Site
Frisco, Dillon, Loveland Pass, and Keystone
U.S.G.S. 7.5 min. quadrangles

Montezuma

Biodiversity Rank: B2 (Very high significance)

The Montezuma site supports a good occurrence of a breeding population of the globally imperiled southern Rocky Mountain boreal toad and excellent examples of several subalpine riparian willow carrs.

Protection Urgency Rank: P2

The Montezuma site is owned both privately and publicly. The southern Rocky Mountain boreal toad occurrence is located on private lands. The site is located in a scenic part of Summit County and therefore the threats from residential and commercial development are high. The southern Rocky Mountain boreal toad occurrence is located adjacent to the only access road to Montezuma. The threat of road enhancement or maintenance projects are very high.

Management Urgency Rank: M2

Management actions need to be taken within 5 years to prevent the further degradation of the southern Rocky Mountain boreal toad population and the loss of the willow carr to impacts from development, mining, or road improvements.

Location: The site is located 0.5 miles north of Montezuma and extends along Deer Creek, Saint John Creek, and Snake River for 3.0 miles south to treeline.

U.S.G.S. 7.5 min. quadrangle: Montezuma

Legal Description: T5S R76W Sections 26, 34, 35, 24

T6S R76W Sections 1, 2, 3, 10, 12

General Description: The Montezuma site consists of three glaciated valleys. Saint John Creek, Deer Creek, and the Snake River drain the site. The prominent peaks that border the site include: Bear, Glacier, Teller, Landslide, and Geneva Peaks. The site supports an extensive willow carr that is approximately 2,800 acres ranging in elevation from 3000 m (10,000 ft.) to 3420 m (11,400 ft.). There are excellent occurrences of subalpine riparian willow carrs (*Salix planifolia*/*Carex aquatilis* and *Salix planifolia*/*Caltha leptosepala*) located mainly on National Forest lands. There is a good occurrence of a subalpine riparian willow carr (*Salix planifolia*/*Calamagrostis canadensis*) that is located near the Town of Montezuma and a breeding occurrence of the southern Rocky Mountain boreal toad. The site supports a series of beaver ponds that are fed by Deer Creek, Saint John Creek, Snake River, intermittent streams, and several springs. There are several areas where fens (peat-accumulating wetland that is supported by ground water discharge) have been created from groundwater discharge, such as the area 1 mile north of Webster Pass.

Portions of the wetlands were heavily mined evidenced by tailings and abandoned equipment throughout much of the site. The site is bisected by 4WD roads that allow access to the alpine areas. These roads are utilized by both private and commercial enterprises.

Biodiversity Rank Justification: The Montezuma site supports excellent examples of subalpine riparian willow carrs (*Salix planifolia/Carex aquatilis* and *Salix planifolia/Caltha leptosepala*) and a good example of a subalpine riparian willow carr (*Salix planifolia/Calamagrostis canadensis-Carex aquatilis*). There is a 1995 occurrence of the state endangered southern Rocky Mountain boreal toad (*Bufo boreas boreas*). There was no evidence of breeding in 1996 or 1997 (Horstman 1996; 1997).

The southern Rocky Mountain population of boreal toads is likely distinct from other populations (A. Goebel unpubl. data). There are approximately 206 historical localities for the southern Rocky Mountain boreal toad in Colorado. Presently, only three to four healthy populations remain, comprised of less than 20 high priority breeding sites (Steve Corn, pers. comm.; Lauren Livo, pers. comm.) Populations have declined precipitously or disappeared over the past 20 years and continue to do so (Goettl 1997). The reasons for the decline are unknown and the factors important to the perseverance of this species are not well understood (Pague et al. 1997). The southern Rocky Mountain boreal toad is currently a candidate for federal listing, a state endangered and a U.S. Forest Service sensitive species.

Natural Heritage elements at the Montezuma site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Bufo boreas boreas</i>	southern Rocky Mountain boreal toad	G4T1Q	S1	C	E	FS	B
<i>Salix planifolia/Calamagrostis canadensis</i>	subalpine riparian willow carr	G2G4	S2S4				C
<i>Salix planifolia/Caltha leptosepala</i>	subalpine riparian willow carr	G4	S4				A
<i>Salix planifolia/Carex aquatilis</i>	subalpine riparian willow carr	G4	S4				A

*EO=Element Occurrence

Boundary Justification: The boundary drawn encompasses the riparian areas adjacent to Deer Creek, Saint John Creek, and the Snake River. The boundary incorporates the Town of Montezuma due to the potential boreal toad habitat located within the town limits. This boundary also includes a buffer zone along the talus slopes to protect the willow carr and the southern Rocky Mountain boreal toad habitat from direct disturbances such as mining, ORV, and road improvements.

Protection Rank Justification: This site is owned both privately and publicly. The southern Rocky Mountain boreal toad occurrence is located on private lands. There are several threats to the site stemming from residential development and off road vehicles travel through the site.

Management Rank Justification: Management actions are needed within 5 years to improve the southern Rocky Mountain boreal toad occurrence. Beaver need to be reintroduced to the site to maintain ponds. Sediment trapping material needs to be placed between the road and wetland to prevent sedimentation of wetland. The hydrology of this site is important to the ecological

processes which support the boreal toad occurrence and its habitat. The water quality, quantity, and timing should be maintained at its current status.

Wetland Functional Evaluation for the Montezuma site:

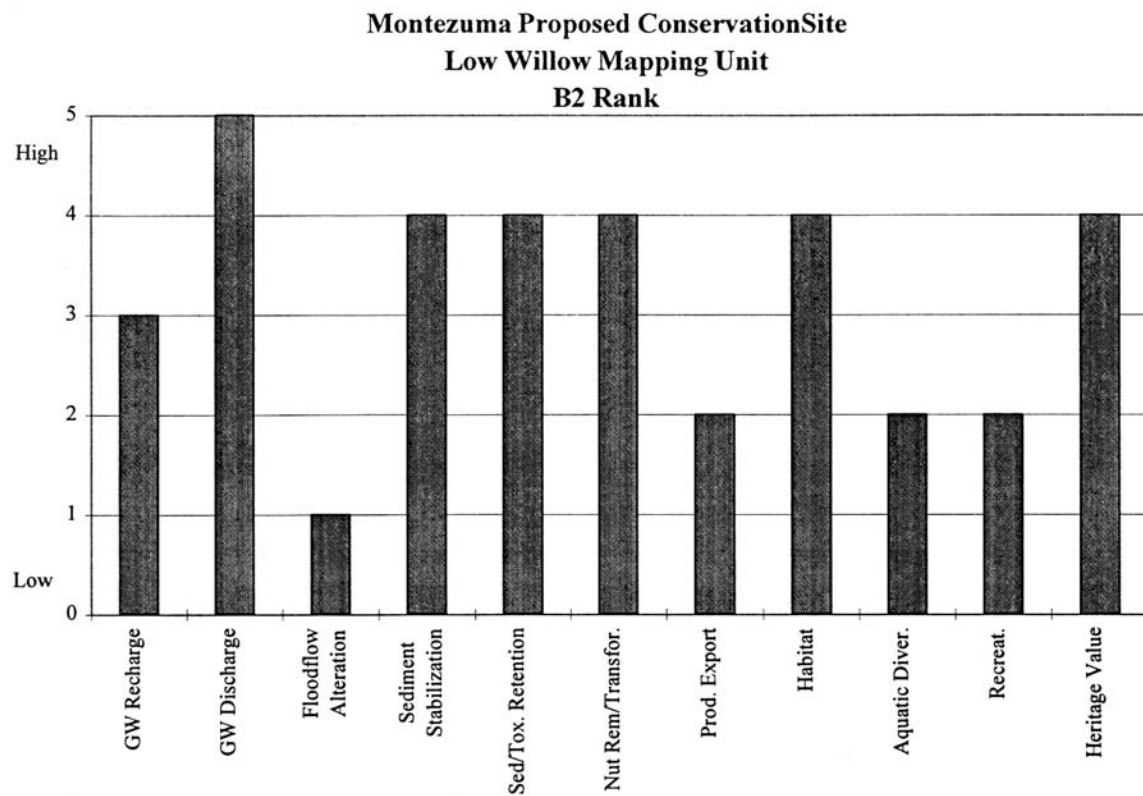
This evaluation is for the wetland that supports the southern Rocky Mountain boreal toad occurrence. The Proposed HGM wetland class is a riverine wetland with several ponds and/or kettle ponds located along river.

Wetland functional evaluation for the Montezuma site (low willow mapping unit).

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	clayey soils in upper layer, then sandy
Groundwater Discharge	very high	high	area receives water from springs south of ponds
Floodflow Alteration	low	high	no signs of flooding, permanently saturated soils
Sediment Stabilization	high	high	densely vegetated around ponds with willows, grasses and sedges
Biogeochemical Functions			
Sediment/Toxicant Retention	high	high	wetland located below Montezuma road and receives run-off of gravel and sand, located below several mines
Nutrient Removal/Transformation	high	medium	some organic material accumulation, high sediment/toxicant retention
Biological Functions			
Production Export	low	medium	permanently flooded, restricted outlet, no flushing
Habitat	high	high	boreal toad, beaver, ungulates
Aquatic Diversity/Abundance	low	high	moss dominated ponds
Recreation	low	high	no passive or active evident
Uniqueness/Heritage Value	high	high	B rank of boreal toad

General Soil Description

Texture	sandy with some clay, organic accumulation 0-20 cm
Color	very dark 10YR 3/1
Cobble Size	small
Percent Mottling	none



Graph of function and value assessment for Montezuma site.

Wetland Functional Evaluation for the Webster Pass Fen site:

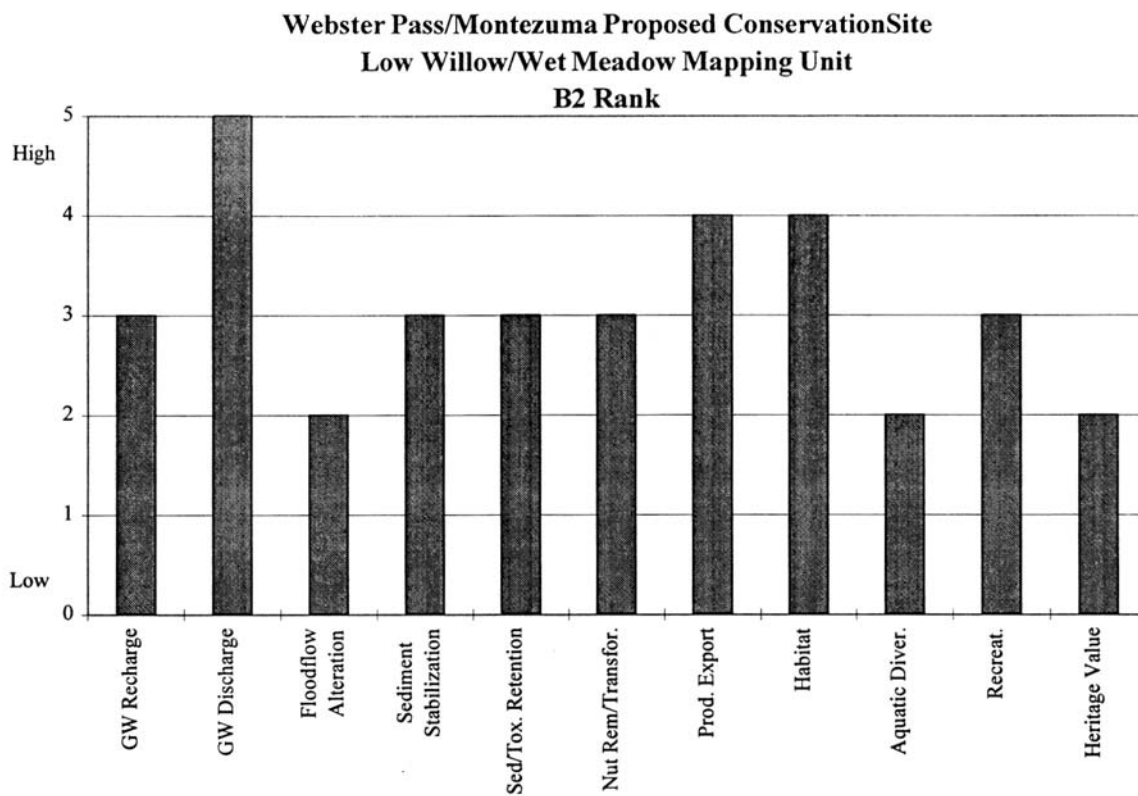
Proposed HGM wetland class: Depressional wetland with permanent saturation and continuous inundation

Wetland functional evaluation for the Webster Pass Fen site (low willow/wet meadow mapping unit).

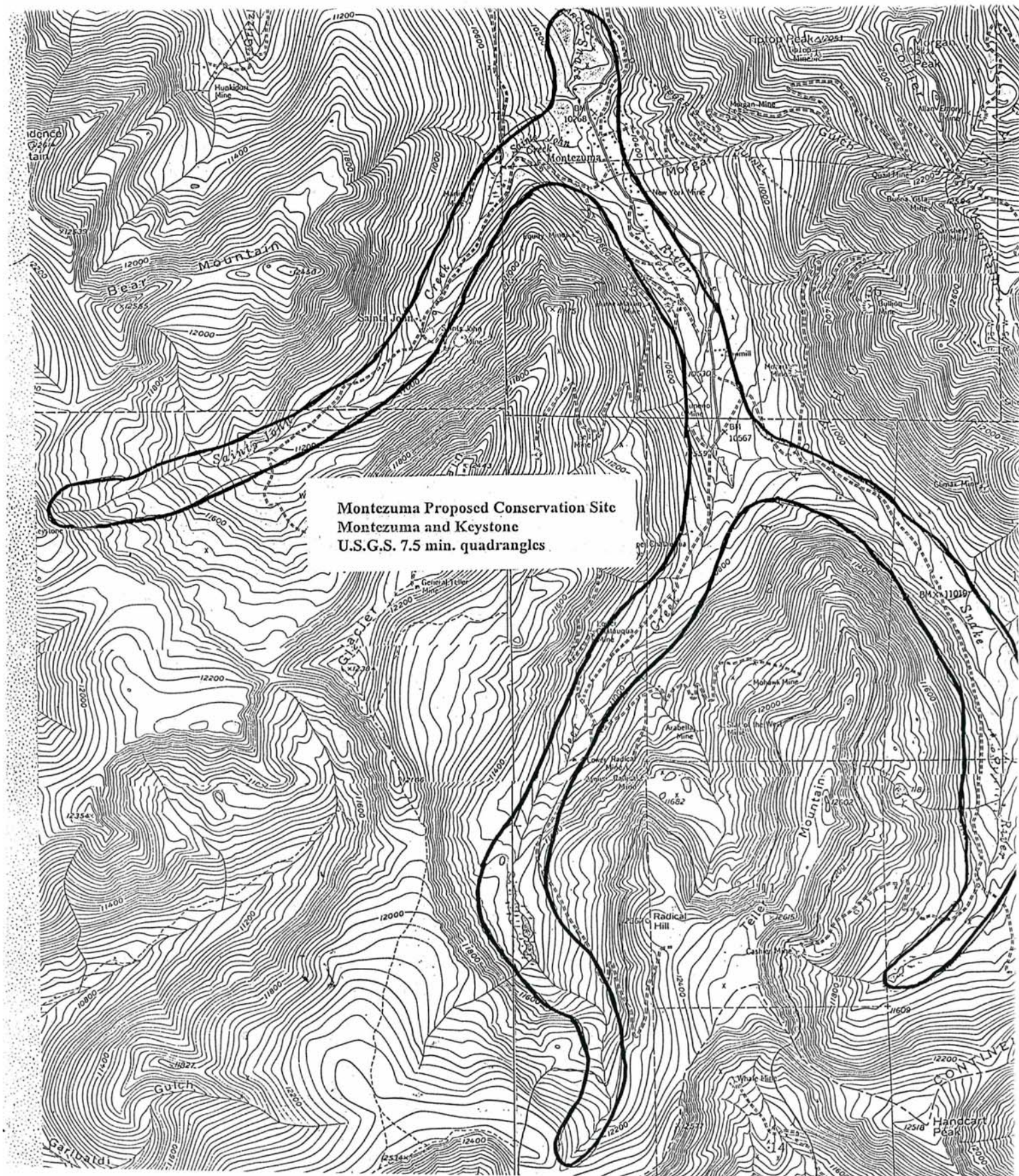
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	sandy soils at 40 cm with overlying peat
Groundwater Discharge	very high	high	location of springs and seeps
Floodflow Alteration	low	medium	ponds are topographical above the wetland, no evidence of sediment trapping or debris
Sediment Stabilization	medium	high	open water, ponds surrounded by dense vegetation
Biogeochemical Functions			
Sediment/Toxicant Retention	medium	low	third order stream, but below mining activities
Nutrient Removal/Transformation	medium	low	organic material accumulation
Biological Functions			
Production Export	high	high	wildlife sign, dense vegetation
Habitat	high	high	beaver, elk, deer
Aquatic Diversity/Abundance	low	high	moss dominated ponds, observed water striders, but no fish
Recreation	medium	high	passive summer and snowmobile and X-C skiing in winter
Uniqueness/Heritage Value	low	high	A rank of globally common willow community

General Soil Description

Texture	peaty sapric soils > 100 cm
Color	dark with gley GLEY 1 6/10Y
Cobble Size	small
Percent Mottling	none



Graph of function and value assessment for Montezuma site (Webster Pass).



Montezuma Proposed Conservation Site
Montezuma and Keystone
U.S.G.S. 7.5 min. quadrangles

Peru Creek

Biodiversity Rank: B2 (Very high significance)

The Peru Creek site supports one of the best breeding populations of southern Rocky Mountain boreal toad observed on private lands in Summit County.

Protection Urgency Rank: P2

The majority of the Peru Creek site is located on public lands. Easiest access is via privately owned property. This site is threatened within the next 5 years due to increased traffic on the Peru Creek road, potential expansion of adjacent ski area, proposed Peru Creek reservoir, and increased beaver activity. A conservation easement or open space designation would be appropriate to ensure the viability of this element occurrence.

Management Urgency Rank: M2

Management actions need to be taken within 5 years to prevent the degradation of the breeding population of boreal toads. Monitoring of the southern Rocky Mountain boreal toad population and its habitat is necessary to ensure viability of the occurrence.

Location: 2 air miles northeast of Montezuma along the Peru Creek road by the Maid of Orleans Mine site

U.S.G.S. 7.5 min. quadrangle: Montezuma

Legal Description: T5S R76W Section 24

General Description: The Peru Creek site is located on the south side of Lenawee Mountain. The site is fed by numerous springs that flow from the base of Lenawee Mountain. Peru Creek borders the wetland to the south. It supports a small montane riparian willow carr (*Salix planifolia*/*Carex aquatilis*) that supports a series of small beaver ponds located on the southside of the Peru Creek road. The abandoned Maid of Orleans mine and a private residence are located within the site. The site is approximately 300 acres ranging in elevation from 3076 m (10,252 ft.) to 3084 m (10,280 ft.).

Biodiversity Rank Justification: The Peru Creek site supports the best example of a breeding population of the southern Rocky Mountain boreal toad (*Bufo boreas boreas*) observed on private lands in Summit County (Horstman 1996). Toads were first discovered on June 20, 1996 by Greg Horstman. Eight juveniles were observed on that date. On July 24, 1996, 150-200 tadpoles were observed in one of the beaver ponds. During 1996 the Peru Creek site was highly successful with definite recruitment (or survival of young) in high numbers (Horstman 1996). The 1997 survey documented approximately 150-200 tadpoles in the same beaver pond. There were two juveniles observed on the survey date.

The southern Rocky Mountain population of boreal toads is likely distinct from other populations (A. Goebel unpubl. data). There are approximately 206 historical localities for the boreal toad in Colorado. Presently, only three to four healthy populations remain, comprised of less than 20 high priority breeding sites (Steve Corn, pers. comm.; Lauren Livo, pers. comm.)

Populations have declined precipitously or disappeared over the past 20 years and continue to do so (Goettl 1997). The reasons for the decline are unknown and the factors important to the perseverance of this species are not well understood (Pague et al. 1997). The boreal toad is currently a candidate for federal listing, a state endangered and U.S. Forest Service sensitive species.

Natural Heritage element at the Peru Creek site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Bufo boreas boreas</i>	southern Rocky Mountain boreal toad	G5T2Q	S1	C	E	FS	A

*EO=Element Occurrence

Boundary Justification: The boundary is drawn to encompass the elements, beaver ponds and upslope area along Lenawee Mountain to protect the occurrence and the hydrology which is the keystone to the viability of the boreal toad. Upslope of the ponds is included to provide an area of post-dispersal for the boreal toad.

Protection Rank Justification: This site is located mainly on National Forest lands, but access is across private lands. The Summit County Small Reservoir Feasibility Study completed for Summit County government in September 1989 identified Peru Creek for a reservoir. No action has been taken of developing the wetlands to date. There are also potential plans for snow making operations at A-Basin that could affect the hydrology of Peru Creek. Increased traffic along the Peru Creek road could increase sedimentation of the beaver ponds.

Management Rank Justification: Management actions will need to occur within 5 years to prevent the loss of the boreal toad. Beaver need to be monitored so that the water level of the ponds are not increased to the degree that it is detrimental to the success of southern Rocky Mountain boreal toad reproduction. A Research Natural Area designation would ensure the long-term viability of this occurrence.

Wetland Functional Evaluation for the Peru Creek site:

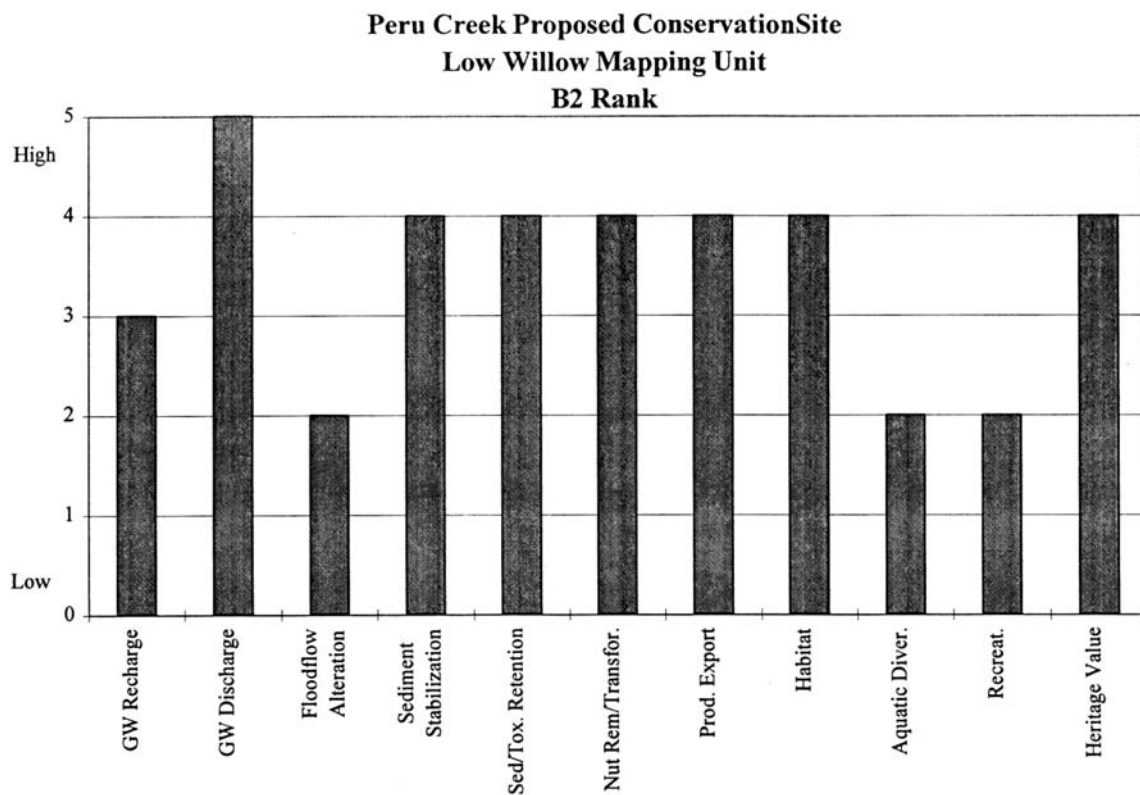
Proposed HGM wetland class: Slope wetland with a groundwater water source and seasonal to permanent saturation

Wetland functional evaluation for the Peru Creek site (low willow mapping unit).

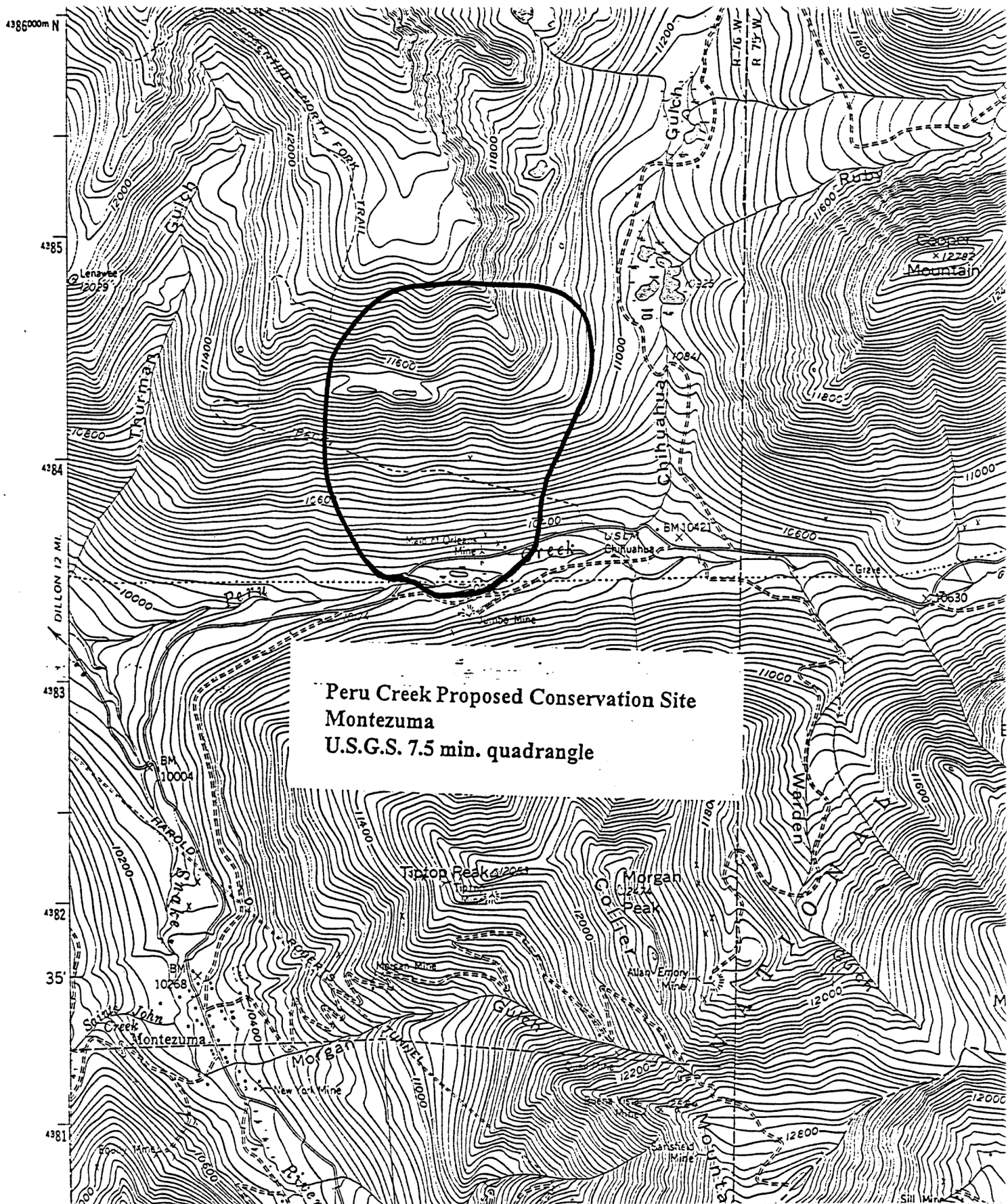
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	mainly sandy soils with some clay, little flooding, presence of several beaver ponds
Groundwater Discharge	very high	high	numerous springs located upslope
Floodflow Alteration	low	high	only 1% mottling, no debris or sediment trapping
Sediment Stabilization	high	high	densely vegetated with willows and sedges
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	site receives run-off from dirt road and mine tailings upslope
Nutrient Removal/Transformation	high	medium	location is below several abandoned mines
Biological Functions			
Production Export	high	medium	peaty soils, an outlet
Habitat	high	medium	densely vegetated with presence of toad and beaver
Aquatic Diversity/Abundance	low	high	no fish observed, several aquatic insects observed
Recreation	low	high	no fishing, scenic
Uniqueness/Heritage Value	high	high	A rank of boreal toad

General Soil Description

Texture	sandy soils with 2% clay
Color	red 2.5 YR 3/2
Cobble Size	none
Percent Mottling	1% within first 10 cm and some organic material



Graph of function and value assessment for Peru Creek site.



Peru Creek Proposed Conservation Site
Montezuma
U.S.G.S. 7.5 min. quadrangle

Soda Springs

Biodiversity Rank: B4 (Moderate significance)

The Soda Springs site supports a good example of a state rare montane willow carr. It is also excellent potential habitat for boreal toads.

Protection Urgency Rank: P3

The majority of the Soda Springs site is privately owned. The threats for development are high due to its location in a rapidly growing section of Summit County.

Management Urgency Rank: M4

Although not currently threatened, management may be needed in the future to maintain current quality of element occurrences. Management for beaver viability and potential southern Rocky Mountain boreal toad may need considered.

Location: 3.5 miles east of junction of Highway 6 and the Montezuma Road

U.S.G.S. 7.5 min. quadrangle: Keystone; Montezuma

Legal Description: T5S R76W Section 22, 23

General Description: The Soda Springs site is located at the base of Porcupine Peak. Thurman Gulch bisects the site and the Snake River forms the southern border. It supports an extensive willow carr (approximately 300 acres) at an elevation of 2928 m (9760 ft.). The wetland supports a series of beaver ponds that are fed by several springs that flow from the base of Porcupine Mountain. The water flow from the springs supports a small fen and a subalpine scrub (*Salix brachycarpa*/mesic forb) community. There is a powerline that bisects the site and a housing development (5-6 homes) to the west. The Montezuma Road borders the site to the south.

Biodiversity Rank Justification: The Soda Springs site supports a good example of a state rare montane riparian willow carr (*Salix drummondiana*/*Carex utriculata*). The site contains excellent southern Rocky Mountain boreal toad (*Bufo boreas boreas*) habitat and was searched in 1997 with negative results.

Natural Heritage elements at the Soda Springs site.

Element	Common Name	Global Rank	State	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Salix drummondiana</i> / <i>Carex utriculata</i>	montane riparian willow carr	GU	S3				B

*EO=Element Occurrence

Boundary Justification: The boundary drawn encompasses the beaver ponds and extends south to the Snake River. The north boundary is drawn 0.5 mi. above the ponds to provide a buffer for the wetland to protect from disturbances e.g., mining and residential development. A much larger area should be considered in any long-term management or protection plan to protect the hydrology of the site.

Protection Rank Justification: The only definable threat for this site is the expansion of the residential area and this would likely take place within the next 5 years. A conservation easement should be considered due to the good potential habitat for the southern Rocky Mountain boreal toad.

Management Rank Justification: There do not appear to be any current management issues. The hydrology of this site is important to protect the ecological processes which support the riparian communities. The water quality, quantity, and timing should be maintained at its current status.

Wetland Functional Evaluation for the Soda Springs site:

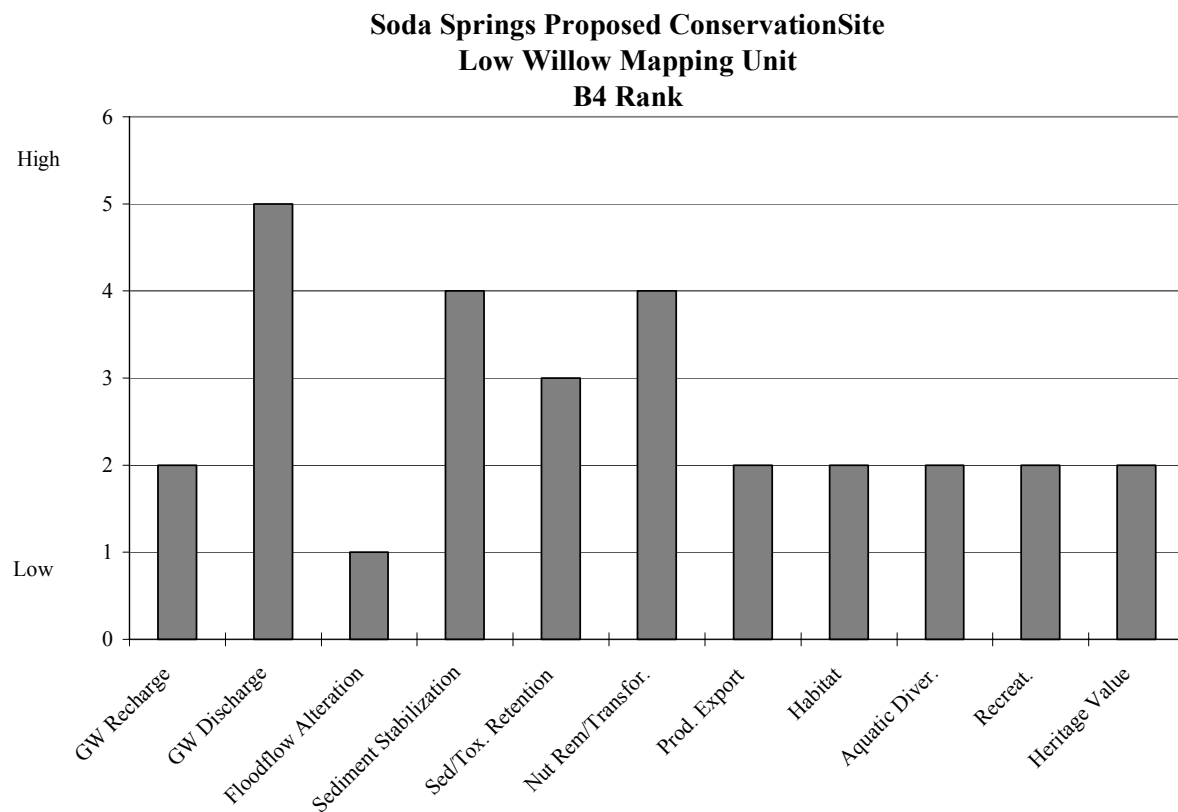
Proposed HGM wetland class: Slope wetland with permanent saturation from groundwater discharge

Wetland functional evaluation for the Soda Springs site (low willow mapping unit).

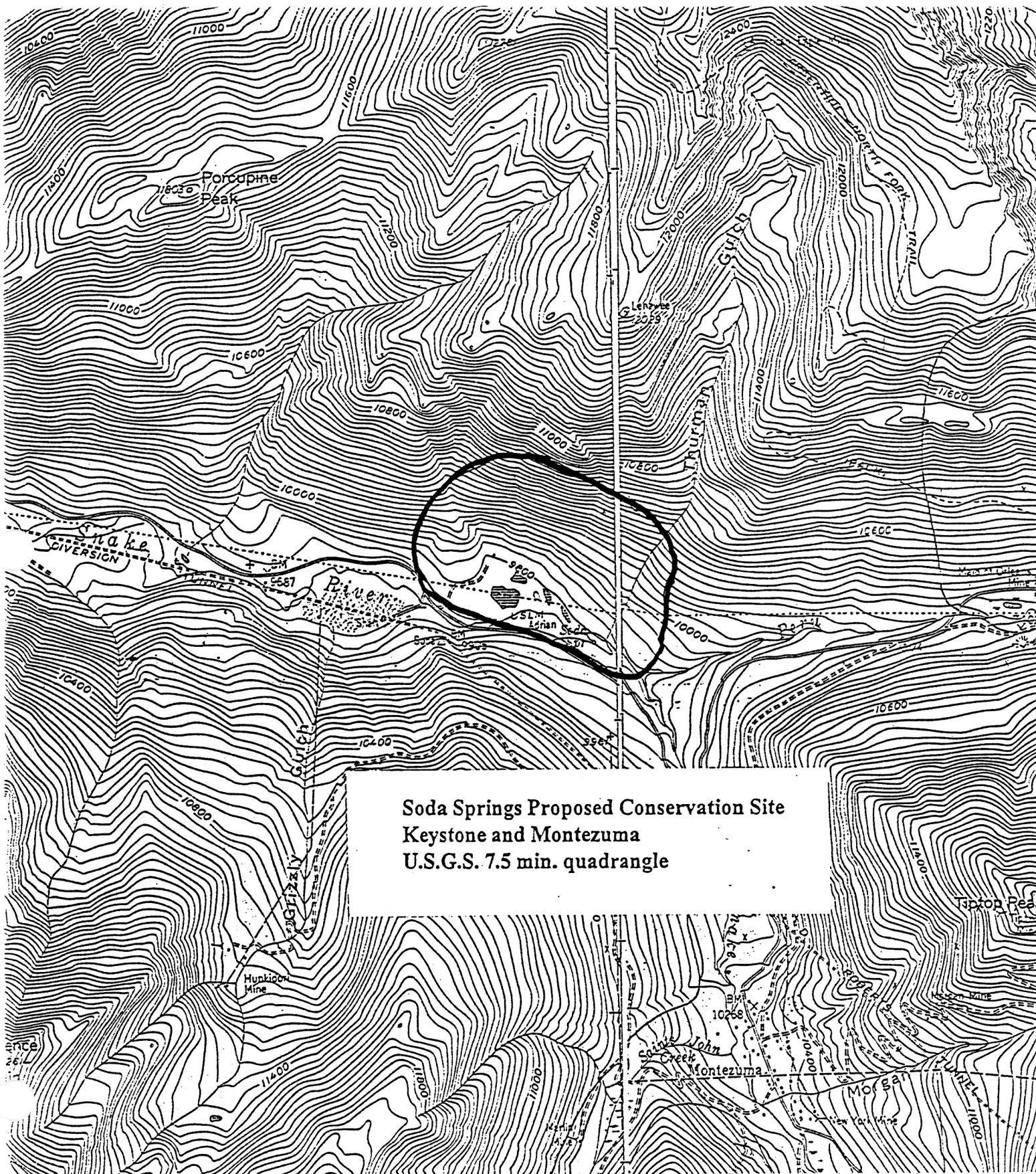
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	low	high	peaty, sapric soils with a clay layer at 80cm
Groundwater Discharge	very high	high	several springs located above (north) of wetland and possible discharge occurring forming ponds
Floodflow Alteration	low	high	no evidence of flooding
Sediment Stabilization	high	high	highly vegetated around open water of ponds
Biogeochemical Functions			
Sediment/Toxicant Retention	medium	medium	ponds do retain water, but no evidence of flooding, likely some sediments entering wetland from steep slopes above
Nutrient Removal/Transformation	high	medium	area is flooded permanently, aquatic vegetation in some smaller ponds, organic material accumulation
Biological Functions			
Production Export	low	medium	no flushing, somewhat stagnant-eutrophic waters
Habitat	low	medium	observed ducks, no fish or wildlife signs
Aquatic Diversity/Abundance	low	medium	open water, but eutrophic
Recreation	low	high	passive, inaccessible to public
Uniqueness/Heritage Value	low	high	B ranked occurrences of common willow communities

General Soil Description

Texture	peaty, saprist soils up to 50 cm then clay layer from 50-80 cm
Color	dark
Cobble Size	none
Percent Mottling	none



Graph of function and value assessment for Soda Springs site.



Soda Springs Proposed Conservation Site
Keystone and Montezuma
U.S.G.S. 7.5 min. quadrangle

AREAS OF LOCAL SIGNIFICANCE

Caravail at Keystone

Location: directly north of Keystone ski area
U.S.G.S. quadrangle name (s): Keystone
Legal Description: T5 4S R77W Section 13

General Description: The Caravail at Keystone area is a riparian wetland located just north of Highway 6. One unnamed stream flows through the montane riparian willow carr (*Salix geyeriana*-*Salix monticola*/*Calamagrostis canadensis*) supporting several active beaver ponds. The area is platted for a subdivision. There is a cul-de-sac that has been preliminary delineated, as well as sewer and water connections. There are several ditches that divert water from the stream, likely for flood control.

Protection Considerations: The area is privately owned and is slated for development. The hydrology has been altered and the willow carr has been fragmented by road construction.

Management Considerations: Management could consider keeping the willow carr intact at least for open space purposes.

Wetland Functional Evaluation for the Caravai at Keystone area:

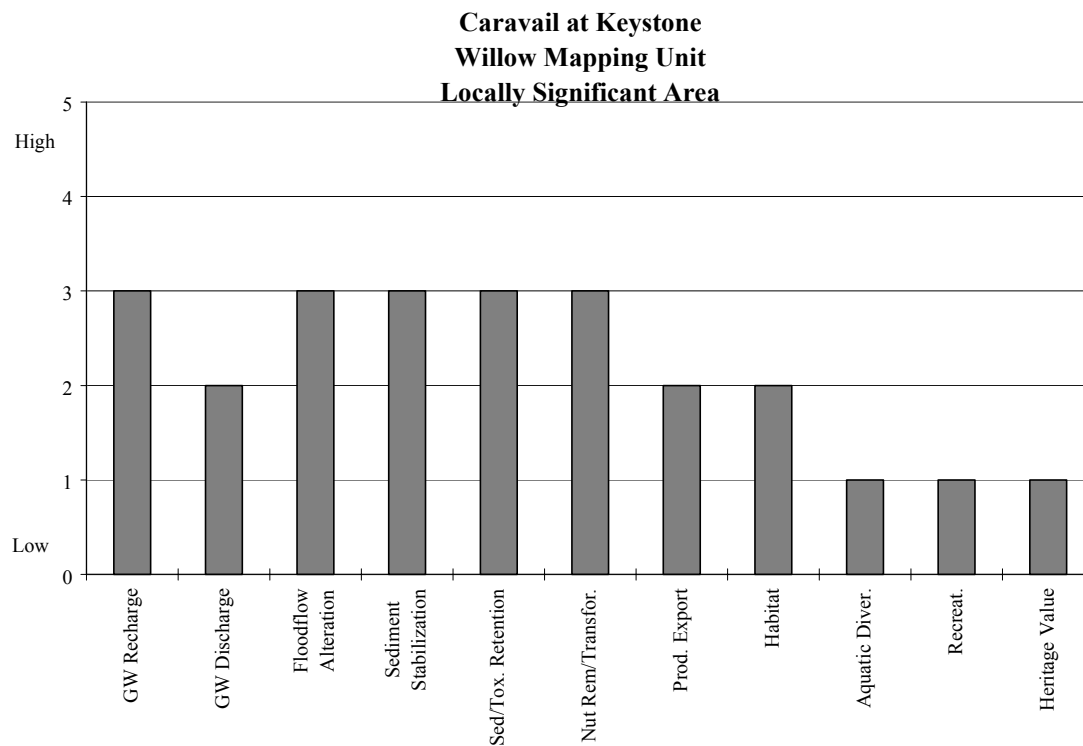
Proposed HGM wetland class: Riverine wetland with seasonal saturation and intermittent to permanent inundation

Wetland functional evaluation for the Caravai at Keystone area.

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	soils are loamy, sandy, evidence of debris, presence of beaver ponds
Groundwater Discharge	low	medium	likely springs upslope of area
Floodflow Alteration	medium	high	evidence of flooding
Sediment Stabilization	medium	high	moderate vegetation
Biogeochemical Functions			
Sediment/Toxicant Retention	medium	medium	construction activity, moderate vegetation
Nutrient Removal/Transformation	medium	medium	construction, areas with peaty soils
Biological Functions			
Production Export	low	high	fragmented willow carr
Habitat	low	high	altered hydrology, fragmented vegetation
Aquatic Diversity/Abundance	no	medium	none observed, no open, clear water
Recreation	no	high	some passive
Uniqueness/Heritage Value	no	high	area is completely degraded

General Soil Description

Texture	sandy, loamy soils
Color	dark
Cobble Size	small
Percent Mottling	2-5%



Graph of function and value assessment for Caravail at Keystone area.

Soda Creek at Summit Cove

Location: 1 mile north of Swan Mountain

U.S.G.S. quadrangle name (s): Frisco

Legal Description: T5 4S R77W

General Description: The Soda Creek at Summit Cove area is a riparian wetland that is located on the main and west forks of Soda Creek. The montane riparian willow carrs (*Salix geyeriana*-*Salix monticola*/mesic graminoid and *Salix brachycarpa*/mesic forb) are located adjacent to several housing developments e.g., Summit Cove, Soda Creek, Meadow Wood, and Swan Meadow. There are parts of the wetland that do appear open space for the residents. There are several ditches throughout the area for water diversion into human-made ponds. The Keystone Ranch Golf Course is located upstream, likely once an extension of the willow carr.

Protection Considerations: The area is privately owned with adjacent public lands. The area has been fragmented by roads and homes. There were no beaver present.

Management Considerations: Management could consider reintroducing beaver and designating the remaining wetland as open space.

Wetland Functional Evaluation for the Soda Creek at Summit Cove area:

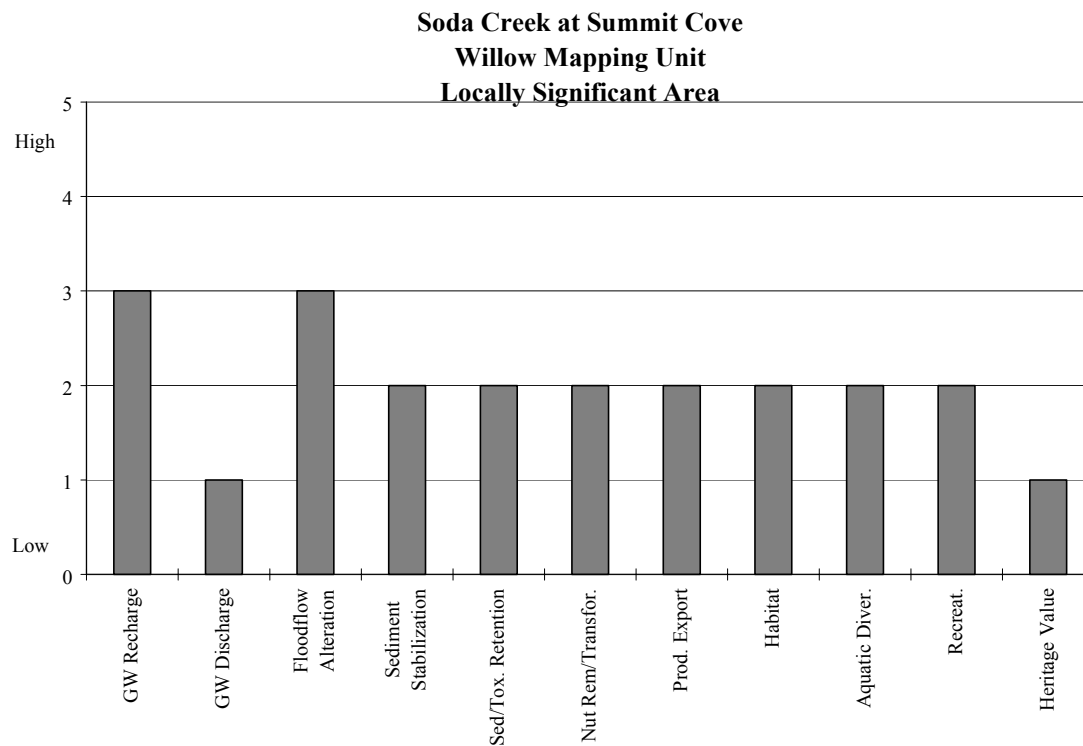
Proposed HGM wetland class: Riparian wetland with a seasonal saturation and occasional flooding

Wetland functional evaluation for the Soda Creek at Summit Cove area.

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	sandy soils, moderately vegetated, constricted outlets (human-made)
Groundwater Discharge	no	medium	no obvious springs
Floodflow Alteration	medium	high	little mottling, a amounts of debris
Sediment Stabilization	low	high	a to moderate densities of vegetation, no open water except human-made ponds
Biogeochemical Functions			
Sediment/Toxicant Retention	low	medium	little organic matter accumulation, moderate vegetation
Nutrient Removal/Transformation	low	medium	little peat accumulation
Biological Functions			
Production Export	low	medium	no outlet, moderate flushing flow
Habitat	low	medium	located in heavily developed area
Aquatic Diversity/Abundance	low	medium	no fish observed, no open, clear water
Recreation	low	high	passive only
Uniqueness/Heritage Value	no	high	degraded occurrence

General Soil Description

Texture	sandy with some clay
Color	loamy dark
Cobble Size	small
Percent Mottling	5 4%



Graph of function and value assessment for Soda Creek at Summit Cove area.

TENMILE BASIN

Meadow Creek

Biodiversity Rank: B2 (Very high significance)

The Meadow Creek site supports a mosaic of plant communities that includes a good example of a globally rare western slope sagebrush shrublands, an excellent occurrence of a globally common montane aspen forest, and a fair examples of a globally rare montane riparian willow carrs. There are several kettle ponds located throughout the site that support aquatic vegetation. There is a historical (1949) occurrence of a southern Rocky Mountain boreal toad and a 1994 occurrence of Colorado River cutthroat trout. The state rare Barrow's goldeneye nests within the site on Dillon Reservoir.

Protection Urgency Rank: P1

The majority of this site is privately owned with adjacent public lands. It is immediately threatened by severely destructive forces within 1 year that include: residential/commercial development, altered hydrology, and continued fragmentation of riparian communities.

Management Urgency Rank: M1

Management actions are required immediately or element occurrences could be lost or irretrievably degraded within one year.

Location: Northwest of the Town of Frisco

U.S.G.S. 7.5 min. quadrangle: Frisco

Legal Description: T5S R78W Sections 22, 23, 27, 26, 35

General Description: The Meadow Creek site is located between the Dillon Reservoir and the Gore Range. The site encompasses the northern portion of the Town of Frisco and portions of Giberson and Frisco Bays. The portion of the site northwest of Frisco and I-70, which is owned both privately and publicly, consists of a western slope sagebrush community (*Artemisia tridentata vaseyana/Festuca thurberi*). The willow carr (*Salix geyeriana/Calamagrostis canadensis*) that follows Meadow Creek is fragmented, but is an important functioning urban wetland. There are several kettle ponds scattered throughout the site that support aquatic vegetation e.g., pondweed (*Potamogeton gramineus*) and chorus frog (*Pseudacris triseriata*). The site is approximately 1,300 acres ranging in elevation from 2705 m (9,017 ft.) to 2940 m (9,800 ft.). The site is highly impacted by urban development, which includes commercial/residential development, road construction, and dam construction. Interstate 70 and Highway 9 bisect the site.

Biodiversity Rank Justification: The Meadow Creek site supports one of the best examples observed in Summit County of a globally common montane aspen forest (*Populus tremuloides*/tall forbs), a good example of a globally rare western slope sagebrush shrublands (*Artemisia tridentata vaseyana/Festuca thurberi*) and a fair example of a globally common montane riparian willow carr (*Salix drummondiana/Carex utriculata*). There are several kettle ponds, including one located in the Frisco Duck subdivision, located throughout the site that support aquatic vegetation e.g., pondweed (*Potamogeton gramineus*). The montane willow carr

(*Salix geyeriana*/*Carex aquatilis*) is located where Meadow Creek enters the reservoir on floodplain that was formerly a very extensive willow carr. The montane willow carr (*Salix drummondiana*/*Carex utriculata*) located between the sewage disposal ponds and Frisco Bay is a highly functioning wetland. There is a historical occurrence (1949) of the state endangered southern Rocky Mountain boreal toad (*Bufo boreas boreas*) and a 1994 occurrence of the state rare Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*), a U.S. Forest Service sensitive and state special concern species. There is a 1990 occurrence of the Barrow's goldeneye (*Bucephala islandica*), a state special concern species, located between Giberson and Frisco Bays on Dillon Reservoir.

Natural Heritage elements at the Meadow Creek site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	Rank
<i>Artemisia cana</i> / <i>Festuca thurberi</i>	western slope sagebrush shrublands	G2G3					B
	Barrow's goldeneye	G5	S2B, SZN		SC		unranked
<i>Bufo boreas boreas</i>	southern Rocky Mountain boreal toad	G4T1Q	S1	C	E	FS	Historical
<i>Oncorhynchus clarki pleuriticus</i>	Colorado River cutthroat trout	G5T3	S3		SC	FS	unranked
<i>Populus tremuloides</i> /tall forbs	montane aspen forest	G5	S5				A
<i>Carex utriculata</i>	lower montane riparian willow carr		S3				C
<i>Salix geyeriana</i> / <i>Carex aquatilis</i>	montane willow carr	G3					C

*EO=Element Occurrence

Boundary Justification: The boundary is drawn to encompass all the elements and to provide a buffer of 1,000 ft. to protect the site from immediate impacts to the hydrology or waterway of the site. The Town of Frisco is incorporated within the site to illustrate the importance of this site to town management of its open space. A much larger area should be considered in any long-term management or protection plan to protect the hydrological regime.

Protection Rank Justification: This site is immediately threatened by severely destructive forces within 1 year. The main threats are continued expansion of urban sprawl, fragmentation and alteration of hydrology, road construction and maintenance, and filling of wetlands. Consideration for open space designation would be appropriate for this site.

Management Rank Justification: Management action is required immediately or element occurrences could be lost or irretrievably degraded within one year. Actions could include beaver management and monitoring of water quality. The hydrology of this site is important to the ecological processes which support the riparian communities. The water quality, quantity, and timing should be maintained at its current status. Control of exotic plant species along the trails is necessary to maintain the integrity of native grass composition.

Wetland Functional Evaluation for the Meadow Creek site:

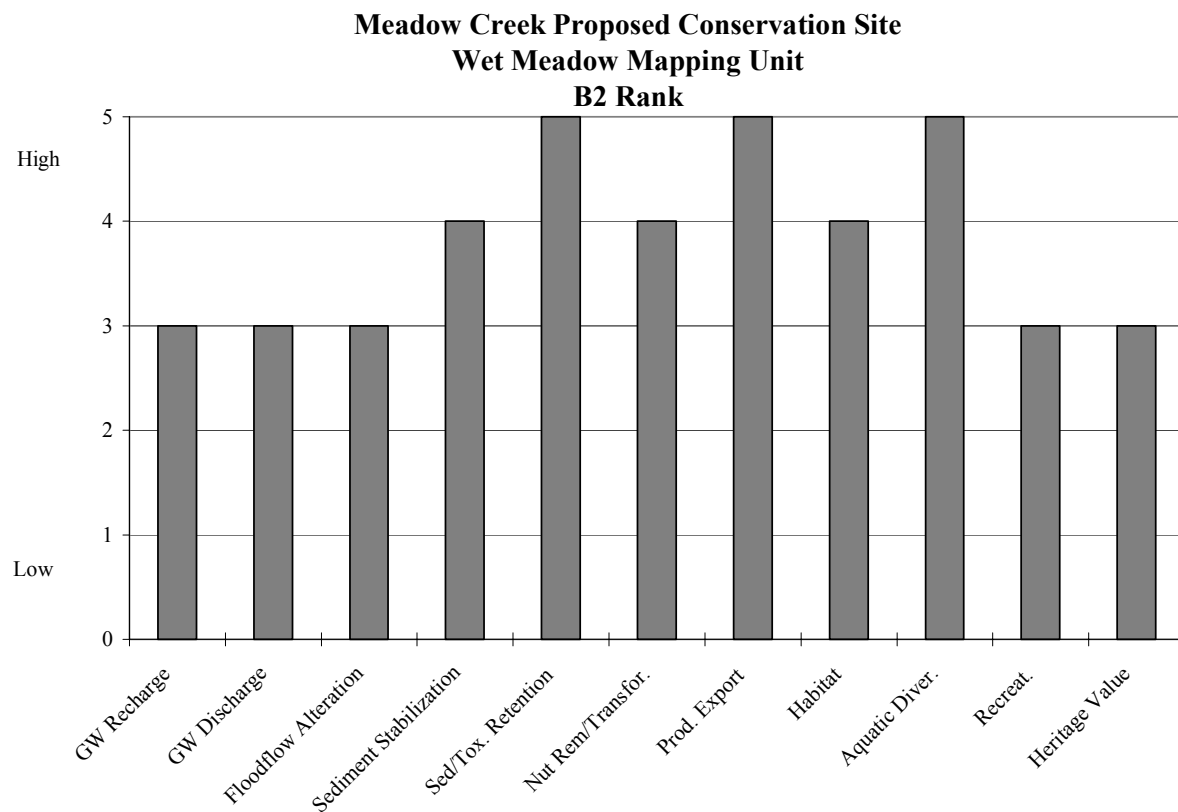
Proposed HGM wetland class: Riverine/lacustrine wetland with seasonal saturation and frequent flooding

Wetland functional evaluation for the Meadow Creek site (wet meadow mapping unit).

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	medium	dense vegetation and beaver ponding along with some recharge
Groundwater Discharge	medium	medium	probably some along edges of wetland, but most water comes from Meadow Creek
Floodflow Alteration	medium	high	dense vegetation and high roughness, but Dillon Reservoir abates run-off to a higher degree
Sediment Stabilization	high	high	densely vegetated shoreline
Biogeochemical Functions			
Sediment/Toxicant Retention	very high	high	sediment deposits throughout the willow carr, important due to close proximity to Frisco
Nutrient Removal/Transformation	high	high	high sediment trapping, high redox, productive vegetation
Biological Functions			
Production Export	very high	high	productive wetland, only seasonally flooded, receives flushing flows
Habitat	high	high	nesting ducks, snipe, warbler, osprey sighted but no nest seen, potential for boreal toad
Aquatic Diversity/Abundance	very high	high	2 species observed
Recreation	medium	high	vistas, bike path
Uniqueness/Heritage Value	medium	high	C rank of a G3 community

General Soil Description

Texture	thin histic epipedon, underlain by sandy loam
Color	dark
Cobble Size	small
Percent Mottling	5-10%



Graph of function and value assessment for Meadow Creek site (slope/riverine).

Wetland Functional Evaluation for the Meadow Creek site (Frisco Duck/kettle pond):

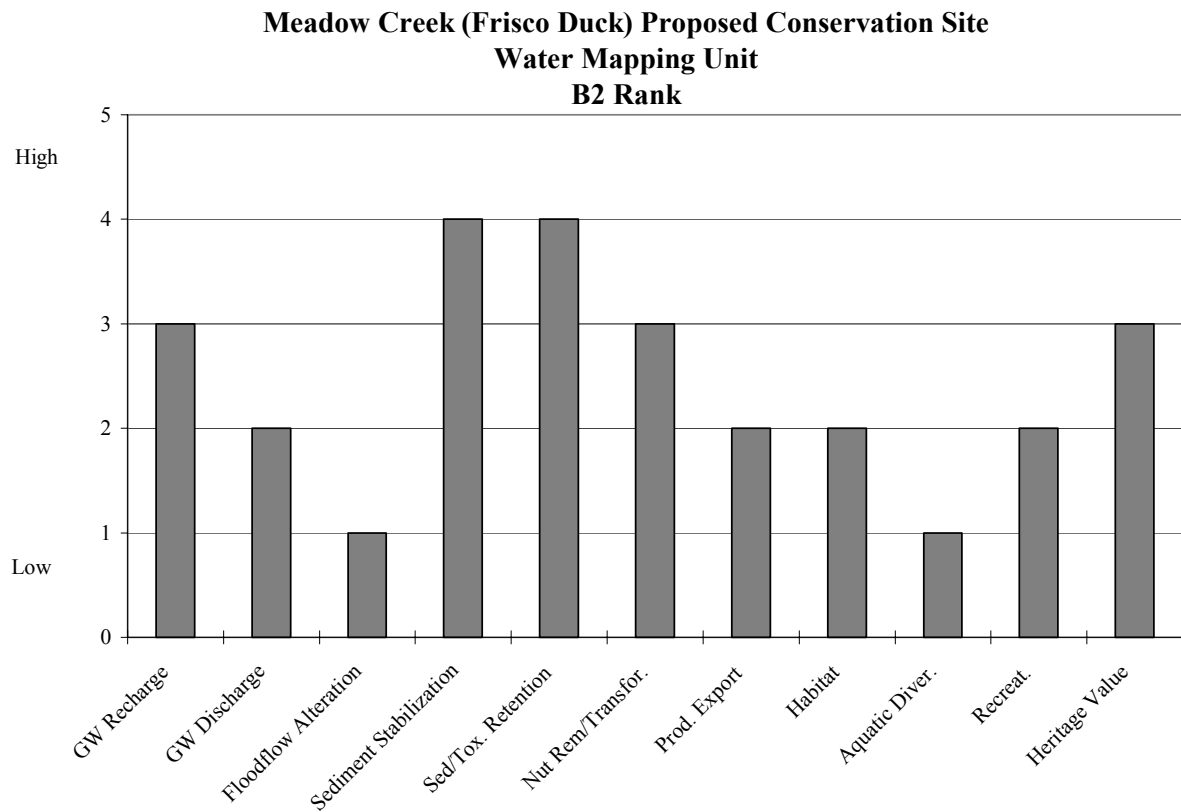
Proposed HGM wetland class: Depressional wetland with permanent to seasonal saturation and frequent to continuous inundation

Wetland functional evaluation for the Frisco Duck/kettle pond site (water mapping unit).

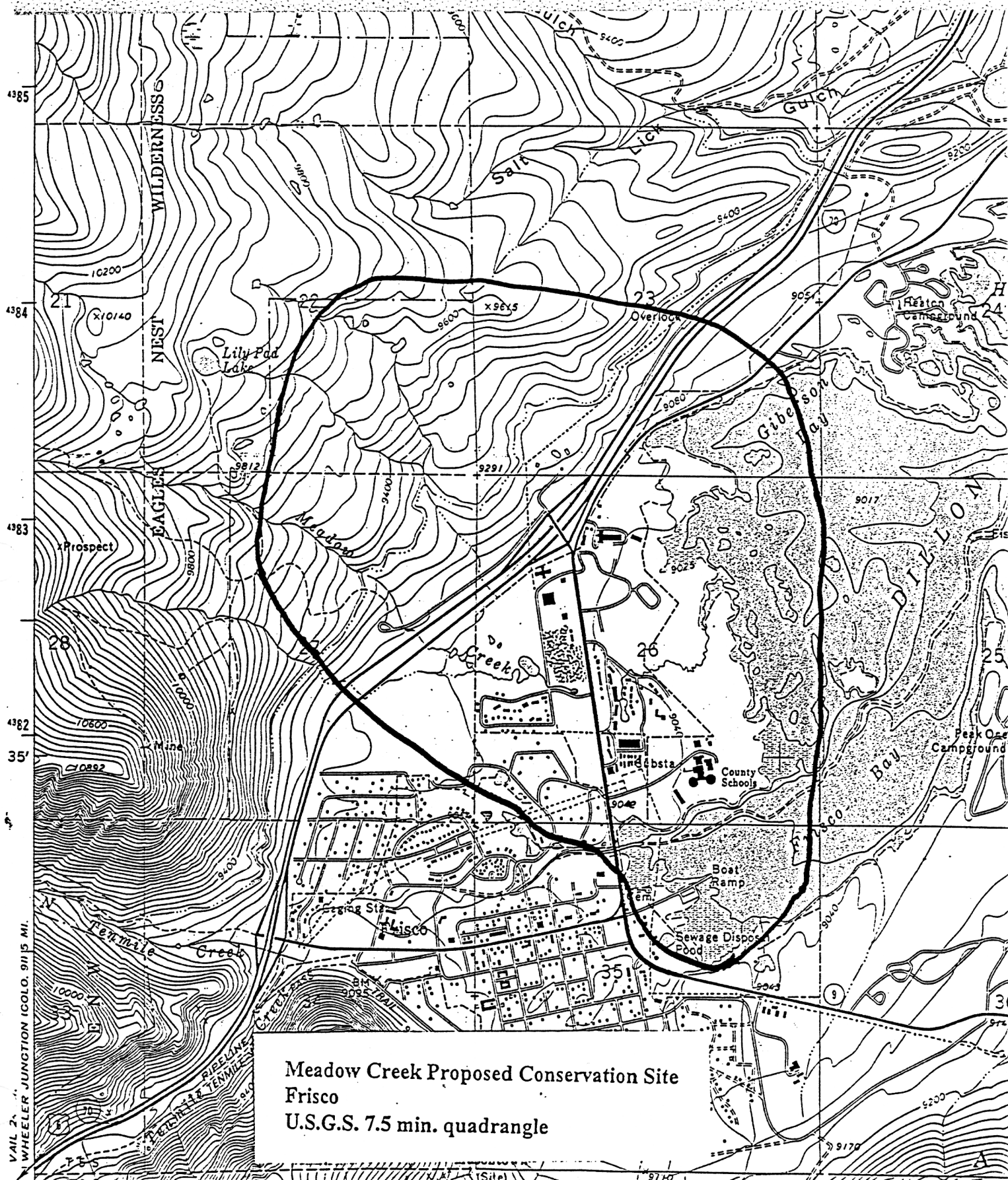
Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	medium	sandy soils, dense vegetation along shores water is received from snowmelt and precipitation
Groundwater Discharge	low	medium	no obvious springs
Floodflow Alteration	no	medium	no evidence
Sediment Stabilization	high	medium	dense vegetation along open water of pond
Biogeochemical Functions			
Sediment/Toxicant Retention	high	medium	constricted outlet, dense vegetation, located next to construction and roads
Nutrient Removal/Transformation	medium	medium	no organic matter due to drying out of pond, constricted outlet, aquatic vegetation, water until late summer
Biological Functions			
Production Export	low	medium	no flushing flows, but aquatic vegetation, even though ponds dry out
Habitat	low	high	observed chorus frogs and tiger salamanders have been reported, construction likely drives birds and wildlife away
Aquatic Diversity/Abundance	no	high	no clear, mixed water
Recreation	low	high	open space, no active
Uniqueness/Heritage Value	medium	high	C ranked communities

General Soil Description

Texture	sandy with some clay
Color	matrix color 10YR 3/2
Cobble Size	none
Percent Mottling	15% in first 15 cm; color 10YR 3/6



Graph of function and value assessment for Meadow Creek site (Frisco Duck).



Clinton Creek

Biodiversity Rank: B3 (High significance)

The Clinton Creek site supports an excellent occurrence of the Colorado River cutthroat trout. It also supports excellent examples of globally common subalpine riparian willow carrs and a mesic alpine meadow. Mayflower Creek drainage supports occurrences of two state rare whitlow-grasses.

Protection Urgency Rank: P4

The Clinton Creek site is privately and publicly owned. Currently, the owners have no plans for the site. A conservation easement should be considered to protect the riparian, meadow, and rare plant habitat from future threats.

Management Urgency Rank: M2

Actions need to be taken within 5 years to control the introduced Snake River cutthroat trout. Additionally, beaver need to be reintroduced to ensure the viability of the willow communities.

Location: 8 miles south of Copper Mountain along Highway 91

U.S.G.S. 7.5 min. quadrangle: Copper Mountain

Legal Description: T7S R79W Sections 36, 25, 24

T7S R78W Sections 19, 30, 29, 32, 31

T8S R79W Section 1

T8S R78W Sections 6, 5

General Description: The Clinton Creek site contains two glacially carved valleys. Clinton and Mayflower creeks flow through the site. The Tenmile Range including Bartlett, Little Bartlett, and Fletcher Mountains border the site to the southeast. It consists of two subalpine riparian willow carrs (*Salix brachycarpa*/mesic forb and *Salix planifolia*/*Caltha leptosepala*) and an alpine mesic meadow (*Deschampsia cespitosa*-*Ligusticum tenuifolium*). There are a series of inactive beaver ponds along Clinton Creek before it enters Clinton Reservoir. Clinton and Mayflower creeks and their riparian communities are fed by numerous springs from both east and west slopes. Two rare plant species are known to occur in the large cirques above Mayflower Creek. The site is approximately 2,500 acres ranging in elevation from 3360 m (11,200 ft.) to 3720 m (12,400 ft.).

There are several abandoned mines above the wetland and there is an abandoned fish weir where Clinton Creek enters the reservoir. The Clinton Reservoir was created in the 1960s with the construction of Highway 91. There are fishing access trails on both sides of the reservoir, but few venture into the thick willow carr.

Biodiversity Rank Justification: The Clinton Creek site supports an excellent occurrence of the Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*), a U.S. Forest Service sensitive and state special concern species. This site also supports excellent examples of subalpine riparian willow carr (*Salix brachycarpa*/mesic forb and *Salix planifolia*/*Caltha*

leptosepala) and an alpine mesic meadow (*Deschampsia cespitosa-Ligusticum tenuifolium*). There are fair occurrences of two state rare whitlow-grasses (*Draba lonchocarpa* var. *lonchocarpa* and *Draba crassa*) located above Mayflower Creek.

Natural Heritage elements at the Clinton Creek site.

Element	Common Name	Global Rank	State Rank	Federa	State	Federal Sens.	EO* Rank
<i>Deschampsia cespitosa-Ligusticum tenuifolium</i>	alpine wet meadow	G4	S4				A
<i>Draba crassa</i>	thick-leaf whitlow-grass	G3	S3				
<i>Draba lonchocarpa</i> var. <i>lonchocarpa</i>	mustard	G4T4					C
<i>clarki pleuriticus</i>	Colorado River cutthroat trout	G5T3	S3		SC	FS	A
<i>Salix brachycarpa</i> / mesic forb	subalpine riparian willow carr		S4				A
<i>Salix planifolia</i> / <i>Caltha leptosepala</i>	subalpine riparian willow carr	G4	S4				A

*EO=Element Occurrence

Boundary Justification: Boundaries drawn encompass the elements and the contiguous water way. A buffer of 1,000 ft. is included to protect hydrology and water quality from direct impacts. The buffer will also protect occurrences from trampling or other surface disturbances for the rare plants and will provide suitable habitat where additional individuals can become established over time.

Protection Rank Justification: The site is owned both privately and publicly. Currently, there are no known threats to the site from anthropogenic activities. However, the Snake River cutthroat trout has been introduced and could interbreed with the native trout in Clinton Creek.

Management Rank Justification: Recreation use (mountain biking, hiking, 4WD vehicles) is high in this site. There are multiple dirt roads which may be used for these activities and recreationists should be encouraged to stay on them. There are only a few exotic plants present e.g., dandelion (*Taraxacum officinale*). Management actions need to consider reintroducing beaver and managing for their longevity.

Wetland Functional Evaluation for the Clinton Creek site:

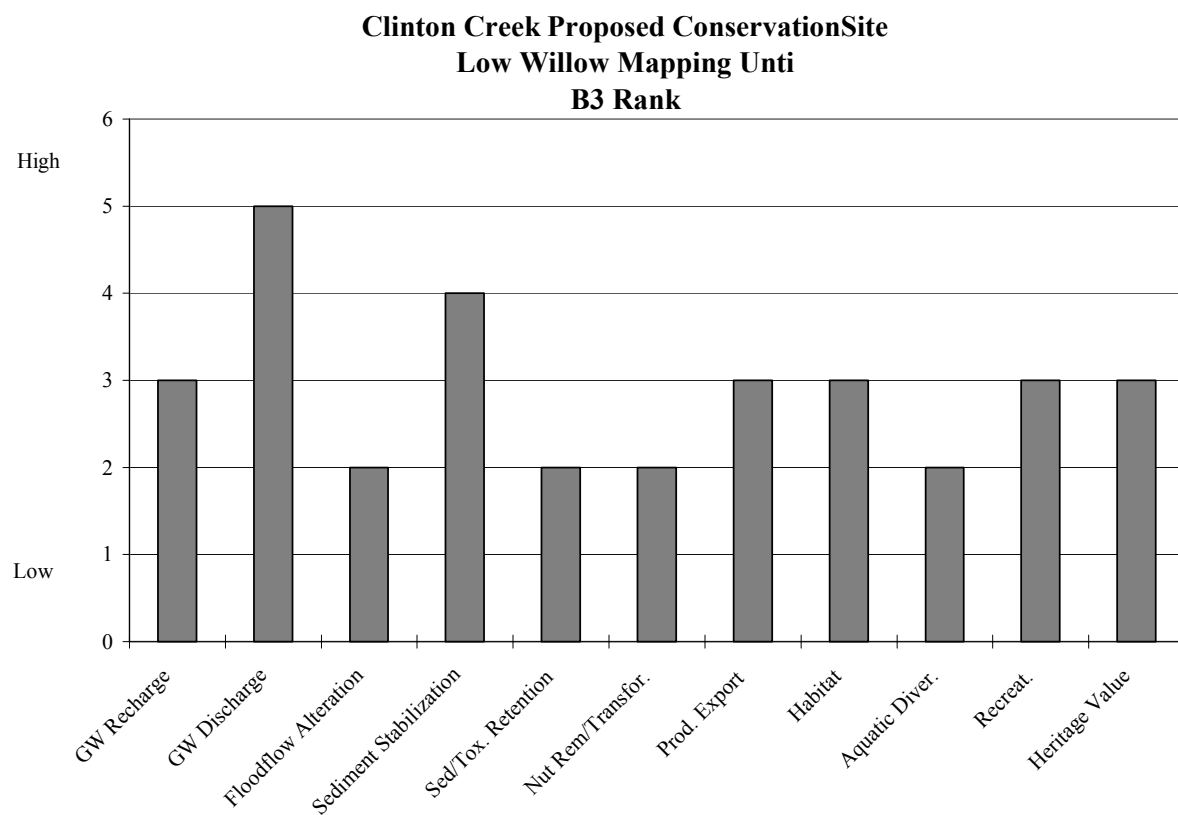
Proposed HGM wetland class: Riverine and slope wetland with seasonal to permanent saturation and occasional flooding

Wetland functional evaluation for the Clinton Creek site (low willow mapping unit).

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	medium	high	sandy soils, dense vegetation, 4-5 ponds, but no active beaver, no evidence of flooding
Groundwater Discharge	very high	high	numerous springs located on both sides of Clinton Creek
Floodflow Alteration	low	high	high order stream, little debris and sediment observed, low gradient with dense vegetation
Sediment Stabilization	high	high	densely vegetated basin, located next to ponds and stream
Biogeochemical Functions			
Sediment/Toxicant Retention	low	medium	ponds, low gradient however wetland is high in watershed, there is historic mines above wetland
Nutrient Removal/Transformation	low	medium	peaty soils, flooded permanently in some areas
Biological Functions			
Production Export	medium	medium	low flooding and flushing, restricted outlets
Habitat	medium	medium	observed fish and wildlife sign especially elk
Aquatic Diversity/Abundance	low	medium	barrier exist for fish e.g., beaver ponds, fish weir (non-functioning), stocked with Snake River cutthroat
Recreation	medium	high	fishing, scenic
Uniqueness/Heritage Value	medium	high	A rank of globally rare trout

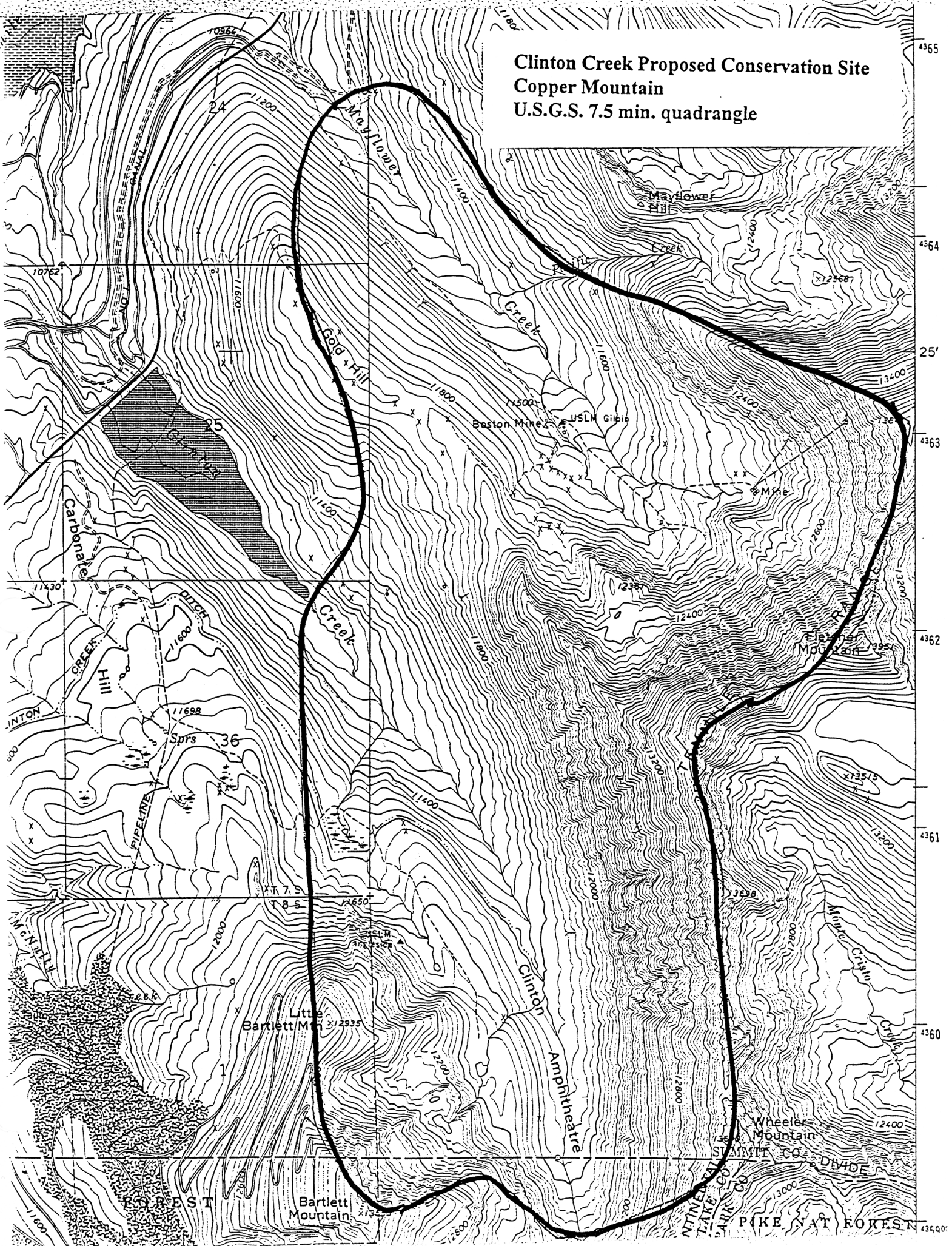
General Soil Description

Texture	sandy with organic matter accumulation to 40 cm
Color	very dark 10YR 3/2
Cobble Size	glacial till
Percent Mottling	1%



Graph of function and value assessment for Clinton Creek site.

Clinton Creek Proposed Conservation Site
Copper Mountain
U.S.G.S. 7.5 min. quadrangle



AREA OF LOCAL SIGNIFICANCE

Union Gulch at Copper Mountain

Location: 5.4 air miles north of Copper Mountain

U.S.G.S. quadrangle name (s): Vail Pass

Legal Description: T6S R79W Section 25

General Description: The Union Gulch at Copper Mountain area is a narrow riparian wetland located at the confluence of Tenmile Creek and Union Gulch. Construction of the bicycle path has fragmented the montane riparian willow carr (*Salix drummondiana/Calamagrostis canadensis*). The willow carr is a narrow band that is restricted between the path and the creek. The understory is dominated by introduced grasses e.g., smooth brome (*Bromus inermis*) and weeds e.g., red clover (*Trifolium repens*), Canada thistle (*Cirsium arvense*).

Protection Considerations: The area is privately owned with adjacent public lands. The hydrology has been altered due to commercial development, Interstate 70, and construction of the bicycle path.

Management Considerations: The area has been heavily altered by roads, commercial development, and homes. Management actions could include designating the remaining riparian area as open space.

Wetland Functional Evaluation for the Union Gulch at Copper Mountain area:

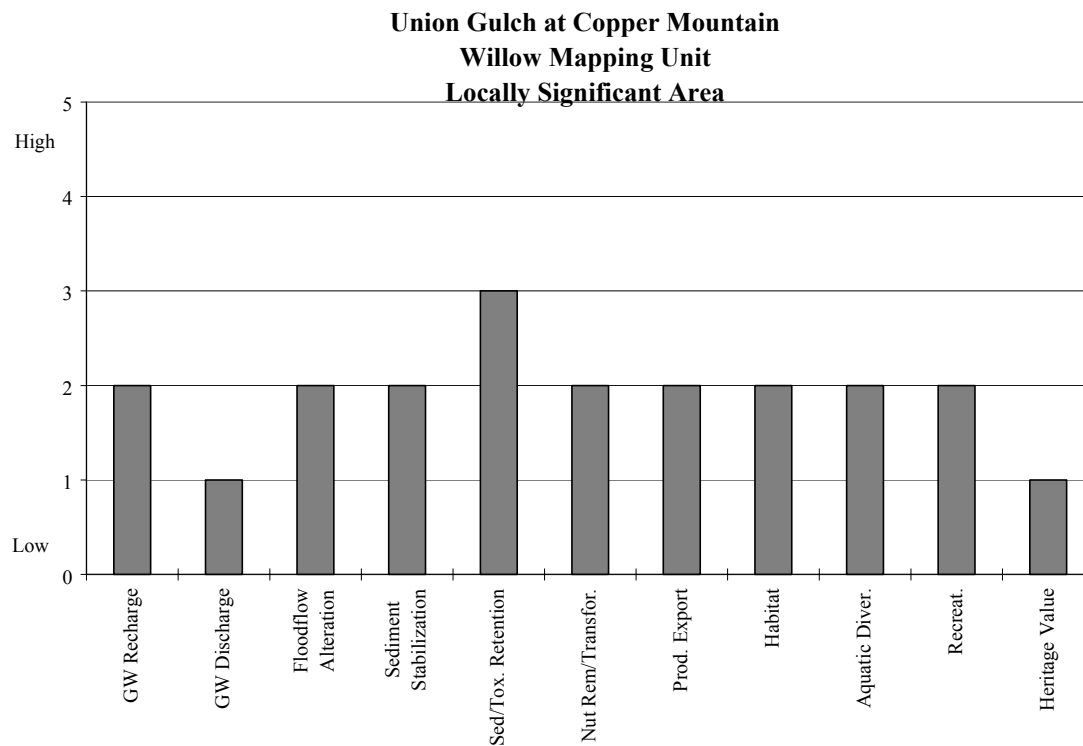
Proposed HGM wetland class: Riparian wetland with seasonal saturation and frequent flooding

Wetland functional evaluation for the Union Gulch at Copper Mountain area.

Function	Ratings	Confidence in Rating	Comments
Hydrological Functions			
Groundwater Recharge	low	high	porous soils, a vegetation density
Groundwater Discharge	no	medium	no obvious springs
Floodflow Alteration	low	high	no mottling, no debris observed
Sediment Stabilization	low	high	a vegetation density, non-native understory
Biogeochemical Functions			
Sediment/Toxicant Retention	medium	medium	road and ski maintenance activities within area, but a vegetation density, no organic matter accumulation
Nutrient Removal/Transformation	low	medium	no peaty soils
Biological Functions			
Production Export	low	medium	flushing flow, some vegetation overhanging water, seasonally flooded
Habitat	low	medium	fragmented willow carr and corridor
Aquatic Diversity/Abundance	low	medium	no fish observed, no open clear water within area
Recreation	low	high	passive
Uniqueness/Heritage Value	no	high	degraded occurrence

General Soil Description

Texture	sandy soils with some clay
Color	dark
Cobble Size	small to medium
Percent Mottling	5%-10% at 5cm



Graph of function and value assessment for Union Gulch at Copper Mountain area.

FUNCTION AND VALUE ASSESSMENT RESULTS

A totally of 38 function and value assessments (see page 25 for descriptions) were performed at 34 locations on private lands within Summit County. There are an additionally 32 function and value assessments profiled that are based on field observations and the mylar overlays produced by Whitehorse Associates and Natural Resource Consulting (1996). Twenty one of those locations are proposed conservation sites and 12 are locally significant areas. Thirteen mapping units derived from vegetation types were identified by Whitehorse Associates and Natural Resource Consulting (1996). The function and values for the twelve mapping units are summarized in Tables 5-19 and Figures 2-13. The streambar mapping unit was not sampled due to its lack of hydrophytic vegetation and shallow soils.

Table 5. Summary of function and value assessment for the wet meadow mapping unit.

Mapping Unit	wet meadow
Colorado Natural Heritage Program Plant Communities	<i>Carex utriculata</i> <i>Deschampsia cespitosa</i> <i>Salix brachycarpa</i> /mesic forb <i>Betula glandulosa</i> /mesic forb-graminoid <i>Phleum pratense</i> , <i>Poa pratensis</i> , <i>Bromus inermis</i> <i>Carex aquatilis</i> - <i>Carex utriculata</i>
Locations in Summit County	Columbine Fen; Muggins Gulch; Slate Creek; Meadow Creek, Spruce Creek
Summary of Functions and Values	medium gw recharge, low gw discharge, medium floodflow alteration, high sediment/toxicant retention, nutrient removal/ transformation, production export, habitat, and aquatic diversity, medium recreation and heritage value
HGM Subclass	slope; lacustrine; riverine

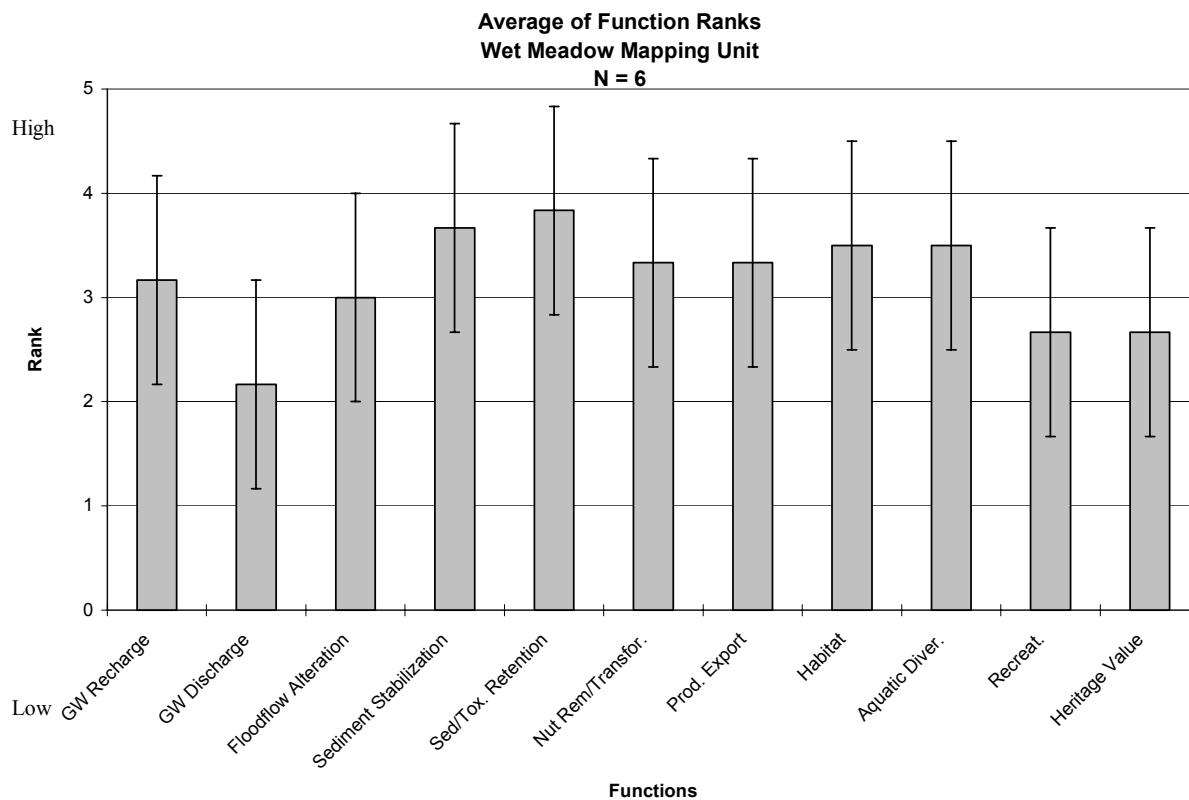


Figure 2. Average of function ranks for wet meadow mapping unit.

Table 6. Summary of function and value assessment for the mesic meadow mapping unit.

Mapping Unit	mesic meadow
Colorado Natural Heritage Program Plant Communities	<i>Carex utriculata</i> hay grasses <i>Carex praegracilis</i> wetland
Locations in Summit County	Spruce Creek; Soda Springs; Big Gulch; Dillon Bay Fen; Cataract Creek; Muggins Gulch
Summary of Functions and Values	medium gw recharge and gw discharge, low floodflow alteration, sediment stabilization, sediment/toxicant retention, nutrient removal/transformation, and low production export, medium habitat, low aquatic diversity and recreation, medium heritage value
HGM Subclass	riverine; slope

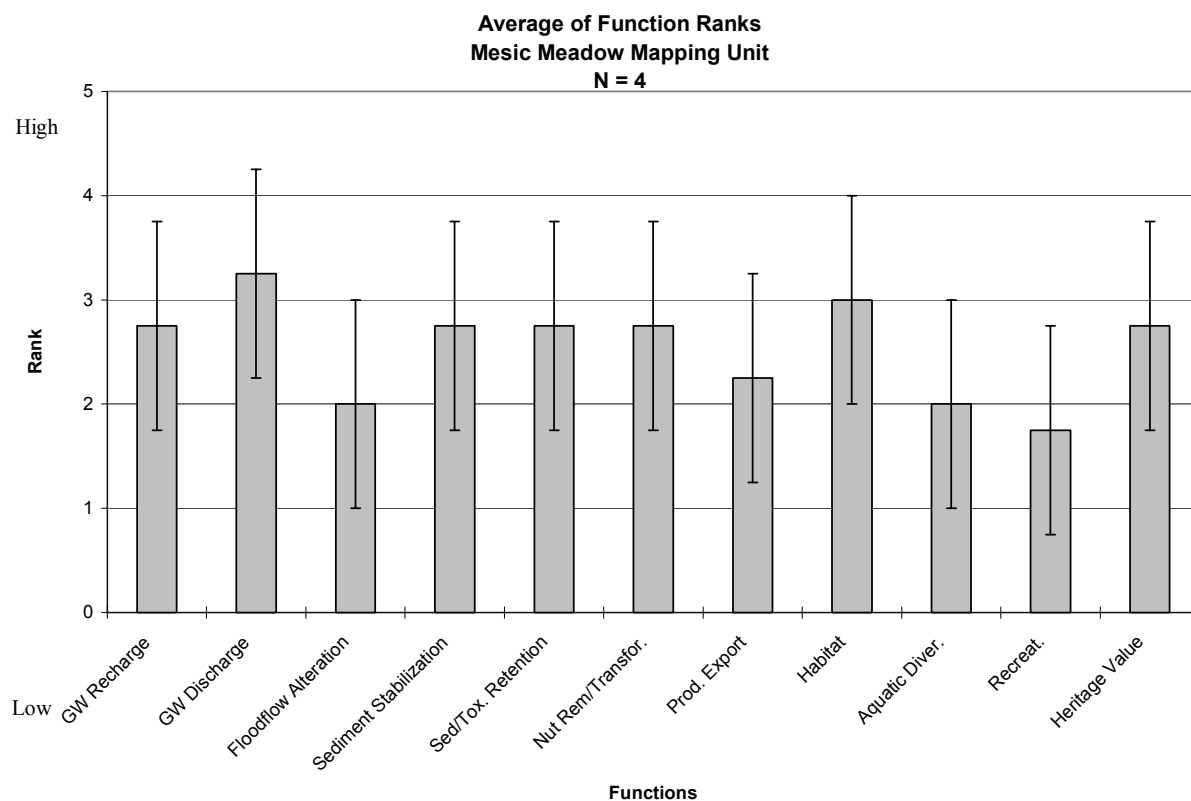


Figure 3. Average of function ranks for mesic meadow mapping unit.

Table 7. Summary of function and value assessment for the irrigated meadow mapping unit. *

Mapping Unit	irrigated meadow
Colorado Natural Heritage Program Plant Communities	<i>Carex praegracilis</i>
Locations in Summit County	Horse Creek Fen Cataract Creek
Summary of Functions and Values	medium to high gw recharge and high gw discharge, low floodflow alteration, medium sediment stabilization, sediment/toxicant retention and nutrient removal/transformation, low production export, high habitat, low aquatic diversity and recreation, and high heritage value
HGM Subclass	slope

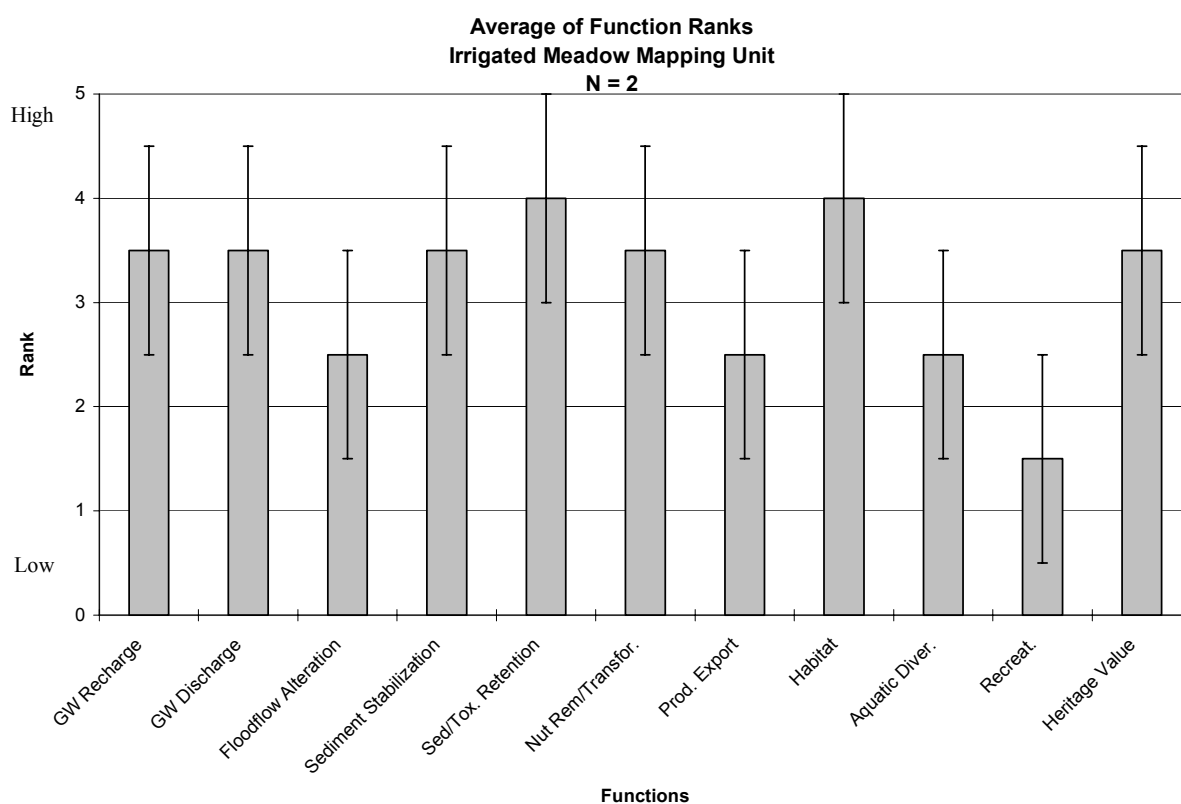


Figure 4. Average of function ranks for irrigated meadow mapping unit.

* This chart misrepresents this mapping unit. Irrigated hay meadows are not usually so highly functioning. The two fens (high functions and values) are located within the irrigated meadows mapping unit.

Table 8. Summary of function and value assessment for the willow mapping unit.

Mapping Unit	willow
Colorado Natural Heritage Program Plant Communities	<i>Salix monticola</i> - <i>Salix geyeriana</i> /mesic graminoid <i>Alnus incana</i> / <i>Salix geyeriana</i> <i>Salix geyeriana</i> / <i>Carex utriculata</i> <i>Salix geyeriana</i> / <i>Calamagrostis canadensis</i>
Locations in Summit County	Bushee Creek; Cataract Creek; Triple Creek Ranch; Meadow Creek Otter Creek; Slate Creek; Horse Creek, Blue River Arm at Dillon Reservoir; Braddock Flats; Silverthorne Wetland; Caravail at Keystone; Soda Creek at Summit Cove
Summary of Functions and Values	medium gw recharge, gw discharge, floodflow alteration, sediment stabilization, low to medium sediment/toxicant retention, nutrient removal/transformation, medium habitat, aquatic diversity, medium to high recreation, low to medium heritage value
HGM Subclass	riverine

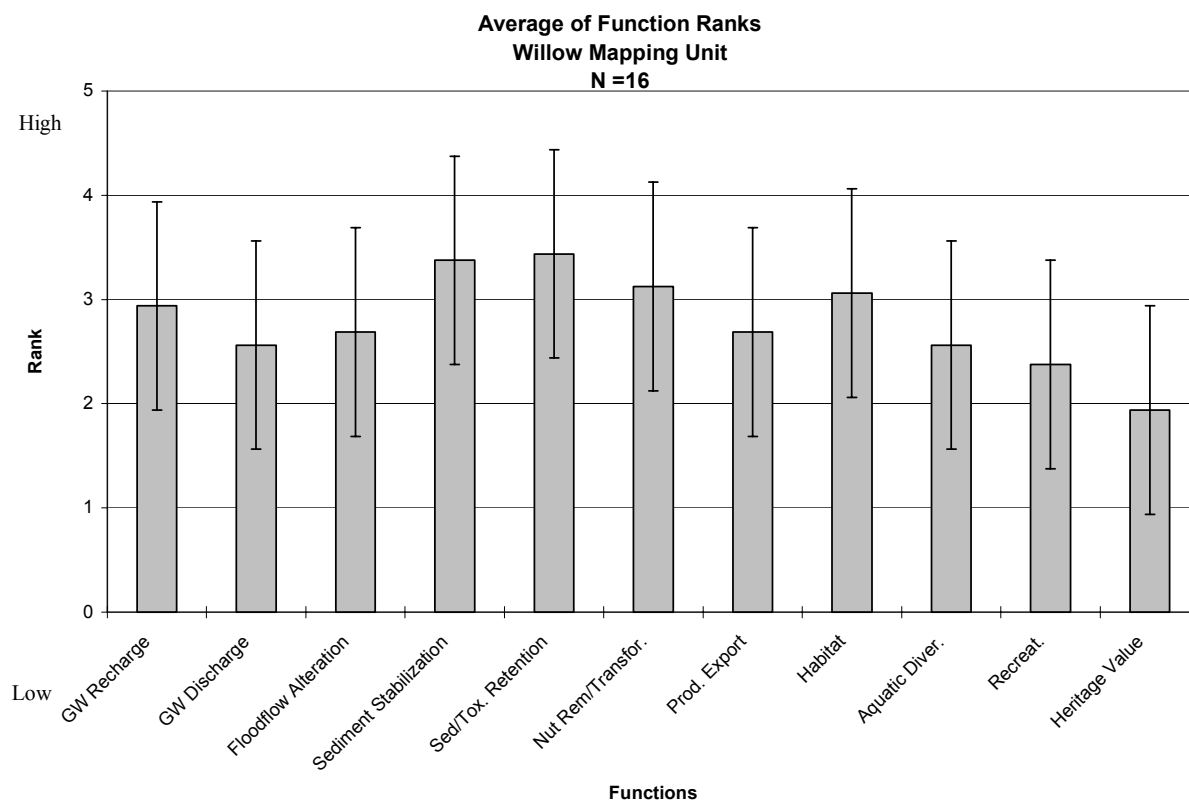


Figure 5. Average of function ranks for willow mapping unit.

Table 9. Summary of function and value assessment for the low willow mapping unit.

Mapping Unit	low willow
Colorado Natural Heritage Program Plant Communities	<i>Salix planifolia/Caltha leptosepala</i> <i>Salix planifolia/Calamagrostis canadensis</i> <i>Salix drummondiana/Carex utriculata</i> <i>Salix brachycarpa/mesic forb</i> <i>Salix planifolia/Carex aquatilis</i> <i>Salix drummondiana/mesic forb</i> <i>Salix brachycarpa/mesic forb</i>
Locations in Summit County	Clinton Creek; Montezuma; Soda Springs; Peru Creek; Indiana Gulch Upper French Gulch; Quandry Peak/Bemrose Subdivision
Summary of Functions and Values	low to high gw recharge, high to very high gw discharge, low floodflow alteration, high sediment stabilization, sediment/toxicant retention, nutrient removal/transformation, medium production export, habitat, recreation, low aquatic diversity, medium heritage value
HGM Subclass	riverine

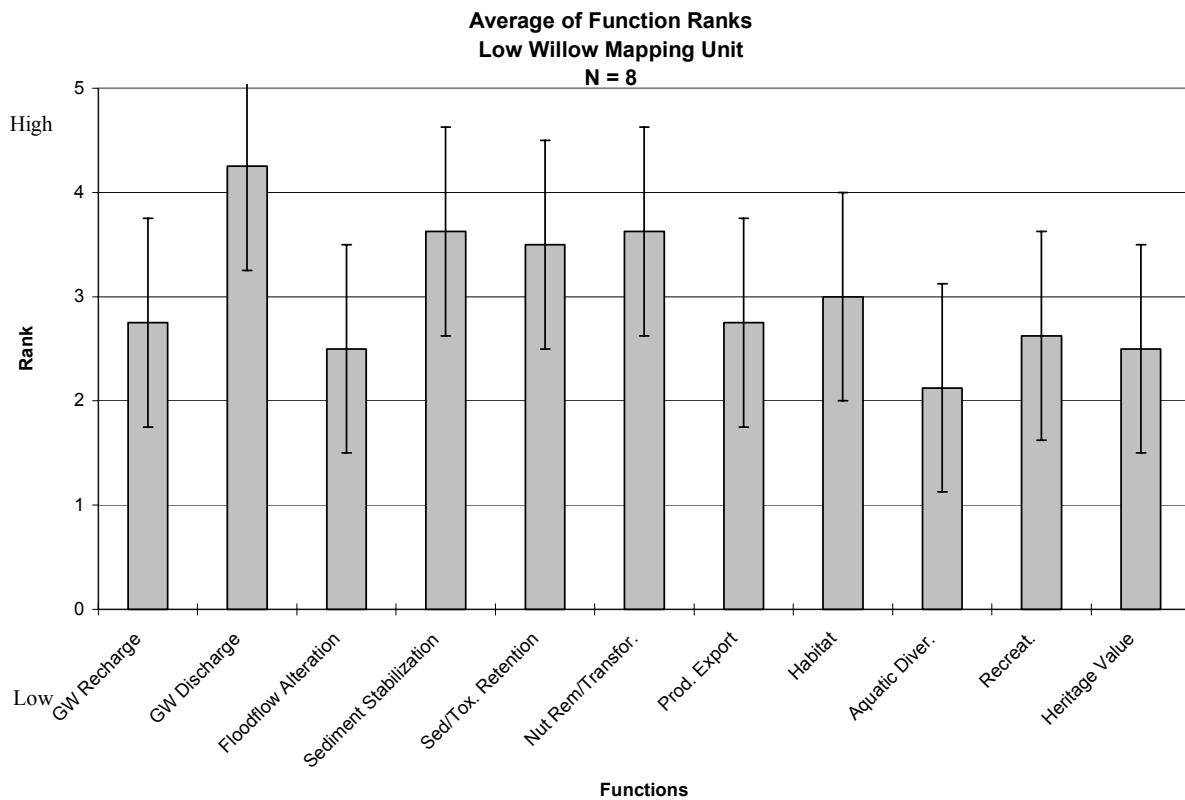


Figure 6. Average of function ranks for low willow mapping unit.

Table 10. Summary of function and value assessment for the willow/wet meadow mapping unit.

Mapping Unit	willow/wet meadow
Colorado Natural Heritage Program Plant Communities	<i>Salix geyeriana</i> - <i>Salix monticola</i> / <i>Calamagrostis canadensis</i> <i>Betula glandulosa</i> /mesic graminoid and forb <i>Salix monticola</i> - <i>Salix geyeriana</i> /mesic graminoid <i>Salix monticola</i> / <i>Calamagrostis canadensis</i> <i>Salix geyeriana</i> / <i>Carex utriculata</i>
Locations in Summit County	Blue River Ranch Lakes; Bushee Creek; Slate Creek, Pass Creek; Spruce Creek, Otter Creek; Triple Creek Ranch; Meadow Creek; Columbine Wetland; Brush Creek; Willow Creek at Silverthorne
Summary of Functions and Values	medium gw recharge, gw discharge, floodflow alteration, high sediment stabilization, sediment/toxicant retention, nutrient removal/transformation, medium production export habitat, aquatic diversity, and recreation, low heritage value
HGM Subclass	riverine

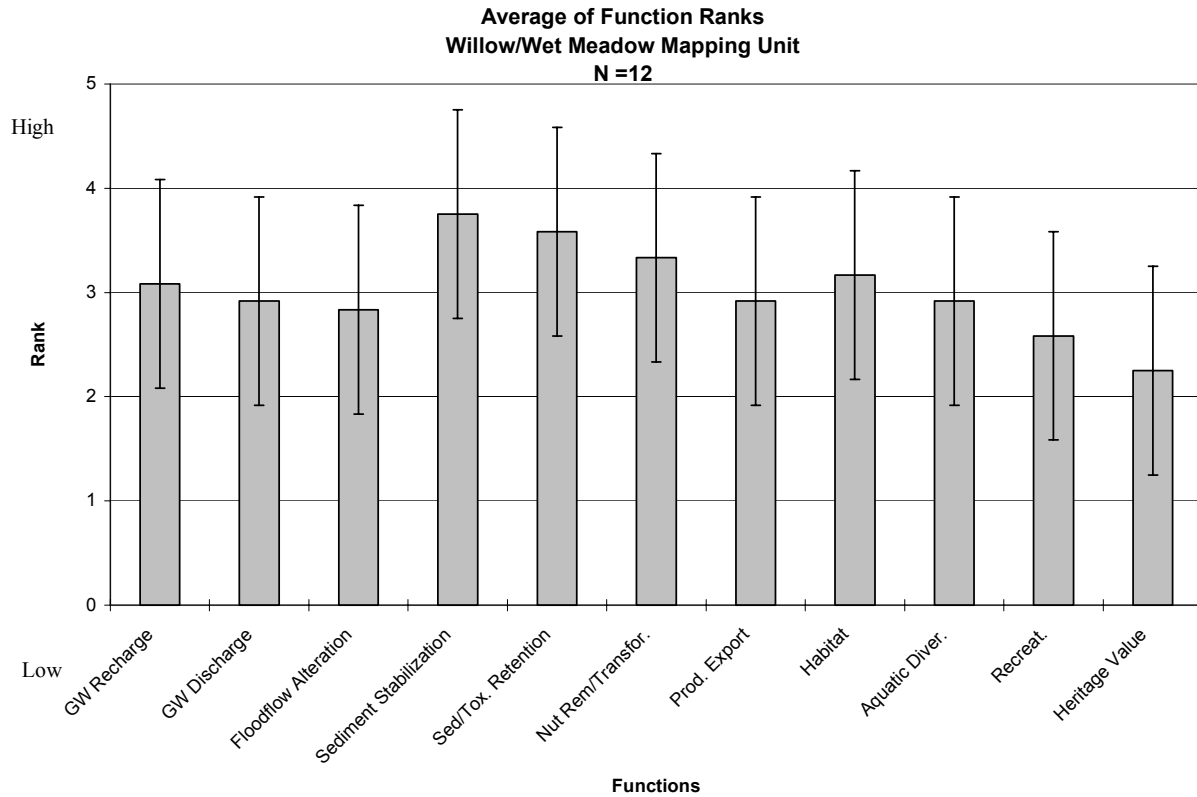


Figure 7. Average of function ranks for the willow/wet meadow mapping unit.

Table 11. Summary of functions and value assessment for the low willow/wet meadow mapping unit.

Mapping Unit	low willow/wet meadow
Colorado Natural Heritage Program Plant Communities	<i>Salix planifolia/Caltha leptosepala</i> <i>Salix planifolia/Carex aquatilis</i> <i>Pentaphylloides floribunda/ Deschampsia cespitosa</i> <i>Salix drummondiana/mesic forb</i> <i>Salix brachycarpa/mesic forb</i>
Locations in Summit County	Clinton Creek; Montezuma; Webster Pass Fen; Cucumber Gulch; Blue River at McCullough Gulch; Goose Pasture Wetland; Blue Lakes; Soda Springs; Hoosier Creek; Whatley Ranch
Summary of Functions and Values	medium gw recharge, high gw discharge, low floodflow alteration, high sediment stabilization, medium sediment/toxicant retention, nutrient removal/transformation, production export, habitat, recreation, aquatic diversity, and heritage value
HGM Subclass	riverine; lacustrine; depressional; riverine

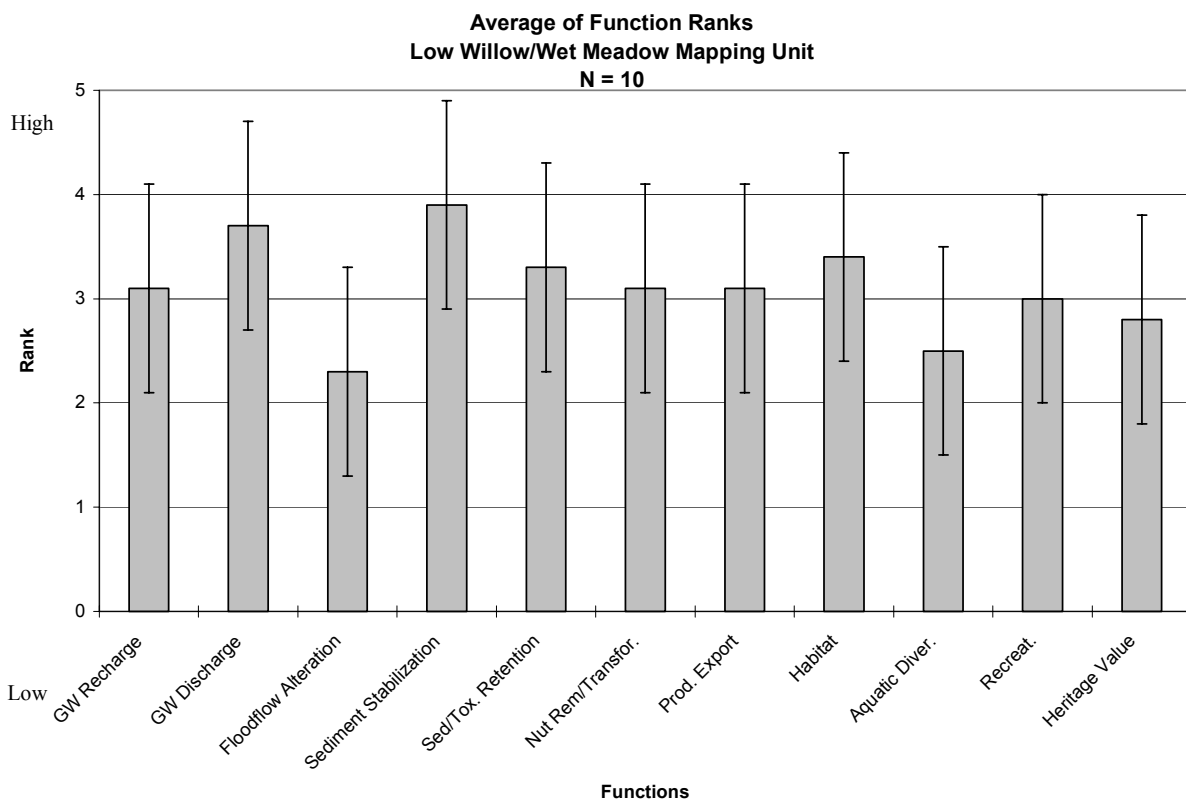


Figure 8. Average of function ranks for the low willow/wet meadow mapping unit.

Table 12. Summary of functions and value assessment for the cottonwood mapping unit.

Mapping Unit	cottonwood
Colorado Natural Heritage Program Plant Communities	<i>Populus angustifolia/Alnus incana</i>
Locations in Summit County	Blue River-North of Silverthorne
Summary of Functions and Values	low gw recharge, discharge; floodflow alteration; high sediment stabilization; sediment/toxicant retention, and nutrient retention; medium production export, habitat, aquatic diversity, recreation, low heritage value
HGM Subclass	riverine

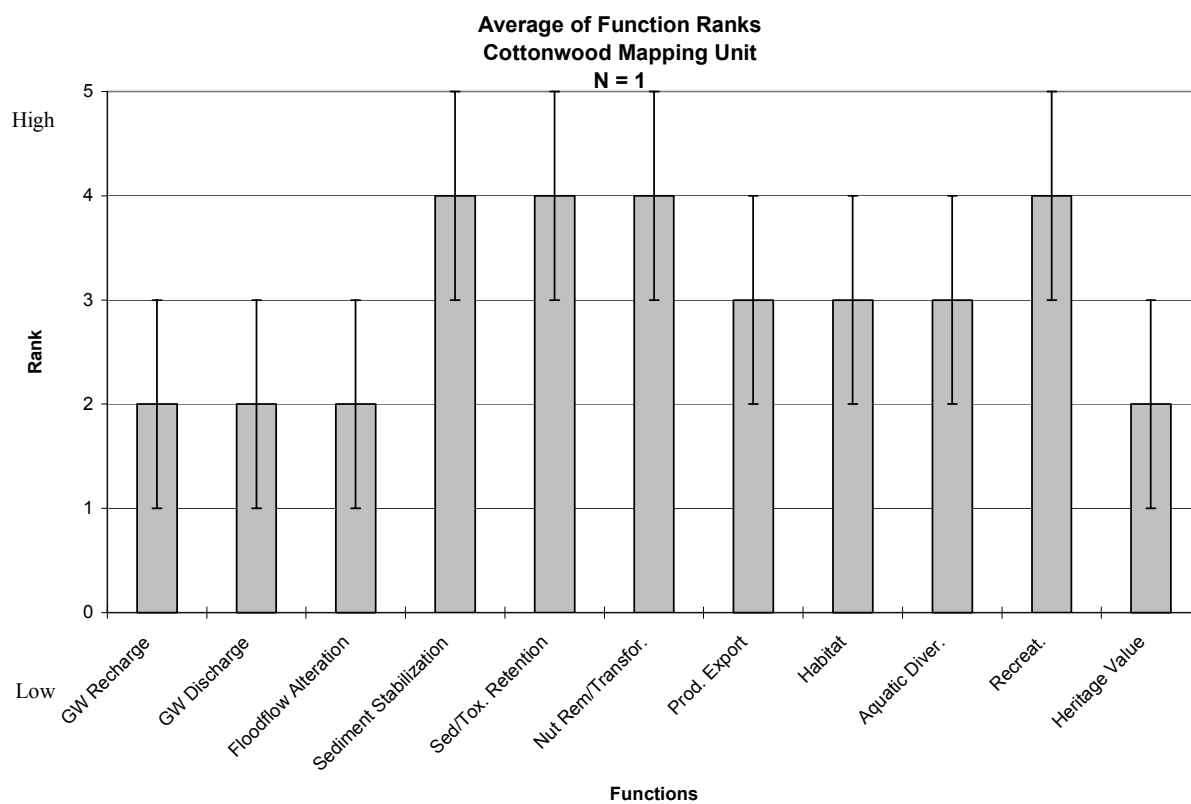


Figure 9. Average of function ranks for cottonwood mapping unit.

Table 13. Summary of function and value assessment for the spruce mapping unit.

Mapping Unit	spruce
Colorado Natural Heritage Program Plant Communities	<i>Picea pungens/Alnus incana</i>
Locations in Summit County	Blue River-North of Silverthorne; Slate Creek; Spruce Creek
Summary of Functions and Values	medium gw recharge, low gw discharge; medium floodflow alteration; sediment stabilization; sediment/toxicant retention; high production export, habitat, medium aquatic diversity, recreation, and heritage value
HGM Subclass	riverine

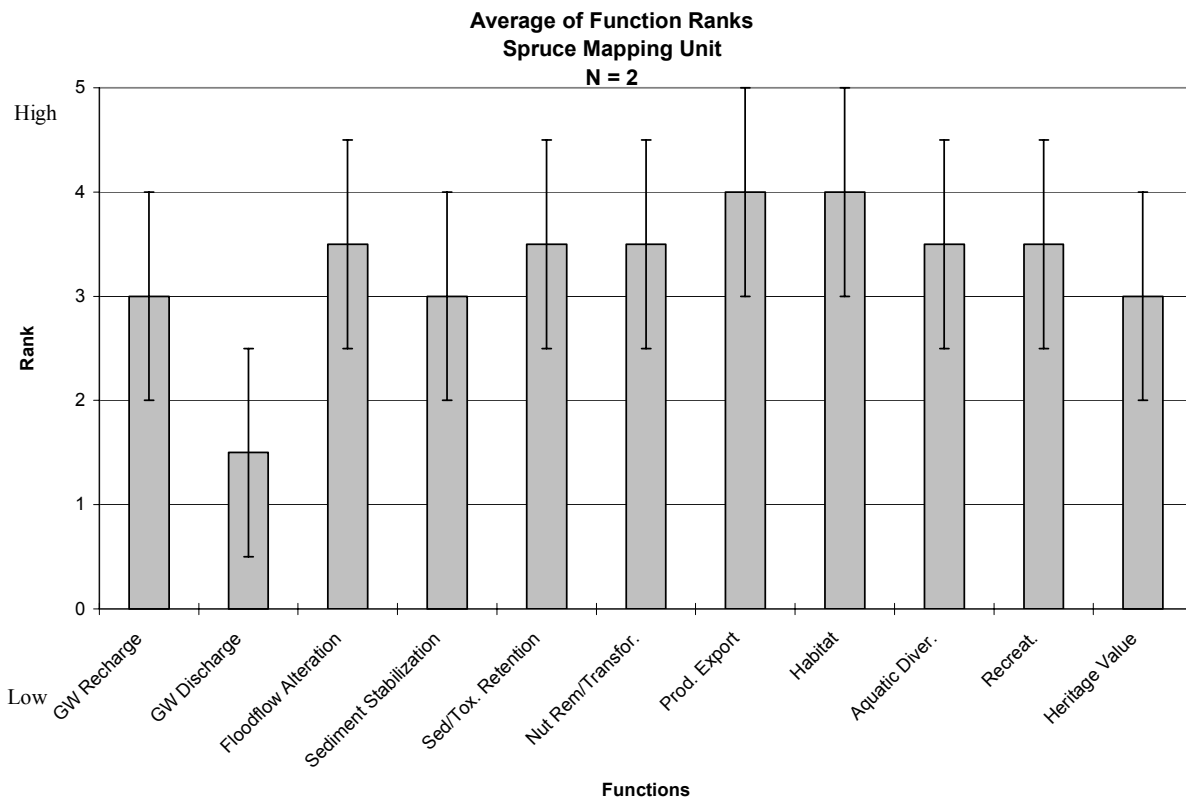


Figure 10. Average of function ranks for spruce mapping unit.

Table 14. Summary of function and value assessment for the mixed riparian mapping unit.

Mapping Unit	mixed riparian
Colorado Natural Heritage Program Plant Communities	<i>Abies lasiocarpa</i> - <i>Picea engelmannii</i> / <i>Mertensia ciliata</i> <i>Picea pungens</i> / <i>Alnus incana</i> <i>Populus tremuloides</i> /tall forbs
Locations in Summit County	Bushee Creek; Pass Creek; Cataract Creek
Summary of Functions and Values	medium to high gw recharge, medium gw discharge, floodflow alteration, high sediment stabilization, sediment/toxicant retention, medium nutrient removal/transformation, high production export, habitat, low aquatic diversity, recreation, medium to high heritage value
HGM Subclass	riverine

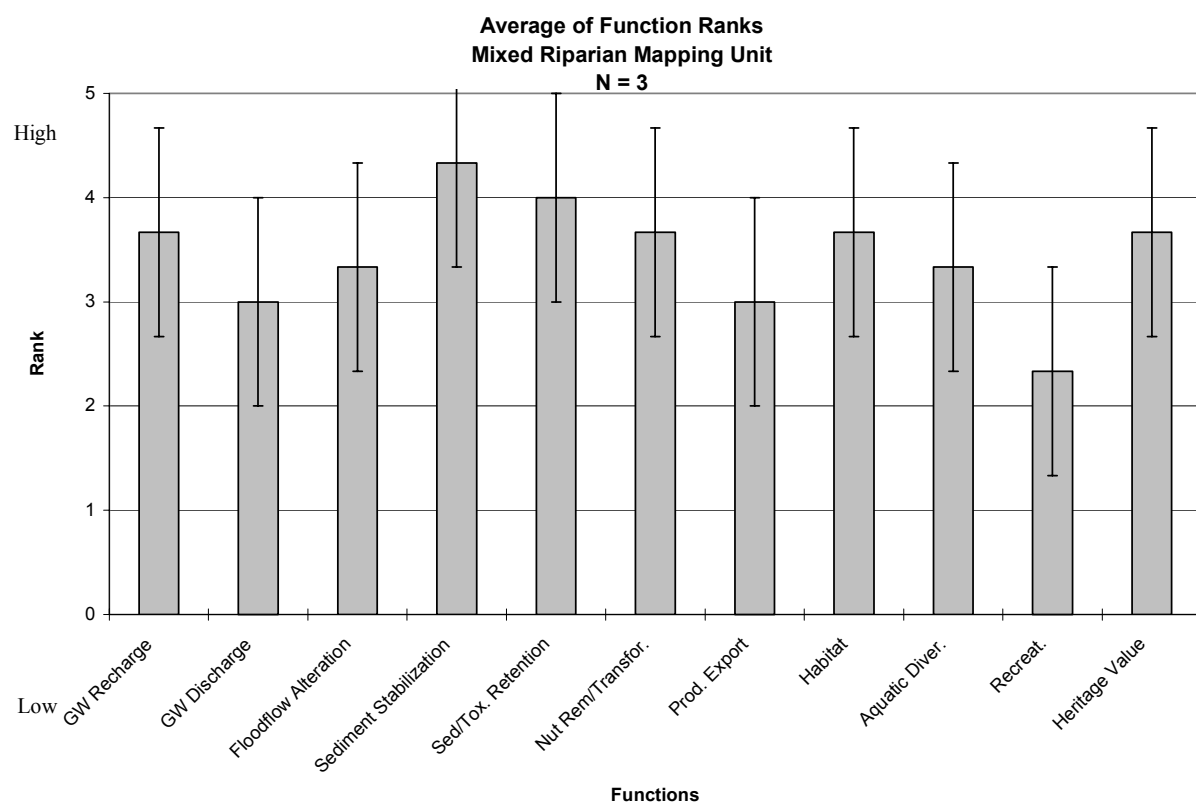


Figure 11. Average of function ranks for mixed riparian mapping unit.

Table 15. Summary of function and value assessment for alpine willow/rock complex mapping unit.

Mapping Unit	alpine willow/rock complex
Colorado Natural Heritage Program Plant Communities	<i>Salix brachycarpa</i> /mesic forb <i>Salix planifolia</i> / <i>Carex aquatilis</i>
Locations in Summit County	Clinton Creek; Blue Lakes; Montezuma
Summary of Functions and Values	low to medium gw recharge, high to very high gw discharge, low floodflow alteration, medium sediment stabilization, sediment/toxicant retention, nutrient removal/transformation, production export, habitat, recreation, low aquatic diversity, medium recreation, medium to high heritage value
HGM Subclass	riverine; slope

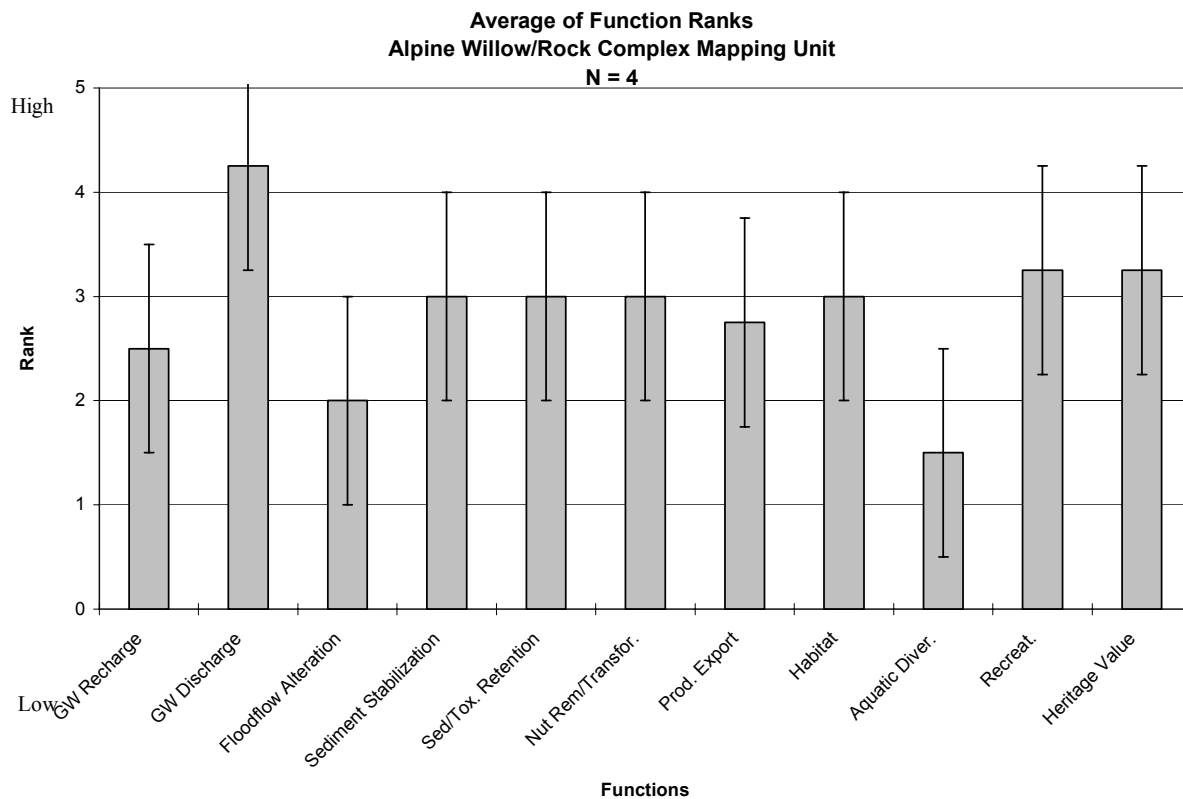


Figure 12. Average of function ranks for alpine willow/rock complex mapping unit.

Table 16. Summary of function and value assessment for assessment for water mapping unit.

Mapping Unit	water
Colorado Natural Heritage Program Plant Communities	<i>Myriophyllum exalbescens</i> <i>Hippuris vulgaris</i> <i>Typha latifolia</i> <i>Nuphar luteum</i> ssp. <i>polysepalum</i>
Locations in Summit County	Otter Creek; Cataract Creek; Spruce Creek subdivision-kettle ponds; Frisco Duck
Summary of Functions and Values	medium gw recharge, low gw discharge, no floodflow alteration, high sediment stabilization, sediment/toxicant retention, medium nutrient removal/transformation, low production export and habitat, low recreation, aquatic diversity, medium heritage value
HGM Subclass	depressional; lacustrine

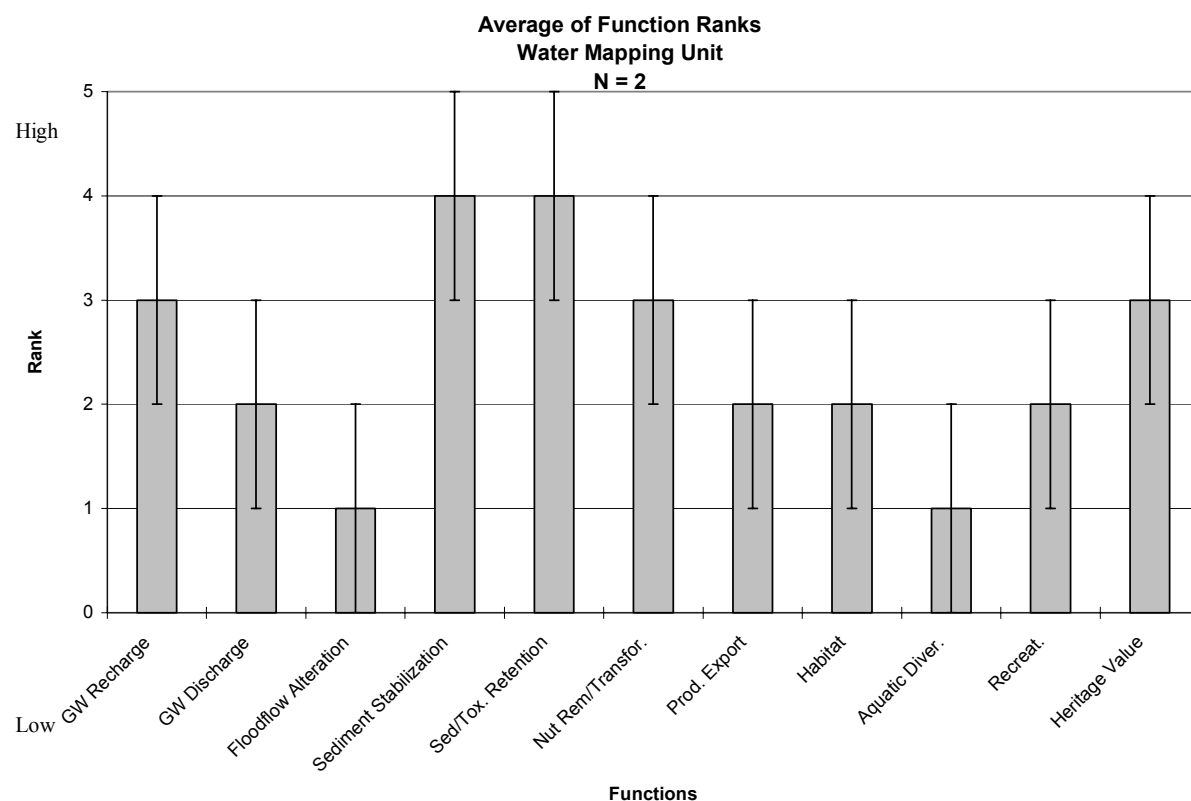


Figure 13. Average of function ranks for water mapping unit.

An analysis of the function and value assessments performed on Summit County private lands resulted in 26 wetlands in Summit County that perform 3 or more function to a high degree (Table 17).

Table 17. Summit County wetlands that performed 3 or more functions to a high or very high degree.

Wetland Name	White Horse Mapping Unit (s)	Wetland Designation (e.g., biodiversity rank or locally significant area)
Blue Lakes	low willow/wet meadow alpine willow/rock complex	B1
Cucumber Gulch	low willow/wet meadow	B2
Horse Creek	irrigated meadow willow	B2
Meadow Creek	willow/wet meadow	B2
Montezuma	low willow/wet meadow alpine willow/rock complex	B2
Peru Creek	low willow	B2
Webster Pass (Montezuma)	low willow/wet meadow	B2
Blue River at McCullough Gulch	low willow/wet meadow	B3
Cataract Creek	mesic meadow	B3
Goose Pasture	low willow/wet meadow	B3
Muggins Gulch	mesic meadow wet meadow	B3
Otter Creek	willow/wet meadow	B3
Pass Creek	mixed riparian willow/wet meadow	B3
Slate Creek	wet meadow willow spruce willow/wet meadow	B3
Spruce Creek	mesic meadow mixed riparian wet meadow willow/wet meadow	B3
Triple Creek	willow willow/wet meadow	B3
Upper French Gulch	low willow	B3
Blue River-North of Silverthorne	willow/wet meadow cottonwood	B4
Soda Springs	low willow	B4
Blue River Arm at Dillon Reservoir	willow	locally significant
Braddock Flats	willow	locally significant
Columbine Wetland	willow/wet meadow	locally significant
Hoosier Creek	low willow/wet meadow	locally significant
Indiana Creek	low willow	locally significant
Quandry Peak/Bemrose Subdivision	low willow	locally significant
Silverthorne Wetland	willow	locally significant

There are 7 wetlands on private lands in Summit County that perform at least 1 function highly (Table 18).

Table 18. Summit County wetlands that performed at least 1 function to a high degree.

Wetland Name	White Horse Mapping Unit (s)	Wetland Designation (e.g., biodiversity rank or locally significant area)
Blue Lakes	alpine willow/rock complex	B1
Dillon Bay	mesic meadow	B2
Meadow Creek (Frisco Duck)	water	B2
Cataract Creek	water	B3
Clinton Creek	alpine willow/rock complex	B3
Bushee Creek	willow/wet meadow	B4
Whatley Ranch	low willow/wet meadow	locally significant

Five wetlands surveyed on private lands in Summit County did not perform any function to a high degree (Table 19).

Table 19. Summit County wetlands that do not perform any function to a high degree.

Wetland Name	White Horse Mapping Unit (s)	Wetland Designation (e.g., biodiversity rank or locally significant area)
Brush Creek	willow/wet meadow	locally significant
Caravai at Keystone	willow	locally significant
Soda Creek at Summit Cove	willow	locally significant
Union Gulch	willow	locally significant
Willow Creek at Silverthorne	willow/wet meadow	locally significant

SIGNIFICANT KNOWN AND POTENTIAL WETLAND ELEMENTS IN SUMMIT COUNTY

The Colorado Natural Heritage Program has records of the following wetland and riparian elements for the wetlands in Summit County. This list *does not* necessarily represent *all* rare or imperiled plants, animals, and plant communities, but it is a complete list of known occurrences.

Wetland and Riparian Plant Associations in Summit County

Information in BCD (CNHP 1997) was used to develop a preliminary list of wetland plant communities in Summit County. This list was further developed with information gathered during the field efforts from this study. Since this study was intended to identify the wetland sites of highest conservation value, and did not encompass wetland classification, CNHP does not presume the following list of plant communities to be a complete list of Summit County plant communities. Nonetheless, CNHP believes the list to be a good representation of the major wetland and riparian plant communities present in the county.

There are 24 wetland and riparian plant communities that have been documented in Summit County (Table 20). The plant communities are presented, in the context of both The Nature Conservancy hierarchical classification (Bourgeron and Engelking 1994) and the U.S. Fish and Wildlife Service's wetland classification (Cowardin et al. 1979). The Fish and Wildlife Service classification units (palustrine system and forested, scrub-shrub, emergent, and aquatic bed classes) will be useful for anyone familiar with the National Wetlands Inventory maps that use this classification. Detailed description for each of these communities is presented on page 214.

Table 20. Riparian and wetland plant communities in Summit County.

Scientific Name	Common Name	Global Rank	State Rank
Palustrine Forested Communities			
Broad-leaved Deciduous			
<i>Populus angustifolia</i> / <i>Alnus incana</i>	montane riparian forest	G3	S3
<i>Populus angustifolia</i> / <i>Picea pungens</i> / <i>Alnus incana</i>	narrowleaf cottonwood riparian forest	G3	S3
<i>Populus tremuloides</i> / <i>Alnus incana</i>	montane riparian forest	GU	S3
<i>Populus tremuloides</i> /tall forbs	montane aspen forest	G5	S5
Palustrine Scrub-Shrub Communities			
Broad-leaved Deciduous			
<i>Betula glandulosa</i> /mesic forb-mesic graminoids	subalpine riparian shrubland	GU	S3S4
<i>Salix brachycarpa</i> /mesic forb	alpine willow scrub	GUQ	S4
<i>Salix drummondiana</i> / <i>Carex utriculata</i>	montane willow carr	GU	S3
<i>Salix drummondiana</i> /mesic forb	Drummond willow/mesic forb	GU	S4
<i>Salix geyeriana</i> - <i>Salix monticola</i> / <i>Calamagrostis canadensis</i>	montane willow carr	G3	S3
<i>Salix geyeriana</i> / <i>Carex aquatilis</i>	montane willow carr	G3	S3
<i>Salix geyeriana</i> / <i>Carex utriculata</i>	Geyer's willow/beaked sedge	G5	S3
<i>Salix geyeriana</i> - <i>Salix monticola</i> /mesic forb	montane willow carr	GU	S3
<i>Salix monticola</i> / <i>Calamagrostis canadensis</i>	montane willow carr	G3	S3
<i>Salix monticola</i> /mesic graminoid	montane riparian willow carr	GU	S3
<i>Salix planifolia</i> / <i>Calamagrostis canadensis</i>	subalpine riparian willow carr	G4	S4
<i>Salix planifolia</i> / <i>Caltha leptosepala</i>	subalpine riparian willow carr	G4	S4
<i>Salix planifolia</i> / <i>Carex aquatilis</i>	montane willow carr	G4G5	S4S5
<i>Salix wolfii</i> / <i>Carex aquatilis</i>	subalpine riparian willow carr	G4	S3
Palustrine Scrub-Shrub Community			
Deciduous			
<i>Pentaphylloides floribunda</i> / <i>Deschampsia cespitosa</i>	montane riparian shrublands	G4	S3
Palustrine Emergent Communities			
Persistent			
<i>Carex praegracilis</i> wetland	clustered sedge wetland	G2G3	S2S3
<i>Deschampsia cespitosa</i> - <i>Ligusticum tenuifolium</i> (= <i>Deschampsia cespitosa</i>)	mesic alpine meadows	G4	S4
Palustrine Aquatic Bed Communities			
Rooted Vascular			
<i>Myriophyllum exalbescens</i>	floating/submerged palustrine wetland	G5?	S4
<i>Nuphar luteum</i> ssp. <i>polysepalum</i>	floating/submergent palustrine wetland	G5?	S4
<i>Potamogeton natans</i>	montane floating/submergent wetland	G5?	S1

Rare or Imperiled Wetland Plants in Summit County Wetlands

Wetlands in Summit County provide habitat for twelve known rare or imperiled plants (Table 21). Weber whitlow-grass (*Draba weberi*) is an extremely restricted endemic, known only from a population of about 100 individuals at the type locality, north of North Star Peak in the Blue Lake site (Rollins 1993). It grows in rock crevices along streamlets near timberline. *Draba weberi* differs from other closely related whitlow-grasses due to the wetter habitat of stream edges (Price and Rollins no date). This plant is critically imperiled globally because of its extreme rarity.

Porter feathergrass (*Ptilagrostis mongholica* ssp. *porteri*) is a globally imperiled plant due to its restricted range, known only from four counties in Colorado. It grows only in peat bog hummocks at elevations from 9,700 ft to 12,000 ft. There are a total of 24 occurrences in Colorado, only one occurrence is known from Summit County (CNHP 1997).

Weber saussurea (*Saussurea weberi*) is a very rare composite that grows only on exposed sites with poorly developed soils derived from Leadville limestone and Manitou dolomite on alpine solifluction lobes, gravely tundra slopes and scree (O'Kane 1988). It occurs in Wyoming, Montana, and two counties (Park and Summit) in Colorado. There are a total of 18 known occurrences in Colorado, seven of which are located in Summit County (CNHP 1997).

The northern rockcress (*Draba borealis*) is apparently secure globally, but rare in Colorado. There are only four known occurrences in Colorado and only one record in Summit County. It occurs on creek banks, cliffs, gravely terraces, steep slopes, meadows, and roadsides from Alaska to Colorado (Rollins 1993).

The arctic draba (*Draba fladnizensis*) is a circumpolar species that is apparently globally secure. There are a total of 23 occurrences in Colorado with five records in Summit County (CNHP 1997). It occurs in wet meadows, on bare soil in dry tundra, and in rocky areas both wet and dry (Rollins 1993).

Kotzebue grass-of-parnassus (*Parnassia kotzebuei*) is a state rare plant. There are a total of 12 occurrences known from Colorado, three of which are located in Summit County (CNHP 1997). This plant is found on wet ledges and rills in subalpine and alpine regions (Weber and Wittman 1996).

The low northern sedge (*Carex concinna*) is a globally common but a state rare plant. There are only three known Colorado locations, only one from Summit County. It is found in cool, moist forests with mosses, on rich peaty soil, often calcareous (Hermann 1997).

The stiff clubmoss (*Lycopodium annotinum* var. *pungens*) is a globally common species. The state rank is unknown due to the lack of information for this plant. It is found in deep wet humus, swampy moist coniferous forests and exposed grass or rocky sites (Flora of North America Editorial Committee 1993). There are four known occurrences in Colorado. The Blue Lakes site is the only documented occurrence in Summit County (CNHP 1997).

The moonwort (*Botrychium lunaria*) is a globally secure, but state rare plant. It can be locally common, but it is very inconspicuous. A total of 34 Colorado occurrences are documented. Three are located within Summit County (CNHP 1997). This moonwort generally occurs on calcareous soils in the sunlight of open fields, wood edges, and occasionally forests in the southern parts of its range (Harrington 1954).

The mountain bladder fern (*Cystopteris montana*) is a globally common fern that is found along streamsides (Weber 1961), near moist sites in woods, heathlands, and meadows, often on limestone (Welsh 1974). A total of 11 Colorado locations are known, two being located within Summit County (CNHP 1997).

Table 21. Rare or imperiled wetland plants associated with Summit County.

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	Federal Sensitive
<i>Draba weberi</i>	Weber whitlow-grass	G1	S1		
<i>Ptilagrostis mongholica</i> ssp. <i>porteri</i>	Porter feathergrass	G2T2	S2		USFS Sensitive
<i>Saussurea weberi</i>	Weber saussurea	G3Q	S2		
<i>Draba borealis</i>	northern rockcress	G4	S2		
<i>Draba fladnizensis</i>	arctic draba	G4	S2S3		
<i>Parnassia kotzebuei</i>	Kotzebue grass-of-parnassus	G4	S1		
<i>Carex concinna</i>	low northern sedge	G4G5	S1		
<i>Lycopodium annotinum</i> var. <i>pungens</i>	stiff clubmoss	G4TU	SU		
<i>Botrychium lunaria</i>	moonwort	G5	S2		
<i>Cystopteris montana</i>	mountain bladder fern	G5	S1		

Rare or Imperiled Amphibian Associated with Summit County Wetlands

One amphibian of concern is found in Summit County (Table 22). There are a total of nine occurrences for the boreal toad (*Bufo boreas boreas*) in the county (CNHP 1997). Five of the occurrences are historical records. The remaining four occurrences are or have been active breeding sites. Three of the four breeding sites are located on private lands. There are only 20 known breeding occurrences for Colorado (G. Hammerson pers. comm. as cited in Pague et al. 1997).

The southern Rocky Mountain population of boreal toads is likely distinct from other populations (A. Goebel unpubl. data as cited in Pague et al. 1997). Although relationships among all populations of this toad are not resolved, recent genetic evaluations suggest that the southern Rocky Mountain population occurs from southern Idaho to New Mexico (Goettl 1997; Steve Corn pers. comm. and A. Goebel unpubl. data as cited in Pague et al. 1997). In Colorado, the species occurs throughout the mountains above 8,000 ft. The boreal toad breeds in marshes, ponds, and lakes and inhabits the drier surrounding habitats at other times (Hammerson 1982). There are approximately 206 historical localities for the boreal toad in Colorado. Presently, only

three to four healthy populations remain, comprised of less than 20 high priority breeding sites (Steve Corn and Lauren Livo, pers. comm. as cited in Pague et al. 1997) Based on the small numbers of egg masses, it is estimated there are currently fewer than 1,000 breeding adults. Although there is an abundance of “protected” habitat, populations have declined precipitously or disappeared over the past 20 years, and continue to do so (Goettl 1997). The reasons for the decline are unknown and the factors important to the perseverance of this species are not well understood (Pague et al. 1997). The southern Rocky Mountain boreal toad is currently a candidate for federal listing, a state endangered, and a U.S. Forest Service sensitive species. The best current method of protecting amphibians is to protect breeding habitat, especially high quality wetlands within their range, and adjacent non-breeding habitat

Table 22. Rare or imperiled amphibian associated with Summit County wetlands.

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Status
<i>Bufo boreas boreas</i>	boreal toad (southern Rocky Mountain pop.)	G4T1Q	S1	C		USFS Sensitive

Rare or Imperiled Fish Associated with Summit County Wetlands

The Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) is a global and state vulnerable subspecies (Pague et al. 1997) (Table 23). It is a U.S. Forest Service sensitive and state special concern species by the Colorado Division of Wildlife. There are a total of 14 occurrences for this fish in Summit County (CNHP 1997). The largest threats stem from the introduction of non-native trout and alteration of habitat.

This subspecies is the only trout native to the upper Colorado River basin. Its native range extends southward to the Escalante River on the west and San Juan drainage on the east sides of the basin, including the Green, Yampa, Gunnison, Dolores, San Juan rivers and their tributaries (CDOW 1986; CDOW 1987; Proebstel 1994; Young et al. 1996). Its current distribution includes remnant populations in Colorado, Wyoming, and Utah. The historical habitat included most clearwater streams and rivers of western Colorado (Behnke and Benson 1980). The trout remains only in smaller order streams and a few high elevation lakes of the mountainous country. The Colorado River cutthroat trout is heavily managed and studied. Presently there are 42 populations in Colorado judged to be genetically pure (“A category”) (Proebstel 1994). However, the primary reasons for conservation concern at the global and state levels are long term trend prognoses and threats. Populations continue to decline in many streams (Young et al. 1996); hybridization between this subspecies and non-native trout species poses the greatest threat to the elimination of pure populations. Competition with non-native trout species and exotic fish diseases also poses a threat.

The wetlands in the floodplain of the Blue River and its tributaries play an important role in sustaining the populations of these fish. Wetlands provide organic input as food, shelter from heat and predators, temperature regulation, and breeding habitat for some species. The presence of these fish is one reason that wetlands along the length of this major river and its tributaries should not be destroyed.

Table 23. Rare or imperiled fish associated with Summit County wetlands.

Scientific Name	Common Name	Global Rank	State Rank	State Status	Federal Status	Fed Sens
<i>Oncorhynchus clarki pleuriticus</i>	Colorado River cutthroat trout	G5T3	S3	SC		USFS Sensitive

Rare or Imperiled Birds Associated with Summit County Wetlands

There are four rare or imperiled birds that are known to be associated with Summit County wetlands (Table 24). The majority of the birds utilize wetlands for foraging and nesting, however the following species nest and forage in the drier lands adjacent to wetlands: northern goshawk and boreal owl.

The Colorado occurrences of the Barrow's Goldeneye are at the southern margin of the species' range, and may be disjunct. This species is globally stable, but considered imperiled in Colorado due to the small numbers of actual breeding localities, uncertain population status, and small number of protected occurrences within Colorado (Pague et al. 1997).

The osprey is considered globally secure, but there are only 11 confirmed breeding occurrences in Colorado, with an additional six probable breeding occurrences (Pague et al. 1997). Although continental numbers have increased significantly in the last three decades (Colorado Bird Observatory 1997), the total population size in Colorado is likely less than 150 birds (Pague et al. 1997).

The northern goshawk is secure globally, there are 62 nest sites reported from Colorado's national forests (CNHP 1997). This species apparently responds negatively to some forms of forest fragmentation (Reynolds 1983), but there are few data on population trends. The northern goshawk is considered vulnerable and is a U.S. Forest Service species of special concern.

The boreal owl is a rare to locally uncommon resident of the high mountains of Colorado. U.S. Forest Service surveys have documented 13 occurrences in Colorado and about 20 breeding pairs (CNHP 1997). This species is globally secure but is considered state vulnerable and is a U.S. Forest Service sensitive species.

Note that for most migratory birds, CNHP documents only breeding locations; migratory birds are otherwise too unpredictable in their locations. However, the CNHP does track predictable locations of migratory birds such as winter roosts of bald eagles and staging areas for greater sandhill cranes. Despite the focus on predictable locations, it should be clearly recognized that many bird species depend heavily on wetlands if only for nourishment and rest during their long migrations.

Table 24. Rare or imperiled birds associated with Summit County wetlands.

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	Status	Federal Status
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<i>Accipiter gentilis</i>	northern goshawk	G5	S3B S4N			USFS Sensitive
<i>Aegolius funereus</i>	boreal owl		S2			USFS Sensitive
<i>Bucephala islandica</i>	Barrow's goldeneye	G5	S2B, SZN		SC	
<i>Pandion haliaetus</i>	osprey	G5				

Rare or Imperiled Mammals Associated with Summit County Wetlands

There are two mammals that are known to associated with Summit County wetlands (Table 25). The Preble's shrews (*Sorex c.f. preblei*) was documented once, Blue River at McCullough Gulch site, during the 1997 survey. The Preble's shrew is a state rare species recently documented for Colorado. Long-tailed shrews are difficult to discern at the species level, and identification is generally only accurately accomplished with cranial (skeletal) analysis. The specimens have been sent to an expert in New Mexico to be verified, however, the early stages of identification have determined that they are Preble's shrew (*Sorex c.f. preblei*). The Preble's shrew is primarily described as a species of the upper Great Basin and Columbian Plateau, where habitats are generally described as semi-arid shrublands, including sagebrush, grasslands, alpine tundra, and sagebrush openings in subalpine forest (Hoffman and Fisher 1978; Fitzgerald et al. 1994). In Colorado, there are only four locations documented, including the Summit County occurrence. In general, there is little known about shrews. It is expected that most of them are more common than the current information reflects.

The lynx (*Felis lynx canadensis*) is critically imperiled in the state of Colorado. This species is considered globally secure, however, the overall range of the species has declined, as it has in Colorado. The current status of the lynx in Colorado is not known. Studies indicate that existing records may represent sporadic populations based more upon wandering and dispersing

individuals rather than viable, long-term populations. Lynx need large home range areas and are being threatened by habitat fragmentation, increased backcountry access by humans, and habitat conversion (Pague et al. 1997). Currently, the lynx (*Felis lynx canadensis*) is a U.S. Forest Service sensitive and state endangered species.

Table 25. Rare or imperiled mammal associated with Summit County wetlands.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.
<i>Felis lynx canadensis</i>	lynx	G5	S1		E	FS
<i>Sorex c.f. preblei</i>	Preble's shrew		S1			

WETLAND PLANT ASSOCIATIONS

Plant communities, as detailed indicators of the various wetland types present in Summit County, were the main focus of this survey. A plant community is a collection of plants that often grow together in response to complex environmental factors. Plant communities are useful indicators of wetland attributes which may be difficult to measure or are poorly understood. Plant community level conservation promotes conservation efforts beyond the individual species, to include processes as well as little known or poorly understood biotic elements (e.g., invertebrate species).

The plant association descriptions provide a thorough picture of the wetland areas in Summit County. The field survey results indicate that virtually every wetland area on private lands within Summit County has been influenced to some notable degree by present and historic post-settlement activities. The majority of the sites visited have been profoundly influenced by introduced European hay grasses, weed infestations, domestic livestock use, hydrological alterations, etc.

For each plant association, a description is provided of its distribution in the state and region, vegetation composition, soils, wetland description, and environmental conditions where it is found (i.e., geomorphologic setting, hydrology, etc.). Plant association descriptions also include notes on successional status and management as well as a list of other wetland plant species with which it may be found.

There are 23 plant associations presented based on dominant species, species composition, and community structure. The plant associations are placed in the context of The Nature Conservancy's Preliminary Vegetation Classification of the Western United States (Bourgeron and Engelking 1994), which is based on the UNESCO Physiognomic-Ecological Classification of Plant Formations of the Earth (1973) as revised by Driscoll et al. (1984). The majority of the plant association descriptions are derived from the riparian plant association and vegetation classification project (Kittel et al. 1998).

Palustrine Forested Communities--Broad-leaved Deciduous

Narrowleaf cottonwood/thinleaf alder (*Populus angustifolia*/*Alnus incana*) plant association

Colorado Natural Heritage Program Rank: G3/S3

General Description and Comments: The *Populus angustifolia*/*Alnus incana* (narrowleaf cottonwood/thinleaf alder) plant association is characterized by a dense stand of *Alnus incana* lining the stream bank and an open to nearly closed canopy of *Populus angustifolia*. It tends to occur along narrow, fast-moving stream reaches in montane areas.

Classification Problems: Distinguishing *Populus angustifolia* (narrowleaf cottonwood) types from *Populus angustifolia*-conifer types requires that there be at least 20% cover of *Populus angustifolia* and less than 10% cover of conifers along the entire reach.

Related Types/Synonyms: In New Mexico, an identical *Populus angustifolia*/*Alnus incana* (narrowleaf cottonwood/thinleaf alder) community type occurs as well as a similar *Populus angustifolia*/*Alnus oblongifolia* (narrowleaf cottonwood/Arizona alder) community type (Durkin et al. 1994). The latter type is very similar in structural and floristic characteristics, but includes a different species of *Alnus*. This association is not well documented in the literature and may be included in other plant associations such as *Populus angustifolia*/*Cornus sericea* (narrowleaf cottonwood/red-osier dogwood) (Padgett et al. 1989; Hansen et al. 1995) or *Populus angustifolia*/*Alnus incana*-*Cornus sericea* (narrowleaf cottonwood/thinleaf alder-red-osier dogwood) (Johnston 1987). A similar *Populus angustifolia*/*Alnus incana*-*Cornus sericea* (narrowleaf cottonwood/thinleaf alder-red-osier dogwood) plant association occurs in western Wyoming and central Colorado (Johnston 1987). This association differs by having significant cover of *Cornus sericea*. A similar *Populus angustifolia*/*Alnus incana* type occur along the Animas River in Colorado (Walford 1993). This type differs by having a sparse shrub and herbaceous understory and occurring on very coarse alluvium.

Regional Distribution: Similar plant associations occur in western Wyoming, central and southern Colorado, and New Mexico (Durkin et al. 1994, Johnston 1987, Walford 1993).

Distribution in Colorado: This plant association was documented once at the Blue River-North of Silverthorne site during the 1997 survey. This plant association also occurs on the West Slope in the Yampa and Gunnison River Basins, and the San Juan National Forest (Kittel and Lederer 1993, Kittel et al. 1994, Richard et al. 1996). It also occurs along the Front Range in the Arkansas River Basin (Kittel et al. 1996).

Elevation Range: 6200-8900 ft. (1900-2700 m).

Site Geomorphology: This plant association occurs on active floodplains in narrow to broad valleys. It forms a narrow, dense band along stream banks and benches. Some of the stands

have signs of recent flooding. Stream gradient and channel width are highly variable. Some sites occur along steep, narrow reaches with little sinuosity (Rosgen's Channel Type: A2-A4). Other sites occur along low gradient, moderately sinuous, broad channel reaches (Rosgen's Channel Type: B2-B5) or low gradient, highly sinuous reaches (Rosgen's Channel Type: C3, C4).

Soils: Soils are mostly coarse textured ranging from deep sands to shallow sandy loams. Some profiles show stratification with loams to clay loams alternating with sands. Most profiles become skeletal at an average depth of 12 inches (30 cm).

Wetland description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Vegetation: This plant association has an open to dense canopy of 5-80% cover of *Populus angustifolia* (narrowleaf cottonwood). *Abies concolor* (white fir), *Pseudotsuga menziesii* (Douglas-fir), or *Picea pungens* (Colorado blue spruce) may occasionally co-dominate the overstory with <10% cover. The shrub understory is dominated by a dense band of 10-80% cover of *Alnus incana* (thinleaf alder) lining the stream bank. A wide variety of other shrubs may be present including 0-40% cover of *Salix* (willow) species, 0-30% cover of *Cornus sericea* (red-osier dogwood), 0-20% cover of *Rosa woodsii* (woods rose), 0-15% cover of *Acer glabrum* (Rocky Mountain maple), and 0-10% cover of *Betula occidentalis* (river birch). The herbaceous undergrowth is generally sparse due to the dense overstory (CNHP 1996).

Successional and Ecological Processes: Plant associations dominated by *Populus* (cottonwoods) species are considered to be early successional vegetation types. Cottonwoods do not regenerate within existing stands (i.e., seedlings cannot establish within mature canopies). Cottonwood woodlands grow within an alluvial environment that is continually changing due to the ebb and flow of the river. Periodic flooding events can leave sandbars of bare, mineral substrate. Cottonwood seedlings germinate and become established on newly deposited, moist sandbars. In the absence of large floods in subsequent years, seedlings begin to trap sediment during lesser flows. In time, the sediment accumulates and the sandbar rises. The young forest community is then above the annual flood zone of the river channel.

In this newly elevated position, with an absence of excessive browsing, fire, and agricultural conversion, this cottonwood community can grow into a mature riparian forest. At the same time, the river channel continually erodes stream banks and creates fresh, new surfaces for cottonwood establishment. This results in a dynamic patchwork of different age classes, plant associations, and habitats (The Nature Conservancy 1992).

As cottonwoods mature, other tree species may become established. Eventually, the land surface may be reworked by the river and the successional processes start over with erosion and subsequent deposition from flooding. If the land surface is not subject to alluvial processes, for example a high terrace, the cottonwoods will be replaced by upland shrub and/or tree species that may be the climax plant association for that area.

The *Populus angustifolia*/*Alnus incana* (narrowleaf cottonwood/thinleaf alder) plant association is considered mid-seral. *Alnus incana* appears to thrive along steeper gradient streams due to

more highly oxygenated water (Padgett et al. 1989). This species also appears to do well along more gradual stream reaches where flooding creates frequent scouring. *Alnus incana* is an excellent stream bank stabilizer because of its rhizomatous roots. Young stands can re-sprout after flood damage or fire and can tolerate a short duration of standing water (Hansen et al. 1995). Without flooding the stream banks may become dominated by north-facing upslope communities such as *Pseudotsuga menziesii* (Douglas-fir) and *Juniperus* (juniper) species.

Adjacent riparian vegetation: In narrow canyons, the *Populus angustifolia*/*Alnus incana* (narrowleaf cottonwood/thinleaf alder) plant association is often the only community along stream banks. Along wider stream reaches, this association is adjacent to stands of *Pseudotsuga menziesii* (Douglas-fir), *Populus angustifolia*-*Picea pungens* (narrowleaf cottonwood-Colorado blue spruce), *Populus angustifolia*/*Cornus sericea* (narrowleaf cottonwood/red-osier dogwood), or *Quercus gambelii* (Gambel's oak). Younger *Populus angustifolia* stands often occur on adjacent point bars and fresh alluvial deposits. *Salix* spp. (willow), *Alnus incana*-*Salix* spp. (thinleaf alder-willow), *Betula occidentalis*/*Carex* spp. (water birch/sedge) shrublands, or *Carex utriculata* (beaked sedge) meadows occur in patches on the floodplain.

Adjacent Upland Vegetation: At lower elevations, south facing slopes have *Pinus edulis*-*Juniperus monosperma* (pinyon pine-one-seed juniper) woodlands. North facing slopes often have mixed conifer-*Populus tremuloides* (quaking aspen) forests or thick to scattered stands of *Pseudotsuga menziesii* (Douglas-fir) and *Quercus gambelii* (Gambel's oak). At higher elevations, *Pseudotsuga menziesii*-mixed conifer forests, or barren talus slopes occur on adjacent slopes.

Management: Because the regeneration and establishment of new stands of cottonwood is dependent upon flooding events, any alteration to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows and reduce flooding frequency and magnitude. This results in fewer flood events that provide conditions for cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Forage productivity for this plant association is high and very palatable to livestock. Cottonwood seedlings and saplings and the nitrogen rich *Alnus incana* (thinleaf alder) leaves are frequently browsed by cattle. Excessive grazing and browsing will reduce plant vigor and allow non-native plant species to gain a competitive advantage. Cottonwood dominated riparian areas in Colorado are best grazed moderately for short periods during the growing season or solely during the winter season. This maintains high forage quality and quantity (Hansen et al. 1995).

Narrowleaf cottonwood-Colorado blue spruce/thinleaf alder (*Populus angustifolia*-*Picea pungens*/*Alnus incana*) plant association

Colorado Natural Heritage Ranks: G3/S3

Classification Problems: This is a *Populus angustifolia* (narrowleaf cottonwood)-mixed-conifer plant association that may not always contain *Picea pungens* (Colorado blue spruce). Stands along reaches at higher elevations can have a conifer cover represented by *Abies lasiocarpa* (subalpine fir), *Picea engelmannii* (Engelmann spruce), or *Abies concolor* (white fir), rather than *Picea pungens*. Stands with this mixed-conifer cover may represent a different plant association, or may simply be transitional from mid- to upper elevations. In order to distinguish this *Populus angustifolia* (narrowleaf cottonwood)-mixed-conifer type from other *Populus angustifolia* or *Picea pungens* types, an occurrence must have at least 20% cover of *Populus angustifolia* and at least 10% cover of conifers. A *Populus angustifolia* type has at least 20% cover of *Populus angustifolia* and less than 10% cover of conifers. A *Picea pungens* type has less than 1% cover of *Populus angustifolia* and at least 20% cover of *Picea pungens*.

Related Types/Synonyms: The *Populus angustifolia*-*Picea pungens*/*Alnus incana* (narrowleaf cottonwood-Colorado blue spruce/thinleaf alder) plant association combines seven existing plant association names given to stands in western Colorado. These identical plant associations include a *Populus angustifolia*-(*Picea pungens*)/*Alnus incana* ssp. *tenuifolia*-*Cornus sericea* (narrowleaf cottonwood-Colorado blue spruce/thinleaf alder-red-osier dogwood) association (Baker 1989, Kittel and Lederer 1993, Richard et al. 1996); a *Populus angustifolia*-*Picea pungens*/*Alnus incana* ssp. *tenuifolia*-*Lonicera involucrata* (narrowleaf cottonwood-Colorado blue spruce/thinleaf alder-honeysuckle) association (Baker 1989, Kittel and Lederer 1993); a *Populus angustifolia*-*Abies lasiocarpa*-*Picea engelmannii*/*Lonicera involucrata* (narrowleaf cottonwood-subalpine fir-Engelmann spruce/honeysuckle) association (Baker 1989, Richard et al. 1996); a *Populus angustifolia*-*Picea pungens*/*Lonicera involucrata* (narrowleaf cottonwood-Colorado blue spruce/honeysuckle) association (Richard et al. 1996); a *Populus angustifolia*-*Picea pungens*/bare ground association (Richard et al. 1996); a *Populus angustifolia*-*Picea engelmannii*/*Lonicera involucrata* (narrowleaf cottonwood-Engelmann spruce/honeysuckle) association (Johnston 1987); and an existing *Populus angustifolia*-*Picea pungens*/*Alnus incana* association (Baker 1986, Baker 1989, Kittel et al. 1994, Kittel et al. 1995).

Regional Distribution: This plant association is probably found in eastern Idaho, western Wyoming, and southern Utah (Baker 1989).

Distribution in Colorado: This plant association was found twice on private lands in Summit County, along the Blue River, north of Silverthorne and Pass Creek. This plant association also occurs in the Yampa, White, Colorado, Gunnison, and San Miguel River Basins, and the Uncompahgre and San Juan National Forests (Johnston 1987, Hess and Wasser 1982, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Komarkova 1986, as cited by Baker 1989, Richard et al. 1996). It is also likely to occur along the Colorado Front Range.

Elevation Range: 7300-9000 feet (2200-2700 m).

Site Geomorphology: This plant association probably constitutes a transition between pure *Populus angustifolia* (narrowleaf cottonwood) dominated reaches and pure *Picea pungens* (Colorado blue spruce) dominated reaches. The two habitats are driven by valley width, cold-air drainage, amount of direct sunlight received at the valley floor, and elevation. In addition, the flooding history and time since the last flood influences the relative abundance of these two species. Elevation alone does not account for the overlap.

Gradual and slightly sinuous stream channels that have overbank flow and sediment deposition favor establishment of *Populus angustifolia*. *Picea pungens* is favored along reaches in deep valleys with steep side-walls that contribute to strong cold-air drainage effects.

This association occurs in valleys with narrow to moderately wide floodplains, 30-430 ft (10-130 m), and in deep canyons. It establishes on narrow terraces, benches, and cobble bars adjacent to the channel. This facilitates the establishment of *Populus angustifolia*. This association is commonly found on slightly meandering to meandering floodplains of broad reaches (Rosgen's Channel Type: B2-B5, C2-C4). Occasionally, stands occur along steep reaches (Rosgen's Channel Type: A2, A3).

Soil: Soils range from shallow sandy loams to silty clay loams and clays over cobbles and boulders. Profiles are generally highly stratified, with layers of fine soils over layers of coarser sediments. In the White and Colorado River Basins, the soils classify as loamy-skeletal, calcareous aquic typic Cryochrepts.

Wetland description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Vegetation: The overstory of this plant association is generally dominated by 20-95% cover of *Populus angustifolia* (narrowleaf cottonwood) and 0-80% cover of *Picea pungens* (Colorado blue spruce). At lower elevations, *Pseudotsuga menziesii* (Douglas-fir) may also be present with 0-35% cover. At higher elevations, *Picea pungens* appears to be replaced by 0-80% cover of *Abies lasiocarpa* (subalpine fir), 0-30% cover of *Picea engelmannii* (Engelmann spruce), and 0-30% cover of *Abies concolor* (white fir) (CNHP 1996).

The dense shrub layer consists of 0-95% cover of *Cornus sericea* (red-osier dogwood), 0-70% cover of *Alnus incana* (thinleaf alder), 0-30% cover of *Amelanchier* spp. (serviceberry), and 0-20% cover each of *Acer glabrum* (mountain maple) and *Lonicera involucrata* (honeysuckle). A variety of *Salix* (willow) species may be present with <50% cover. The undergrowth is diverse yet sparse, rarely with more than 30% total cover. Common forb species include *Actaea rubra* (baneberry), *Osmorhiza depauperata* (blunt-fruit sweet-cicely), *Maianthemum stellatum* (false Solomon seal), *Geranium richardsonii* (Richardson's geranium), *Mertensia ciliata* (mountain bluebell), and *Fragaria virginiana* (mountain strawberry). Graminoid cover is minor.

Successional and Ecological Processes: This mixed deciduous-evergreen plant association represents a transition zone between *Populus angustifolia* (narrowleaf cottonwood) dominated reaches downstream and *Picea pungens* (Colorado blue spruce) dominated reaches upstream. The transition zone can be several miles long. This plant association is a mid-seral community

maintained by flooding, channel migration, sediment deposition, and scouring. On higher terraces that no longer experience flooding, *Picea* spp. may become the climax tree.

At higher elevations, *Abies lasiocarpa* (subalpine fir), *Picea engelmannii* (Engelmann spruce), or *Abies concolor* (white fir) represent the conifer cover in these stands, rather than *Picea pungens*. These stands may represent a new plant association or may simply be transitional from mid- to upper-elevations. *Abies concolor* is a facultative riparian species in this setting and its presence differentiates stands from those further north in Colorado, beyond this species geographic limits.

Adjacent riparian vegetation: The adjacent riparian vegetation is highly variable. Some of the adjacent communities include *Populus angustifolia*-*Picea pungens* (narrowleaf cottonwood-Colorado blue spruce) forests with drier upland shrub species in the understory or *Populus angustifolia*-*Pseudotsuga menziesii*-*Populus tremuloides* (narrowleaf cottonwood-Douglas-fir-quaking aspen) forests on elevated terraces above the main channel. Narrow reaches support pure *Picea pungens*/*Alnus incana* (Colorado blue spruce/thinleaf alder) stands. *Alnus incana* and mixed *Alnus incana*-*Cornus sericea* (thinleaf alder-red-osier dogwood) or *Alnus incana*-*Salix drummondiana* (thinleaf alder-Drummond's willow) shrublands occur adjacent to the floodplain forest on steep-sided banks. *Salix* (willow) species shrublands occur in low, open areas, on point bars, overflow channels, and islands.

Adjacent upland vegetation: At lower elevations, mixed coniferous forests including *Pseudotsuga menziesii* (Douglas-fir), *Pinus ponderosa* (ponderosa pine), *Abies concolor* (white fir), or *Picea pungens* (Colorado blue spruce) occur on adjacent hill slopes. *Pinus edulis*-*Juniperus monosperma* (pinyon pine-Rocky Mountain juniper) and *Populus tremuloides* (quaking aspen) woodlands, *Quercus gambelii* (Gambel's oak) scrub, and *Amelanchier alnifolia* (serviceberry) shrublands also occur. At higher elevations, *Picea engelmannii*-*Abies lasiocarpa* (Engelmann spruce-subalpine fir) forests occur on adjacent hill slopes.

Management: Because the regeneration and establishment of new stands of cottonwood is dependent upon flooding events, any alterations to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows and reduce flooding frequency and magnitude. This results in fewer flood events that would allow for cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Forage productivity for this plant association can be high and very palatable to livestock. Cottonwood seedlings and saplings and the associated shrub species are frequently browsed by cattle. Excessive grazing and browsing will reduce plant vigor and allow non-native plant species to gain a competitive advantage. Cottonwood dominated riparian areas in Colorado are best grazed moderately for short periods during the growing season or solely during the winter season. This maintains high forage quality and quantity. This plant association also provides excellent hiding and thermal cover for mammals and birds (Hansen et al. 1995).

Quaking aspen/thin-leaf alder (*Populus tremuloides*/*Alnus incana* ssp. *tenuifolia*) plant association

Colorado Natural Heritage Program Rank: GU/S3

General Description and Comments: The *Populus tremuloides*/*Alnus incana* ssp. *tenuifolia* (quaking aspen/thinleaf alder) plant association is located in narrow ravines and along first and second-order streams where upland *Populus tremuloides* forests intermix with riparian shrub vegetation. The presence of obligate riparian shrub species distinguish this association from upland *Populus tremuloides* communities.

Regional Distribution: This plant association has not been documented outside of Colorado.

Distribution in Colorado: This plant association was documented twice during the 1997 Conservation Inventory, above Cataract Creek. This association also occurs in the Routt National Forest, and the Colorado and Gunnison River Basins (Kettler and McMullen 1996, Kittel et al. 1994, Kittel et al. 1995).

Elevation Range: 8400-9600 ft (2600-2900 m).

Site Geomorphology: This plant association occurs in narrow, 25-225 feet (10-70 m) wide, valleys along stream banks of first- and second-order streams. Stream channels are steep and narrow (Rosgen's Channel Type: A3, A4) and occasionally, of moderate gradient and width (Rosgen's Channel Type: B3). Stream gradients range from 1-30%.

Soils: Soils are generally skeletal, shallow, sandy and sandy clay loams or deeper sandy clay loams. In the Colorado River Basin, the soils classify as coarse loamy to sandy cumulic Cryaqualls or Cryoborolls to oxyaquic Cryorthents.

Wetland Description: Riverine wetland with seasonal hydroperiod and occasional flooding.

Vegetation: This plant association has a tall, 20-40 foot (6-12 m), overstory of 10-70% cover of *Populus tremuloides* (quaking aspen). Several conifer species may also occur including 0-20% cover of *Pinus contorta* (lodgepole pine) and 0-10% cover each of *Abies lasiocarpa* (subalpine fir), *Picea pungens* (Colorado blue spruce), and *Pseudotsuga menziesii* (Douglas-fir). The adjacent hillslopes are often covered with *Populus tremuloides* (CNHP 1996).

The shrub understory and forb species along the immediate stream bank distinguish this riparian plant association from the adjacent hillslope forests. The shrub layer is dominated by 10-70% cover of *Alnus incana* (thinleaf alder). Other shrubs include 0-20% cover of *Salix drummondiana* (Drummond's willow), and 0-10% cover each of *Lonicera involucrata* (honeysuckle) and *Rosa woodsii* (woods rose). The forb undergrowth can be dense and includes 0-20% cover *Mertensia ciliata* (mountain bluebells), 0-10% cover of *Osmorhiza depauperata* (blunt-fruit sweet-cicely), and 0-5% cover of *Senecio triangularis* (arrowleaf groundsel). Graminoid cover is insignificant.

Successional and Ecological Processes: *Populus tremuloides* (quaking aspen) woodlands can be self-perpetuating climax plant associations or an early-seral stage of coniferous types (DeByle and Winokur 1985). *Populus tremuloides* (quaking aspen) is a non-obligate riparian species and often occurs in upland communities. Where valley bottoms are moist and stable, *Populus tremuloides* can dominate the riparian area, while also occurring on adjacent mesic hillslopes.

Alnus incana ssp. tenuifolia (thinleaf alder) is a long-lived, early-seral species. *Alnus incana* is shade-intolerant (Vierick 1970), and many mature stands in Colorado are restricted to stream bank edges, possibly because these are the only sites where light can penetrate the neighboring overstory canopy (Kittel pers. comm.). *Alnus incana* has been observed on high gradient streams and is thought to require well-aerated water (Hansen et al. 1988, Padgett et al. 1989).

Alnus incana fixes atmospheric nitrogen through a symbiotic relationship with the bacteria *Frankia* (Binkley 1986) and increases the ecosystem nitrogen supply with the deposition of nitrogen-rich leaf litter (Binkley 1986). The annual input of nitrogen to soils from several species of alders ranges from 16 to 150 kg/ha annually (Binkley 1986) compared to 1 to 10 kg/ha/yr deposited by precipitation (Bowman and Steltzer 1997).

If sites remain undisturbed, it is thought that *Alnus incana* stands will become dominated by *Salix* (willow) species or conifer stands (Hansen et al. 1989). In Alaska, however, thick stands of alders inhibit succession by competing with spruce for nutrients and light (Chapin et al. 1994). In Utah, *Acer negundo* (boxelder) may become the dominant canopy species on more xeric sites (Padgett et al. 1989).

Adjacent Riparian Vegetation: *Alnus incana* (thinleaf alder) and *Salix* spp. (willow) shrublands often occur on adjacent, rockier and steeper gradient stream reaches.

Adjacent Upslope Vegetation: *Pinus contorta* (lodgepole pine) and *Populus tremuloides* (quaking aspen) forests occur on adjacent hill slopes.

Management: Dense stands of *Alnus incana* (thinleaf alder) hinder livestock access into this plant association. *Alnus incana* is not particularly palatable to livestock, but can be trampled as animals search for more palatable species. Open stands may provide moderate forage and shade in the summer (Hansen et al. 1995). With heavy livestock grazing, the shrub layer can become dominated by *Symphoricarpos* spp. (snowberry) (DeByle and Winokur 1985). This is likely to occur in valley bottoms where overgrazing has dried the soil and dropped the water table.

According to Hansen et al. (1995), all fires in *Alnus incana* dominated stands, except for light ground fires, kill the shrub. The result is a sparse herbaceous understory and bank destabilization. *Alnus incana* sprouts quickly when cut at 4-5 year intervals and can be used for restabilizing stream banks. Cutting in spring and winter results in rapid sprouts. Cutting in the summer results in fewer, slow-growing sprouts (Hansen et al. 1995).

Quaking aspen/tall forb (*Populus tremuloides*/tall forb) plant association

Colorado Natural Heritage Program Rank: G5/S5

General Description and Comments: *Populus tremuloides* (quaking aspen) is a non-obligate or facultative riparian species. *Populus tremuloides* plant associations are often found on upslopes, but can also dominate riparian areas. The undergrowth of the *Populus tremuloides*/tall forb plant association is characterized by a thick carpet of 1-3 foot (<1 m) tall forbs with no one species dominant.

Related Types/Synonyms: An identical *Populus tremuloides*/tall forb plant association occurs in Nevada, Idaho, Montana, Wyoming, Colorado, and Utah (Reid and Bourgeron 1994). An identical *Populus tremuloides*/*Ligusticum* spp. (quaking aspen/ligusticum) plant association occurs in Wyoming, Colorado, and Utah (Johnston 1987). *Heracleum lanatum* is a synonym for *Heracleum sphondylium* (Kartesz 1994). A similar *Populus tremuloides*/*Heracleum sphondylium* (quaking aspen/cow parsnip) plant association occurs in Wyoming, Colorado, and Utah (Johnston 1987). It differs slightly by having significant shrub cover. A similar *Populus tremuloides*/*Heracleum sphondylium* plant association occurs in the Routt National Forest of Colorado, but the mesic forb species are slightly different (Hoffman and Alexander 1980).

Regional Distribution: This plant association occurs in Nevada, Idaho, Montana, Wyoming, Utah, and Colorado (Reid and Bourgeron 1994, Johnston 1987).

Distribution in Colorado: An excellent example of this plant association was found in the Meadow Creek site in Summit County during the 1997 survey. This association also occurs in the White River Basin and the Routt National Forest (Johnston 1987, Kittel et al. 1994, Kettler and McMullen 1996).

Elevation Range: 7000-10,000 ft (2100-3000 m).

Site Geomorphology: This plant association occurs on broad, gently sloping hillsides and valley bottoms or along high-gradient, very narrow streams.

Soil: The soils are derived from alluvial deposition of a variety of parent materials (Mueggler 1988). The soils are deep, well-drained loams, sandy loams to clay loams (Boyce 1977, Hess and Wasser 1982). With increasing depth, coarse rock fragments increase in proportion. There is a thin litter layer on the surface (Hess and Wasser 1982) and little organic matter in the A horizon (Boyce 1977). Soils in the Colorado River Basin classify as fine-loamy pachic and cumelic Cryoborolls and fine-loamy or fine clayey mollic Cryofluvents.

Wetland Description: This is a slope wetland that receives supports an intermittent hydroperiod with rare flooding.

Vegetation: *Populus tremuloides* is the dominant tree species in this plant association with 10-20% cover. Shrub cover is minor. The undergrowth is characterized by the presence of one or

more species of tall forbs, accompanied by a mixture of low forbs and graminoids. Forb cover includes 0-50% *Hydrophyllum fendleri* (waterleaf), 0-40% *Heracleum lanatum* (cow parsnip), 0-30% *Osmorhiza occidentalis* (western sweet-cicely), and 0-10% each of *Delphinium barbeyi* (western larkspur) and *Senecio triangularis* (arrowleaf groundsel). Other tall forbs include *Aconitum columbianum* (monkshood), *Delphinium barbeyi* (larkspur), *Mertensia ciliata* (mountain bluebells), and *Rudbeckia laciniata* (cutleaf coneflower). Other low forbs include *Achillea lanulosa* (yarrow), *Galium boreale* (northern bedstraw), *Galium triflorum* (sweet-scented bedstraw), *Geranium richardsonii* (Richardson geranium), *Maianthemum stellatum* (false Solomon's seal), *Thalictrum fendleri* (Fendler meadowrue), and *Viola* spp. (violet). Graminoid cover includes 5-20% cover of *Poa pratensis* (Kentucky bluegrass) and 0-15% cover of *Equisetum arvense* (field horsetail). Other graminoid cover includes *Calamagrostis canadensis* (bluejoint reedgrass), *Carex* spp. (sedge), and *Elymus glaucus* (blue wildrye) (CNHP 1996).

Successional and Ecological Processes: *Populus tremuloides* (quaking aspen) woodlands can be self-perpetuating climax plant associations or an early-seral stage of coniferous types (DeByle and Winokur 1985). *Populus tremuloides* is a non-obligate riparian species and often occurs in upland communities. Where valley bottoms are moist and stable, *Populus tremuloides* can dominate the riparian area, while also found on adjacent mesic hillslopes.

Adjacent Riparian Vegetation: Other *Populus tremuloides* (quaking aspen) riparian types and forb communities occur in adjacent riparian areas.

Adjacent Upslope Vegetation: *Populus tremuloides* woodlands and *Artemisia tridentata* (big sagebrush) or *Symphoricarpos* spp. (snowberry) shrublands occur on adjacent upslopes.

Management: The primary source of disturbance for this plant association is livestock grazing, which can have severe impacts. Species diversity will decrease and palatable forbs may be eliminated. There may also be a shift in species composition to dominance by unpalatable forbs such as *Lathyrus* and *Rudbeckia* species. Extreme overgrazing may result in a community dominated by annuals (Mueggler 1988). Livestock may also significantly impact the growth of aspen shoots, impeding regeneration (Johnston and Hendzel 1985). This plant association provides high quality summer range for large mammals as well as cover for other wildlife species. Forage production can be high with proper management (Hoffman and Alexander 1980).

This association is moderately to highly productive for timber harvesting. Clearcutting in patches or small blocks is the most effective method for harvesting. Erosion is generally not a problem on the high quality sites where soils are well developed. However, there is potential for mass movement of soils if the overstory is clearcut in large blocks (Hoffman and Alexander 1980). Large clearcuts will also result in a higher water table and reduced regeneration of aspen. If the goal of cutting is to stimulate aspen suckering, diseased trees should be removed first to avoid infection of young shoots (Powell 1988).

Fire as a management tool may be useful in regenerating old stands of *Populus tremuloides* (quaking aspen). The tall forb layer may help to carry fires, particularly during the dry fall

season. Light fires will stimulate *Populus tremuloides* suckering, but may also kill the canopy trees. It may be necessary to protect these sites from beaver and grazing animals in order to ensure successful regeneration following a fire (Hansen et al. 1995).

Palustrine Scrub-Shrub Communities--Broad-leaved Deciduous

Bog birch/mesic forb-mesic graminoid (*Betula glandulosa*/mesic forb-mesic graminoid) plant association

Colorado Natural Heritage Program Ranks: GU/S3S4

General Description and Comments: The *Betula glandulosa*/mesic forb-mesic graminoid (bog birch) plant association occurs with various *Salix* (willow) species and an understory of graminoid and/or forb species. This association typically occurs in small pockets within a mosaic of *Salix* dominated shrublands and *Carex* (sedge) meadows. It also occurs on peat that is saturated throughout the growing season.

Related Types/Synonyms: A similar *Betula glandulosa*/*Carex scopulorum* (bog birch/rock sedge) plant association occurs in the Gunnison National Forest and a similar *Betula glandulosa*/*Carex rostrata* (bog birch/beaked sedge) habitat type occurs in Montana. Both of these similar types have different understory species (Johnston 1987, Hansen et al. 1995). A similar *Betula glandulosa*/*Carex lasiocarpa* (bog birch/slender sedge) plant association occurs in Idaho, but no plot data is available to verify its species composition (Bourgeron and Engelking 1994).

Regional Distribution: This plant association and similar types occur in Montana (Hansen et al. 1995), Idaho (Bourgeron and Engelking 1994), and Colorado (CNHP 1996).

Distribution in Colorado: There were two good occurrences documented for this plant association during the 1997 survey: Blue River-North of Silverthorne and the Muggins Gulch site. This plant association also occurs in the Routt National Forest, on the east slope of the Gore Range in central Colorado, and in the Gunnison River Basin (Kettler and McMullen 1996, Kittel et al. 1995, Sanderson and Kettler 1996).

Elevation Range: 8500-10,000 ft (2600-3000 m).

Site Geomorphology: Most stands of the *Betula glandulosa*/mesic forb-mesic graminoid (bog birch/mesic forb-mesic graminoid) plant association occur in subalpine meadows and willow communities. This association occurs in areas where soils are saturated from snowmelt for a significant part of the growing season. One stand occurs in a relatively narrow valley on a moderately wide bench or floodplain dissected by many small channels in the Gunnison River Basin. The stand is small in size, approximately 100 by 150 feet (30 by 45 m). One stand in the Gore Range occurs in a fen on the upper forested edge of a very slightly inclined area above a beaver pond. The vegetation receives water from several small seeps and springs in the stand. In the forest above the stands, there are several small, ephemeral channels. The water table appears to be at or near the surface for most of the growing season.

Soils: Soils are deep, organic peat.

Wetland Description: Slope wetland with a permanent hydroperiod and rare to never flooding episodes.

Vegetation: *Betula glandulosa* (bog birch) dominates the canopy with 20-80% cover. However, one stand along a very narrow reach below a wide, wet subalpine valley is dominated by 50% cover of *Picea engelmannii* (Engelmann spruce) and *Pinus contorta* (lodgepole pine). Other shrubs include 0-20% cover each of *Salix planifolia* (planeleaf willow), *Salix monticola* (Mountain willow), *Salix wolfii* (wolf willow), and *Pentaphylloides floribunda* (shrubby cinquefoil) and 0-10% cover each of *Salix brachycarpa* (barrenground willow) and *Lonicera involucrata* (honeysuckle).

The herbaceous undergrowth grows on small hummocks and is usually dominated by a dense mixture of mesic forbs and mesic graminoids. Mesic graminoids include 0-30% cover of *Calamagrostis canadensis* (bluejoint reedgrass), 0-10% cover each of *Carex aquatilis* (aquatic sedge), *Carex utriculata* (beaked sedge), and *Deschampsia cespitosa* (tufted hairgrass), and 0-5% cover of *Carex norvegica* (Scandinavian sedge). Forb species include 0-10% cover each of *Epilobium angustifolium* (fireweed), *Caltha leptosepala* (marsh marigold), *Ligusticum filicinum* (fernleaf ligusticum), *Angelica pinnata* (small-leaved angelica), *Mertensia ciliata* (mountain bluebells), and *Thalictrum alpinum* (arctic meadowrue) and 0-5% cover of *Conioselinum scopulorum* (hemlock parsley).

Successional and Ecological Processes: This plant association may be a mid-seral community on a long successional trajectory. As hummocks develop on peatlands they may become more heavily dominated by *Salix* (willow) species. Due to cold temperatures and a short growing season, this process may take several decades to occur.

Adjacent Riparian Vegetation: *Salix planifolia*/*Carex aquatilis* (planeleaf willow/aquatic sedge), *Salix wolfii*/mesic forb (wolf willow/mesic forb), *Salix geyeriana*/*Calamagrostis canadensis* (Geyer willow/bluejoint reedgrass), and *Pentaphylloides floribunda*/*Deschampsia cespitosa* (shrubby cinquefoil/tufted hairgrass) shrublands occur in adjacent riparian areas. *Carex* (sedge) species, *Deschampsia cespitosa* (tufted hairgrass), and *Eleocharis quinqueflora* (spikerush) meadows are also present.

Adjacent Upland Vegetation: This information is not available.

Management: Forage production for this plant association can be moderate to high because of the herbaceous understory. Livestock will heavily graze *Carex* (sedge) species meadows in narrow riparian and wetland areas if they are located within extensive rangelands. Overgrazing causes reduced vigor of shrubs and eventually, the shrub cover may be completely eliminated. Overgrazing can also cause soil compaction and stream bank sloughing due to the wet nature of the soils. *Betula glandulosa* (bog birch) is a valuable browse species for elk (Hansen et al. 1995).

The dense network of roots of *Betula glandulosa* and the rhizomatous nature of *Carex* species provide effective stream bank stabilization. *Betula glandulosa* may also overhang the stream bank and provide cover and shade for fish (Hansen et al. 1995).

Burning of this association can temporarily increase the productivity of *Carex* species, but livestock grazing must be eliminated for one year prior to burning. Care should be taken when burning the stands because they provide valuable stream bank stability (Hansen et al. 1995).

Barrenground willow/mesic forb (*Salix brachycarpa*/mesic forb) plant association

Colorado Natural Heritage Program Rank: GUQ/S4

General Description and Comments: Typically, the *Salix brachycarpa*/mesic forb (barrenground willow/mesic forb) plant association occurs on well-drained slopes in subalpine valleys. This association is often documented as being part of a *Salix planifolia*-*Salix brachycarpa* (planeleaf willow-barrenground willow) mixed type. However, *Salix brachycarpa* occurs on slightly drier sites and is often adjacent to wetter, pure stands of *Salix planifolia*. The two species intermix at the ecotone between the wetter and drier sites.

Related Types/Synonyms: An identical *Salix planifolia*-*Salix brachycarpa*/*Caltha leptosepala* (planeleaf willow-barrenground willow/marsh marigold) plant association occurs in the Routt National Forest in Colorado (Kettler and McMullen 1996). A similar *Salix planifolia*-*Salix wolfii*/*Caltha leptosepala*-*Carex aquatilis* (planeleaf willow-Wolf willow/marsh marigold-aquatic sedge) association occurs in Colorado, but does not have significant cover of *Salix brachycarpa* (Baker 1989). *Salix phylicifolia* ssp. *planifolia* is a synonym for *Salix planifolia* (Kartesz 1994). A similar *Salix phylicifolia* ssp. *planifolia*/*Caltha leptosepala* (planeleaf willow/marsh marigold) plant association occurs in Colorado (Johnston 1987). A similar *Salix wolfii*/*Deschampsia cespitosa* (Wolf willow/tufted hairgrass) plant association occurs in Colorado and Wyoming, but has significant cover of both *Deschampsia cespitosa* and *Salix wolfii* (Johnston 1987).

Regional Distribution: Similar types occur in western Wyoming and Utah (Johnston 1987, Padgett et al. 1989).

Distribution in Colorado: This common subalpine community is ubiquitous in Summit County. Three excellent occurrences of this plant association were documented for private lands in Summit County. This plant association also occurs in subalpine areas of the San Juan Mountains, the San Miguel/Dolores, Gunnison, Colorado and White River Basins, the Routt National Forest, and along the Colorado Front Range (Baker 1989, Hess and Wasser 1982, Komarkova 1986, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kettler and McMullen 1996, Richard et al. 1996).

Elevation Range: 8600-11,200 ft (2600-3400 m).

Site Geomorphology: The *Salix brachycarpa*/mesic forb (barrenground willow/mesic forb) plant association occurs along the drier fringes of broad, glaciated basins and along broad, straight streams in the subalpine zone. This association occupies elevated hummocks and drier side slopes, often surrounding wetter low areas vegetated with *Salix planifolia* (planeleaf willow) associations. Stream channels are wide and shallow (Rosgen's Channel Type: B1-B3) or narrow, deep and sinuous (Rosgen's Channel Type: E4).

Soil: Soil textures range from silty clay loams to fine sandy loams with some mottling. There is often an upper or buried fibric or hemic layer. Soils in the Colorado River Basin classify as typic Cryaquolls and Cryorthents.

Wetland Description: Riverine or slope wetland with a permanent to seasonal hydroperiod and rare flooding.

Vegetation: *Salix brachycarpa* (barrenground willow) occurs in almost pure stands with 20-90% cover on hummocks and well-drained slopes adjacent to the valley floor. *Salix planifolia* (planeleaf willow) occurs as pure stands in low, poorly drained areas and intermixes with *Salix brachycarpa* at the ecotone between the micro-sites. *Salix planifolia* is therefore, occasionally present in this association with 0-30% cover. *Salix monticola* (Mountain willow) is present along straight stream stretches with 0-50% cover and *Salix wolfii* (Wolf willow) occurs with 0-30% cover.

The herbaceous undergrowth is dense. Forb cover includes 0-30% cover of *Caltha leptosepala* (marsh marigold), 0-20% cover of *Senecio triangularis* (arrowleaf groundsel), and 0-10% cover each of *Thalictrum* spp. (meadowrue), *Pseudocymopterus montanus* (mountain parsley), *Fragaria virginiana* (mountain strawberry), *Oxypolis fendleri* (cowbane), *Ligusticum* spp. (ligusticum) and *Mertensia ciliata* (mountain bluebells). Graminoids include 0-25% cover of *Deschampsia cespitosa* (tufted hairgrass), 0-20% cover of *Carex aquatilis* (aquatic sedge), and 0-10% cover of *Calamagrostis canadensis* (bluejoint reedgrass). Lichen and moss covered boulders are also present (CNHP 1996).

Successional and Ecological Processes: This plant association appears to be stable, but little is known about its successional trends. This association occurs on slightly drier sites than *Salix planifolia* (planeleaf willow) associations. It is sometimes heavily grazed by sheep, which may alter the species composition.

Adjacent riparian vegetation: *Salix planifolia* (planeleaf willow) and *Salix wolfii* (Wolf willow) shrublands occur on adjacent wet swales and hummocks. *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge) meadows occur on adjacent flat, saturated areas. *Abies lasiocarpa*-*Picea engelmannii*/*Calamagrostis canadensis* (subalpine fir/bluejoint reedgrass) forests also occur in adjacent riparian areas.

Adjacent upland vegetation: Adjacent hillslopes are covered with *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce) forests, *Salix brachycarpa* (barrenground willow) shrublands, and dry subalpine meadows with *Danthonia* spp. (oatgrass) or *Festuca thurberi* (thurber fescue).

Management: Management information for this plant association is not well-known.

Drummond willow-beaked sedge (*Salix drummondiana*/*Carex utriculata*) plant association

Colorado Natural Heritage Program Rank: GU/S3

General Description and Comments: The *Salix drummondiana*/*Carex aquatilis* (Drummond willow/water sedge) plant association is a narrow band of tall, 5-8 ft. (1.5-2.5 m), willows lining a steep to moderately steep stream channel at montane elevations of the Rocky Mountains. The dominance of *Carex aquatilis* in the undergrowth is an indication of a wet, stable site. This association represents one of the wettest types within the *Salix drummondiana* Alliance.

Classification Problems: Without catkins, *Salix drummondiana* (Drummond willow) is difficult to distinguish from its look-alike willow, *Salix geyeriana* (Geyer willow). Both species are tall, greater than 5 feet (2 m), montane willows with strongly pruinose (a waxy covering that rubs off, similar to the coating on a plum) twigs. However, *Salix drummondiana* can be distinguished from *Salix geyeriana* vegetatively by the width of the mature leaves. The leaves of *Salix geyeriana* are never more than 0.5 inches (13 mm) wide on non-sucker shoots (Welsh et al. 1987).

In addition, *Salix geyeriana* generally forms large, wide shrublands, on braided, saturated floodplains of lower-gradient channels. *Salix drummondiana* grows along steeper stream reaches. Generally, *Salix drummondiana* becomes the dominant willow and forms dense bands on steep, boulder-filled streams in narrow canyons and gulches. *Salix drummondiana* rarely dominates broad shrublands on gentle floodplains, although it has been observed to do so in the San Juan Mountains (Richard et al. 1996). Occasionally, *Salix drummondiana* intermixes with other willows and forms broad willow carrs or shrublands.

Related Types/Synonyms: A similar *Salix boothii*/*Carex aquatilis* (Booth willow/water sedge) community type that includes stands dominated by *Salix drummondiana* is described from Utah and southeastern Idaho (Padgett et al. 1989). A similar *Salix drummondiana*/*Carex rostrata* (Drummond willow/beaked sedge) habitat type that sometimes has abundant *Carex aquatilis* in the undergrowth is described from Montana (Hansen et al. 1995). A similar *Salix drummondiana*/*Carex utriculata* plant association is documented from Colorado, but further information is needed in order to properly classify it (CNHP 1997).

Regional Distribution: Similar plant associations have been reported from Utah, southeastern Idaho (Padgett et al. 1989), and Montana (Hansen et al. 1995).

Distribution in Colorado: Two occurrences of this community were documented at the Meadow Creek and Soda Creek sites. This plant association has only been documented from the South Platte River Basin along the Colorado Front Range (Kittel et al. 1997).

Elevation Range: 10,460 ft (3190 m).

Site Geomorphology: *Salix drummondiana* (Drummond willow) typically becomes the dominant willow on floodplains of high-gradient streams in narrow, V-shaped valleys (Rosgen's Channel Type: G4).

Soils: Soils textures are deep sandy clays with high organic content in the top layers. Mottling is infrequent (10%) at 6-20 inches (15-50 cm) depth and the soil profile becomes skeletal at 13 inches (33 cm) depth.

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Vegetation: *Salix drummondiana* (Drummond willow) forms a thick band of tall, 5-8 ft. (1.5-2.5 m), shrubs overhanging the stream channel with 40% cover. Other shrubs include 15% cover of *Salix monticola* (mountain willow) and 10% cover of *Pentaphylloides floribunda* (shrubby cinquefoil). The undergrowth is a thick carpet of grasses, grass-like plants and forbs including 20% cover of *Carex aquatilis* (water sedge), <3% cover each of *Carex utriculata* (beaked sedge) and *Carex microptera* (smallwing sedge) and 10% cover of *Conioselinum scopulorum* (Rocky Mountain hemlock parsley) (CNHP 1997).

Successional and Ecological Processes: The *Salix drummondiana*/*Carex aquatilis* (Drummond willow/water sedge) plant association is early- to mid-seral. *Salix drummondiana* is a prolific seed producer and one of the first to colonize coarse-textured cobble bars and recently scoured alluvial surfaces. *Salix drummondiana* is flexible and can tolerate most flood events. With time and flooding events, fine textured particles are deposited on the alluvial surface, raising the ground level to above the annual flood stage. These fine textured particles and litter deposition will eventually develop into soils and if the site remains close to the water table, but is not heavily disturbed by flooding (no scouring), grasses and grass-like plants will become established. The presence of *Carex aquatilis* and other sedge species is a good indication of a wet-mesic and stable site. With time, these sites may become dominated by conifer trees.

Adjacent Riparian Vegetation: Adjacent riparian vegetation includes *Carex utriculata* (beaked sedge) meadows and *Picea pungens* (Colorado blue spruce) woodlands.

Adjacent Upland Vegetation: *Pinus contorta* (lodgepole pine) and *Populus tremuloides* (quaking aspen) forests occur on adjacent hillslopes.

Management: *Salix drummondiana* (Drummond willow) is highly palatable to livestock and wildlife (Kovalchik 1987). *Carex* (sedge) species are also heavily utilized by livestock in narrow riparian areas in mid- to high-elevation rangelands. Overgrazing by livestock can dry sites, increase non-native grass cover, and result in decreased vigor of willow root structure and eventually eliminate them from the site. The wet and often saturated soils of this plant association are also vulnerable to compaction by livestock and heavy equipment. In order to maintain productivity and vigor of the plants and prevent damage to the soils, livestock grazing should be deferred until soils dry (Hansen et al. 1995).

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for

plant establishment. Late summer and fall grazing is not recommended because willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams abate channel downcutting, bank erosion, and downstream movement of sediment. Beaver dams raise the water across the floodplain and provide year-round saturated soils. Plant establishment and sediment build-up behind beaver dams raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity rather than removing them (Hansen et al. 1995).

Burning of this plant association temporarily increases the productivity of *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge). However, livestock grazing needs to be eliminated for the year prior to burning and for at least 2-3 years after to prevent livestock from consuming young, palatable regrowth. Prescribed burning is also an effective method of rejuvenating decadent stands of willows. The willow species in this plant association vigorously sprout following quick, hot fires. Slow burning fires can actually damage the plants. (Hansen et al. 1995).

Salix drummondiana (Drummond willow), *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge) are all effective stream bank stabilizers. *Carex aquatilis* and *Carex utriculata* hold stream banks with their dense network of rhizomatous roots. *Salix drummondiana* can be grown from nursery cuttings and then transplanted. Cuttings should be taken in the spring from dormant, 2-4 year-old wood. Cuttings should be 12-20 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen et al. 1995).

Drummond willow/mesic forb (*Salix drummondiana*/mesic forb) plant association

Colorado Natural Heritage Program Rank: GU/S4

General Description and Comments: *Salix drummondiana* (Drummond willow) grows along steeper stream reaches than other willows. Generally, *Salix drummondiana* becomes the dominant willow and forms dense bands on steep, narrow banks of boulder-filled streams in narrow canyons and gulches. Occasionally, *Salix drummondiana* intermixes with other willows and forms broad willow carrs or shrublands.

Classification Problems: Without catkins, *Salix drummondiana* can be difficult to distinguish from its look-alike willow, *Salix geyeriana* (Geyer's willow). Both are tall, at least 5 feet (2 meters), montane willows with strongly pruinose twigs (a waxy covering that rubs off, similar to the coating on a plum). *Salix geyeriana* is distinguished from *Salix drummondiana* vegetatively by the width of mature leaves. The leaves of *Salix geyeriana* are never more than 0.5 inches (13 mm) wide on non-sucker shoots (Welsh et al. 1987).

Related Types/Synonyms: An identical *Salix drummondiana*/*Mertensia ciliata* (Drummond willow/mountain bluebell) association occurs along the Colorado Front Range (Cooper and Cottrell 1990). An identical *Salix drummondiana*-*Salix monticola* (Drummond willow-Mountain willow) type occurs in the upper Laramie River Valley in northern Colorado (Phillips 1977). A similar *Salix boothii*/mesic forb (Booth's willow/mesic forb) community type, often dominated by *Salix drummondiana* (Drummond willow), occurs in Utah (Padgett et al. 1989). A similar *Salix boothii*/*Smilacina stellata* (Booth's willow/false Solomon's seal) community type, also often dominated by *Salix drummondiana*, occurs in eastern Idaho and western Wyoming (Youngblood et al. 1985). A similar *Salix drummondiana* community type occurs in Nevada, but does not have significant forb cover (Manning and Padgett 1995).

Regional Distribution: This plant association and similar types occur in Nevada, eastern Idaho, western Wyoming and Utah (Manning and Padgett 1995, Padgett et al. 1989, Youngblood et al. 1985).

Distribution in Colorado: This plant association is common in Summit County. One excellent occurrence was documented on private lands, Goose Pasture site, during the 1997 survey. This plant association also occurs throughout the West Slope and in montane regions along the Front Range (Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Richard et al. 1996, Rondeau et al. 1997, Cooper and Cottrell 1990, Phillips 1977).

Elevation Range: 7500-11,300 ft (2400-3500 m).

Site Geomorphology: This plant association occurs in a variety of habitats. It occurs in narrow, V-shaped valleys as a dense, narrow band along high gradient (1-41%) streams (Rosgen's Stream Channel Type: A1-A3). This association also occurs as large willow carrs in broad valleys, 150-1000 feet wide (50-300 m), along low gradient (1-3%), moderately sinuous streams (Rosgen's Channel Type: B1-B4). It is also located along broad, highly sinuous streams (Rosgen's Channel

Type: C3-C5) and broad, actively eroding channels (Rosgen's Channel Type: F6). This association also occur near seeps.

Soil: Soils range from deep sandy loams and sandy clay loams with no coarse fragments to shallow silty clay loams and sandy clay loams over coarse, angular cobbles. Soils in the Colorado and White River Basins classify as typic and oxyaquic Cryorthents, pachic and typic Cryofluvents, histic and typic Cryaquents, and pachic and typic Cryoborolls.

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Vegetation: *Salix drummondiana* (Drummond willow) forms an open to closed, narrow canopy of tall shrubs lining the stream bank with 20-100% cover. Other shrubs present at the upper elevations of the community's range include 0-40% cover of *Salix brachycarpa* (barrenground) and 0-20% cover of *Salix planifolia* (planeleaf willow). At lower elevations, other shrub species include 0-30% cover of *Lonicera involucrata* (honeysuckle), 0-20% cover each of *Alnus incana* (thinleaf alder) and *Salix monticola* (Mountain willow), and <1% cover of *Salix bebbiana* (Bebb willow). Tree species, occasionally present in the overstory, include 0-30% cover each of *Picea engelmannii* (Engelmann spruce) and *Abies lasiocarpa* (subalpine fir) and 0-20% cover of *Populus angustifolia* (narrowleaf cottonwood). The herbaceous undergrowth in some stands is sparse due to heavy shade and shallow soils. Other stands have a rich diversity of forbs in the undergrowth. Dominant forbs include 0-40% cover each of *Mertensia ciliata* (mountain bluebell) and *Heracleum lanatum* (cow parsnip), 0-30% cover of *Cardamine cordifolia* (heartleaf bittercress), 0-20% cover each of *Oxypolis fendleri* (cowbane) and *Hydrophyllum fendleri* (waterleaf), and 0-15% cover of *Saxifrage odontoloma* (brook saxifrage). Graminoid species include 0-30% cover each of *Carex utriculata* (beaked sedge) and *Equisetum arvense* (field horsetail) and 0-20% cover of *Calamagrostis canadensis* (bluejoint reedgrass).

Successional and Ecological Processes: The *Salix drummondiana*/mesic forb (Drummond willow/mesic forb) plant association is often an early colonizer of first-order, boulder-strewn, steep streams. This association could be an early-seral stage of the *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce) forest type which also occurs along steep streams and alternates with the willow carrs. In wider valleys, the *Salix drummondiana*/mesic forb association occurs as a broad willow carr on well-developed soils near seeps or downstream from beaver dams. It appears to be a stable community in these environments.

Adjacent Riparian Vegetation: At higher elevations, *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce) forests or mesic forb seeps dominate adjacent stream banks along narrow reaches and *Salix planifolia* (planeleaf willow) shrublands occur in wider, sub-alpine valleys. At lower elevations, adjacent riparian communities include *Alnus incana*-*Salix drummondiana* (thinleaf alder-Drummond willow), *Cornus sericea*-*Salix drummondiana* (red-osier dogwood-Drummond willow), and *Salix monticola* (Mountain willow) shrublands, and *Populus angustifolia*-*Picea pungens* (narrowleaf cottonwood-Colorado blue spruce), *Picea pungens*/*Alnus incana* (Colorado blue spruce/thinleaf alder) and *Populus angustifolia*/*Alnus incana* (narrowleaf cottonwood/thinleaf alder) riparian woodlands.

Adjacent Upland Vegetation: At higher elevations, north-facing slopes are covered with *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce) forests. South-facing slopes are more open and have *Pinus ponderosa* (ponderosa pine), *Pinus contorta* (lodgepole pine) or *Pinus edulis* (pinyon pine) woodlands and *Populus tremuloides* (quaking aspen) forests. Dry, upland grasslands with *Danthonia* spp. (oatgrass) and *Festuca thurberi* (Thurber fescue) occur on steep hillsides. At lower elevations, *Psuedotsuga menziesii*-*Abies concolor*-*Picea pungens*/*Quercus gambelii* (Douglas-fir-white fir-Colorado blue spruce/Gambel's oak) forests occur.

Management: Season-long grazing can reduce native forb cover and increase the abundance of non-native grasses including *Poa pratensis* (Kentucky bluegrass) and *Agrostis stolonifera* (redtop). Continued heavy grazing and browsing may weaken the root systems of *Salix drummondiana* (Drummond willow) (Padgett et al. 1989).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams aid in controlling channel downcutting, stream bank erosion, and downstream movement of sediment. Beaver dams raise the water table and provide water for hydrophytic plants including willows and sedges. The trapping of sediment behind beaver dams, along with plant reproduction, raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity in an area versus their removal (Hansen et al. 1995).

Prescribed burning in this association is an effective method of rejuvenating decadent stands of the associated willow species. The willows will vigorously sprout following fire, especially in wetter stands. Quick, hot fires produce more sprouts than slower fires (Hansen et al. 1995).

Salix drummondiana is useful for revegetating stream banks. The best results come from transplanting cuttings grown in a nursery. Cuttings, which should be 12-20 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter, should be taken in the spring from dormant 2-4 year-old wood. Roots and shoots will appear 10-15 days following planting (Hansen et al. 1995).

Geyer willow-mountain willow/bluejoint reedgrass (*Salix geyeriana*-*Salix monticola*/*Calamagrostis canadensis*) plant association

Colorado Natural Heritage Program Rank: G3/S3

General Description and Comments: The *Salix geyeriana*-*Salix monticola*/*Calamagrostis canadensis* (Geyer willow-mountain willow/bluejoint reedgrass) plant association is a tall, 4-8 feet (1.5-2.5 m), deciduous shrubland that has patches of willows interspersed with wet meadows, open channels, and beaver ponds. The willow canopy is nearly a homogeneous mix of the two willow species.

Classification Problems: Without catkins, *Salix geyeriana* (Geyer willow) is difficult to distinguish from its look-alike willow, *Salix drummondiana* (Drummond willow). Both species are tall, greater than 5 feet (2 m), montane willows with strongly pruinose (a waxy covering that rubs off, similar to the coating on a plum) twigs. However, *Salix geyeriana* can be distinguished from *Salix drummondiana* vegetatively by the width of the mature leaves. The leaves of *Salix geyeriana* are never more than 0.5 inches (13 mm) wide on non-sucker shoots (Welsh et al. 1987).

In addition, *Salix geyeriana* generally forms large, wide shrublands, on braided, saturated floodplains of lower-gradient channels. *Salix drummondiana* grows along steeper stream reaches. Generally, *Salix drummondiana* becomes the dominant willow and forms dense bands on steep, boulder-filled streams in narrow canyons and gulches. *Salix drummondiana* rarely dominates broad shrublands on gentle floodplains, although it has been observed to do so in the San Juan Mountains (Richard et al. 1996). Occasionally, *Salix drummondiana* intermixes with other willows and forms

Related Types/Synonyms: A similar *Salix monticola*/*Calamagrostis canadensis* (mountain willow/bluejoint reedgrass) plant association with several stands dominated by *Salix geyeriana* (Geyer willow) is described from the Colorado Front Range (Cooper and Cottrell 1990). A similar *Salix geyeriana*/*Calamagrostis canadensis* type without *Salix monticola* is documented from Montana (Hansen et al. 1995), Utah (Padgett et al. 1989), Idaho, Wyoming (Youngblood et al. 1985) and Colorado (Cooper and Cottrell 1990). Two similar types are documented from Colorado, but require further research in order to properly classify. These types are: *Salix geyeriana*-*Salix monticola*/mesic graminoid (Geyer willow-mountain willow/mesic graminoid) and *Salix geyeriana*-*Salix monticola*/*Carex aquatilis* (Geyer willow-mountain willow/water sedge) (CNHP 1997).

Regional Distribution: This plant association is only documented from Colorado (Cooper and Cottrell 1990, CNHP 1997).

Distribution in Colorado: This plant association was documented twice in Summit County; the Horse Creek and Blue River-North of Silverthorne sites. This association occurs on the western slope and on the Colorado Front Range (Cooper and Cottrell 1990, Kittel et al. 1997).

Elevation Range: 8200-9200 ft (2500-2800 m).

Site Geomorphology: This plant association occurs on wide, flat, or hummocky floodplains within 2 ft. (0.5 m) of the channel high water mark. Stream channels are narrow and highly sinuous (Rosgen's Channel Type: E4) or braided by beaver activity (Rosgen's Channel Type: D4).

Soils: Soils textures range from sandy loam to silty clay. Profiles are relatively deep, 25+ inches (65+ cm), with up to 50% organic matter in the upper layers. Water table depths range from 8-25 inches (20-60 cm).

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Vegetation: The shrub canopy is dominated by 20-25% cover of *Salix geyeriana* (Geyer willow) and 15-30% cover of *Salix monticola* (mountain willow). Other shrubs present include 5-15% cover of *Salix planifolia* (plane-leaf willow), 0-10% cover each of *Salix drummondiana* (Drummond willow) and *Lonicera involucrata* (bush honeysuckle), and <1% cover of *Ribes inerme* (gooseberry). The undergrowth is patchy, but dominated by 30-50% cover of *Calamagrostis canadensis* (bluejoint reedgrass), and 0-15% cover each of *Carex aquatilis* (water sedge) and *Geum macrophyllum* (largeleaf avens) (CNHP 1996).

Successional and Ecological Processes: Stands dominated by *Salix geyeriana* (Geyer willow) appear to be stable. *Salix geyeriana* appears to grow only where the water table does not drop below 3 ft. (1 m) of the surface. It appears to be limited to cold, wet environments of broad valley bottoms at high elevations. Due to the colder environments, organic matter builds up in the soils and it is likely that succession to other associations is slow (Padgett et al. 1989). Beaver activity is also important in maintaining this association since it may be the last successional community to establish on naturally silted-in beaver ponds (Cooper and Cottrel 1990).

Carex utriculata (beaked sedge), *Carex aquatilis* (water sedge), and *Calamagrostis canadensis* (bluejoint reed grass) separate out along a moisture gradient related to the depth of the water table at a particular site. *Carex utriculata* (beaked sedge) occurs on the wettest sites, such as low-lying swales, with the highest water tables. *Carex aquatilis* (water sedge) occurs on intermediate sites. *Calamagrostis canadensis* (bluejoint reedgrass) dominates the driest sites with the lowest water tables and can colonizes drying stands of *Carex utriculata* (beaked sedge) and *Carex aquatilis* (water sedge) (Cooper 1986).

Successional shifts in species composition can be initiated by a change in the physical environment with the riparian area. Flooding events can result in sediments deposited on the floodplain, raising the surface higher above the water table (Cooper 1986). As aggradation, or build up, of the floodplain proceeds, the site becomes drier, and the dominant graminoid understory can change. Beaver ponds also go through a similar succession. With time, ponds become silted in, and *Carex utriculata* (beaked sedge) invades the new, saturated substrate. As the site becomes firm, and slightly raised above the old pond level, *Carex aquatilis* (water sedge)

and willows move in. With further aggradation and time, *Calamagrostis canadensis* (bluejoint reedgrass) moves in.

Distance from the stream channel can also differentiate the graminoid dominance spatially within the riparian mosaic. *Carex utriculata* (beaked sedge) commonly occurs at the stream channel edge where the water table is close to the ground surface, often in standing water. As the floodplain surface becomes higher with increased distance from the channel edge, the ground becomes slightly less saturated and shifts to mesic meadows of *Carex aquatilis* (water sedge), or on higher surfaces, to slightly drier meadows of *Calamagrostis canadensis* (bluejoint reedgrass) (Kittel 1994).

Adjacent Riparian Vegetation: This plant association usually occupies the entire stream reach, but meadows of *Carex aquatilis* (water sedge) or *Poa pratensis* (Kentucky bluegrass) may also occur nearby.

Adjacent Upland Vegetation: Adjacent hill slopes have *Populus tremuloides* (quaking aspen), *Pinus contorta* (lodgepole pine), and *Pinus ponderosa* (ponderosa pine) forests.

Management: The management responses of this plant association are likely to be similar to other tall-willow shrublands dominated by *Salix geyeriana* (Geyer willow) or *Salix monticola* (mountain willow). The wet and often saturated soils of this plant association are vulnerable to compaction by livestock and heavy equipment. Overgrazing by livestock can dry the site, increase non-native grass cover, and reduce the vigor of willow root structure. In order to maintain productivity and vigor of the plants and prevent damage to the soils, livestock grazing should be deferred until soils dry (Hansen et al. 1995).

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for plant establishment. Late summer and fall grazing is not recommended because willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams abate channel downcutting, bank erosion, and downstream movement of sediment. Beaver dams raise the water across the floodplain and provide year-round saturated soils. Plant establishment and sediment build-up behind beaver dams raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity rather than removing them. (Hansen et al. 1995).

Prescribed burning is an effective method of rejuvenating decadent stands of willows. The willow species in this plant association vigorously sprout following quick, hot fires. Slow burning fires can actually damage the plants. *Calamagrostis canadensis* is an aggressive invader of moist, burned sites due to its propagation from seeds and rhizomes. Burning also temporarily increases the productivity of *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge). Grazing should be eliminated from burned sites for 2-3 years following a fire in order to prevent livestock from browsing the young, palatable regrowth (Hansen et al. 1995).

Both *Salix geyeriana* (Geyer willow) and *Calamagrostis canadensis* (bluejoint reedgrass) are valuable for revegetating and stabilizing stream banks. *Calamagrostis canadensis* is valuable due to its propagation from rhizomes. *Salix geyeriana* can be grown from nursery cuttings and then transplanted. Cuttings should be taken in the spring from dormant, 2-4 year-old wood. Cuttings should be 12-20 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen et al. 1995).

Geyer willow/aquatic sedge (*Salix geyeriana*/*Carex aquatilis*) plant association

Colorado Natural Heritage Program Rank: G3/S3

General Description and Comments: *Salix geyeriana* (Geyer willow) forms a tall-willow shrubland with smaller shrubs often occurring under the canopy. The canopy is closed to nearly closed and a thick carpet of mesic grasses and forbs blanket the undergrowth. The ground surface is often hummocky with willows establishing on the raised mounds and grasses dominating the swales.

Classification Problems: Without catkins, *Salix geyeriana* (Geyer willow) is difficult to distinguish from its look-alike willow, *Salix drummondiana* (Drummond willow). Both species are tall, greater than 5 feet (2 m), montane willows with pruinose (a waxy covering that rubs off, similar to the coating on a plum) current year twigs. However, *Salix geyeriana* can be distinguished from *Salix drummondiana* vegetatively by the width of the mature leaves. The leaves of *Salix geyeriana* are never more than 0.5 inches (13 mm) wide on non-sucker shoots (Welsh et al. 1987).

In addition, *Salix geyeriana* generally forms large, wide shrublands, on braided, saturated floodplains of lower-gradient channels. *Salix drummondiana* grows along steeper stream reaches. Generally, *Salix drummondiana* becomes the dominant willow and forms dense bands on steep, boulder-filled streams in narrow canyons and gulches. *Salix drummondiana* rarely dominates broad shrublands on gentle floodplains, although it has been observed to do so in the San Juan Mountains (Richard et al. 1996). Occasionally, *Salix drummondiana* intermixes with other willows and forms broad willow carrs or shrublands.

Related Types/Synonyms: An identical *Salix geyeriana*/*Carex aquatilis* (Geyer willow/aquatic sedge) community type occurs in Utah (Padgett et al. 1989). A similar *Salix geyeriana*/*Carex utriculata* (Geyer willow/beaked sedge) type occurs in Montana and Idaho, but has higher cover of *Carex utriculata* than *Carex aquatilis* (Hansen et al. 1995, Youngblood et al. 1985). A similar *Salix geyeriana*-*Salix* spp./*Calamagrostis canadensis* (Geyer willow-willow/bluejoint reedgrass) plant association occurs in Idaho, Wyoming, and Colorado, but has a significant and consistent cover of *Calamagrostis canadensis* (Johnston 1987).

Regional Distribution: This plant association and similar types occur in Montana (Hansen et al. 1995), Idaho (Youngblood et al. 1985), Utah (Padgett et al. 1989), Wyoming and Colorado (Johnston 1987, Colorado Natural Heritage Program 1997).

Distribution in Colorado: This association was documented once in Summit County within the Meadow Creek site. It also occurs in the Routt National Forest (Kettler and McMullen 1996) and in the Gunnison and Arkansas River Basins (Kittel et al. 1995, Kittel et al. 1996).

Elevation Range: 6800-10,500 ft (2100-3200 m).

Site Geomorphology: This plant association occurs on narrow, flat benches along steep stream reaches (Rosgen's Channel Type: G3). It also occurs on floodplains of narrow, subalpine, low gradient (1-5%), braided or highly sinuous streams (Rosgen's Channel Type: D3, E3). Stream channels can also be broad and sinuous (Rosgen's Channel Type: C3). Floodplains have an undulating topography with hummocks, ridges and swales that create a microenvironment for a heterogeneous understory. Floodplains are broad and usually flooded in early spring/summer, while soils remain saturated throughout the growing season. In Utah, this community also occurs on seeps (Padgett *et al.* 1989).

Soil: Soils are shallow to deep with mottling often occurring near the surface. Soil textures are fine sandy clay loams, clay loams and silty loams often alternating with layers of coarse sand. In Utah, soils of this type are described as developing on alluvium or in place with an organic layer at the surface. The water table is within 15 inches (35 cm) of the surface.

Wetland Description: Riparian wetland with a seasonal hydroperiod and rare to occasional flooding.

Vegetation: This plant association is characterized by a tall-willow canopy dominated by 10-80% cover of *Salix geeyeriana* (Geyer willow). Other shrubs include 0-30% cover each of *Salix brachycarpa* (barrenground willow) and *Salix boothii* (Booth's willow), 0-25% cover of *Betula glandulosa* (glandular birch), 0-20% cover of *Salix monticola* (mountain willow), and 0-10% cover of *Salix planifolia* (planeleaf willow). Graminoid cover is greater than forb cover and is dominated by 20-40% cover of *Carex aquatilis* (aquatic sedge). Other graminoids include 0-20% cover each of *Carex utriculata* (beaked sedge), *Deschampsia cespitosa* (tufted hairgrass), and *Calamagrostis canadensis* (bluejoint reedgrass). Forb cover is low in swales and abundant on ridges and higher areas where shrubs are rooted. Forb species include 0-15% cover of *Senecio triangularis* (arrowleaf groundsel) and 0-10% cover each of *Achillea millefolium* (yarrow), *Conioselinum scopulorum* (hemlock parsley), and *Geum macrophyllum* (large-leaved avens) (CNHP 1997).

Successional and Ecological Processes: The successional status of *Salix geeyeriana* is unknown. It appears to be a long-lived, late-seral wetland species and tends to gain dominance in areas where a high water table saturates soils for much of the growing season. More is understood about the dominant undergrowth species. *Carex utriculata* (beaked sedge), *Carex aquatilis* (aquatic sedge), and *Calamagrostis canadensis* (bluejoint reedgrass) are common dominant understory species of several *Salix* plant associations. These graminoids indicate different microenvironments within the *Salix* communities (Padgett *et al.* 1989) and may represent different stages of succession of the floodplain (Cooper 1986).

Carex utriculata, *Carex aquatilis*, and *Calamagrostis canadensis* separate out along a moisture gradient related to the depth of the water table at a particular site. *Carex utriculata* occurs on the wettest sites, such as low-lying swales, with the highest water tables. *Carex aquatilis* occurs on intermediate sites. *Calamagrostis canadensis* dominates the driest sites with the lowest water tables and colonizes drying stands of *Carex utriculata* and *C. aquatilis* (Cooper 1986).

Successional shifts in species composition can be initiated by a change in the physical environment of the riparian area. Flooding events can result in sediments deposited on the floodplain, raising the surface higher above the water table (Cooper 1986). As aggradation, or build up, of the floodplain proceeds, the site can become drier and the dominant graminoid understory changes.

Distance from the stream channel can also differentiate the graminoid dominance spatially within the riparian mosaic. *Carex utriculata* commonly occurs at the stream channel edge where the water table is close to or at the ground surface. As the floodplain surface becomes higher with increased distance from the channel edge, the ground becomes slightly less saturated and shifts to mesic meadows of *Carex aquatilis*, or on higher surfaces, to slightly drier meadows of *Calamagrostis canadensis* (Kittel 1994).

Adjacent Riparian Vegetation: Along narrow stream reaches, adjacent riparian communities include *Abies lasiocarpa*-*Picea engelmannii*/*Alnus incana* (subalpine fir-Engelmann spruce/thinleaf alder), *Abies lasiocarpa*-*Picea engelmannii*/*Salix drummondiana* (subalpine fir/Drummond willow) and *Picea pungens*/*Alnus incana* (Colorado blue spruce/thinleaf alder) forests or *Alnus incana* (thinleaf alder) and *Salix drummondiana* (Drummond willow) shrublands. Broader floodplains have open meadows of *Carex* (sedge) species or hay grasses.

Adjacent Upland Vegetation: Adjacent hillslopes have *Artemisia tridentata* (big sagebrush) shrublands, *Populus tremuloides* (quaking aspen) woodlands, and *Picea engelmannii* (Engelmann spruce) or *Pseudotsuga menziesii* (Douglas-fir) forests.

Management: *Salix geyeriana* (Geyer willow) appears to be less tolerant of browsing pressure than other tall montane willow species (Hansen et al. 1995). *Salix geyeriana* (Geyer willow) will form the classic “mushroom” shape with over browsing by deer and cattle. *Carex* (sedge) species are often heavily utilized by livestock in narrow riparian areas in mid- to high-elevation rangelands. Overgrazing by livestock can dry sites, increase non-native grass cover, and result in decreased vigor of willow root structure and eventually eliminate them from the site. The wet and often saturated soils of this plant association are also vulnerable to compaction by livestock and heavy equipment. In order to maintain productivity and vigor of the plants and prevent damage to the soils, livestock grazing should be deferred until soils dry (Hansen et al. 1995).

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for plant establishment. Late summer and fall grazing is not recommended because willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams abate channel downcutting, bank erosion, and downstream movement of sediment. Beaver dams raise the water across the floodplain and provide year-round saturated soils. Plant establishment and sediment build-up behind beaver dams raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity rather than removing them (Hansen et al. 1995).

According to Hansen et al. (1995), burning this plant association temporarily increases the productivity of *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge). However, livestock grazing needs to be eliminated for the year prior to burning and for at least 2-3 years after to prevent livestock from consuming young, palatable regrowth. Prescribed burning is also an effective method of rejuvenating decadent stands of willows. The willow species in this plant association vigorously sprout following quick, hot fires. Slow burning fires can actually damage the plants.

Salix geyeriana (Geyer willow), *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge) are all effective stream bank stabilizers. *Carex aquatilis* and *Carex utriculata* hold stream banks with their dense network of rhizomatous roots. *Salix geyeriana* can be grown from nursery cuttings and then transplanted. Cuttings should be taken in the spring from dormant, 2-4 year-old wood. Cuttings should be 12-20 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen et al. 1995).

Geyer's willow/beaked sedge (*Salix geyeriana*/*Carex utriculata*) plant association

Colorado Natural Heritage Program Rank: G5/S3

General Description and Comments: The *Salix geyeriana*/*Carex utriculata* (Geyer willow/beaked sedge) plant association is a tall (5-15 ft, 1.5-2.5 m), deciduous shrubland with a nearly closed canopy of willows and thick carpet of sedges in the undergrowth. It is often wet, with saturated soils throughout much of the growing season.

Classification Problems: Without catkins, *Salix geyeriana* (Geyer willow) is difficult to distinguish from its look-alike willow, *Salix drummondiana* (Drummond willow). Both species are tall, greater than 5 feet (2 m), montane willows with pruinose (a waxy covering that rubs off, similar to the coating on a plum) current year twigs. However, *Salix geyeriana* can be distinguished from *Salix drummondiana* vegetatively by the width of the mature leaves. The leaves of *Salix geyeriana* are never more than 0.5 inches (13 mm) wide on non-sucker shoots (Welsh et al. 1987).

In addition, *Salix geyeriana* generally forms large, wide shrublands, on braided, saturated floodplains of lower-gradient channels. *Salix drummondiana* grows along steeper stream reaches. Generally, *Salix drummondiana* becomes the dominant willow and forms dense bands on steep, boulder-filled streams in narrow canyons and gulches. *Salix drummondiana* rarely dominates broad shrublands on gentle floodplains, although it has been observed to do so in the San Juan Mountains (Richard et al. 1996). Occasionally, *Salix drummondiana* intermixes with other willows and forms broad mixed-willow carrs or shrublands.

Related Types/Synonyms: An identical *Salix geyeriana*/*Carex rostrata* (Geyer willow/beaked sedge) type is described from Montana (Hansen et al. 1995), Idaho (Youngblood et al. 1985), Utah (Padgett et al. 1989), and Wyoming (Girard et al. 1995, Jones 1992). Johnston (1987) reports a *Salix geyeriana*-*Salix* spp./*Carex utriculata* (Geyer willow-willow spp./beaked sedge) plant association from Colorado and Idaho as described by Phillips (1977) and Haynes and Aird (1981, as cited in Johnston 1987) and indicates it is identical to the Youngblood et al. (1985) type listed above. *Carex rostrata* var. *utriculata* is a synonym for *Carex utriculata* (Kartesz 1994).

Regional Distribution: This plant association occurs in Montana (Hansen et al. 1995), Utah (Padgett et al. 1989), Idaho and Wyoming (Youngblood et al. 1985, Girard et al. 1995, Jones 1992) and Colorado (Johnston 1987, CNHP 1997).

Distribution in Colorado: This plant association was documented for the Triple Creek site during the 1997 survey. It also occurs in north-central Colorado, in the Yampa and South Platte River Basins, and on the Arapaho-Roosevelt and Routt National Forests (Johnston 1987, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1997).

Elevation Range: 6800-9000 ft (2100-2800 m).

Site Geomorphology: This tall-willow plant association occurs in moderately wide to wide valley bottoms in swales and overflow channels of active floodplains adjacent to wide stream channels. This association often occurs near beaver activity. Stream channels are slightly meandering (Rosgen's Channel Type: B4) or braided from beaver activity (Rosgen's Channel Type: D6).

Soil: Soils textures are silty clay loam, clay, and sandy clay, usually forming thick, cohesive layers interspersed with layers of gravel or sand. Mottling or gleying is often present. In Utah, this association occurs on organic and mineral soils. Mottling often occurs in the mineral soil horizons (Padgett et al. 1989)

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Vegetation: *Salix geyeriana* (Geyer willow) dominates the shrub overstory with 20-60% cover. Other willow species include 0-20% cover of *Salix monticola* (Mountain willow) and 0-10% cover each of *Salix drummondiana* (Drummond willow), *Salix wolfii* (Wolf willow) and *Salix planifolia* (planeleaf willow). Other shrubs with less than 10% cover include *Alnus incana* spp. *tenuifolia* (thinleaf alder) and *Lonicera involucrata* (honeysuckle). The graminoid layer is dominated by 20-60% cover of *Carex utriculata* (beaked sedge). Other graminoids include 0-30% cover of *Carex aquatilis* (aquatic sedge), 0-10% cover of *Calamagrostis canadensis* (bluejoint reedgrass) and 0-5% cover each of *Carex nebrascensis* (Nebraska sedge) and *Carex praegracilis* (clustered sedge). Forb cover is generally minor (CNHP 1997).

Successional and Ecological Processes: This plant association requires a high water table and saturated soils for much of the growing season. The successional status of *Salix geyeriana* is unknown. It appears to be a long-lived, late-seral wetland species and tends to gain dominance in areas where a high water table saturates soils for much of the growing season. More is understood about the dominant undergrowth species. *Carex utriculata* (beaked sedge), *Carex aquatilis* (aquatic sedge), and *Calamagrostis canadensis* (bluejoint reedgrass) are common dominant understory species of several *Salix* plant associations. These graminoids indicate different microenvironments within the *Salix* communities (Padgett et al. 1989) and may represent different stages of succession of the floodplain (Cooper 1986).

Carex utriculata, *Carex aquatilis*, and *Calamagrostis canadensis* separate out along a moisture gradient related to the depth of the water table at a particular site. *Carex utriculata* occurs on the wettest sites, such as low-lying swales, with the highest water tables. *Carex aquatilis* occurs on intermediate sites. *Calamagrostis canadensis* dominates the driest sites with the lowest water tables and colonizes drying stands of *Carex utriculata* and *C. aquatilis* (Cooper 1986).

Successional shifts in species composition can be initiated by a change in the physical environment of the riparian area. Flooding events can result in sediments deposited on the floodplain, raising the surface higher above the water table (Cooper 1986). As aggradation, or build up, of the floodplain proceeds, the site can become drier and the dominant graminoid understory changes.

Abandoned beaver ponds also go through a similar succession. With time, ponds become silted-in and *Carex utriculata* establishes on the new, saturated substrate. As the site becomes firm and slightly raised above the old pond level, *Carex aquatilis* and willows may become established. With further aggradation and time *Calamagrostis canadensis* may become established in the undergrowth.

Distance from the stream channel can also differentiate the graminoid dominance spatially within the riparian mosaic. *Carex utriculata* commonly occurs at the stream channel edge where the water table is close to or at the ground surface. As the floodplain surface becomes higher with increased distance from the channel edge, the ground becomes slightly less saturated and shifts to mesic meadows of *Carex aquatilis*, or on higher surfaces, to slightly drier meadows of *Calamagrostis canadensis* (Kittel 1994).

Adjacent Riparian Vegetation: Adjacent riparian areas have *Populus tremuloides* (quaking aspen) and *Picea pungens* (Colorado blue spruce) forests, *Salix geyeriana*-*Salix monticola* (Geyer willow-Mountain willow) and *Alnus incana* (thinleaf alder) shrublands and *Carex utriculata* (beaked sedge) and *Ranunculus aquatilis*/*Callitriche palustris* (water crowfoot/water-starwort) meadows.

Adjacent Upland Vegetation: *Pinus contorta* (lodgepole pine) forests and *Artemisia tridentata* (big sagebrush) scrub.

Management: *Salix geyeriana* (Geyer willow) appears to be less tolerant of browsing pressure than other tall montane willow species (Hansen et al. 1995). *Salix geyeriana* (Geyer willow) will form the classic “mushroom” shape with over browsing by deer and cattle. *Carex* (sedge) species are often heavily grazed by livestock in narrow riparian areas in mid-elevation rangelands. Overgrazing by livestock can dry the site, increase non-native grass cover, and reduce the vigor of willow root structure. The wet and often saturated soils of this plant association are also vulnerable to compaction by livestock and heavy equipment. In order to maintain productivity and vigor of the plants and prevent damage to the soils, livestock grazing should be deferred until soils dry (Hansen et al. 1995).

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for plant establishment. Late summer and fall grazing is not recommended because willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams abate channel downcutting, bank erosion, and movement of sediment by slowing stream flow and reducing stream gradients. Beaver dams raise the water table across the floodplain and provided year-round saturated soils. Plant establishment and sediment build-up behind beaver dams raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity rather than removing them (Hansen et al. 1995).

According to Hansen et al. (1995), burning this plant association temporarily increases the productivity of *Carex utriculata* (beaked sedge) and *Carex aquatilis* (aquatic sedge) . However, livestock grazing needs to be eliminated for the year prior to burning and for at least 2-3 years after to prevent livestock from consuming young, palatable regrowth. Prescribed burning is also an effective method of rejuvenating decadent stands of willows. The willow species in this plant association vigorously sprout following quick, hot fires. Slow burning fires can actually damage the plants.

Salix geyeriana (Geyer willow), *Carex utriculata* (beaked sedge) and *Carex aquatilis* (aquatic sedge) are all effective stream bank stabilizers. *Carex utriculata* and *Carex aquatilis* are useful due to their dense network of rhizomatous roots. *Salix geyeriana* can be grown from nursery cuttings and then transplanted. Cuttings should be taken in the spring from dormant, 2-4 year-old wood. Cuttings should be 12-20 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen et al. 1995).

Geyer's willow-mountain willow/mesic forb (*Salix geyeriana*-*Salix monticola*/mesic forb) plant association

Colorado Natural Heritage Program Rank: GU/S3

General Description and Comments: The *Salix geyeriana*-*Salix monticola*/mesic forb plant association is a tall, mixed-willow shrubland with an undergrowth species composition that is grazing-induced. The undergrowth is a carpet of grasses and forbs on a hummocky ground surface. Season-long grazing has increased the non-native grass cover and reduced the native forbs.

Classification Problems: Without catkins, *Salix geyeriana* (Geyer willow) is difficult to distinguish from its look-alike willow, *Salix drummondiana* (Drummond willow). Both species are tall, greater than 5 feet (2 m), montane willows with pruinose (a waxy covering that rubs off, similar to the coating on a plum) current-year twigs. However, *Salix geyeriana* can be distinguished from *Salix drummondiana* vegetatively by the width of the mature leaves. The leaves of *Salix geyeriana* are never more than 0.5 inches (13 mm) wide on non-sucker shoots (Welsh et al. 1987).

In addition, *Salix geyeriana* generally forms large, wide shrublands, on braided, saturated floodplains of lower-gradient channels. *Salix drummondiana* grows along steeper stream reaches. Generally, *Salix drummondiana* becomes the dominant willow and forms dense bands on steep, boulder-filled streams in narrow canyons and gulches. *Salix drummondiana* rarely dominates broad shrublands on gentle floodplains, although it has been observed to do so in the San Juan Mountains (Richard et al. 1996). Occasionally, *Salix drummondiana* intermixes with other broad willow carrs or shrublands.

Related Types/Synonyms: An identical *Salix monticola*-*Salix geyeriana*/mesic forb plant association occurs in the San Miguel and Arkansas River Basins in Colorado (Kittel and Lederer 1993, Kittel et al. 1996). A similar *Salix geyeriana*-*Salix monticola*/*Calamagrostis canadensis*-*Carex aquatilis*-*Carex rostrata* (Geyer willow-mountain willow/bluejoint reedgrass-aquatic sedge-beaked sedge) plant association occurs in Colorado, but is dominated by native graminoids in the undergrowth (Baker 1989). A similar *Salix geyeriana*-*Salix* spp./*Calamagrostis canadensis* (Geyer willow-willow/bluejoint reedgrass) plant association occurs in Wyoming and Colorado, but is also dominated by native graminoids in the undergrowth (Johnston 1987). In Utah, stands dominated or co-dominated by *Salix monticola* (mountain willow) are included in *Salix boothii* (Booth willow) community types (Padgett et al. 1989).

Regional Distribution: The *Salix geyeriana*-*Salix monticola*/mesic forb (Geyer willow-mountain willow /mesic forb) plant association and similar types occur in eastern Utah, Idaho (Padgett et al. 1989), Wyoming, and Colorado (Johnston 1987, Baker 1989, Bourgeron and Engelking 1994, CNHP 1997).

Distribution in Colorado: This plant association was documented for the Otter and Slate Creek sites during the 1997 survey. It also occurs in the Routt National Forest (Kettler and McMullen 1996) and the San Miguel and Arkansas River Basins (Kittel and Lederer 1993, Kittel et al. 1996).

Elevation Range: 7700-9400 ft (2300-2900 m).

Site Geomorphology: This plant association occurs on broad alluvial floodplains of U- and V-shaped valleys with steep side slopes. Stream channels are broad and moderately sinuous to highly sinuous (Rosgen's Channel Type: B3, C4) or narrow, entrenched, ephemeral gullies (Rosgen's Channel Type: G4).

Soil: Soils are silt, silty loams, silty clay loams, sandy clay loams and deep sands. Several stands in the San Miguel River Basin occur on deep clay loams of old beaver ponds. Some soil profiles have considerable coarse materials while others are relatively fine textured. Mottling is evident near the surface indicating elevated water tables during part of the year.

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Vegetation: This plant association is characterized by a tall, nearly closed canopy of 10-90% cover of *Salix monticola* (mountain willow) and 0-70% cover of *Salix geyeriana* (Geyer willow). Other shrubs include 0-35% cover of *Ribes inerme* (whitestem gooseberry), 0-20% cover of *Alnus incana* (thinleaf alder) and 0-5% cover each of *Salix drummondiana* (Drummond willow) and *Pentaphylloides floribunda* (shrubby cinquefoil). The undergrowth in undisturbed stands is a thick carpet of forbs including 0-15% cover each of *Mertensia ciliata* (mountain bluebells), *Achillea millefolium* (yarrow) and *Heracleum lanatum* (cow parsnip), 0-10% cover each of *Conioselinum scopulorum* (hemlock parsley) and *Senecio triangularis* (arrowleaf groundsel) and 0-5% cover of *Cardamine cordifolia* (heartleaf bittercress). The graminoid layer is usually sparse, but includes 0-10% cover each of *Carex utriculata* (beaked sedge) and *Carex aquatilis* (aquatic sedge). Disturbed stands have a high cover of non-native grasses including 0-50% cover of *Agrostis stolonifera* (redtop) and 0-20% cover of *Poa pratensis* (Kentucky bluegrass) (CNHP 1996).

Successional and Ecological Processes: *Salix geyeriana* (Geyer's willow) willow carrs seem to require a high water table that is less than 3 feet (1 m) deep (Padgett et al. 1989). These willow carrs are commonly, but not always, associated with beaver ponds, which can maintain a higher water table than would be present otherwise. Where this association occurs on first- and second-order streams, it may be a fairly stable, late-seral community. Along lower order streams subject to flooding and channel adjustments or where associated with beaver ponds, this plant association may be subject to a shorter successional cycle.

The *Salix geyeriana*-*Salix monticola*/mesic forb plant association differs from the *Salix geyeriana*/mesic forb plant association because *Salix monticola* is always present with a significant cover and sometimes in a greater abundance than *Salix geyeriana*. The presence of *Salix monticola* may be due to differences in environmental factors or may represent a different successional stage of the *Salix geyeriana*/mesic forb association. This plant association is a

grazing-induced type due to the abundance of non-native grasses in some stands (Kittel et al. 1996). With removal of season-long grazing, this association may return to a native forb dominated undergrowth or a dominance of *Calamagrostis canadensis* (bluejoint reedgrass), becoming a *Salix geyeriana*-*Salix monticola*/*Calamagrostis canadensis* plant association.

Adjacent Riparian Vegetation: This plant association tends to form large willow carrs that cover the valley floor. A narrow band of *Alnus incana* (thinleaf alder) or *Betula occidentalis* (river birch) may occur at the stream edge. Upstream and downstream plant associations include *Picea pungens*-*Populus angustifolia*/*Alnus incana* (Colorado blue spruce-narrowleaf cottonwood/thinleaf alder-) forests, *Alnus incana* (thinleaf alder) and *Salix planifolia* (planeleaf willow) shrublands, and *Carex aquatilis* (aquatic sedge), *Carex utriculata* (beaked sedge) and *Eleocharis quinqueflora* (spikerush) meadows.

Adjacent Upland Vegetation: *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce), *Pseudotsuga menziesii* (Douglas-fir), *Picea pungens* (Colorado blue spruce) and *Populus tremuloides* (quaking aspen) forests and *Quercus gambelii* (Gambel oak) woodlands occur on adjacent hillslopes.

Management: The management responses of this plant association are likely to be similar to other tall-willow shrublands dominated by *Salix geyeriana* (Geyer willow) or *Salix monticola* (mountain willow). The wet and often saturated soils of this plant association are vulnerable to compaction by livestock and heavy equipment. Overgrazing by livestock can dry the site, increase non-native grass cover, and reduce the vigor of willow root structure. In order to maintain productivity and vigor of the plants and prevent damage to the soils, livestock grazing should be deferred until soils dry (Hansen et al. 1995) and continue for only short duration.

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for plant regrowth. Late summer and fall grazing is not recommended because willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams abate channel downcutting, bank erosion, and downstream movement of sediment. Beaver dams raise the water across the floodplain and provide year-round saturated soils. Plant establishment and sediment build-up behind beaver dams raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity rather than removing them (Hansen et al. 1995).

Prescribed burning is an effective method of rejuvenating decadent stands of willows. The willow species in this plant association vigorously sprout following quick, hot fires. Slow burning fires can actually damage the plants. (Hansen et al. 1995).

Salix geyeriana (Geyer willow) is an effective stream bank stabilizer that can be grown from nursery cuttings and then transplanted. Cuttings should be taken in the spring from dormant, 2-4 year-old wood. Cuttings should be 12-20 inches (30-50 cm) long and at least 0.5 inches (1 cm)

in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen et al. 1995).

Mountain willow/bluejoint reedgrass (*Salix monticola*/*Calamagrostis canadensis*) plant association

Colorado Natural Heritage Program Rank: G3/S3

General Description and Comments: The *Salix monticola*/*Calamagrostis canadensis* (Mountain willow/bluejoint reedgrass) plant association generally occurs along streams in the montane or upper montane zones. It is recognized by medium to tall *Salix monticola* with a moderate to dense overstory and a mesic graminoid and mesic forb undergrowth. *Calamagrostis canadensis* is always present in the undergrowth, but may not have a high cover.

Related Types/Synonyms: Similar *Salix drummondiana*-*Salix monticola*/*Calamagrostis canadensis*-*Carex utriculata* (Drummond willow-Mountain willow/bluejoint reedgrass-beaked sedge) and *Salix geyeriana*-*Salix monticola*/*Calamagrostis canadensis*-*Carex aquatilis*-*Carex utriculata* (Geyer willow-Mountain willow/bluejoint reedgrass-aquatic sedge-beaked sedge) associations occur in Colorado (Baker 1989). In the Gunnison National Forest in Colorado, a similar *Salix drummondiana*/*Calamagrostis canadensis* (Drummond willow/bluejoint reedgrass) association occurs with *Salix monticola* in the canopy, but with a more significant cover of *Salix drummondiana* (Komarkova 1986, Johnston 1987). A similar *Salix monticola*-*Salix geyeriana*/mesic forb plant association occurs in the San Miguel River Basin in Colorado, but does not have a significant cover of *Calamagrostis canadensis* (Kittel and Lederer 1993).

In Wyoming and Colorado, a similar *Salix geyeriana*-*Salix* spp./*Calamagrostis canadensis* (Geyer willow-willow/bluejoint reedgrass) association occurs with *Salix monticola* in the overstory, but with a more significant cover of *Salix geyeriana* (Johnston 1987). A similar *Salix boothii*/*Calamagrostis canadensis* (Booth willow/bluejoint reedgrass) community type with *Salix drummondiana* (Drummond willow) and *Salix geyeriana* (Geyer willow) in the overstory, but not *Salix monticola*, occurs in Utah (Padgett et al. 1989).

Regional Distribution: The *Salix monticola*/*Calamagrostis canadensis* (mountain willow/bluejoint reedgrass) plant association has only been found in Colorado, however, similar associations occur in Utah (Padgett et al. 1989) and Wyoming (Johnston 1987). *Salix monticola* (mountain willow) is more abundant in Colorado and becomes less frequent to the north and west in the Rocky Mountains. Outside of Colorado, *Salix monticola* mixes with other *Salix* species and is included as a less dominant species in other plant associations. In central and eastern Utah, *Salix monticola* dominated stands are infrequent and due to structural and ecological similarities are included in *Salix boothii* (Booth willow) associations (Padgett et al. 1989). *Salix monticola* also has a limited distribution in Idaho and largely associates with other *Salix* (willow) species. (Brunsfeld and Johnson 1985).

Distribution in Colorado: This plant association was documented for the Spruce Creek site in Summit County. It also occurs along the Colorado Front Range (Cooper and Cottrell 1990), in north-central Colorado and the Crested Butte region (Cooper 1993). It also occurs in the Colorado and South Platte River Basins (Kittel et al. 1994, Sanderson and Kettler 1996, Kittel et al. 1997).

Elevation Range: 8300-9400 ft (2500-2900 m)

Site Geomorphology: This plant association occurs on narrow to wide, 100-1,000 feet (30-300 m) wide, low-gradient (2-3.5%) valley bottoms and floodplains. In wider valleys, large stands of this association occur between meanders and at the edges of beaver ponds. Stream channels are steep and narrow (Rosgen's Channel Type: A4), moderately steep and wide (Rosgen's Channel Type: B4), wide and sinuous (Rosgen's Channel Type: C3, C4), or braided from beaver activity (Rosgen's Channel Type: D6).

Soils: Soils are relatively deep, 30 inches (70+ cm), fine textured sandy clays to silty clay loams, often saturated to within 10 inches (30 cm) of the surface. Soils can also be silty loams over sand and coarse sand. Mottling often occurs at 5-15 inches (20-40 cm) depth. Soils in the Colorado River Basin classify as fluventic Cryoborolls and oxyaquic Cryorthents.

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Vegetation: This plant association has a closed, mixed canopy of willows with *Salix monticola* (mountain willow) the dominant with 20-90% cover. Other willows include 0-40% cover of *Salix drummondiana* (Drummond willow), 0-20% cover each of *Salix wolfii* (Wolf willow) and *Salix geyeriana* (Geyer willow), and 0-10% cover of *Salix boothii* (Booth willow). *Calamagrostis canadensis* (bluejoint reedgrass) forms an open to dense graminoid layer with 1-50% cover. Other graminoids include 0-10% cover each of *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge) and 0-5% cover of *Carex microptera* (small-wing sedge), *Deschampsia cespitosa* (tufted hairgrass), and *Glyceria striata* (fowl mannagrass). Total forb cover ranges from 20-50%. Forb cover is diverse, but each species has only approximately 1% cover. Forb species include *Cardamine cordifolia* (heartleaf bittercress), *Geranium richardsonii* (Richardson geranium), *Mertensia ciliata* (mountain bluebells), *Oxypolis fendleri* (cowbane), *Geum macrophyllum* (large-leaved avens), *Solidago canadensis* (goldenrod), *Senecio biglovii* (Bigelow groundsel), and *Galium boreale* (northern bedstraw) (CNHP 1997).

Successional and Ecological Processes: *Salix monticola* (mountain willow) dominated plant associations appear to be long lived and stable. They occur on mesic sites that support a diversity of graminoids and forbs. *Salix monticola* appears to grow only where the water table does not drop below 3 feet (1 m) of the surface. It appears to be limited to cold, wet environments in broad valley bottoms at high elevations. Due to the colder environments, organic matter builds up in the soils, and it is likely that succession to other associations is slow (Padgett et al. 1989). The presence of dying conifer trees in these associations may indicate an increase in the water table. A higher water table allows for the increase in cover of *Calamagrostis canadensis* (bluejoint reedgrass) and the conversion from a conifer/*Calamagrostis canadensis* type to a *Salix* spp./*Calamagrostis canadensis* type (Padgett et al. 1989).

Carex utriculata (beaked sedge), *Carex aquatilis* (aquatic sedge), and *Calamagrostis canadensis* (bluejoint reedgrass) are common dominant understory species of several *Salix* plant associations. These graminoids indicate different microenvironments within the *Salix*

communities (Padgett et al. 1989) and may represent different stages of succession of the floodplain (Cooper 1986).

Carex utriculata, *Carex aquatilis*, and *Calamagrostis canadensis* separate out along a moisture gradient related to the depth of the water table at a particular site. *Carex utriculata* occurs on the wettest sites, such as low-lying swales, with the highest water tables. *Carex aquatilis* occurs on intermediate sites. *Calamagrostis canadensis* dominates the driest sites with the lowest water tables and colonizes drying stands of *Carex utriculata* and *C. aquatilis* (Cooper 1986).

Successional shifts in species composition can be initiated by a change in the physical environment of the riparian area. Flooding events can result in sediments deposited on the floodplain, raising the surface higher above the water table (Cooper 1986). As aggradation, or build up, of the floodplain proceeds, the site becomes drier and the dominant graminoid understory changes.

Distance from the stream channel can also differentiate the graminoid dominance spatially within the riparian mosaic. *Carex utriculata* commonly occurs at the stream channel edge where the water table is close to or at the ground surface. As the floodplain surface becomes higher with increased distance from the channel edge, the ground becomes slightly less saturated and shifts to mesic meadows of *Carex aquatilis*, or on higher surfaces, to slightly drier meadows of *Calamagrostis canadensis* (Kittel 1994).

Adjacent Riparian Vegetation: *Abies lasiocarpa*-*Picea engelmannii*/*Salix drummondiana* (subalpine fir-Engelmann spruce/Drummond willow) forests and mesic forb plant associations occur along steep, narrow reaches. *Salix monticola* (mountain willow) and *Salix drummondiana* (Drummond willow) shrublands occur on broad floodplains. *Carex aquatilis* (aquatic sedge), *Carex utriculata* (beaked sedge) and *Deschampsia cespitosa* (tufted hairgrass) meadows also occur on adjacent floodplains.

Adjacent Upland Vegetation: At higher elevations, *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce) and *Pinus contorta* (lodgepole pine) forests and *Populus tremuloides* (quaking aspen) woodlands occur on adjacent hillslopes. At lower elevations, *Pinus ponderosa* (ponderosa pine) and *Pseudotsuga menziesii* (Douglas-fir) forests occur on adjacent hill slopes

Management: The forage value of *Calamagrostis canadensis* (bluejoint reedgrass) is moderate to high with young foliage the most palatable to livestock. With high grazing pressure, the production of *Calamagrostis canadensis* will decrease (Hansen et al. 1995, Girard et al. 1995).

The soils of this plant association are susceptible to compaction by livestock due to saturated conditions throughout much of the growing season. However, livestock will typically avoid these sites until August or September, due to the wet soils. If season-long grazing does occur, the plants and soils will be damaged. Heavy grazing opens the canopy and lowers the water table due to streambed downcutting.

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for the basic biological requirements for plant establishment. Late summer and fall grazing is not recommended because willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams abate channel downcutting, bank erosion, and downstream movement of sediment. Beaver dams raise the water table across the floodplain and provided year-round saturated soils. Plant establishment and sediment build-up behind beaver dams, along with plant reproduction, raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity rather than removing them (Hansen et al. 1995).

Burning stands of this association may renew production of browse species for wildlife and livestock. *Calamagrostis canadensis* (bluejoint reedgrass) is an aggressive invader of moist, burned sites due to its propagation from seeds and rhizomes. Prescribed burning can also aid in rejuvenating decadent stands of willows. Quick, hot fires result in more sprouts, while slow fires damage the willows and result in fewer sprouts. Care should be taken when burning this association near stream banks due to the excellent erosion protection it provides (Hansen et al. 1995).

Both *Salix monticola* (mountain willow) and *Calamagrostis canadensis* (bluejoint reedgrass) are valuable species for stabilizing or rehabilitating stream banks. *Calamagrostis canadensis* is valuable due to its propagation from rhizomes. *Salix monticola* can probably be grown and transplanted from nursery cuttings in the same manner as *Salix geeyeriana*. Cuttings should be taken in the spring from dormant, 2-4 year old wood. Cuttings should be 12-20 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen et al. 1995).

Mountain willow/mesic graminoid (*Salix monticola*/mesic graminoid) plant association

Colorado Natural Heritage Program Rank: GU/S3

General Description and Comments: The *Salix monticola*/mesic graminoid (mountain willow/mesic graminoid) plant association is a tall, 5-8 ft. (1.5-2.5 m), deciduous shrubland, with an open to closed canopy of willows on broad, gentle floodplains, or in narrow canyon bottoms. The herbaceous undergrowth is diverse, with a variety of graminoid (grass and grass-like) and forb species. Generally, there is more graminoid than forb cover.

Related Types/Synonyms: One stand from a *Salix monticola*-*Salix planifolia*/mesic forb (mountain willow-planeleaf willow/mesic forb) plant association described from the Gunnison National Forest is identical to the *Salix monticola*/mesic graminoid association (Kittel et al. 1995). A similar *Salix boothii*/mesic graminoid (Booth willow/mesic graminoid) type described from Utah and southeastern Idaho includes stands dominated by *Salix drummondiana* (Drummond willow) that occasionally have some *Salix monticola* (Padgett et al. 1989).

Similar types with *Salix monticola* as an associated canopy species and *Calamagrostis canadensis* as the dominant undergrowth species have been described by Johnston (1987) and Cooper and Cottrell (1990). These similar types include a *Salix drummondiana*/*Calamagrostis canadensis* (Drummond willow/bluejoint reedgrass) plant association from the Gunnison National Forest in Colorado, a *Salix geyeriana*-*Salix* spp./*Calamagrostis canadensis* plant association from Idaho, Wyoming and Colorado (Johnston 1987) and a *Salix monticola*/*Calamagrostis canadensis* from the Colorado Front Range (Cooper and Cottrell 1990). A similar *Salix drummondiana*/*Mertensia ciliata* association is also described from the Colorado Front Range by Cooper and Cottrell (1990).

Regional Distribution: The *Salix monticola*/mesic graminoid (mountain willow/mesic graminoid) plant association has not been previously reported outside of Colorado, however, similar associations occur in Utah, Idaho, and Wyoming (Padgett et al. 1989, Johnston 1987). *Salix monticola* is more abundant in Colorado and becomes less frequent to the north and west in the Rocky Mountains. Outside of Colorado, *Salix monticola* mixes with other *Salix* species and is included as a less dominant species in other plant associations. In central and eastern Utah, *Salix monticola* dominated stands are infrequent and due to structural and ecological similarities are included in *Salix boothii* (Booth willow) associations (Padgett et al. 1989). *Salix monticola* also has a limited distribution in Idaho and largely associates with other *Salix* (willow) species. (Brunsfield and Johnson 1985).

Distribution in Colorado: This plant association was documented for the Bushee Creek site in Summit County. It also occurs in the Gunnison and South Platte River Basins (Kittel et al. 1995, Kittel et al. 1997) as well as the San Juan National Forest (Richard et al. 1996).

Elevation Range: 7800-10,200 ft. (2400-3100 m).

Site Geomorphology: The *Salix monticola*/mesic graminoid (mountain willow/mesic graminoid) plant association dominates stream reaches in narrow to wide valleys, 65-400 feet (20-120 m) wide, with active floodplains and broad, swift-moving streams. Stands usually occur > 2 feet (0.5 m) above the bankfull channel along the stream edge or away from the channel up to 50 feet (15 m). The ground surface is usually undulating due to past flooding or beaver activity. Stream channels can be fairly steep and narrow with cobble beds (Rosgen's Channel Type: A4, F4), moderately wide and sinuous with cobble beds (Rosgen's Channel Type: B3) or broad, meandering rivers with a developed floodplain (Rosgen's Channel Type: C4). Some stands also occur along channels that are braided due to beaver activity (Rosgen's Channel Type: D6)

Soil: Soils are fine textured clay loams and sandy clay loams of varying depths, 4-18 inches (10-45 cm). Mottling and gleyed layers often occur within 5 inches (12 cm) of the ground surface.

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Vegetation: *Salix monticola* (mountain willow) forms a dense to open canopy with 15-80% cover. Other shrubs present at higher elevations include 0-40% cover of *Salix planifolia* (planeleaf willow), 0-20% cover of *Salix geyeriana* (Geyer willow) and 0-5% cover of *Salix brachycarpa* (barrenground willow). At lower elevations, other shrubs include 0-45% cover of *Salix irrorata* (bluestem willow), 0-25% cover of *Salix lucida* var. *caudata* (whiplash willow), 0-15% cover of *Alnus incana* (thinleaf alder), and 0-10% cover of *Pentaphylloides floribunda* (shrubby cinquefoil) (CNHP 1996).

Total graminoid cover ranges from 10-55% and includes 0-40% cover of *Poa pratensis* (Kentucky bluegrass) and 0-10% cover each of *Juncus balticus* (Baltic sedge), *Carex utriculata* (beaked sedge) and *Carex aquatilis* (aquatic sedge). Forb cover ranges from 5-20% and includes 0-30% cover of *Heracleum lanatum* (cow parsnip), 0-20% cover of *Fragaria virginiana* (strawberry), and 0-10% cover of *Achillea lanulosa* (yarrow). Graminoids typically dominate the undergrowth in low-lying, wetter swales, while forbs dominate under shrubs on hummocks and ridges (CNHP 1996).

Successional and Ecological Processes: The *Salix monticola*/mesic graminoid (mountain willow/moist grasses and grass-like plants) plant association appears to be a stable, long-lived community. Stands with an abundance of *Poa pratensis* (Kentucky bluegrass) or *Agrostis stolonifera* (redtop) may be a grazing-induced disclimax, or community of non-native grasses that displace native *Salix monticola* (mountain willow) plant associations. Stands with abundant *Salix planifolia* (planeleaf willow) may indicate a transition between higher elevational sites dominated by *Salix planifolia* and lower elevational sites where *Salix monticola* is more abundant.

Adjacent Riparian Vegetation: This plant association is often the only riparian community along a stream reach. However, *Populus angustifolia* (narrowleaf cottonwood) woodlands and *Pentaphylloides floribunda* (shrubby cinquefoil) shrublands can occur on adjacent floodplains of wider valleys and *Picea pungens* (Colorado blue spruce) forests can occur along adjacent, steeper canyon reaches.

Adjacent Upslope Vegetation: At lower elevations, *Pinus ponderosa* (ponderosa pine), *Pinus contorta* (lodgepole pine) and *Populus tremuloides* (aspen) forests or arid grasslands occur on adjacent hill slopes. At higher elevations, *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce) and *Populus tremuloides* (aspen) forests occur on adjacent hill slopes.

Management: Overgrazing by livestock in this plant association can dry sites, increase non-native cover, and reduce the vigor of willow root structure. Rest periods from grazing are recommended in order to provide time for plant establishment. Late summer and fall grazing is not recommended because willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995, Kovalchik and Elmore 1992).

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods from grazing are recommended in order to provide time for plant establishment. Late summer and fall grazing is not recommended because willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995, Kovalchik and Elmore 1992).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams abate channel downcutting, bank erosion, and downstream movement of sediment. Beaver dams raise the water table across the floodplain and provided year-round saturated soils. Plant establishment and sediment build-up behind beaver dams raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity rather than removing them (Hansen et al. 1995).

Burning of this plant association temporarily increases the productivity of *Carex utriculata* (beaked sedge) and *Carex aquatilis* (aquatic sedge). However, livestock grazing needs to be eliminated for the year prior to burning and for at least 2-3 years after in order to prevent livestock from consuming young, palatable regrowth. Prescribed burning is also an effective method of rejuvenating decadent stands of willows. The willow species in this plant association vigorously sprout following quick, hot fires. Slow burning fires can actually damage the plants. (Hansen et al. 1995).

Salix monticola (mountain willow), *Carex utriculata* (beaked sedge), and *Carex aquatilis* (water sedge) are effective stream bank stabilizers. *Carex utriculata* (beaked sedge) and *Carex aquatilis* hold stream banks with their dense network of rhizomatous roots. *Salix monticola* can probably be grown and transplanted from nursery cuttings in the same manner as *Salix geyeriana*. Cuttings should be taken in the spring from dormant, 2-4 year-old wood. Cuttings should be 12-20 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen et al. 1995).

Planeleaf willow/bluejoint reedgrass (*Salix planifolia*/*Calamagrostis canadensis*) plant association

Colorado Natural Heritage Program Rank: G4/S4

General Description and Comments: *Salix planifolia* is an abundant subalpine willow, forming large shrublands (carrs) with a wide variety of undergrowth species. The *Salix planifolia*/*Calamagrostis canadensis* type is less common and is frequently heavily grazed to the point of shifting the dominant undergrowth grasses. In Colorado, this type is frequently encountered and occurs as small stands. It may have been more abundant historically.

Related Types/Synonyms: Identical *Salix planifolia*/*Calamagrostis canadensis* (planeleaf willow/bluejoint reedgrass) ecological/habitat types are reputed in Wyoming, Colorado and Utah (Girard et al. 1995, Cooper and Cottrell 1990, Padgett et al. 1987). Several stands of a *Salix planifolia*/*Calamagrostis canadensis*-*Carex aquatilis* (planeleaf willow/bluejoint reedgrass-aquatic sedge) association described by Baker (1989) are identical to the *Salix planifolia*/*Calamagrostis canadensis* association.

Regional Distribution: This plant association occurs in the Big Horn National Forest in north-central Wyoming and in northeastern Utah (Girard et al. 1995, Padgett et al. 1989).

Distribution in Colorado: This plant association is ubiquitous in Summit County. One excellent example was documented in the Montezuma site during the 1997 survey. It also occurs in southeast Colorado, the San Juan National Forest, the White River Basin, and along the Front Range (Baker 1989, Richard et al. 1996, Kittel et al. 1994, Cooper and Cottrell 1990).

Elevation Range: 9000-11,000 ft (2700-3400 m).

Site Geomorphology: This is a high elevation wetland plant association, usually occurring in broad, glacial valleys and swales where direct snow melt is the primary moisture source throughout the growing season. Stream channels are wide and moderately sinuous, often associated with beaver ponds (Rosgen's Channel Type: B3). This association also occurs in narrow valleys with sinuous streams and wet floodplains (Rosgen's Channel Type: E4).

Soil: *Salix planifolia* shrublands occur on peat or mineral soils, deep clay loams and sandy clay loams, derived from glacial till. The mineral soils can have a high organic content.

Wetland Description: Riverine or slope wetland with a permanent to seasonal hydroperiod and rare flooding.

Vegetation: *Salix planifolia* (planeleaf willow) forms a dense shrub layer with 40-90% cover. A few other willow species are also present including 0-30% cover of *Salix brachycarpa* (barrenground willow) and 0-5% cover each of *Salix monticola* (Mountain willow) and *Salix wolfii* (Wolf willow). *Calamagrostis canadensis* (bluejoint reedgrass) dominates the dense and sometimes rich herbaceous layer with 5-70% cover. Several *Carex* (sedge) species are also

present including 0-10% cover each of *Carex utriculata* (beaked sedge) and *Carex microptera* (small-wing sedge) and 0-5% cover of *Carex aquatilis* (aquatic sedge). The forb layer can be diverse, but generally has less than 10% total cover. Forb species include *Caltha leptosepala* (marsh marigold), *Cardamine cordifolia* (heartleaf bittercress), *Pedicularis groenlandica* (elephant-head), and *Mertensia ciliata* (mountain bluebell) (CNHP 1996).

Successional and Ecological Processes: The *Salix planifolia*/*Calamagrostis canadensis* (planeleaf willow/bluejoint reedgrass) ecological/habitat type generally occurs on well-drained sites (Girard et al. 1995, Padgett et al. 1989). However, in the San Juan Mountains in southwestern Colorado, this association occurs in wet swales that are saturated throughout the growing season (Richard et al. 1996).

According to Johnston (1987), *Calamagrostis canadensis* is often abundant in early seral stages of the *Salix planifolia*/*Carex aquatilis* (planeleaf willow/aquatic sedge) association. According to Padgett et al. (1989), the *Salix planifolia*/*Calamagrostis canadensis* association occurs on sites with better drainage than the *Salix planifolia*/*Carex aquatilis* association and that *Salix planifolia*/*Calamagrostis canadensis* may represent an ecotonal community to the conifer/*Calamagrostis canadensis* community type. In Colorado, *Salix planifolia*/*Calamagrostis canadensis* stands have been observed at the ecotone to the conifer/*Calamagrostis canadensis* plant association (Sanderson and Kettler 1996, Kittel pers. comm.).

Adjacent Riparian Vegetation: Adjacent riparian vegetation include wet meadows of *Carex aquatilis* (aquatic sedge), *Carex utriculata* (beaked sedge), or *Calamagrostis canadensis* (bluejoint reedgrass). The meadows intergrade with *Betula glandulosa* (glandular birch) and *Salix wolfii*/mesic graminoid (Wolf willow/mesic graminoid) shrublands at the bottom of wet swales. *Salix brachycarpa*/mesic forb (barrenground willow/mesic forb) or *Salix wolfii* shrublands and *Deschampsia cespitosa* (tufted hairgrass) meadows occur on drier hummocks and hill slopes.

Adjacent Upland Vegetation: Adjacent hill slopes are covered with *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce) forests or subalpine meadows.

Management: *Salix planifolia* (planeleaf willow) is highly palatable to wildlife and livestock. The forage value of *Calamagrostis canadensis* (bluejoint reedgrass) is moderate to high with young foliage the most palatable to livestock. With high grazing pressure, the height and density of *Salix planifolia* will be decreased and the production of *Calamagrostis canadensis* will decrease (Hansen et al. 1995, Girard et al. 1995).

Low-stature *Salix planifolia* willow carrs appear to be sensitive to trampling and soil compaction by livestock due to saturated conditions throughout the growing season (Girard et al. 1995). However, livestock will typically avoid these sites until August or September, due to the wet soils. If season-long grazing does occur, the plants and soils will be damaged. Heavy grazing opens the canopy and lowers the water table. This allows *Salix brachycarpa* (barrenground willow), *Salix wolfii* (Wolf willow) or *Pentaphylloides floribunda* (shrubby cinquefoil) and drier herbaceous species to become established (Hansen et al. 1995).

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for plant establishment. Late summer and fall grazing should be carefully controlled because willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995).

Beaver activity in the vicinity of this plant association is important for maintaining a high water table and a wetland environment. This allows for the establishment of hydrophytic plants including willows and sedges as well as providing excellent habitat for waterfowl and fish. Land managers should consider maintaining beaver activity in an area versus their removal (Hansen et al. 1995).

Burning *Salix planifolia*/*Calamagrostis canadensis* stands may renew production of browse species for wildlife and livestock. *Calamagrostis canadensis* (bluejoint reedgrass) is an aggressive invader of moist, burned sites due to its propagation from seeds and rhizomes. Burning also temporarily increases the productivity of *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge), if present. However, livestock grazing needs to be eliminated for the year prior to burning and for at least 2-3 years after to prevent livestock from consuming young, palatable regrowth. Little is known about the response of *Salix planifolia* to fire (Hansen et al. 1995).

Both *Salix planifolia* (planeleaf willow) and *Calamagrostis canadensis* (bluejoint reedgrass) are valuable species for stabilizing or rehabilitating stream banks. *Calamagrostis canadensis* is valuable due to its propagation from rhizomes. *Salix planifolia* cuttings should first be rooted and grown in a nursery. Best results are obtained from cuttings taken in the spring from dormant 2-4 year old wood. The cuttings should be 12-20 inches (30-50 cm) long and greater than 0.5 inches (1 cm) in diameter. Once transplanted, roots and shoots should appear within 10-15 days (Hansen et al. 1995).

Planeleaf willow/marsh marigold (*Salix planifolia*/*Caltha leptosepala*) plant association

Colorado Natural Heritage Program Rank: G4/S4

General Description and Comments: The *Salix planifolia*/*Caltha leptosepala* (planeleaf willow/marsh marigold) plant association is a common upper montane and subalpine community occurring on very wet to saturated soils. This association is characterized by low-stature shrubs, less than 2 feet (0.5 m) tall, and a thick carpet of forbs in the undergrowth. There may be scattered patches of other willows present.

Related Types/Synonyms: Identical communities include a *Salix planifolia*-*Salix wolfii*/*Caltha leptosepala* (planeleaf willow-Wolf willow/marsh marigold) type and a *Salix planifolia*-*Salix brachycarpa*/*Caltha leptosepala* (planeleaf willow-barrenground willow/marsh marigold) type described by Reid and Bourgeron (1991). Other identical communities include a *Salix brachycarpa*-*Salix planifolia*/*Caltha leptosepala*-*Carex aquatilis* (barrenground willow-planeleaf willow/marsh marigold-aquatic sedge) type described by Baker (1986), a *Salix planifolia*/*Caltha leptosepala* type described by Cooper and Cottrell (1990) and Hess and Wasser (1982), and a *Salix phylicifolia* spp. *planifolia*/*Caltha leptosepala* association described by Johnston (1987). *Salix phylicifolia* spp. *planifolia* is a synonym for *Salix planifolia* (Kartesz 1994). A similar *Salix planifolia*/forb community type is described by Girard et al. (1995), but does not include *Caltha leptosepala* in the undergrowth.

Regional Distribution: This plant association occurs in northwestern and north-central Wyoming (Johnston 1987).

Distribution in Colorado: This plant association is a common subalpine community in Summit County. An excellent example was found in the Montezuma site during the 1997 survey. It is a major subalpine wetland plant association that occurs throughout the Rocky Mountains of Colorado. It has been documented from the San Juan, Gunnison, Routt, Roosevelt, Arapaho and Pike National Forests (Richard et al. 1996, Johnston 1987, Kettler and McMullen 1996). It has also been documented from the San Miguel/Dolores, Gunnison, Colorado, Arkansas and South Platte River Basins (Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996).

Elevation Range: 9200-12,100 ft (2800-3700 m).

Site Geomorphology: This plant association typically occurs in wide, glaciated valleys adjacent to streams. It occurs in swales, depressions and on slopes where snow melt runoff saturates soils for much of the growing season. The ground may be flat or uneven with raised hummocks. Stream gradients range from <1% in broad floodplains to 14% in steep snowmelt basins. Stream channels vary. Channels may be steep and narrow, first-order streams in snow melt basins (Rosgen's Channel Type: A3), relatively wide and straight (Rosgen's Channel Type: B3 and B4), narrow, relatively deep, and meandering in broad glaciated valleys (Rosgen's Channel Type: E3 and E4) or braided, multiple channels below beaver dams (Rosgen's Channel Type: D6).

Soil: Soil textures are highly variable. Mineral soils vary along a moisture gradient. Wet sites have soil textures of silty clays and silt loams, while slightly drier sites have loamy sands and sandy loams overlying gravely alluvium. Stands occur on well-drained, mineral soils with well-oxygenated water and no mottled or gleyed layers. Some sites have an organic layer. Soils with an organic layer overlying a gravel or cobble layer within 10-20 inches (20-50 cm) of the surface. The water table at these sites is usually near the surface throughout the growing season and may be perched by a clay horizon. Other stands occur on deep, dark clay loams with high organic content or a fibric or hemic layer on top. Soils in the Colorado River Basin classify as oxyaquic Cryumbrepts, typic Cryoborolls, Cryochrepts, typic Cryorthents, and typic Cryaquents.

Wetland Description: Slope or riverine wetland with a permanent hydroperiod and rare flooding.

Vegetation: *Salix planifolia* (planeleaf willow) forms nearly pure stands with 30-100% cover. Other willows present at lower elevations include 0-20% cover of *Salix geyeriana* (Geyer's willow) and 0-10% cover of *Salix monticola* (Mountain willow). At higher elevations, other shrubs include 0-30% cover of *Salix brachycarpa* (barrenground willow) on drier sites, and 0-15% cover of *Betula glandulosa* (glandular birch) and 0-10% cover of *Salix wolfii* (Wolf willow) on wetter sites. *Picea engelmannii* (Engelmann spruce) is occasionally scattered throughout the stand with 0-30% cover.

Typically, the willow canopy is closed and an herbaceous undergrowth occurs only in openings between willow patches. The undergrowth is characterized by an abundance of forbs with few graminoids. Forb species include 0-60% cover of *Cardamine cordifolia* (heartleaf bittercress), 1-40% cover of *Caltha leptosepala* (marsh marigold), 0-30% cover of *Senecio triangularis* (arrowleaf groundsel), 0-20% cover of *Mertensia ciliata* (mountain bluebells), and 0-10% cover each of *Pedicularis groenlandica* (elephant-head), *Polygonum bistortoides* (American bistort), and *Sedum rhodanthum* (pink stonecrop). Graminoids include 0-40% cover of *Calamagrostis canadensis* (bluejoint reedgrass) and 0-30% cover of *Carex aquatilis* (aquatic sedge) (CNHP 1996).

Successional and Ecological Processes: The *Salix planifolia*/*Caltha leptosepala* (planeleaf willow/marsh marigold) plant association occurs in wet swales that are saturated throughout most or all of the growing season. It is considered to be a long-lived, stable association that will change with fluctuations in the water table and degree of soil saturation. Heavy grazing will open the canopy and lower the water table through increased evapotranspiration. This will dry the site and allow *Salix brachycarpa* (barrenground willow) or *Salix wolfii* (Wolf willow) to become established (Kittel et al. 1994). Cooper and Cottrell (1990) state that it is possible, but unlikely, that this type is successional to another (presumably drier) *Salix planifolia* type.

Adjacent Riparian Vegetation: Adjacent saturated areas are *Carex aquatilis* (aquatic sedge), *Carex utriculata* (beaked sedge) *Caltha leptosepala* (marsh marigold) and *Eleocharis palustris* (creeping spikerush) meadows or *Salix planifolia*/*Carex aquatilis* (planeleaf willow/aquatic sedge) and *Salix planifolia*-*Salix brachycarpa*/*Caltha leptosepala* (planeleaf willow-barrenground willow/marsh marigold) shrublands. Adjacent drier areas are *Salix brachycarpa*

(barrenground willow) shrublands or *Deschampsia cespitosa* (tufted hairgrass) grasslands. *Picea engelmannii*/*Salix* spp. (Engelmann spruce/willow) and *Abies lasiocarpa*/*Mertensia ciliata* (subalpine fir/mountain bluebells) types occur in adjacent riparian areas along narrower valley reaches.

Adjacent Upland vegetation: Adjacent hillslopes are covered with *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce) forests, *Salix brachycarpa* (barrenground willow) shrublands, or upland meadows with *Danthonia* spp. (oatgrass). At higher elevations, the surrounding slopes are alpine tundra dominated by *Acomastylis rossii* (Ross avens).

Management: The soils of this plant association are highly susceptible to compaction by livestock due to saturated conditions throughout the growing season. However, livestock will typically avoid these sites until August or September, due to the wet soils. If season-long grazing does occur, the plants and soils will be damaged. Heavy grazing opens the canopy and lowers the water table due to streambed downcutting. This allows *Salix brachycarpa* (barrenground willow) or *Salix wolfii* (Wolf willow) and drier herbaceous species to become established (Hansen et al. 1995).

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for plant establishment. Late summer and fall grazing is not recommended because willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams aid in controlling channel downcutting, stream bank erosion, and downstream movement of sediment. Beaver dams raise the water table and provide water for hydrophytic plants including willows and sedges. The trapping of sediment behind beaver dams, along with plant reproduction, raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity in an area versus their removal (Hansen et al. 1995).

Little is known on the response of *Salix planifolia* to fire. Care should be taken when burning this association near stream banks due to the excellent erosion protection it provides (Hansen et al. 1995).

Salix planifolia is valuable in revegetating disturbed stream banks. Cuttings should first be rooted and grown in a nursery. Best results are obtained from cuttings taken in the spring from dormant 2-4 year old wood. The cuttings should be 12-20 inches (30-50 cm) long and greater than 0.5 inches (1 cm) in diameter. Once transplanted, roots and shoots will appear within 10-15 days (Hansen et al. 1995).

Planeleaf willow/aquatic sedge (*Salix planifolia*/*Carex aquatilis*) plant association

Colorado Natural Heritage Program Rank: G4G5/S4S5

General Description and Comments: This is a common plant association of subalpine glacial valleys. It is a low-stature willow shrubland of nearly pure stands of *Salix planifolia* (planeleaf willow). At higher elevations, *Salix planifolia* occasionally mixes with *Salix brachycarpa* (barrenground willow) or *Salix wolfii* (Wolf willow). At lower elevations, *Salix planifolia* grades into taller willow carrs with *Salix monticola* (Mountain willow).

Related Types/Synonyms: Several authors have reported an identical *Salix planifolia*/*Carex aquatilis* habitat/community (Padgett et al. 1989, Johnston 1987, Komarkova 1986, Hess 1981, Cooper and Cottrell 1990). Girard et al. (1995) reported an identical *Salix planifolia*/*Carex* spp. ecological type in the Bighorn National Forest. Hess and Wasser (1982) reported an identical *Salix planifolia*/*Caltha leptosepala*-(*Carex aquatilis*-*Carex rostrata* phase) habitat type in Colorado. *Carex rostrata* var. *utriculata* is a synonym for *Carex utriculata* (Kartesz 1994).

The similar *Salix planifolia* community type reported by Youngblood et al. (1985) does not always have a significant cover of *Carex aquatilis*. The similar *Salix planifolia*-*Salix wolfii*/*Caltha leptosepala*-*Carex aquatilis* (planeleaf willow-Wolf willow/marsh marigold-aquatic sedge) plant association reported by Baker (1989) is a broader plant association that includes stands of more narrowly defined *Salix wolfii*/*Carex aquatilis* and *Salix planifolia*/*Caltha leptosepala* associations within it. A similar *Salix planifolia*/*Deschampsia cespitosa* (planeleaf willow/tufted hairgrass) type is reported from western Colorado, but may be a drier type representing the outer fringe of *Salix planifolia* areas (CNHP 1997).

A similar *Salix planifolia*/*Carex scopulorum* (planeleaf willow/mountain sedge) type is reported from the Arapaho-Roosevelt National Forest (Hess 1982) and the Indian Peaks area of Colorado (Komarkova 1986), but appears to be an alpine community with different soil pH than the *Salix planifolia*/*Carex aquatilis* association. This may actually be a new type, but further research is needed in order to properly classify it.

Regional Distribution: This plant association and similar types occur in Montana (Hansen et al. 1995), Wyoming (Girard et al. 1995, Youngblood et al. 1985), Idaho (Youngblood et al. 1985), Utah (Padgett et al. 1989), and Colorado (Johnston 1987, Hess 1981, Cooper and Cottrell 1990, Komarkova 1986).

Distribution in Colorado: This plant association is a common type and occurs throughout the Rocky Mountains of Colorado, including Summit County.

Elevation Range: 9000-11,200 ft (2800-3400 m).

Site Geomorphology: This plant association occurs in wide, wet valleys on snow-melt fed swales. It also occurs in narrow valleys with sinuous streams and wet floodplains associated with beaver ponds. Stream channels are wide and moderately sinuous (Rosgen's Channel Type:

B3), narrow and sinuous (Rosgen's Channel Type: E4), or highly divided by beaver activity (Rosgen's Channel Type: D4).

Soil: Soils have an organic peat top layer over mineral silty clays, heavy silty clay loams, silty loams, sandy loams, or loamy sands. Mottling is often evident. Soils in the Colorado River Basin classify as Histosols, Cryaquolls, Hemists, and Borochemists.

Wetland Description: Riverine or slope wetland with a permanent hydroperiod and rare flooding.

Vegetation: This plant association is characterized by 10-70% cover of low-stature (.5-1.5 m) *Salix planifolia* (planeleaf willow). Other willows include 0-40% cover each of *Salix monticola* (Mountain willow) and *Salix wolfii* (Wolf willow), 0-20% cover of *Salix boothii* (Booth willow), and 0-10% cover each of *Salix geyeriana* (Geyer willow) and *Salix drummondiana* (Drummond willow). One stand in the Colorado River Basin had 80% cover of *Salix brachycarpa* (barrenground willow) which was confined to steeper, drier slopes at the outer edges of the *Salix planifolia* dominated wet swale.

The undergrowth is dominated by graminoids including 0-30% cover of *Carex aquatilis* (aquatic sedge), 0-50% cover of *Carex utriculata* (beaked sedge), 0-40% cover of *Calamagrostis canadensis* (bluejoint reedgrass), and 0-20% cover of *Deschampsia cespitosa* (tufted hairgrass). Forb cover is typically less than 20% of the total undergrowth cover and includes 0-10% cover each of *Caltha leptosepala* (marsh marigold), *Cardamine cordifolia* (heartleaf bittercress) and *Pedicularis groenlandica* (elephant-head) and 0-5% cover of *Conioselinum scopulorum* (hemlock parsley) (CNHP 1996).

Successional and Ecological Processes: This plant association occurs in wet swales that are saturated throughout the growing season. The dense canopy layers and thick undergrowth indicate stable conditions. Both *Caltha leptosepala* (marsh marigold) and *Carex aquatilis* (aquatic sedge) can tolerate saturated soils, and occasionally they co-dominate the undergrowth (Padgett et al. 1989). Patches of *Carex utriculata* (beaked sedge) also occur (Johnston 1987). Succession towards other *Salix planifolia* types would be an extremely slow process following a drying trend and subsequent decomposition of organic material (Padgett et al. 1989). If the water table is lowered, other herbaceous species may become dominant in the undergrowth and eventually give way to non-native graminoid species such as *Poa pratensis* (Kentucky bluegrass) (Hansen et al. 1995).

Salix wolfii (Wolf willow) is occasionally present in the *Salix planifolia*/*Carex aquatilis* plant association. *Salix wolfii* only occurs in small patches, never forming large, expansive willow carrs as does *Salix planifolia*. Mixed *Salix wolfii* and *Salix planifolia* stands represent a transition from *Salix wolfii* habitats to the more abundant and widespread *Salix planifolia* habitat. In Montana, it is believed that *Salix planifolia* occurs on wetter, finer textured soils than *Salix wolfii*. As sites become drier, *Salix wolfii* and grasses adapted to drier conditions increase in abundance (Hansen et al. 1988). In Idaho, the presence of *Salix wolfii* indicates a transitional habitat between wetter sites dominated by *Salix planifolia* (planeleaf willow) and drier sites dominated by *Salix geyeriana* (Geyer's willow) (Brunsfeld and Johnson 1985). In Colorado, the

opposite occurs. *Salix wolfii* establishes in wetter habitats and at slightly lower elevations than *Salix planifolia* (Gwen Kittel pers. comm.).

Carex utriculata (beaked sedge), *Carex aquatilis* (aquatic sedge), and *Calamagrostis canadensis* (bluejoint reedgrass) are dominant understory species of several *Salix* plant associations. These graminoids indicate different microenvironments within the *Salix* communities (Padgett et al. 1989) and may represent different stages of succession of the floodplain (Cooper 1986).

Cooper (1986) found that *Carex utriculata*, *Carex aquatilis*, and *Calamagrostis canadensis* separate out along a moisture gradient related to the depth of the water table at a particular site. *Carex utriculata* occurs on the wettest sites, such as low-lying swales, with the highest water tables. *Carex aquatilis* occurs on intermediate sites. *Calamagrostis canadensis* dominates the driest sites with the lowest water tables and often colonizes clumps of *Carex utriculata* and *Carex aquatilis* (Cooper 1986).

Floodplain aggradation, or build up, can result in a change in species composition over time. Late spring snow melt and long periods of summer rain cause upper elevation streams to overflow their banks. Sediments are deposited on the floodplain, raising the surface higher above the water table (Cooper 1986). As aggradation of the floodplain proceeds and the site becomes less saturated, the dominant graminoid understory can change from *Carex utriculata* to *Carex aquatilis* to *Calamagrostis canadensis*.

Distance from the stream channel can differentiate the graminoids spatially. *Carex utriculata* commonly occurs at the stream channel edge where the water table is close to the ground surface. *Carex utriculata* is usually found in standing water. Further away from the channel are mesic meadows of *Carex aquatilis* and slightly drier meadows of *Calamagrostis canadensis* (Kittel, pers. comm.).

Adjacent riparian vegetation: Adjacent riparian areas include *Carex aquatilis* (aquatic sedge), *Carex utriculata* (beaked sedge), or *Calamagrostis canadensis* (bluejoint reedgrass) wet meadows intergrading with the *Salix planifolia*/*Carex aquatilis* plant association. *Salix brachycarpa* (barrenground willow) shrublands occur on higher ground.

Adjacent upslope vegetation: At higher elevations, *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce) or *Pinus contorta* (lodgepole pine) forests occur on adjacent hillsides. At lower elevations, *Artemisia tridentata* (big sagebrush) scrub is present.

Management: In general, graminoid and forb production is moderate in this plant association. Forage value for *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge) is variable depending on the season, previous grazing use, and the size of the rangelands. In narrow riparian areas within extensive rangelands, the undergrowth of this association may be heavily grazed (Hansen et al. 1995). *Salix planifolia* (planeleaf willow) is highly palatable to wildlife and livestock while *Salix wolfii* (Wolf willow) is slightly less palatable.

Low-stature *Salix planifolia* willow carrs appear to be sensitive to trampling and soil compaction by livestock due to saturated conditions throughout the growing season. However, livestock will

typically avoid these sites until August or September, due to the wet soils. If season-long grazing does occur, the plants and soils will be damaged. Heavy grazing opens the canopy and lowers the water table due to streambed downcutting. This allows *Salix brachycarpa* (barrenground willow) or *Salix wolfii* (Wolf willow) and drier herbaceous species to become established (Hansen et al. 1995).

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for plant establishment. Late summer and fall grazing is not recommended because willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams aid in controlling channel downcutting, stream bank erosion, and downstream movement of sediment. Beaver dams raise the water table and provide water for hydrophytic plants including willows and sedges. The trapping of sediment behind beaver dams, along with plant reproduction, raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity in an area versus their removal (Hansen et al. 1995).

Burning of this plant association temporarily increases the productivity of *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge). However, livestock grazing needs to be eliminated for the year prior to burning and for at least 2-3 years after to prevent livestock from consuming young, palatable regrowth. Little is known about the response of *Salix planifolia* to fire. Care should be taken when burning this association near stream banks due to the excellent erosion protection it provides (Hansen et al. 1995).

Salix planifolia and *Carex* (sedge) species are valuable for stabilizing or revegetating stream banks. *Carex aquatilis* and *Carex utriculata* are very effective due to their dense network of rhizomatous roots. *Salix planifolia* is valuable in revegetating disturbed stream banks. Cuttings should first be rooted and grown in a nursery. Best results are obtained from cuttings taken in the spring from dormant 2-4 year old wood. The cuttings should be 12-20 inches (30-50 cm) long and greater than 0.5 inches (1 cm) in diameter. Once transplanted, roots and shoots will appear within 10-15 days (Hansen et al. 1995).

Wolf willow/aquatic sedge (*Salix wolfii*/*Carex aquatilis*) plant association

Colorado Natural Heritage Program Rank: G4/S3

General Description and Comments: This is an uncommon plant association of very wet sites in subalpine areas of western Colorado. In Colorado, *Salix wolfii* only occurs in small patches and never forms large, expansive willow carrs common to *Salix planifolia*. *Salix wolfii* occurs in wetter sites than those dominated by *Salix planifolia* (planeleaf willow) and often forms a mosaic with stands of *Salix planifolia*, *Salix brachycarpa* (barrenground willow) and open *Carex* spp. (sedge) meadows.

Related Types/Synonyms: Identical *Salix wolfii*/*Carex aquatilis* (Wolf willow/aquatic sedge) types occur in Utah, Idaho, Montana and Wyoming (Youngblood et al. 1985, Padgett et al. 1989, Johnston 1987, Girard et al. 1995, Hansen et al. 1995). Several stands of a *Salix planifolia*-*Salix wolfii*/*Calamagrostis canadensis*-*Carex aquatilis* (planeleaf willow-Wolf willow/bluejoint reedgrass-aquatic sedge) association in Colorado are identical to the *Salix wolfii*/*Carex aquatilis* association (Kittel et al. 1995, Baker 1989).

Regional Distribution: The *Salix wolfii*/*Carex aquatilis* (Wolf willow/aquatic sedge) plant association occurs in Utah, southeastern Idaho (Padgett et al. 1989), Montana (Hansen et al. 1995), Wyoming (Youngblood et al. 1985), and Colorado.

Distribution in Colorado: This association was found within the Muggins Gulch site during the 1997 survey. It occurs on the Colorado West Slope in the San Juan and Routt National Forests, the San Miguel/Dolores, Gunnison and Colorado River Basins and on the East Slope in the Arkansas River Basin (Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kettler and McMullen 1996, Richard et al. 1996, Johnston 1987).

Elevation Range: 8400-11,400 ft (2600-3500 m)

Site Geomorphology: *Salix wolfii* (Wolf willow) appears to establish on heavier soils and wetter sites than those supporting *Salix planifolia* (planeleaf willow) associations. The *Salix wolfii*/*Carex aquatilis* (Wolf willow/aquatic sedge) plant association occurs in moderately narrow to wide valleys and glacial basins. It occurs on saturated peat bogs, mesic swales and hummocks along flat to rolling floodplains with lateral seepage of ground water. Stream reaches can be moderately steep (gradient of 3-7%). Stream channels are deep, narrow, and sinuous (Rosgen's Channel Type: E4, E6), shallow, broad, and gently meandering (Rosgen's Channel Type: B2-B3), and highly divided by beaver activity (Rosgen's Channel Type: D4).

Soil: Soils vary from highly organic or peat to mineral-based. Soils textures include heavy silty clay loams, silty loams, and sandy clay loams with mottling. Some stands occur on deep sandy clays, often with a high organic content, and others occur on shallow silty clays over gravels and rocks. Stands in the Colorado River Basin occur on silty clay over deep peat and classify as hydric Borofibrists.

Wetland Description: Riverine wetland with a seasonal to permanent hydroperiod and rare flooding.

Vegetation: The mid- to tall-shrub layer is dominated by 10-70% cover of *Salix wolfii* (Wolf willow). Other willow species include 0-30% cover of *Salix planifolia* (planeleaf willow), 0-10% cover each of *Salix boothii* (Booth's willow) and *Salix monticola* (Mountain willow), and on better-drained micro-sites, 0-5% cover of *Salix brachycarpa* (barrenground willow). *Betula glandulosa* (glandular birch) also occurs with 0-20% cover. The graminoid undergrowth is generally dense and rich, dominated by 10-80% cover of *Carex aquatilis* (aquatic sedge). Other graminoids include 0-30% cover of *Carex utriculata* (beaked sedge) and 0-10% cover of *Deschampsia cespitosa* (tufted hairgrass). Forb cover varies from sparse (<10%) to very dense (70%) and is generally diverse. Forb species include 0-20% cover each of *Caltha leptosepala* (marsh marigold), *Ligusticum tenuifolium* (small ligusticum) and *Thalictrum alpinum* (arctic meadowrue) (CNHP 1996).

Successional and Ecological Processes: The dense canopy and thick undergrowth of the *Salix wolfii*/*Carex aquatilis* (Wolf willow/aquatic sedge) plant association indicate stable conditions. *Carex aquatilis* is well-suited to wet, organic soils and succession will occur slowly under these conditions (Hansen et al. 1988). If the water table is lowered, other herbaceous species may become dominant in the undergrowth and eventually give way to non-native graminoid species such as *Poa pratensis* (Kentucky bluegrass) (Hansen et al. 1995).

Salix wolfii (Wolf willow) is occasionally present in the *Salix planifolia*/*Carex aquatilis* plant association. *Salix wolfii* only occurs in small patches, never forming large, expansive willow carrs as does *Salix planifolia*. Mixed *Salix wolfii* and *Salix planifolia* stands represent a transition from *Salix wolfii* habitats to the more abundant and widespread *Salix planifolia* habitat. In Montana, it is believed that *Salix planifolia* occurs on wetter, finer textured soils than *Salix wolfii*. As sites become drier, *Salix wolfii* and grasses adapted to drier conditions increase in abundance (Hansen et al. 1988). In Idaho, the presence of *Salix wolfii* indicates a transitional habitat between wetter sites dominated by *Salix planifolia* (planeleaf willow) and drier sites dominated by *Salix geyeriana* (Geyer's willow) (Brunsfeld and Johnson 1985). In Colorado, the opposite occurs. *Salix wolfii* establishes in wetter habitats and at slightly lower elevations than *Salix planifolia* (Gwen Kittel pers. comm.).

Adjacent Riparian Vegetation: Adjacent wet areas include *Salix planifolia*/*Caltha leptosepala* (planeleaf willow/marsh marigold) shrublands and *Carex aquatilis* (aquatic sedge), *Carex utriculata* (beaked sedge), or *Calamagrostis canadensis* (bluejoint reedgrass) meadows. *Deschampsia cespitosa* (tufted hairgrass) meadows and *Salix brachycarpa*/mesic forb (barrenground willow/mesic forb) shrublands occur on hummocks and side slopes.

Adjacent Upland Vegetation: At higher elevations, adjacent hillsides are covered with *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce) or *Pinus contorta* (lodgepole pine) forests, subalpine meadows with *Festuca thurberi* (Thurber fescue) or alpine tundra. At lower elevations, *Artemisia tridentata* (big sagebrush) scrub is present.

Management: Forage value for *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge) is variable depending on the season, previous grazing use, and the size of the rangelands. In narrow riparian areas within extensive rangelands, the undergrowth of this association may be heavily grazed (Hansen et al. 1995).

Low-stature *Salix wolfii* willow carrs appear to be sensitive to trampling and soil compaction by livestock due to saturated conditions throughout the growing season. However, livestock will typically avoid these sites until August or September, due to the wet soils. If season-long grazing does occur, the plants and soils will be damaged. Heavy grazing opens the canopy and lowers the water table due to streambed downcutting. This can result in the decrease of *Carex aquatilis* and the increase of other grasses and forbs (Hansen et al. 1995).

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for plant establishment. Late summer and fall grazing is not recommended because willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams aid in controlling channel downcutting, stream bank erosion, and downstream movement of sediment. Beaver dams raise the water table and provide water for hydrophytic plants including willows and sedges. The trapping of sediment behind beaver dams, along with plant reproduction, raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity in an area versus their removal (Hansen et al. 1995).

Burning of this plant association temporarily increases the productivity of *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge). However, livestock grazing needs to be eliminated for the year prior to burning and for at least 2-3 years after to prevent livestock from consuming young, palatable regrowth. Prescribed burning can also aid in rejuvenating decadent stands of *Salix wolfii*. Quick, hot fires result in more sprouts, while slow fires damage the willows and result in fewer sprouts (Hansen et al. 1995).

Salix wolfii and *Carex* (sedge) species are valuable for stabilizing or rehabilitating stream banks. *Salix wolfii* is valuable in revegetating disturbed stream banks, but success in transplanting cuttings is inconsistent. Cuttings should first be rooted and grown in a nursery. Best results are obtained from cuttings taken in the spring from dormant 2-4 year old wood. The cuttings should be 12-20 inches (30-50 cm) long and greater than 0.5 inches (1 cm) in diameter. Once transplanted, roots and shoots will appear within 10-15 days. *Carex aquatilis* and *Carex utriculata* are very effective stream bank stabilizers due to their dense network of rhizomatous roots (Hansen et al. 1995).

Palustrine Scrub-Shrub Community--Deciduous

Shrubby cinquefoil/tufted hairgrass (*Pentaphylloides floribunda*/*Deschampsia cespitosa*) plant association

Colorado Natural Heritage Program: G4/S3

General Description and Comments: In Colorado, this plant association may be grazing-induced. The graminoids in the understory are highly palatable to livestock and mule deer. With continued grazing, the graminoids are reduced and *Pentaphylloides floribunda* (shrubby cinquefoil) increases in abundance (Stubbenieck et al. 1982). In the Routt National Forest, this association occurs on terraces of stream channels. In Park County, this association occurs along the drier edges of isolated wetlands and rich fens.

Related Types/Synonyms: *Potentilla fruticosa* is a synonym of *Pentaphylloides floribunda* (Kartesz 1994). This plant association is identical to *Potentilla fruticosa*/*Deschampsia cespitosa* (shrubby cinquefoil/tufted hairgrass) community types found in Utah, southeastern Idaho, western Wyoming, and Montana (Padgett et al. 1989, Youngblood et al. 1985, Johnston 1987, and Hansen et al. 1995). Occurrences of a *Pentaphylloides floribunda*/*Salix brachycarpa*/*Kobresia mysosuiroides* (shrubby cinquefoil/barrenground willow/kobresia) plant association in Park County, Colorado, are considered part of the *Pentaphylloides floribunda*/*Deschampsia cespitosa* plant association that have intergraded with rich fens, peatlands, and wetlands (Sanderson and March 1996).

Regional Distribution: This plant association has been found in Utah, southeastern Idaho, western Wyoming, and Montana (Padgett et al. 1989, Youngblood et al. 1985, Johnston 1987, and Hansen et al. 1995).

Distribution in Colorado: This plant association was documented once in the Blue River at McCullough Gulch site, Summit County. It also occurs in Park County and the Routt National Forest (Sanderson and March 1996, Kettler and McMullen 1996).

Elevation Range: 8400-9900 ft (2500-3000 m).

Site Geomorphology: This association occurs on terraces above the stream channel and along the drier edges of isolated wetlands and rich fens.

Soils: The soils are sandy loams over sand and gravel layers.

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Vegetation: *Pentaphylloides floribunda* (shrubby cinquefoil) dominates the overstory of this plant association with 30% cover. In stands along the drier edges of wetlands in Park County,

Salix brachycarpa (barrenground willow) is a co-dominant in the shrub layer and *Kobresia myosuroides* (kobresia) and *Juncus balticus* (Baltic rush) are present in the undergrowth. The undergrowth of the stand in the Routt National Forest is dominated by a mixture of graminoids including 30% cover of *Poa secunda* (Sandberg bluegrass), 20% cover of *Festuca rubra* (red fescue), and 10% cover each of *Deschampsia cespitosa* (tufted hairgrass) and *Juncus balticus* (Baltic rush). *Rumex aquaticus* (western dock) and *Fragaria virginiana* (Virginia strawberry) are present with 10% cover each indicating possible disturbance in the past (CNHP 1996).

Succession and Ecological Processes: This plant association may be subject to heavy grazing, which increases cover of *Poa pratensis* (Kentucky bluegrass), *Juncus balticus* (Baltic rush), and *Taraxacum officinale* (dandelion) (Padgett et al. 1989). Extended grazing may cause this plant association to convert to a *Pentaphylloides floribunda*/*Poa pratensis* (shrubby cinquefoil/Kentucky bluegrass) plant association.

Adjacent Riparian Vegetation: *Betula glandulosa* (bog birch shrubland) communities are found in adjacent riparian areas.

Adjacent Upland Vegetation: This information is not available.

Management: In Colorado, the *Pentaphylloides floribunda*/*Deschampsia cespitosa* (shrubby cinquefoil/tufted hairgrass) plant association is considered to be grazing-induced (G. Kittel pers. comm.). *Pentaphylloides floribunda* is not very palatable to livestock and large mammals. However, *Deschampsia cespitosa* is highly palatable and is heavily grazed. With livestock grazing, *Pentaphylloides floribunda* and less palatable *Juncus balticus* (Baltic rush) increase in cover while the highly palatable *Deschampsia cespitosa* (tufted hairgrass) decreases in cover (Hansen et al. 1995). Grazing should be delayed until soils are dry to maintain vigor of the plants in this association and to prevent damage to soils (Hansen et al. 1988).

Pentaphylloides floribunda quickly resprouts after fires. The use of prescribed burning may not be particularly effective if the desired outcome is a reduced cover of this species. *Deschampsia cespitosa* is resistant to damage from fire. With repeated burning, however, rhizomatous species such as *Poa pratensis* (Kentucky bluegrass) will establish and may outcompete *Deschampsia cespitosa* (Hansen et al. 1995).

Pentaphylloides floribunda is an effective streambank stabilizer. It grows fairly quickly and provides soil stability (Hansen et al. 1988). *Pentaphylloides floribunda* has been used for erosion control and beautification projects along highways (Stubbendieck et al. 1982). *Deschampsia cespitosa* has a weak fibrous root system and is not very valuable as a streambank stabilizer (Youngblood et al. 1985).

Palustrine Emergent Communities--Persistent

Clustered sedge (*Carex praegracilis*) wetland

Colorado Natural Heritage Program Rank: G2G3/S2S3

General Description and Comments: The *Carex praegracilis* (clustered sedge) plant association forms an open meadow in swales and along stream channels of the short-grass prairie.

Related Types/Synonyms: Similar community types include a *Carex praegracilis*-*Carex aquatilis* (clustered sedge-aquatic sedge) type found in Utah and possibly Idaho (Bourgeron and Engelking 1994) and a *Juncus balticus*-*Carex praegracilis* type found in New Mexico (Durkin et al. 1994). Stands dominated by *Carex praegracilis* are found in Utah, Idaho (Brotherson and Brown 1984, as cited in Jones and Walford 1995), Montana (Hansen et al. 1988), eastern Wyoming (Jones and Walford 1995), and in moist swales of the Great Plains (Herman 1970). The *Carex praegracilis* dominance type in Wyoming appears to be very similar in species composition and environmental setting to the stands in Colorado.

Regional Distribution: Plant associations dominated or co-dominated by this species occur in Montana, Idaho, Utah, Wyoming, and New Mexico (Bourgeron and Engelking 1994, Hansen et al. 1988, Jones and Walford 1995, and Durkin et al. 1994).

Distribution in Colorado: This association was documented for three locations in Summit County: Horse Creek, Cataract Creek, and Dillon Bay sites. There are only two other locations in Colorado for this plant association. It is also found along small creeks of the Pawnee National Grassland and is likely to occur throughout the eastern plains.

Elevation Range: 5000 ft (1500 m)

Site Geomorphology: This plant association occurs along small, shallow drainages, usually no more than 7-17 feet (2-5 meters) wide. The stream banks are gentle and flat. Stream channels are wide and flat, with little sinuosity, low gradient (0.5-1%), and little to no floodplain development (Rosgen's Channel Type: F6).

Soil: Soils are fairly deep and range from heavy clays to sandy clay loams with mottling.

Wetland Description: Slope wetland with a permanent hydroperiod.

Vegetation: This plant association completely covers the ground forming moist, narrow bands of 25-35% cover of *Carex praegracilis* (clustered sedge), 3-10% cover of *Carex nebrascensis* (Nebraska sedge), 0-10% cover of *Eleocharis palustris* (spike rush), and 1-3% cover of *Equisetum laevigata* (scouring rush). No trees or shrubs are present (CNHP 1996).

Successional and Ecological Processes: Little is known about the successional pattern of *Carex praegracilis* (clustered sedge) dominated areas.

Adjacent Riparian Vegetation: The *Carex praegracilis* (clustered sedge) plant association often occurs as the only vegetation type along small streams. It can occur with patches of *Carex nebrascensis* (Nebraska sedge) and *Agropyron smithii* (Western wheatgrass) or patches of *Scirpus pungens* (common threesquare) and *Scirpus lacustris* (hardstem bulrush) in adjacent pools within the channel.

Adjacent Upland Vegetation: The upland is short-grass prairie. In years of high precipitation, large patches of *Descurainia sophia*, a non-native mustard, can also occur.

Management: In southwestern Montana, *Carex praegracilis* (clustered sedge) forms large meadows. This sedge is considered to have medium to high forage value for horses and cattle, especially early in the grazing season (Herman 1970). In Colorado, *Carex praegracilis* never forms extensive meadows and may be limited to more mesic habitats found within riparian areas. Soils of this association are susceptible to compaction if grazed in early spring and summer when saturated.

Carex praegracilis may be an effective stabilizer of degraded, wet meadows. It has long, creeping rhizomes that quickly produce a tall, dense canopy of aboveground shoots (Hansen et al. 1988).

Tufted hairgrass (*Deschampsia cespitosa*) plant association

Colorado Natural Heritage Program Rank: G4/S4

General Description and Comments: This dense graminoid meadow occurs in broad, nearly flat, valley bottoms in openings of willow carrs and coniferous forests in subalpine regions across Colorado. It is characterized by a dense sward of *Deschampsia cespitosa* (tufted hairgrass) and minor cover of other graminoids and forbs.

Related Types/Synonyms: Identical *Deschampsia cespitosa* (tufted hairgrass) community types are documented from Nevada (Manning and Padgett 1995), Montana (Hansen et al. 1995), Utah (Padgett et al. 1989), Idaho and Wyoming (Youngblood et al. 1985). Other identical types include *Deschampsia-Carex* spp. from Oregon, Montana, Idaho, Utah, Wyoming, and Colorado (Johnston 1987, Kittel et al. 1994, Richard et al. 1996), *Deschampsia cespitosa-Carex aquatilis* (tufted hairgrass-water sedge) from the Routt National Forest (Kettler and McMullen 1996), *Deschampsia cespitosa-Carex nebrascensis* (tufted hairgrass-Nebraska sedge) wet montane meadow from Colorado and Wyoming (USDA SCS 1978, as cited in Johnston 1987), *Deschampsia cespitosa-Caltha leptosepala* (tufted hairgrass-marsh marigold) from Colorado (Johnston 1987, Sanderson and Kettler 1996), *Deschampsia cespitosa-Mertensia ciliata* (tufted hairgrass-mountain bluebells) from Colorado (CNHP 1997), and *Deschampsia cespitosa*-mesic forb and *Deschampsia cespitosa/Senecio sphaerocephalus* (tufted hairgrass/ballhead groundsel) from Wyoming (Girard et al. 1995).

Regional Distribution: This plant association and similar types are documented from throughout the West in Oregon, Washington (Dyrness 1973, as cited in Hansen et al. 1995), Nevada (Manning and Padgett 1995), western Montana (Hansen et al. 1995), eastern and central Idaho, western Wyoming (Youngblood et al. 1985, Girard et al. 1995), Utah (Padgett et al. 1989), and Colorado (Johnston 1987, Colorado Natural Heritage Program 1997).

Distribution in Colorado: This plant association was found in the Clinton Creek site in Summit County. It has been documented from the White River Basin (Kittel et al. 1994), the Colorado River Basin (Sanderson and Kettler 1996), and the Routt and San Juan National Forests (Kettler and McMullen 1996, Richard et al. 1996).

Elevation Range: 9000-11,000 ft (2800-3300 m).

Site Geomorphology: This meadow plant association generally occurs in broad, glaciated valleys on well-drained ridges and hummocks adjacent to low to moderate gradient streams. It occurs on sites with a moderately high water table (indicated by the presence of mottles or gleying in the soil) and other environmental conditions similar to the *Carex aquatilis* (water sedge) and *Carex utriculata* (beaked sedge) plant associations. Stream channels are wide and moderately sinuous (Rosgen's Channel Type: C4) or narrow and highly sinuous (Rosgen's Channel Type: E6).

Soils: Soils are a shallow to deep organic layer over stratified sandy or silty loams and loamy sands. Mottles and/or gleying may be present below 50 inches (20 cm) depth.

Wetland Description: Slope wetland with a permanent hydroperiod.

Vegetation: This plant association is characterized by a dense sward of 20-70% cover of *Deschampsia cespitosa* (tufted hairgrass). Other graminoids include 0-50% cover of *Carex aquatilis* (water sedge) and 0-20% cover each of *Carex utriculata* (beaked sedge) and *Calamagrostis canadensis* (bluejoint reedgrass). Forb cover is generally low with *Caltha leptosepala* almost always present with 0-45% cover. Other forb cover is minor. Occasionally, a few shrub stems from adjacent stands occur within this association, including *Pentaphylloides floribunda* (shrubby cinquefoil), *Salix planifolia* (planeleaf willow), and *Salix brachycarpa* (barrenground willow) (CNHP 1996).

Successional and Ecological Processes: *Deschampsia cespitosa* (tufted hairgrass) is an early-seral species that can continue to occupy sites indefinitely under relatively stable conditions (Manning and Padgett 1995). *Deschampsia cespitosa* occurs along a broad moisture gradient from mesic and dry-mesic environments to those that are very wet (Padgett et al. 1989). As sites become drier, *Deschampsia cespitosa* cover gradually decreases and *Pentaphylloides floribunda* (shrubby cinquefoil) cover may increase on sites with well-drained soils. In contrast, if a site becomes wetter, *Carex* (sedge) species may become dominant (Girard et al. 1995).

According to Padgett et al. (1989), the absence of increaser or exotic species such as *Poa pratensis* (Kentucky bluegrass), *Juncus balticus* (Baltic rush) and *Taraxacum officinale* (dandelion) in this plant association may indicate low disturbance conditions. As disturbance levels in this plant association increase, *Poa pratensis* may replace *Deschampsia cespitosa*. Many sub-alpine areas now dominated by *Poa pratensis* may have supported *Deschampsia cespitosa* communities in the past. However, this can not be assumed for all sub-alpine habitats with *Poa pratensis* (Padgett et al. 1989).

Adjacent Riparian Vegetation: Adjacent riparian vegetation includes *Carex aquatilis* (water sedge), *Carex utriculata* (beaked sedge), *Eleocharis palustris* (common spikerush), and *Calamagrostis canadensis* (bluejoint reedgrass) wet meadows, and *Salix planifolia* (planeleaf willow), *Salix wolfii* (Wolf willow), *Salix brachycarpa* (barrenground willow), and *Betula glandulosa* (bog birch) shrublands.

Adjacent Upland Vegetation: *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce) forests occur on adjacent hillslopes.

Management: *Deschampsia cespitosa* (tufted hairgrass) is highly palatable to livestock and is therefore, subject to heavy grazing pressure. To maintain vigor and prevent damage to soils and vegetation, grazing should be deferred until soils dry and grazing levels should be light to moderate. On moderately disturbed sites, livestock grazing should take place after surface soils have dried and after maturation of the seedheads. On more severely disturbed sites, intensive rehabilitation is required when there is a high cover of exotic and increaser species. Rest periods from grazing are necessary in order to provide time for plant regrowth (Hansen et al. 1995).

Deschampsia cespitosa is relatively resistant to fire. However, with repeated burning, rhizomatous species such as *Poa pratensis* (Kentucky bluegrass) may be favored. Livestock grazing should be deferred immediately after burning in order to protect the young, palatable regrowth (Hansen et al. 1995).

The typically wet soils of this plant association are easily compacted by vehicles and livestock use (Padgett et al. 1989). *Deschampsia cespitosa* is not very useful as a stream bank stabilizer due to its fibrous root structure. However, this is a useful species for revegetation and mine reclamation efforts (Hansen et al. 1995).

Palustrine Aquatic Bed Communities--Rooted Vascular

American milfoil (*Myriophyllum exalbescentis*) plant association

Colorado Natural Heritage Program Rank: G5?/S4

General Description and Comments: This community is found submerged in lakes and ponds and may be recognized by the whorled filiform-pinnatisect leaves and interrupted terminal spikes of small greenish flowers (Weber and Wittman 1996). This plant association is frequently highly productive and may contain several other aquatic macrophytes (Sanderson and Kettler 1996).

Related Types/Synonyms: *Myriophyllum sibiricum* and *M. spicatum* ssp. *exalbescentis* is a synonym for *M. exalbescentis* (Weber and Wittman 1992). The Eurasian *M. spicatum* is introduced and spreading in eastern U.S. It is very similar to *M. exalbescentis* but differs in having leaves more finely divided (Larson 1993).

Regional Distribution: The lack of reporting in the literature probably results from inadequate study of aquatic communities; this type should be expected to have a wider distribution (Sanderson and Kettler 1996). *M. exalbescentis* is a circumboreal species distributed in North America south to West Virginia, Arkansas, Texas, New Mexico, Arizona, and California.

Distribution in Colorado: Weber and Wittman (1992) state that this plant species is common in lakes and ponds at lower and middle altitudes. This plant association was found in one location in Boulder, CO (Cooper 1988). Additionally, it was found to dominate a few beaver ponds that were filling with sediment in the Telluride region, CO (Cooper and Gilbert 1990). Sanderson and Kettler (1996) found two stands that were dominated by *Myriophyllum exalbescentis*. There was only one location for this plant association documented on private lands in Summit County. It is suspected that this plant association is under collected and is widely distributed.

Site Geomorphology: This plant association generally occurs in still, shallow (up to 1.5 meters or slightly more) water. Nutrient rich water (which may result from an influx of sewage, livestock waste, etc.) characterizes its environment (Sanderson and Kettler 1996).

Soils: Mucky peat with gleying occurring at 10-15 cm.

Wetland Description: Lacustrine or depressional wetland with a permanent hydroperiod and rare flooding.

Vegetation: *Myriophyllum exalbescentis* dominates this plant association with cover ranging from 10 to over 70%. Other aquatic macrophytes (e.g., *Potamogeton* spp., *Utricularia macrorhiza*).

Succession and Ecological Processes: The *Myriophyllum sibiricum* plant association provides important waterfowl food/habitat (Cooper 1993). The dense aquatic stands it often forms also provide habitat for copious aquatic macroinvertebrates. This plant association may indicate excessive input of nutrients from human activities (Sanderson and Kettler 1996).

Rocky Mountain pond lily (*Nuphar luteum* ssp. *polysepalum*) plant association

Colorado Natural Heritage Program Rank: G5?/S4

General Description and Comments: The presence of *Nuphar lutea* ssp. *polysepala*, often in abundance, makes this type a conspicuous plant association. In Summit County, it is found in relatively shallow water of kettle ponds in the subalpine. The prominent yellow flowers, broad floating leaves, and general lack of associated species make this plant association unmistakable.

Related Types/Synonyms: According to Weber and Wittman (1992) synonyms for *Nuphar luteum* ssp. *polysepalum* are *N. polysepala* and *Nymphaea polysepala*.

Regional Distribution: This type has been reported from Colorado, Wyoming, and Idaho (Bourgeron and Engelking 1994). It can be expected to have a much wider distribution.

Distribution in Colorado: Weber and Wittman (1996) state that this plant species occurs in subalpine ponds, most common on Grand Mesa. This plant association was located once on private lands during the 1997 survey.

Elevation Range: This plant association may occur at low elevations, but in Summit County it was found between 2700 and 3000 m (9,000 and 10,000 ft.). Cooper (1990) reported this type from 2870 m (9,400 ft.).

Site Geomorphology: The *Nuphar lutea* ssp. *polysepala* plant association occurs in standing water that ranges from less than 0.1 m to greater than 1 m (Cooper 1990) in ponds and lakes with long-term stability (i.e., rarely in more ephemeral water bodies such as beaver ponds). In the montane area of Colorado, this type tends to occur in nutrient poor water. The water where these stands occur usually has a pH less than 7.0 (more commonly around 6.0) and very low conductivity (Sanderson and Kettler 1996).

Soils: Substrate in which plants are anchored is usually loosely consolidated organics, from mucks to mucky-peat.

Wetland Description: Depressional wetland with permanent hydroperiod and no flooding.

Vegetation: *Nuphar lutea* ssp. *polysepala* generally dominates this type with a wide range of cover, ranging from 10% to 100%, even at on site in western Colorado (Sanderson and Kettler 1996). Often, *Nuphar lutea* ssp. *polysepala* occurs in a monoculture, but it may also occur with other aquatic plants e.g., *Potamogeton gramineus* (Cooper 1990; Sanderson and Kettler 1996).

Succession and Ecological Processes: Cooper (1990) reports that in the Green Mountain Trail Pond in Rocky Mountain National Park, peat accumulation and sedimentation along the shores of the pond have reduced the extent of this plant association. At this site, basal peat cores indicated that *Nuphar lutea* ssp. *polysepala* has been present in this pond for almost 12,000 years.

Co-occurring Wetland Plant Associations: The *Nuphar lutea* ssp. *polysepala* plant association is commonly found adjacent to *Carex* spp. plant associations, especially *Carex utriculata*. It also may co-occur with *Menyanthes trifoliata* and *Carex aquatilis*-*Carex utriculata* stands, as well as with *Salix planifolia* plant associations where they form an outer ring near a lake or pond (Sanderson and Kettler 1996).

Pondweed (*Potamogeton natans*) plant association

Colorado Natural Heritage Program Rank: G5?/S1

General Description and Comments: *Potamogeton natans* is a herbaceous aquatic perennial with slender rhizomes. It is one of the pondweeds with dimorphic leaves. It is found in shallow lakes or kettle ponds in brackish waters.

Related Types/Synonyms: There are no known synonyms known for this plant association.

Regional Distribution: *Potamogeton natans* is found in Eurasia and North America; Alaska to Newfoundland, south to southern California; central Arizona, northern New Mexico, and most of the midwest and northeastern U.S.; widely scattered throughout the Intermountain region (Cronquist et al. 1977).

Distribution in Colorado: Weber and Wittman (1996) state that in Colorado, *Potamogeton* spp. are not well-enough collected to justify precise comments on habitat or altitude. This plant association was found once on private lands in Summit County. There are three other occurrences documented in Colorado; two in Jackson County and one in Routt County.

Elevation Range: 2400 m to 2940 m (8,000 ft to 9,800 ft).

Soils: Mucky to mucky peat with gleying common.

Wetland Description: Depressional wetland with a permanent hydroperiod, no flooding.

Vegetation: *Potamogeton natans* dominates this type with cover ranging from 50% to 100%.

Succession and Ecological Processes: Not available

Co-occurring Wetland Plant Associations: Adjacent vegetation consists of *Carex utriculata* (beaked sedge). Adjacent uplands are *Populus tremuloides* (quaking aspen) with *Pinus contorta* (lodgepole pine).

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APPENDIX A—EXAMPLES OF FIELD FORMS

SITE No.

DATE:

RECORDER

WETLAND DATA FORM

Size (indicate acres or hectares):

Wetland Class: Riverine Lacustrine Depressional Slope

Water source:

Hydroperiod: Permanent Seasonal Intermittent

Flooding/Inundation: Continuous Frequent Occasional Rare Never

Water Chemistry: pH conductivity marl alkali iron

General Soils Description (Peat/Alluvium? Mottles? Gley? Cobbles? Parent material (if known), etc.):

% Open Water: % Vegetated: % Bare Ground:

Plant associations in Vegetated Portion	% of Veg area	Comments
Miscellaneous minor associations		

FUNCTIONAL EVALUATION

Ratings: 1=no; 2=low; 3=medium; 4=high; 5=very high

Confidence in Rating: a=low; b=medium; c=high

Function	Comments
Ground Water Recharge R: C:	
Ground Water Discharge R: C:	
Floodflow Alteration R: C:	
Sediment Stabilization R: C:	
Sediment/Toxicant Retention R: C:	
Nutrient Removal/Transformation R: C:	
Production Export R: C:	
Habitat R: C:	
Aquatic Diversity/Abundance R: C:	
Recreation R: C:	
Uniqueness/Heritage Value R: C:	

Comments:

COLORADO NATURAL HERITAGE PROGRAM
ELEMENT OCCURRENCE RECORD:

NEW?: _____ UPD?: _____

{ID: _____}

SCIENTIFIC NAME: _____ {EONUM}: _____

{SITE NAME}: _____ SURVEYSITE: _____

{PRECISION} _____ COUNTY (code): CO _____ / CO _____ / CO _____

QUADNAME(S): _____ {QUADCODE}: _____ / _____ / _____

{DOTNUM}: ____/____/____

{LAT}: _____ {S}: _____ {N}: _____

{LONG}: _____ {E}: _____ {W}: _____

TOWNRANGE: _____ SECTION(S): __, __, __, __ MERIDIAN: ____

TRSNOTE: _____

DIRECTIONS: _____

{PHYS PROV}: _____ {WATERSHED}: _____

SURVEYDATE: 1. 9. ____ - ____ - ____ (LASTOBS): ____ - ____ - ____ (FIRSTOBS): ____ - ____ - ____
m d (year)

EORANK: _____ EORANKDATE: 1. 9. ____ - ____ - ____

EORANKCOM: _____

EODATA: _____
(pop'n. size and structure, extent, reproduction, disease, predation / community condition, size, dominance, special features)

GENDESC: _____
(habitat, landform, land use, associated species, etc.)

MINELEV: _____ MAX ELEV: _____

MANAME: _____ {CNTND1}: _____

MANAME: _____ {CNTND2}: _____

MANAME: _____ {CNTND3}: _____

MGMTCOM: _____
(threats e.g. overshadowing, overcollecting AND mgmt resolutions e.g. fire, fencing, etc)

PROTCOM: _____
(threats e.g. development, etc AND protection resolutions e.g. acquisition, easement, special designation)

OWNER: _____

OWNERCOM: _____

COMMENTS: _____

DATASENS: _____ BOUNDARIES: _____ PHOTOS: _____

SPECIMENS: _____

BESTSOURCE: _____

SOURCECODES: _____ COUS / _____ COUS / _____ COUS / _____ COUS / _____
COUS / _____ COUS / _____ COUS / _____ COUS / _____

TRANSCRIBER: ____ - ____ - ____ {MAPPER}: ____ - ____ - ____ {QC1}: ____ - ____ - ____

MAP MARGIN BK COMPLETED? _____ EOLOG BK COMPLETED? _____ COEOR.FRM 3/94

SURVEY SITE NAME: _____

SITE NAME _____ NEW: _____ EXISTING: _____ UNDECIDED: _____ NO: _____

te Visit Chronology

1.9. Surveyor(s) Sourcecode (F96***01COUS)

(B): ROAD DIRECTIONS TO SITE:

(C): LOCATION OF SITE ACCESS POINT:(where to park, location of important trail):

IS MAP ATTACHED (Y or N)?____ TIA BOUNDARY MAP (Y or N)?____ MAP OF ROUTE WALKED (Y or N)?____ SITE MAP (Y OR N)?____

ELEMENT OCCURRENCES:

List all elements sought, reported, or confirmed at the site. Generate simple letter or number codes which identify the location of each element occurrence on the base map. Indicate whether the element was found (Y, N, N/A) on the date of the site visit, and whether a return visit is needed.

[illegible]

SITE DESCRIPTION - General visual description:(geology, substrate or soil; dominant vegetation types; major landforms; hydrologic features; landscape context). Note key ecological processes. If applicable, described both the inventory area and the conservation site.

ELEVATION: max. min. SITE AND/OR ELEMENT PHOTOS (photographer, roll and frame #):

STEWARDSHIP:

Land Use Comments:

Describe current and past land use, improvements, and structures, and possible stewardship implications.

A) Current _____

Historic _____

C) Ownership: Public _____ Private _____ Mixed _____ Adjacent public _____

OTHER VALUES (recreation or general open space, scenic vistas, general wildlife, etc.)

Potential Hazards Comments:

Describe any potential hazards, both natural (e.g. cliffs, caves, venomous snakes, etc.), and of anthropogenic nature e.g. mine shafts, old wells, dangerous structures. Prescribe appropriate precautions.

Exotic Flora/Fauna Comments:

List problem exotic species and the effects on the element(s). If possible prescribe control methods.

Off-site Considerations:

Describe off-site land uses (e.g. farming, ranching, mining, urban development, stream perturbations) and how the landscape context might affect the element(s) on the site and future management.

Information Needs:

Site and Element Management Recommendations:

Summarize the expected management needs for the site and its element(s).

Managed Area Comments:

Explain relationship to existing managed areas.

Tract Ownership (name, address, phone # - attach contact history form if applicable):

TOPOGRAPHIC BASE MAP:

Attach a photocopy of the topographic map or aerial photograph showing the site. Note author and date on each map. Label map with the appropriate quadname, indicate EOs, code for the path traveled, code for the TIA boundary, code for the site boundary.

Boundary Justification:

PROTECTION URGENCY:
(circle one)

P1 immediately threatened
P2 threat expected within 5 yrs.
P3 threatened, but not in the next 5 yrs.
P4 no threats imminent
P5 land protection complete

MANAGEMENT URGENCY:
(circle one)

M1 management needed this year
M2 management needed within 5
yrs to prevent loss of Eos
M3 management needed within 5
yrs. to maintain quality
M4 management may be needed in
the future
M5 no management needed

Protection Urgency Comments (& date)

Management Urgency Comments (& date)

THREAT ASSESSMENT TABLE: Name of preparer _____ Date _____

Source of Stress	Stress	Targeted Ecosystem(s)/ Elements(s) Impacted	Reversibility of Stress	Current Negative Impacts of Stress on System	Potential for Stress to Increase in the Future

DETAILED SKETCH MAP:

The purpose of this map is to show fine details of the site which are not shown on the topographic base map. This map can be used to show (1) EO locations, (2) study plots or marked individuals, (3) natural landmarks, and (4) disturbance features such as structures and trails. Include scale and indicate north.

For communities indicate relative abundance (eg. d-dominant, c-common, p-present, t-trace). List common species or any others that are characteristic or distinctive of the community.

species

[illegible]

KEY ECOLOGICAL FACTORS: (hydrology, fire, herbivory, etc.)

OCCURRENCE RANK:

COLORADO NATURAL HERITAGE PROGRAM
TARGETED INVENTORY AREA FORM

TIA Name: _____ TIA #: _____

Location: _____

Quadrangle(s): _____ Quad Code(s): _____

Survey priority: Very High: _____ High: _____ Medium: _____ Low: _____

Survey phenology (what time of year do surveys need to take place?): _____

Map and aerial photo examination:

initials	date	photo source	photo type	photo number	photo date	notes
----------	------	-----------------	---------------	-----------------	---------------	-------

Description: _____

Disturbance features: _____

Survey features:

element	potential/known (lastobs)	phenology	specific search areas
---------	---------------------------	-----------	-----------------------

Comments:

Information needs: _____

Experts and other sources: _____

Ownership (attach contact history form if necessary):

Preliminary surveys (drive-by, aerial, etc.):

Needed (Y/N)? _____

Prelim. survey date: _____ Investigators: _____

Description/evaluation: _____

Site visit history:

[illegible]

Note: Site survey summary, including map, need to be completed for every TIA surveyed. EORs need to be completed for every significant element found. Attach field forms to this sheet.

Additional notes:

[illegible]