

Survey of Critical Wetlands and Riparian Areas in Dolores County



**Colorado Natural Heritage Program
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April 2005



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Survey of Critical Wetlands and Riparian Areas in Dolores County

Prepared for:

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April 2005**

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Cover photograph: Riverine wetlands dominated by Mountain Willow along Fish Creek, SJNF. Photo taken by Sarah Eastin.

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EXECUTIVE SUMMARY

Although the rate of wetland loss in Dolores County is difficult to quantify, it is clear that many wetlands have been lost or profoundly altered from their pre-settlement state. Agriculture, grazing, construction of reservoirs, water diversions, and mining have had many impacts on wetlands throughout the study area. Fertile soils and available water for irrigation make floodplains and the glacial silts on the Colorado Plateau productive areas for agriculture. Since the nineteenth century hydrological diversions have been developed for irrigation and drinking water supplies. Such activities have eliminated or altered some wetlands, and created other wetlands very different from those in existence prior to European settlement. It is clear that with the current rate of land use conversion and the lack of comprehensive wetland protection programs, wetlands will continue to be lost or dramatically altered. However, the likelihood for human conflicts with biologically important wetlands is minimized if there is the opportunity to proactively plan for managing human activity or managing wetland-dependent species or their habitat. The purpose of this project is to provide a data resource for managers and planners in Dolores County, Towns of Dove Creek and Rico, the Colorado Department of Natural Resources, Colorado Division of Wildlife, Southwest Wetlands Focus Area Committee, Forest Service, Bureau of Land Management, The Nature Conservancy, and the citizens of Dolores County for proactive planning and restoration of wetlands. This document should be considered a tool for managing lands that support imperiled and sensitive wetland-dependent species and plant communities within Dolores County.

In 2004 the Colorado Natural Heritage Program (CNHP) received funding from the Colorado Department of Natural Resources (CDNR) through a grant from the U.S. Environmental Protection Agency, Region 8 to survey for critical wetlands within Dolores County as part of a statewide effort to identify significant wetland habitat. The goal of the project was to systematically identify the localities of significant species and plant communities dependent on wetland and riparian areas.

This project supports the CDNR's effort to strategically protect Colorado's valuable wetland resources. The results of this survey support **six** statewide wetland efforts:

- (1) CDNR's Colorado Wetlands Program, which includes many partners such as The Nature Conservancy, U.S. Fish and Wildlife's Partners for Wildlife, Ducks Unlimited, and others;
- (2) Southwest and Five Rivers Wetland Focus Area Committees' effort to identify protection and restoration priorities;
- (3) CNHP's Wetland Classification;
- (4) The Nature Conservancy's Priority Conservation Sites in the Southern Rocky Mountain and Colorado Plateau Ecoregions;
- (5) DOW Wetlands Monitoring and Evaluation Project; and
- (6) Vegetation Index of Biological Integrity (VIBI) project.

Field surveys began in June 2004 and continued through September 2004. High quality examples of wetlands and riparian areas and those supporting populations of rare wetland-dependent species were given highest priority. Such locations were identified by: (1) examining existing biological data for rare or imperiled plant and animal species and significant plant communities (collectively called **elements**) from the CNHP's database, (2) accumulating additional existing information on these elements, (3) input from local citizens of Dolores County and more specifically, the Southwest Wetlands Focus Area Committee members and agency personnel, and, (4) conducting extensive field surveys. Areas that were found to contain significant elements were delineated as Potential Conservation Areas (PCA). These areas were prioritized by their biological urgency (the most rare or imperiled) and their ability to maintain

viable populations of the elements (degree of threat). A qualitative functional assessment was conducted at most of the wetland and riparian areas visited. The restoration potential of each PCA was also noted. On Bureau of Land Management parcels, Proper Functioning Condition of the wetland was determined.

Results of the wetland and riparian survey confirm that Dolores County contains wetland areas with high biological significance and a diverse array of wetland types that support at least 35 major wetland/riparian plant communities, three plants, three birds, one fish from CNHP's Tracking List. Twenty-five wetland and riparian sites of biodiversity significance are profiled in this report as Potential Conservation Areas (PCAs). These PCAs represent the best examples of wetland and riparian communities and their ecological processes observed on private and public lands. Some sites visited have been combined with existing PCAs, to encourage conservation success along a continuum in riparian/wetland zones. PCAs profiled include those wetlands that merit conservation efforts, while emphasizing that protecting only these PCAs will, in no way, adequately protect all the functions associated with wetlands in Dolores County. In addition to the PCAs, four Sites of Local Significance are profiled within this report to encourage restoration and conservation of these areas. Despite the best efforts during one field season, it is likely that some elements that are present were not documented during the survey due to either lack of access, phenology (reproductive timing) of species, or time constraints. Future surveys will likely identify additional areas of biological significance that have not been identified in this report. The delineation of PCA boundaries in this report does not confer any regulatory protection on recommended areas, rather are intended to support wise planning and decision making for the conservation of these significant areas. Additional information may be requested from Colorado Natural Heritage Program, Colorado State University, 8002 Campus Delivery, Fort Collins, CO 80523-8002, www.cnhp.colostate.edu.

Protection and/or proper management of the PCAs will help to conserve the biological integrity of Dolores County and Colorado. Of these PCAs, several stand out as very significant such as the *Carex illota* (sheep sedge) dominated fens at the Lakes at Bolam Pass and Snow Spur Tributary PCAs. Another significant area to Dolores County is the extensive beaver enhanced *Salix monticola* (mountain willow) dominated wetlands along Fish Creek. From its headwaters to its junction with West Dolores River, Fish Creek supports seven element occurrences associated with wetlands and the riparian area.

Of the 25 PCAs, we identified three as being **nearly irreplaceable biodiversity significance** (B2), 13 of **high biodiversity significance** (B3), eight of **moderate biodiversity significance** (B4), and one of **general biodiversity significance** (B5). The highest-ranking PCAs are the highest priorities for conservation action. Overall, the concentration and quality of imperiled elements and habitats attest to the fact that wetland conservation efforts in Dolores County will have both state and global significance.

The results of the survey will be provided to CDNR, Colorado Division of Wildlife's Wetlands Program, EPA Region 8 Wetlands Division, San Juan National Forest Service, San Juan Field Office, Bureau of Land Management, Dolores County, The Nature Conservancy, Town of Rico, Colorado State University, and the Southwest Wetland Focus Area Committee, as well as available to the public on CNHP's website (<http://www.cnhp.colostate.edu>).

CONSERVATION STRATEGIES

Conservation strategies can be classified as three major types:

- (1) **Land protection** can be accomplished through conservation easements, land exchanges, long term leases, purchase of mineral or grazing rights, acquisition, or government regulation;
- (2) **Management** of the land can be influenced so that significant resources are protected; and
- (3) **Public education** about the significant ecological values of the county can engender support for land use decisions that protect these values.

The first necessary step, identification of the significant elements of biodiversity in the county, and their locations, has been taken with this survey. The next step is to use this information to conserve these elements and Potential Conservation Areas (PCA). Specific protection and management needs are addressed under the descriptions of individual PCAs. However, some general recommendations for conservation of biological diversity in Dolores County are given here:

1. Develop and implement a plan for protecting the Potential Conservation Areas profiled in this report, with most attention directed toward PCAs with biodiversity rank (B-rank) B2 and B3. The PCAs in this report provide a basic framework for implementing a comprehensive conservation program. The B2 and B3 PCAs, because they have global significance, are in need of priority attention. Consider purchasing development rights or outright purchase from willing owners of land for significant PCAs that are in need of protection. Support local organizations, such as land trusts, in purchasing or acquiring conservation easements for protection of biological diversity or open space. Explore opportunities to form partnerships to access federal funding for conservation projects. Continue to promote cooperation among local entities to preserve the county's biodiversity.

2. Use this report in the review of proposed activities in or near Potential Conservation Areas to determine whether activities do or do not adversely affect elements of biodiversity. All of the areas presented contain natural heritage elements of state or global significance. Also, consider the potential natural heritage values of all other PCAs for which land use decisions are made, using this report as a guide for values to be considered. Insist on careful assessments of potential damages, including weed invasion and fragmentation.

Certain land use activities in or near a PCA may affect the element(s) present. Wetland and riparian areas are particularly susceptible to impacts from off-site activities if the activities affect water quality or hydrologic regimes. In addition, cumulative impacts from many small changes can have effects as profound and far-reaching as one large change. As proposed land use changes within Dolores County are considered, they should be compared to the maps presented herein. If a proposed project has the potential to impact a PCA, planning personnel should contact persons, organizations, or agencies with the appropriate biological expertise for input in the planning process. The Colorado Natural Heritage Program routinely conducts site-specific environmental reviews and should be considered a valuable resource. To contact CNHP's Environmental Review Coordinator call 970-491-7331. In addition, one of our key partners, the Colorado Division of Wildlife, should be consulted.

3. Recognize the importance of all natural communities and lands at all elevations.

Although much effort in the past has been directed at protecting the most scenic, high elevation areas, the lower elevations have received less attention. While the specific PCAs identified here

contain the known locations of significant elements of natural diversity, protection of large areas in each vegetation type, especially where these are connected, may ensure that we do not lose species that have not yet been located. Work to protect large blocks of land in each of the major vegetation types in the county, and avoid fragmenting large natural areas unnecessarily with roads, trails, etc. Although large migrating animals like deer and elk are not tracked by CNHP as rare species, they are a part of our natural diversity, and their needs for winter range and protected corridors to food and water should be taken into consideration. Fragmentation of the landscape also affects smaller animals and plants, opening more edge habitats and introducing exotic species. Encourage cluster developments that designate large common areas for preservation of natural communities, as an alternative to scattering residences over the landscape with one house on each 35-acre parcel. Work with developers early in the planning process to educate them about the benefits of retaining natural areas. Locate trails and roads to minimize impacts on native plants and animals. See Forman and Alexander (1998) for an excellent review of the literature on the ecological effects of roads. See the booklet published by the State Trails Program (Colorado Department of Natural Resources 1998) for suggestions regarding planning trails with minimum impacts to wildlife.

4. Develop and implement comprehensive programs to address loss of wetlands. In conjunction with the information contained in this report, information regarding the degree and trend of loss for all wetland types (e.g., fens, emergent marshes, riparian forests, seeps/springs, etc.) should be sought and utilized to design and implement a comprehensive approach to the management and protection of Dolores County wetlands. Such an effort could provide a blueprint for wetland conservation in the County. Encourage and support statewide wetland protection efforts such as CDOW's Wetlands Partnership. County governments are encouraged to support research efforts on wetlands to aid in their conservation. Countywide education on the importance of wetlands could be implemented through the county extension service or other local agencies. Encourage communication and cooperation with landowners regarding protection of wetlands in Dolores County. Utilize the expertise and breadth of experience within the Southwest Wetland Focus Area Committee. The Colorado Natural Areas Program has published a book entitled, **Best Management Practices for Wetlands**. This book can be download at http://parks.state.co.us/cnap/Wetlands_BMP/BMPindex.Htm

5. Increase efforts to protect biodiversity, promote cooperation and incentives among landowners, pertinent government agencies, and non-profit conservation organizations, and increase public awareness of the benefits of protecting significant natural areas. Involve all stakeholders in land use planning. The long-term protection of natural diversity in Dolores County will be facilitated with the cooperation of many private landowners, businesses, government agencies, and non-government organizations. Efforts to provide stronger ties among federal, state, local, and private interests involved in the protection or management of natural lands will increase the chance of success. Expand public and staff awareness of Dolores County's natural heritage and its need for protection by providing community education and forums where protection of our natural heritage is discussed.

6. Promote wise management of the biodiversity resources that exist within Dolores County, recognizing that delineation of potential conservation areas does not by itself provide protection of the plants, animals, and plant communities. Development of a site-specific conservation plan is a necessary component of the long-term protection of a Potential Conservation Area. Because some of the most serious impacts to Dolores County's ecosystems are at a large scale (e.g., altered hydrology, residential encroachment, and non-native species invasion), considering each area in the context of its surroundings is critical. Several organizations and agencies are available for consultation in the development of conservation

plans, including the Colorado Natural Heritage Program, the Colorado Division of Wildlife, the Natural Resources Conservation Service, The Nature Conservancy, and various academic institutions. With the rate of population growth in Colorado, rare and imperiled species will continue to decline if not given appropriate protection. Increasing the public's knowledge of the remaining significant areas will build support for the initiatives necessary to protect them, and allow proactive planning. Encourage good management by supporting incentives to landowners for improvements such as fencing riparian areas, controlling weeds, and restoring wildlife habitat.

7. Stay informed and involved in public land management decisions. Many of the PCAs identified here are on public land that may be protected from development, but not from incompatible uses. Even ownership is not always secure, since the federal and state agencies are becoming more and more involved in land exchanges. Encourage protection for the most biologically significant PCAs on public lands by implementation of compatible management designated in Forest Management Plans, Grazing Management Plans, etc.

8. Continue inventories where necessary, including inventories for species that cannot be surveyed adequately in one field season and inventories on lands that CNHP could not access in 2004. Not all targeted inventory areas can be field surveyed in one year due to either lack of access, phenology of species, or time constraints. Because some species are ephemeral or migratory, completing an inventory in one field season is often difficult. Despite the best efforts during one field season, it is likely that some elements that are present were not documented during the survey and other important sites have not been identified in this report.

9. Continue to take a proactive approach to weed control in the County. Give adequate support, in funding and staff, to the county Weed Management offices for weed control. Recognize that weeds affect both agriculture and native plant communities. Discourage the introduction and/or sale of non-native species that are known to significantly impact natural areas. Encourage the use of native species for revegetation and landscaping efforts. Ideally, seed should be locally harvested. This includes any seeding done on county road right-of ways. The Colorado Natural Areas Program has published a book entitled *Native Plant Revegetation Guide for Colorado* that describes appropriate species to be used for revegetation. Please visit http://www.parks.state.co.us/cnap/revegetation_Guide/Reveg_index.html for further details.

10. Encourage public education. One of the greatest tools in conserving land for biodiversity is to explain the value of such areas to the public. As described in this report, Dolores County is rich in wetland animal and plant diversity and houses some of the most unique environments in Colorado as well as the nation. Conveying the value and function of these habitats and the species that inhabit them to the public can generate greater interest in conserving lands. Conducting forums or presentations that highlight the biodiversity of Dolores County should increase awareness of the uniqueness of the habitats within the county. Similarly, providing educational pamphlets or newsletters that explain why these areas are so valuable can increase public interest and support for biodiversity conservation.

INTRODUCTION

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. Consequently, many wetlands across North America were purposefully drained. Since 1986, wetlands have been lost at a rate of 58,500 acres/year (Dahl 2000). 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 Dolores County is difficult to quantify, it is clear that many wetlands have been lost or profoundly altered from their pre-settlement state. Agriculture, grazing, development, construction of reservoirs, water diversions, and mining have had many impacts on wetlands throughout the study area. Fertile soils and available water for irrigation make floodplains productive areas for agriculture. Since the nineteenth century, hydrological diversions have been developed for irrigation and drinking water supplies. Such activities have eliminated or altered some wetlands, and created other wetlands very different from those in existence prior to European settlement. For example, the development of an extensive network of canals and irrigation agriculture has created irrigation-induced wetlands where none previously existed. This same activity has altered many natural wetlands by changing hydrological patterns across the landscape. It is clear that with the current rate of land use conversion and the lack of comprehensive wetland protection programs, wetlands will continue to be lost or dramatically altered.

Because of the profound hydrological alterations within Dolores County, restoring degraded wetlands and riparian areas to pre-settlement conditions is probably not realistic. However, by enacting a watershed level wetland protection and enhancement program, many of the beneficial functions and values performed by wetlands could be enhanced or restored.

Increasingly, local Colorado governments, federal agencies, and non-profit organizations, 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 approached this project with the intent of addressing this desire. Rare plants, animals, and plant associations are usually the least understood organisms in a landscape. Some of these organisms are only understood after their rarity is recognized, as in the case of federal threatened and endangered species. However, conservation of these organisms can often be accomplished more quickly and less expensively if there is a clear understanding of their distribution and abundance. Furthermore, the likelihood for human conflicts is minimized if there is the opportunity to proactively plan for managing human activity or managing the species or habitat of interest.

The Survey of Critical Wetlands and Riparian Areas in Dolores County, conducted by the Colorado Natural Heritage Program (CNHP), is a part of ongoing wetland surveys of Colorado counties by CNHP. To date, similar surveys have been conducted in all or parts of over 18 counties. CNHP has completed the Comprehensive Statewide Wetland Characterization and Classification Project (Carsey *et al.* 2003). This project compiled data from multiple sources, including CNHP's Riparian Classification, to produce a comprehensive wetland classification for the State of Colorado.

The purpose of this project is to provide a data resource for the Southwest Wetland Focus Area Committee and federal, state, and local agencies in conducting proactive planning for wetland conservation in Dolores County. This document should be considered a tool for managing lands that support rare wetland species and plant associations within Dolores County, although there are limitations to the information within it. In particular, the survey work was conducted over a one-year period. The distribution and abundance of all organisms change with time, and it is anticipated that the conservation areas described in the report will also change with time. Also, all areas of Dolores County were not surveyed. Due to limitations of time and land

access, this report only includes information from readily observed species or from areas that biologists received permission to visit. Finally, this report does not include all wetland species or associations found within Dolores County. This project specifically targeted the organisms that are tracked by CNHP (CNHP has a methodology specific to Natural Heritage Programs and this study was intended to survey for those species believed to be the most rare or the least known). The primary objective was to identify biologically significant wetlands within Dolores County. The *Survey of Critical Wetlands and Riparian Areas in Dolores County* used the methodology that is used throughout Heritage Programs in North, South, and Central America. The primary focus was to identify the locations of the wetland plant and animal populations, and plant associations on CNHP's list of rare and imperiled elements of biodiversity, assess their conservation value, and to systematically prioritize these for conservation action. Wetland functions and restoration potential for each site visited was also assessed.

The locations of biologically significant wetlands were identified by:

- Examining existing biological data for rare or imperiled plant and animal species, and significant plant associations (collectively called **elements**);
- Accumulating additional existing information from local knowledgeable citizens, National Wetland Inventory maps, and aerial photographs;
- Conducting extensive field surveys.

Locations in the county with natural heritage significance (those places where elements have been documented) are presented in this report as Potential Conservation Areas (PCAs). The goal is to identify a land area that can provide the habitat and ecological needs upon which a particular element or suite of elements 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 to delineate PCA boundaries.

The PCA boundaries delineated in this report do not confer any regulatory protection of the PCA, nor do they recommend automatic exclusion of all activity. It is hypothesized that some activities will prove degrading to the element(s) or the ecological processes on which they depend, while others will not. The boundaries represent the best professional estimate of the primary area supporting the long-term survival of the targeted species or plant associations and are presented 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 of natural heritage resources and sensitive species. Please note that these boundaries are based primarily on our understanding of the ecological systems. A thorough analysis of the human context and potential stresses was not conducted. All land within the PCA 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.

CNHP uses the Heritage Ranking Methodology to prioritize conservation actions by identifying those areas that have the greatest chance of conservation success for the most imperiled elements. The PCAs are prioritized according to their **biodiversity significance rank**, or "B-rank," which ranges from B1 (irreplaceable) to B5 (general or statewide biodiversity significance). These ranks are based on the conservation (imperilment or rarity) ranks for each element and the element occurrence ranks (quality rank) for that particular location. Therefore, the highest quality occurrences (those with the greatest likelihood of long-term survival) of the most imperiled elements are the highest priority (receive the highest B-rank). See the section on Natural Heritage Ranking System for more details. The B1-B3 PCAs are the highest priorities for conservation actions. The sum of all the PCAs in this report represents the area CNHP recommends for protection in order to preserve the natural heritage of Dolores County's wetlands.

WETLAND DEFINITIONS, REGULATIONS, AND FUNCTIONAL ASSESSMENTS

Wetland Definitions

The federal regulatory definition of a jurisdictional wetland is found in the regulations used by the U.S. Army Corps of Engineers (Corps) for the implementation of a dredge and fill permit system required by Section 404 of the Clean Water Act Amendments (Mitsch and Gosselink 1993). 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 conditions.” For Corps programs, a wetland 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 wetland (i.e., a wetland subject to federal regulations), it must have **all** three of the following criteria: (1) wetland plants; (2) wetland hydrology; and (3) hydric soils.

The U.S. Fish and Wildlife Service defines wetlands from an ecological point of view. *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin *et al.* 1979) 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/or (3) the substrate is non-soil 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.

CNHP 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, which often do not meet all three of the Corps’ criteria, should be included in a wetland conservation program. Riparian areas perform many of the same functions as other wetland types, including maintenance of water quality, storage of floodwaters, and enhancement of biodiversity, especially in the western United States (National Research Council 1995).

Wetland Regulation in Colorado

Wetlands in Colorado are currently regulated under the authority of the Clean Water Act. A permit issued by the Corps is required before placing fill in a wetland 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.

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). Photo-interpretation and field

reconnaissance was 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 for a 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.

Wetland Functions and Values

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:

- Groundwater recharge--the replenishing of below ground aquifers.
- Groundwater 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 adsorbed to these particles.
- Nutrient removal/transformation--the removal of excess nutrients from the water, in particular nitrogen and phosphorous. Phosphorous is often removed via sedimentation; transformation includes converting inorganic forms of nutrients to organic forms and/or the conversion of one inorganic form to another inorganic form (e.g., NO_3^- converted to N_2O or N_2 via denitrification).
- Production export--supply organic material (dead leaves, soluble organic carbon, etc.) to the base of the food chain.
- Aquatic diversity/abundance--wetlands support fisheries and aquatic invertebrates.
- 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, bird watching, etc.
- Uniqueness/heritage value--wetlands support rare and unique plants, animals, and plant associations.

"Values" are subject to societal perceptions, whereas "functions" are biological or physical 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.

Wetland Functional Assessment

For this project, CNHP utilized a qualitative, descriptive functional assessment based on the best professional judgment of CNHP ecologists while incorporating some of the principles of the hydrogeomorphic (HGM) assessment method. Each wetland was classified according to both the Cowardin *et al.* (1979) and hydrogeomorphic (HGM) (Brinson 1993) classification systems and twelve categories (listed below) were used to assess each wetland. Using the HGM method, wetland functions are evaluated or compared 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 associations never found on a large river but provides little in the way of flood control, while wetlands along a major river perform important flood control functions but may not harbor rare plant species. Thus, the category,

Overall Functional Integrity was included in the functional assessment to provide the user of some indication of how a particular wetland is functioning in comparison to its natural capacity, as opposed to comparing it to different wetland types.

The functional assessment assigns to most of the functions a value rating of “low,” “moderate,” or “high.” Overall Functional Integrity is given as either “At Potential” or “Below Potential.” Elemental Cycling is rated as either “Normal” or “Disrupted” depending on unnatural disturbances. The following functions were evaluated for most of the PCAs profiled in this report:

- Overall functional integrity
- Flood attenuation and storage
- Sediment/shoreline stabilization
- Groundwater discharge/recharge
- Dynamic surface water storage
- Elemental cycling
- Removal of imported nutrients, toxicants, and sediments
- Habitat diversity
- General wildlife habitat
- General fish/aquatic habitat
- Production export/food chain support
- Uniqueness

Overall Functional Integrity

The overall functional integrity of each wetland is a rating indicating how a particular wetland is functioning in comparison to wetlands in its same hydrogeomorphic class and/or subclass. For example, mineral soil flats (salt meadows) do not typically function as high wildlife habitat but do have high capacity for storing surface/groundwater. Thus, a mineral soil flat that is given a low rating for General Wildlife Habitat, General Fish Habitat, and Production Export/Food Chain Support does not necessarily indicate that the wetland is not functioning to its capacity. These ratings may just reflect that mineral soil flats, because of their landscape position and soil chemistry, naturally perform fewer functions than a depressional wetland. However, this particular wetland may be functioning the ‘best’ that could be expected from a mineral soil flat. The Overall Functional Integrity rating would reflect this by giving this particular wetland an "At Potential" rating based on the best professional judgment of CNHP ecologists. In summary, a mineral soil flat wetland having more low ratings than a depressional wetland does not necessarily mean that it is functioning improperly. However, if this particular mineral soil flat was given an Overall Functional Integrity rating of "Below Potential," then it could be assumed

that the wetland is not functioning to the capacity that it should (relative to other mineral soil flat wetlands).

Flood Attenuation and Storage

Many wetlands have a high capacity to store or delay floodwaters 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. This field assesses the capability of the wetland to detain moving water from in-channel flow or overbank flow for a short duration when the flow is outside of its channel.

Sediment/Shoreline Stabilization

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 sediment/shoreline anchoring.

Groundwater Discharge/Recharge

Groundwater recharge occurs when the water level in a wetland is higher than the surrounding water table resulting in the movement (usually downward) of surface water. Groundwater discharge results when the groundwater level of a wetland is lower than the surrounding water table, resulting in the movement (usually laterally or upward) of surface water (e.g., springs, seeps, etc.). Ground water movement can greatly influence some wetlands, whereas in others it may have minimal effect (Carter and Novitzki 1988).

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 the presence of seeps and springs and wet slopes with no obvious source.

Dynamic Surface Water Storage

Dynamic surface water storage refers to the potential of the wetland to capture water from precipitation and upland surface (sheetflow). Sheetflow is nonchannelized flow that usually occurs during and immediately following rainfall or a spring thaw. Wetlands can also receive surface inflow from seasonal or episodic pulses of floodwaters from adjacent streams and rivers that may otherwise not be hydrologically connected with a particular wetland (Mitsch and Gosselink 1993). Spring thaw and/or rainfall can also create a time-lagged increase in groundwater flow. Wetlands providing dynamic surface water storage are capable of releasing these episodic pulses of water at a slow, stable rate thus alleviating short term flooding from such events. This function is applicable to wetlands that are not subject to flooding from in-channel or overbank flow (see Flood Storage and Attenuation). Indicators of potential surface water storage include flooding frequency, density of woody vegetation (particular those species with many small stems), coarse woody debris, surface roughness, and size of the wetland.

Elemental Cycling

The cycling of nutrients, or the abiotic and biotic processes that convert elements from one form to another, is a fundamental ecosystem process, which maintains a balance between living biomass and detrital stocks (Brinson *et al.* 1985). Disrupting nutrient cycles could cause an imbalance between the two resulting in one factor limiting the other. Thus, impacts to aboveground primary productivity or disturbances to the soil, which may cause a shift in nutrient cycling rates, could change soil fertility, alter plant species composition, and affect potential

habitat functions. Indicators of wetlands with intact nutrient cycling need to be considered relative to wetlands within the same hydrogeomorphic class/subclass. Such indicators include high aboveground primary productivity and high quantities of detritus, within the range expected for that particular hydrogeomorphic class of wetlands.

Removal of Imported Nutrients, Toxicants, and Sediments

Nutrient retention/removal is the storing and/or transformation of nutrients within the sediment or vegetation. Inorganic nutrients can be transformed into an organic form and/or converted to another inorganic form via microbial respiration and redox reactions. For example, denitrification, which is a process that is mediated by microbial respiration, results in the transformation of nitrate (NO_3^-) to nitrous oxide (N_2O) and/or molecular nitrogen (N_2). Nutrient retention/removal may help protect water quality by retaining or transforming nutrients before they 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 may be for long-term (greater than 5 years) as in peatlands or depressional marshes or short-term (30 days to 5 years) as in riverine wetlands. 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.

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. 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.

Habitat Diversity

Habitat diversity refers to the number of Cowardin wetland classes present at each site. Thus, a site with emergent, scrub/shrub, and forested wetland habitat would have high habitat diversity. The presence of open water in these areas also increases the habitat diversity at a site.

General Wildlife and Fish 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. 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, diversity of vegetation structure, and a sinuous and irregular basin.

Production Export/Food Chain Support

Production export refers to the flushing of organic material (both particulate and dissolved organic carbon and detritus) from the wetland to downstream ecosystems. Production export emphasizes the production of organic substances within the wetland and the utilization of these substances by fish, aquatic invertebrates, and microbes. Food chain support is the direct or indirect use of nutrients, carbon, and even plant species (which provide cover and food for many invertebrates) by organisms, which inhabit or periodically use wetland ecosystems. Indicators of wetlands that provide downstream food chain support are: an outlet, seasonally flooded hydrological regime, overhanging vegetation, and dense and diverse vegetation composition and structure.

Uniqueness

This value expresses the general uniqueness of the wetland in terms of relative abundance of similar sites occurring in the same watershed, size, geomorphic position, peat accumulation, mature forested areas, and the replacement potential.

Hydrogeomorphic (HGM) Approach to Wetland Functional Assessment

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 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 (Colorado Geological Survey *et al.* 1998).

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 Colorado: riverine, slope, depression, and mineral soil flats (Table 1). 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.

One of the fundamental goals of HGM is to create a system whereby every wetland is evaluated according to the same standard. In the past, wetland functional assessments typically were on a site-by-site basis, with little ability to compare functions or assessments between sites. HGM 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 reference wetlands is a *reference standard*, wetlands that correspond to the highest level of functioning of the ecosystem across a suite of functions (Brinson and Rheinhardt 1996).

HGM assumes that the 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 are assumed to be at a dynamic equilibrium, which allows maximum ecological function (Smith *et al.* 1995). If a wetland is to be designated a reference standard for a given subclass of wetlands, it must meet these criteria. The need to locate reference wetlands is compatible 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 biological significance.

Table 1. Hydrogeomorphic wetland classes in Colorado (Colorado Geological Survey *et al.* 1998).

Class	Geomorphic setting	Water Source	Water Movement	Subclass	Examples
	In riparian areas along rivers and streams	Overbank flow from channel	One-directional and horizontal downstream	R1-steep gradient, low order streams	The <i>Salix brachycarpa</i> / mesic forbs community at Dolores River at Snow Spur
				R2-moderate gradient, low to middle order	Wetlands along Fish Creek.

Class	Geomorphic setting	Water Source	Water Movement	Subclass	Examples
Riverine				R3-middle elevation, moderate gradient along small/mid-order stream	The <i>Picea pungens</i> - <i>Populus angustifolia</i> plant communities found along West Dolores River and Dolores River
				R4-low elevation canyons or plateaus	The riparian plant communities within the Dolores River Canyon
				R5-low elev. floodplains	San Juan River; Colorado River floodplains
Slope	At the base of slopes, e.g., along the base of the foothills; also, places where porous bedrock overlying non-porous bedrock intercepts the ground surface.	Groundwater	One-directional, horizontal to the surface from groundwater	S1-alpine and subalpine fens on non-calcareous substrates.	Iron fens in San Juan County.
				S2-subalpine and montane fens on calcareous substrates	Fen at Snow Spur tributary and wet meadows of The Coal Creek Meadows.
				S3-wet meadows at middle elev.	Large hillside seeps. Stock reservoir sites in western SJNF.
				S4-low elevation meadows	Dolores River Canyon <i>Epipactis gigantea</i> location in Montezuma County.
Depressional	In depressions cause by glacial action (in the mountains) and oxbow ponds within floodplains. Lake, reservoir, and pond margins are also included.	Shallow ground water	Generally two-directional, vertical: flowing into and out of the wetland in the bottom and sides of the depression	D1-mid to high elevation basins with peat soils or lake fringe without peat	Lakes at Bolam Pass fen.
				D2-low elevation basins that are permanently or semi-permanently flooded	Wetlands at Glade Lake. Depressional oxbow wetlands in Animas River floodplain
				D3-low elevation basin with seasonal flooding	Depressional wetlands in Colorado River floodplain
				D4-low elevation basins that are temporarily flooded	Abandoned beaver ponds

Class	Geomorphic setting	Water Source	Water Movement	Subclass	Examples
				D5-low elevation basins that are intermittently flooded	Playa lakes
Mineral Soil Flat	Topographically flat wetland	Precipitation and groundwater	Two directional	F1-low elevation with seasonal high water table	Antero Reservoir in South Park

THE NATURAL HERITAGE NETWORK AND BIOLOGICAL DIVERSITY

Just as ancient artifacts and historic buildings represent our cultural heritage, a diversity of plant and animal species and their habitats represent our “natural heritage.” Colorado’s natural heritage encompasses a wide variety of ecosystems from tallgrass prairie and shortgrass high plains to alpine cirques and rugged peaks, from canyon lands and sagebrush shrublands to dense subalpine spruce-fir forests and wide-open tundra.

These widely diversified habitats are determined by water availability, temperature extremes, altitude, geologic history, and land use history. The species that inhabit each of these ecosystems have adapted to the specific set of conditions found there. Because human influence today touches every part of the Colorado environment, we are responsible for understanding our impacts and carefully planning our actions to ensure our natural heritage persists for future generations.

Some generalist species, like house finches, have flourished over the last century, having adapted to habitats altered by humans. However, many other species are specialized to survive in vulnerable Colorado habitats; among them are Bell’s twinpod (a wildflower), the Arkansas darter (a fish), and the Pawnee montane skipper (a butterfly). These species have special requirements for survival that may be threatened by incompatible land management practices and competition from non-native species. Many of these species have become imperiled not only in Colorado, but also throughout their range of distribution. Some species exist in less than five populations in the entire world. The decline of these specialized species often indicates disruptions that could permanently alter entire ecosystems. Thus, recognition and protection of rare and imperiled species is crucial to preserving Colorado’s diverse natural heritage.

Colorado is inhabited by some 800 vertebrate species and subspecies, and tens of thousands of invertebrate species. In addition, the state has approximately 4,300 species of plants and more than 450 recognized plant associations that represent upland and wetland ecosystems. It is this rich natural heritage that has provided the basis for Colorado’s diverse economy. Some components of this heritage have always been rare, while others have become imperiled with human-induced changes in the landscape. This decline in biological diversity 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 biological diversity has been recognized for decades in the scientific community. However, many conservation efforts made in this country were not based upon preserving biological diversity; 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 biological diversity Dr. Robert Jenkins of The Nature Conservancy pioneered the Natural Heritage Methodology in the early 1970s.

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 their biology and known threats. By ranking the relative rarity or imperilment of a species, the quality of its populations, and the importance of associated conservation sites, the methodology can facilitate the prioritization of conservation efforts so the most rare and imperiled species may be preserved first. As the scientific community realized that plant associations are equally important as individual species, this methodology has been applied to ranking and preserving rare plant associations, as well as the best examples of common associations.

The Natural Heritage Methodology is used by Natural Heritage Programs throughout North, Central, and South America, forming an international database network. The 85 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. Information collected by the Natural Heritage Programs can provide a means to protect species before the need for legal endangerment status arises. It can also enable 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 single-celled organisms such as bacteria and protists through the multicellular kingdoms of plants and animals. 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 associations in which species live, the ecosystems in which associations exist, and the interactions between these levels. All levels are necessary for the continued survival of species and plant associations, and many are important for the well being of humans.

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

Genetic Diversity — the genetic variation within a population and among populations of a plant or animal species. The genetic makeup of a species varies 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. Once lost, this unique genetic information cannot be reclaimed.

Species Diversity — the total number and abundance of plant and animal species and subspecies in an area.

Community Diversity — the variety of plant communities or associations within an area that represent the range of species relationships and inter-dependence. These associations may be diagnostic or even restricted to an area. Although the terms plant association and plant community have been described by numerous ecologists, no general consensus of their meaning has developed. The terms are similar, somewhat overlapping, and are often used more or less interchangeably. The U.S. National Vegetation Classification (USNVC) (Anderson *et al.* 1998), the accepted national standard for vegetation, defines a community as an "assemblage of species that co-occur in defined areas at certain times and that have the potential to interact with one another", and a plant association as a type of plant community with "definite floristic

composition, uniform habitat conditions, and uniform physiognomy" (Flahault and Schroter 1910). Identifying and protecting representative examples of plant communities ensures conservation of multiple numbers of species, biotic interactions, and ecological process. Using communities as a "coarse-filter" enables conservation efforts to work toward protecting a more complete spectrum of biological diversity.

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

Colorado 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 the Colorado Division of Parks and Outdoor Recreation for 14 years, the Program was relocated to the University of Colorado Museum in 1992, and then to the College of Natural Resources at Colorado State University in 1994, where it has operated since.

The multi-disciplinary team of scientists, planners, and information managers at CNHP gathers comprehensive information on the rare, threatened, and endangered species and significant plant associations 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.

Biodiversity Tracking and Conservation System (Biotics) developed by NatureServe is used by all Natural Heritage Programs to house data about imperiled species. This database includes taxonomic group, global and state rarity rank, federal and state legal status, observation source, observation date, county, township, range, watershed, and other relevant facts and observations. These rare species and plant associations are referred to as "elements of natural diversity" or simply "elements."

Concentrating on site-specific data for each element enables CNHP to evaluate the significance of each location for the conservation of biological diversity in Colorado and in the nation. By using species imperilment ranks and quality ratings for each location, priorities can be established to guide conservation action. A continually updated locational database and priority-setting system such as that maintained by CNHP provides an effective, proactive land-use planning tool.

To assist in biological diversity conservation efforts, CNHP scientists strive to answer questions such as the following:

- 1) What species and ecological associations exist in the area of interest?
- 2) Which are at greatest risk of extinction or are otherwise significant from a conservation perspective?
- 3) What are their biological and ecological characteristics, and where are these priority species or associations found?
- 4) What is the species' condition at these locations, and what processes or activities are sustaining or threatening them?
- 5) Where are the most important sites to protect?
- 6) Who owns or manages those places deemed most important to protect, and what is threatening those places?
- 7) What actions are needed for the protection of those sites and the significant elements of biological diversity they contain?
- 8) How can we measure our progress toward conservation goals?

CNHP has effective working relationships with several state and federal agencies, including the Colorado Department of Natural Resources, the Colorado Division of Wildlife, Colorado State Parks, Colorado Department of Transportation, the Bureau of Land Management, and the U.S. Forest Service. Numerous local governments and private entities, such as consulting firms, educators, landowners, county commissioners, and non-profit organizations, also work closely with CNHP. Use of the data by many different individuals and organizations encourages a cooperative and proactive approach to conservation, thereby reducing the potential for conflict.

The Natural Heritage Ranking System

Key to the functioning of Natural Heritage Programs is the concept of setting priorities for gathering information and conducting inventories. The number of possible facts and observations that can be gathered about the natural world is essentially limitless. The financial and human resources available to gather such information are not. Because biological inventories tend to be under-funded, there is a premium on devising systems that are both effective in providing information that meets users' needs and efficient in gathering that information. The cornerstone of Natural Heritage inventories is the use of a ranking system to achieve these twin objectives of effectiveness and efficiency.

Ranking species and ecological associations according to their imperilment status provides guidance for where Natural Heritage Programs should focus their information-gathering activities. For species deemed secure, only general information needs to be maintained by Natural Heritage Programs. Fortunately, the more common and secure species constitute the majority of most groups of organisms. On the other hand, for those species that are by their nature rare, more detailed information is needed. Because of these species' rarity, gathering comprehensive and detailed population data can be less daunting than gathering similarly comprehensive information on more abundant species.

To determine the status of species within Colorado, CNHP gathers information on plants, animals, and plant associations. Each of these elements of natural diversity is assigned a rank that indicates its relative degree of imperilment on a five-point scale (for example, 1 = extremely

rare/imperiled, 5 = abundant/secure). The primary criterion for ranking elements is the number of occurrences (in other words, the number of known distinct localities or populations). This factor is weighted more heavily than other factors 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, the trends in both population and distribution, identifiable threats, and the number of protected occurrences.

Element imperilment ranks are assigned both in terms of the element's degree of imperilment within Colorado (its State-rank or S-rank) and the element's imperilment over its entire range (its Global-rank or G-rank). Taken together, these two ranks indicate the degree of imperilment of an element. For example, the lynx, which is thought to be secure in northern North America but is known from less than five current locations in Colorado, is ranked G5 S1 (globally-secure, but critically imperiled in this state). The Rocky Mountain Columbine, which is known only in Colorado from about 30 locations, is ranked a G3 S3 (vulnerable both in the state and globally, since it only occurs in Colorado and then in small numbers). Further, a tiger beetle that is only known from one location in the world at the Great Sand Dunes National Monument is ranked G1 S1 (critically imperiled both in the state and globally, because it exists in a single location). CNHP actively collects, maps, and electronically processes specific occurrence information for animal and plant species considered extremely imperiled to vulnerable in the state (S1 - S3). Several factors, such as rarity, evolutionary distinctiveness, and endemism (specificity of habitat requirements), contribute to the conservation priority of each species. Certain species 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 2.

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 3, ranks followed by a "B," for example S1B, indicate that the rank applies only to the status of breeding occurrences. Similarly, ranks followed by an "N," for example S4N, refer to non-breeding status, typically during migration and winter. Elements without this notation are believed to be year-round residents within the state.

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 with an "S" or a "G" respectively, followed by a number or letter. These ranks should not be interpreted as legal designations.

Table 2. Definition of natural heritage imperilment ranks.

G/S1	Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or 1,000 or fewer individuals), or because some factor of its biology makes it especially vulnerable to extinction.
G/S2	Imperiled globally/state because of rarity (6 to 20 occurrences, or 1,000 to 3,000 individuals), or because other factors demonstrably make 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, or 3,000 to 10,000 individuals).
G/S4	Apparently secure globally/state, though it may be quite rare in parts of its range, especially at the periphery. Usually more than 100 occurrences and 10,000 individuals.
G/S5	Demonstrably secure globally/state, though it may be quite rare in parts of its range, especially at the periphery.
G/SX	Presumed extinct globally, or extirpated within the state.
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 usually not verified for an extended period of time.
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 residents.
S#N	Refers to the non-breeding season imperilment of elements that are not permanent residents. Where no consistent location can be discerned for migrants or non-breeding populations, a rank of SZN is used.
SZ	Migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected.
SA	Accidental in the state.
SR	Reported to occur in the state but unverified.
S?	Unranked. Some evidence that species may be imperiled, but awaiting formal rarity ranking.

Note: Where two numbers appear in a state or global rank (for example, S2S3), the actual rank of the element is uncertain, but falls within the stated range.

Legal Designations for Rare Species

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 3 defines the special status assigned by these agencies and provides a key to abbreviations used by CNHP.

Candidate species for listing as endangered or threatened under the Endangered Species Act are indicated with a “C.” While obsolete legal status codes (Category 2 and 3) are no longer used, CNHP continues to maintain them in its Biological and Conservation Data system for reference.

Table 3. Federal and State Agency special designations for rare species.

Federal Status:	
1. U.S. Fish and Wildlife Service (58 Federal Register 51147, 1993) and (61 Federal Register 7598, 1996)	
LE	Listed Endangered: defined as a species, subspecies, or variety in danger of extinction throughout all or a significant portion of its range.
E (S/A)	Endangered: treated as endangered due to similarity of appearance with listed species.
LT	Listed Threatened: defined as a species, subspecies, or variety likely to become endangered in the foreseeable future throughout all or a significant portion of its range.
P	Proposed: taxa formally proposed for listing as Endangered or Threatened (a proposal has been published in the Federal Register, but not a final rule).
C	Candidate: taxa for which substantial biological information exists on file to support proposals to list them as endangered or threatened, but no proposal has been published yet in the Federal Register.
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: Significant current or predicted downward trends in population numbers or density. 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.
4. State Status:	
The Colorado Division of Wildlife has developed categories of imperilment for non-game species (refer to the Colorado Division of Wildlife’s Chapter 10 – Nongame Wildlife of the Wildlife Commission's regulations). The categories being used and the associated CNHP codes are provided below.	
E	Endangered: those species or subspecies of native wildlife whose prospects for survival or recruitment within this state are in jeopardy, as determined by the Commission.
T	Threatened: those species or subspecies of native wildlife which, as determined by the Commission, are not in immediate jeopardy of extinction but are vulnerable because they exist in such small numbers, are so extremely restricted in their range, or are experiencing such low recruitment or survival that they may become extinct.
SC	Special Concern: those species or subspecies of native wildlife that have been removed from the state threatened or endangered list within the last five years; are proposed for federal listing (or are a federal listing “candidate species”) and are not already state listed; have experienced, based on the best available data, a downward trend in numbers or distribution lasting at least five years that may lead to an endangered or threatened status; or are otherwise determined to be vulnerable in Colorado.

Element Occurrences and their Ranking

Actual locations of elements, whether they are single organisms, populations, or plant associations, 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. To prioritize element occurrences for a given species, an element occurrence rank (EO-Rank) is assigned according to the ecological quality of the occurrences 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 three factors:

Size – a measure of the area or abundance of the element’s occurrence, relative to other known, and/or presumed viable, examples. Takes into account factors such as area of occupancy, population abundance, population density, population fluctuation, and minimum dynamic area (which is the area needed to ensure survival or re-establishment of an element after natural disturbance).

Condition/Quality – an integrated measure of the composition, structure, and biotic interactions that characterize the occurrence. This includes factors such as reproduction, age structure, biological composition (such as the presence of non-native versus native species), structure (for example, canopy, understory, and ground cover in a forest community), and biotic interactions (such as levels of competition, predation, and disease).

Landscape Context – an integrated measure of two factors: the dominant environmental regimes and processes that establish and maintain the element, and connectivity. Dominant environmental regimes and processes include herbivory, hydrologic and water chemistry regimes (surface and groundwater), geomorphic processes, climatic regimes (temperature and precipitation), fire regimes, and many kinds of natural disturbances. Connectivity includes such factors as a species having access to habitats and resources needed for life cycle completion, fragmentation of ecological associations and systems, and the ability of the species to respond to environmental change through dispersal, migration, or re-colonization.

Each of these factors is 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 not enough information is available to rank an element occurrence, an EO-Rank of E is assigned. EO-Ranks and their definitions are summarized in Table 4.

Table 4. Element occurrence ranks and their definitions.

A	Excellent viability.
B	Good viability
C	Fair viability.
D	Poor viability.
H	Historic: known from historical record, but not verified for an extended period of time.
X	Extirpated (extinct within the state).
E	Extant: the occurrence does exist but not enough information is available to rank.
F	Failed to find: the occurrence could not be relocated.

Potential Conservation Areas and Their Ranking

In order to successfully protect populations or occurrences, it is helpful to delineate Potential Conservation Areas (PCAs). These PCAs focus on capturing the ecological processes that are necessary to support the continued existence of a particular element occurrence of natural

heritage significance. Potential Conservation Areas may include a single occurrence of a rare element, or a suite of rare element occurrences or significant features.

The goal of the PCA process is to identify a land area that can provide the habitat and ecological processes upon which a particular element occurrence, or suite of element occurrences, depends for its continued existence. The best available knowledge about each species' life history is used in conjunction with information about topographic, geomorphic, hydrologic features, vegetative cover; and current and potential land uses. In developing the boundaries of a Potential Conservation Area, CNHP scientists consider a number of factors that include, but are not limited to:

- ecological processes necessary to maintain or improve existing conditions;
- species movement and migration corridors;
- maintenance of surface water quality within the PCA and the surrounding watershed;
- maintenance of the hydrologic integrity of the groundwater;
- land intended to buffer the PCA against future changes in the use of surrounding lands;
- exclusion or control of invasive non-native species;
- land necessary for management or monitoring activities.

The boundaries presented are meant to be used for conservation planning purposes and have no legal status. The proposed boundary does not automatically recommend exclusion of all activity. Rather, the boundaries designate ecologically significant areas in which land managers may wish to consider how specific activities or land use changes within or near the PCA affect the natural heritage resources and sensitive species on which the PCA is based. Please note that these boundaries are based on our best estimate of the primary area supporting the long-term survival of targeted species and plant associations. A thorough analysis of the human context and potential stresses has not been conducted. However, CNHP's conservation planning staff is available to assist with these types of analyses where conservation priority and local interest warrant additional research.

Off-Site Considerations

Frequently, all necessary ecological processes cannot be contained within a site of reasonable size. The boundaries described in this report indicate the immediate, and therefore most important, area to be considered for protection. Continued landscape level conservation efforts are necessary as well, which will involve regional efforts in addition to coordination and cooperation with private landowners, neighboring land planners, and state and federal agencies.

Ranking of Potential Conservation Areas

CNHP uses element and element occurrence ranks to assess the overall biological diversity significance of a PCA, which may include one or many element occurrences. Based on these ranks, each PCA is assigned a biological diversity rank (or B-rank). See Table 5 for a summary of these B-ranks.

Table 5. Natural Heritage Program biological diversity ranks and their definitions.

B1	<p>Outstanding Significance:</p> <p>Only known occurrence of an element</p> <p>A-ranked occurrence of a G1 element (or at least C-ranked if best available occurrence)</p> <p>Concentration of A- or B-ranked occurrences of G1 or G2 elements (four or more)</p>
B2	<p>Very High Significance:</p> <p>B- or C-ranked occurrence of a G1 element</p> <p>A- or B-ranked occurrence of a G2 element</p> <p>One of the most outstanding (for example, among the five best) occurrences rangewide (at least A- or B-ranked) of a G3 element.</p> <p>Concentration of A- or B-ranked G3 elements (four or more)</p> <p>Concentration of C-ranked G2 elements (four or more)</p>
B3	<p>High Significance:</p> <p>C-ranked occurrence of a G2 element</p> <p>A- or B-ranked occurrence of a G3 element</p> <p>D-ranked occurrence of a G1 element (if best available occurrence)</p> <p>Up to five of the best occurrences of a G4 or G5 community (at least A- or B-ranked) in an ecoregion (requires consultation with other experts)</p>
B4	<p>Moderate Significance:</p> <p>Other A- or B-ranked occurrences of a G4 or G5 community</p> <p>C-ranked occurrence of a G3 element</p> <p>A- or B-ranked occurrence of a G4 or G5 S1 species (or at least C-ranked if it is the only state, provincial, national, or ecoregional occurrence)</p> <p>Concentration of A- or B-ranked occurrences of G4 or G5 N1-N2, S1-S2 elements (four or more)</p> <p>D-ranked occurrence of a G2 element</p> <p>At least C-ranked occurrence of a disjunct G4 or G5 element</p> <p>Concentration of excellent or good occurrences (A- or B-ranked) of G4 S1 or G5 S1 elements (four or more)</p>
B5	<p>General or State-wide Biological Diversity Significance: good or marginal occurrence of common community types and globally secure S1 or S2 species.</p>

Protection Urgency Ranks

Protection urgency ranks (P-ranks) refer to the timeframe in which it is recommended that conservation protection occur. In most cases, this rank refers to the need for a major change of protective status (for example agency special area designations or ownership). The urgency for protection rating reflects the need to take legal, political, or other administrative measures to protect the area. Table 6 summarizes the P-ranks and their definitions.

Table 6. Natural Heritage Program protection urgency ranks and their definitions.

P1	Protection actions needed immediately. It is estimated that current stresses may reduce the viability of the elements in the PCA within 1 year.
P2	Protection actions may be needed within 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA within this approximate timeframe.
P3	Protection actions may be needed, but probably not within the next 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA if protection action is not taken.
P4	No protection actions are needed in the foreseeable future.
P5	Land protection is complete and no protection actions are needed.

A protection action involves increasing the current level of protection accorded one or more tracts within 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. Situations that may require a protection action are as follows :

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

Management Urgency Ranks

Management urgency ranks (M-ranks) indicate the timeframe in which it is recommended that a change occur in management of the element or site. This rank refers to the need for management in contrast to protection (for example, increased fire frequency, decreased grazing, 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 non-natives, 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. Table 7 summarizes M-ranks and their definitions.

Table 7. Natural Heritage Program management urgency ranks and their definitions.

M1	Management actions may be required within one year or the element occurrences could be lost or irretrievably degraded.
M2	New management actions may be needed within 5 years to prevent the loss of the element occurrences within the PCA.
M3	New management actions may be needed within 5 years to maintain the current quality of the element occurrences in the PCA.
M4	Current management seems to favor the persistence of the elements in the PCA, but management actions may be needed in the future to maintain the current quality of the element occurrences.
M5	No management needs are known or anticipated in the PCA.

PROJECT BACKGROUND

Location and Physical Characteristics of the Study Area

Dolores County comprises approximately 1,076 square miles or 689,207 acres of southwest Colorado (Figure 1). The western portion of the county is located within the Colorado Plateau Ecoregion and the eastern portion is located within the Southern Rocky Mountains Ecoregion as described by The Nature Conservancy (Figure 2). Elevations range from approximately 6,000 to 14,300 feet. San Miguel, San Juan, and Montezuma counties border Dolores County in Colorado and San Juan County, Utah. The northeastern county line follows the divide between the San Miguel and Dolores rivers (northern and southern exposures of the San Miguel Mountains), while the eastern border is defined as



Figure 1. Location of Dolores County in Colorado.

the divide between the Dolores River and Hermosa Creek. Otherwise, county borders are straight political boundaries. The major population centers in Dolores County are towns of Dove Creek (county seat) and the Town Rico. Dove Creek is in the western part of the county where dry land and irrigated agriculture dominates the landscape. The Town of Rico is in the eastern part of the county, in a montane setting on the Dolores River. National Forest surrounds the Town of Rico where land use is dominated by recreation. According to the United States Census Bureau (2002), Dolores County had a population of 1,844 individuals in the year 2000, with a projected population decreasing to 1,825 by the year 2003.

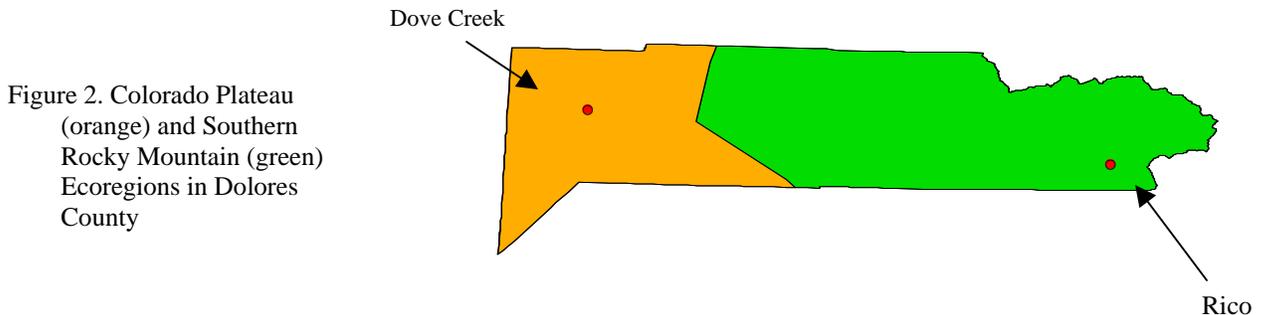


Figure 2. Colorado Plateau (orange) and Southern Rocky Mountain (green) Ecoregions in Dolores County

The climate of Dolores County is generally sunny and dry, where the montane region in the east receives more annual precipitation than the plateau region. There are four distinct seasons where temperatures are generally moderate, due to the relatively low humidity (Doesken *et al.* 2003). There are nearly 100 days of freeze-free period and an average of 300 days of sunshine annually (WRCC 2005). Rico's average maximum temperature in July is 75.4°F, according with averaged data from 1948 to 2001 (WRCC 2005). Northdale (near Dove Creek) records an average maximum temperature in July of 86.5°F, according with averaged data from 1948 to 2002 (WRCC 2005). Average high and low temperatures for Rico in January are 38.2°F and 5.2°F respectively while for Northdale they are 36.7°F and 9.8°F (WRCC 2005). The climate is influenced by prevailing westerly winds that carry storms from the Pacific and by the overall north/south orientation of the San Juan Mountains. Generally, in the western plateau region, the driest month is June and the wettest is August, when the summer monsoons ensue (WRCC 2005). In the mountains the wettest and driest months can vary due to the local elevations, topography and wind patterns (Doesken *et al.* 2003). Winter precipitation varies with

altitude as does snow and rain fall. Records show Rico's annual precipitation averages 26 inches per year, and Northdale's averages 12 inches per year (WRCC 2005; WorldClimate 2005). During the summer of 2002, on-going drought conditions culminated where people in the region commonly reported turning off irrigation ditches early, closing farm operations, or selling cattle to reduce herd demands.

The varied physical characteristics of Dolores County are derived from geologic formations ranging in age from Tertiary volcanic rock, to Mesozoic Era sedimentary shale and sandstone, to the sedimentary and conglomerates of the Paleozoic formations, to the Pre Cambrian quartzite, granite, conglomerates and shale. At Lizardhead Pass, in the northeastern part of the County, the San Miguel Mountains dominate the skyline. The mountain range is generally comprised from volcanic tuff from the Middle Phase volcanism (Chronic and Williams 2002) with Tertiary granites and metamorphic rock (Blair *et al.* 1996). Sheep Mountain, a prominent peak west of the San Miguel Mountains displays large rock slides that are comprised of volcanic tuff and ash, and Telluride conglomerate (Blair *et al.* 1996). Cretaceous aged Mancos shale is exposed by the slides, which lends the mountain its greenish hue (Chronic and Williams 2002). Mancos shale is quite common in the county, and comprises the surface underlying the wet meadows at Lizardhead Pass (Blair *et al.* 1996). Glaciers carved this wide valley and others in the last glacial epoch, some leaving behind glacial moraines (Blair *et al.* 1996). The Rico Mountains rise above the Town of Rico along an east west axis and are comprised of Pennsylvanian aged Hermosa Formation, Permian aged Cutler formation (Blair *et al.* 1996) and other sedimentary rock. The Rico Dome was lifted upward by Tertiary intrusions (Chronic and Williams 2002) and then fractured several times. These fractures are often rich in minerals, hence a long history of silver mining occurs in the area. The Dolores River neatly reveals rocks of the Cutler Formation immediately south of Rico (Blair *et al.* 1996). Otherwise, surface geology surrounding the town is covered by numerous rock slides. Along the West Dolores River, south of the Rico Mountains, the Cutler Formation and the Triassic aged Dolores Formation are revealed (Tweto 1979). The mountains rising west of the West Dolores River expose the Dakota sandstone (Tweto 1979).

Mancos shale and Dakota sandstone dominate the middle elevation geology in Dolores County, especially in the central and western parts. For example, The Glade, a non-forested anticline, is comprised of Mancos shale exposed in a long ridge above the Dakota sandstone (Tweto 1979). The estimated boundary between the Colorado Plateau and Southern Rocky Mountains Ecoregions is located where a large expanse of Dakota Sandstone and Mancos Shale meet and intermix (Tweto 1979). This area is rich in spring discharges, and in addition to the gentle rising gradient and open grasslands and sage flats, is widely used for cattle grazing. Other formations in the central part of the County include the Mesa Verde Formation exposed at South Mountain, and the Jurassic aged Morrison formation exposed in the canyons draining northward into the Disappointment Creek (Tweto 1979).

The landscape in the western portion of the County is comprised of the canyons, plateaus and cuernas of the Colorado Plateau. This large uplift occurred in the Cenozoic Era during the Laramide Orogeny when pressures that caused the mountain uplifts changed direction, twisting free the Colorado Plateau from the mountain ranges (Chronic and Williams 2002). Locally, the area is known as the Dolores Plateau (USDA, NRCS 2003) and Dakota sandstone, a common cap rock is widely exposed (Tweto 1979). Near Dove Creek, the "...Dakota surface ... is veneered with a layer of glacially ground, windblown Pleistocene silt particularly well suited to growing beans – the fine soil is a relic of a very different climate" (Chronic and Williams 2002). Pinto beans are the most common dry land crop in the area where winter wheat is also grown. Irrigated crops include alfalfa and small grains (USDA, NRCS 2003). The lower Dolores River Canyon carves deep into the Colorado Plateau revealing sandstones from the Entrada and Wanakah formations and the soft shale and sandstone of the Morrison Formation – this same combination exists in the Narraquinne and Plateau Canyon tributaries. Farther north in the canyon, the

formations shift slightly to the Morrison Formation, Entrada sandstone and the Summerville Formation comprised of shale and siltstone. The Entrada sandstone is often the cap rock over the softer, brighter colored Morrison shale. As the Dolores River exits the County, the Glen Canyon group and Chinle Formation (red siltstone) are revealed. The Glen Canyon Group is comprised of Navajo Sandstone, Kayenta Formation (red siltstone, shale and sandstone), and Wingate Sandstone (Tweto 1979). These sedimentary formations combine to create a colorful display of tan, white, yellow, orange, and red, creating the awesome beauty for which the canyon is well known.

The geology of Dolores County is the basis for the various soils, and in many cases minerals and subsequent land uses. Western Dolores County lies on the fine ground soils of glaciated rock suitable for agriculture. The western part of the county is mainly irrigated crops as well as dry land crops e.g., pinto beans. The eastern part of the county lies in the mineral belt of Colorado, where remnants of mining activity are common. Geologic structural units influence the distribution of wetland plant associations through their direct effect on soil development, groundwater movement, and fluvial processes. For example, numerous seeps and springs exist in the San Juan volcanic area, and are likely discharging from permeable bedrock derived from lava flows, tuffs, and ash flows. Slope and depressional wetlands are found in these areas. Spring discharges are common in the region between the Colorado Plateau and the Southern Rocky Mountains, where the Dakota Sandstone and Mancos Shale meet and intermix. Most of these discharges are developed for stock ponds and stock reservoirs. Steep terrain in mountainous regions results in narrow linear riparian areas. Broad floodplain wetlands, associated with the alluvial groundwater system in the gravels of the Dolores and West Dolores River drainages are the result of the San Juan uplift, and subsequent erosion.

Soils of the area may be alluvial, wind deposited, or weathered in place. Mountain soils are typically rocky and shallow, except in areas where groundwater discharge or slope wetlands occur, such as at The Meadows or Snow Spur Creek. At high elevation sites, these areas often form organic soils (e.g., peat or muck) due to organic matter production, persistent soil saturation, and cool year round temperatures, such as at Bolam Pass and Snow Spur Creek tributaries. Along drainages, both in the mountains and at lower elevations, wetland plant associations occur on alluvial soils. Soil development around many of the seeps and springs in Dolores County varies according to their geomorphic setting (e.g., steep hillsides, atop geologic bedrock, or gentle slopes). Soils along the lower river valleys (e.g., Dolores River; West Dolores River; Plateau Creek; Beaver Creek) are highly variable ranging from very fine material to areas of gravel and cobble. Some stream backchannels may have organic soil horizons but may not be classified as an organic soil. Soils also vary according to the parent material from which they've weathered. For more specific information, see Soil Survey of Cortez Area, Colorado, Parts of Dolores and Montezuma Counties (USDA, NRCS 2003) and Soil Survey of Animas-Dolores Area, Colorado, Parts of Archuleta, Dolores, Hinsdale, La Plata, Montezuma, San Juan, and San Miguel counties (USDA, NRCS 2002).

Ownership

Dolores County land owners consist primarily of San Juan National Forest, Bureau of Land Management, private citizens, and Colorado State (Figure 3). USFS land is generally in the eastern and central parts of the county with private land in between, where BLM land is in the

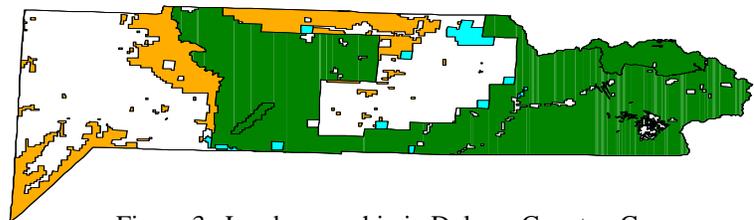


Figure 3. Land ownership in Dolores County. Green areas are San Juan NF; orange areas are BLM; blue areas are Colorado state land; and white areas are private.

north, central and southwest corners. Private land dominates the western part of the county where agriculture is the primary land use. State wildlife areas (SWA) and school board sections are scattered throughout the county; the Lone Cone State Wildlife Area is the largest SWA in the north central part of the county.

Hydrology

Most rivers within Dolores County are part of the Dolores River watershed. The largest tributaries are West Dolores River and Disappointment Creek. Smaller tributaries are numerous, important to the distribution of wetlands throughout the county. The Dolores River headwaters are located in northeast Dolores County (Figure 4).

The Dolores River spans the elevational zones throughout Dolores County. It drains southward through subalpine to montane settings. The river leaves

Dolores County at its southeastern border, and is dammed near the Town of Dolores (McPhee Reservoir) in Montezuma County. The Dolores River turns northward due to a plateau uplift blocking further southward drainage (Chronic and Williams 2002), and reenters Dolores County.

It continues to flow northward across the entire county, cutting a large canyon in the Colorado

Plateau, and exits Dolores County at the northwestern border. Eventually the Dolores River joins the Colorado River in Utah. The West Dolores River, a main tributary to the Dolores River, is the primary drainage for the southern San Miguel Mountains. It flows southward and eventually joins the Dolores River in Montezuma County. The Disappointment Creek, another primary tributary originates in the southwest part of the Lone Cone and flows east, across the north central part of the county. It converges with the Dolores River in San Miguel County.

The lower canyons and ephemeral draws in the southwestern part of the county drain into the San Juan River basin. Cross Canyon, the largest canyon in southwest Dolores County, flows southwest into the San Juan River watershed.

Historically, flows of the Dolores River and West Dolores River were high and turbid in the spring with a low and clear flow later in summer and throughout the winter. The water impoundment at McPhee Reservoir has severely altered this pattern for the Dolores River downstream. Upstream of the water impoundment, flows are altered by irrigation diversions and smaller impoundments occurring on tributaries to the Dolores River (e.g., Groundhog and Narraguinnep reservoirs). A major tributary to Disappointment Creek, Morrison Creek, is impounded at Arrowhead Lake in the Lone Cone SWA. In addition to altered hydrology, there are several impacts and threats to wetland ecosystems occurring in Dolores County (please see Observations to Major Threats on Wetland Biodiversity in this report).

Mostly charged by snowmelt from the higher elevations, water is measured in cubic feet per second (cfs) on the Dolores River. At the Town of Dolores, the Dolores River measurements considered high are approximately 2000 cfs, and low is approximately 50 cfs although peaks can be as high as 5000 cfs during spring, and low points are less than 20 cfs, usually in winter (see gauge data at http://nwis.waterdata.usgs.gov/nwis/discharge?site_no09166500). Downstream of McPhee Reservoir, releases to in stream flow were documented at 40 cfs for most days in July, 2004 and 25 cfs for most days in February, 2005 (www.doloreswater.com). Water is allocated to

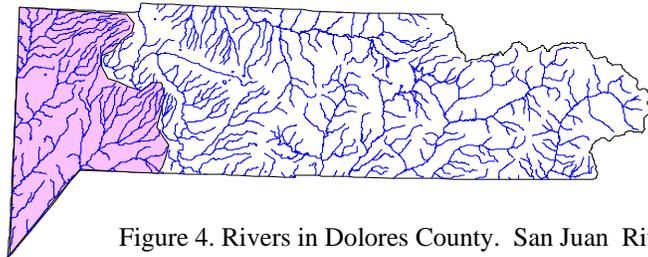


Figure 4. Rivers in Dolores County. San Juan River watershed is in pink highlight and remaining area is within the Dolores River watershed.

paying groups and those with senior water rights. The main stakeholders include the Montezuma Valley Irrigation Company, Ute Farm and Ranch, Municipal and Industrial use for Dove Creek, Cortez, Towaoc, the Ute Mountain Ute Indian Tribe, and the fishery (see newsletter budget at www.doloreswater.com). Water for in stream flow, is purchased by the Colorado Division of Wildlife for fishery use. It is difficult to assess the natural historic hydrological conditions of the Dolores River downstream of the McPhee dam as diversions began as early as the middle 1800s. By 1890, a large tunnel and canal system had been completed with the capacity to channel 1300 cfs from the Dolores River. Water was diverted from Dolores River near the present day McPhee dam site to the Montezuma Valley, often leaving very little in the stream channel. The diversion was created for agricultural development (Dolores Water Conservancy 2005) to make life possible in the then considered “wasteland” of southwestern Colorado. In addition to the McPhee dam, Dolores County has several smaller reservoirs and irrigation channels. Floodplains are not inundated as frequently during spring runoff due to altered flows and channelization structures. In summary, floodplain dynamics along these rivers in Dolores County, which are necessary for continued development of viable wetland habitat, have been greatly altered and nearly impossible to restore. As a result, wetlands have been destroyed and new wetlands are not being created within the floodplains and aquatic habitat has been reduced.

Alluvial aquifers in Dolores County are associated with the West Dolores River and the Dolores River, upstream of the Town of Dolores. Downstream of the McPhee Dam, the Dolores River has down-cut a deeply incised canyon, where coarse alluvial material associated with alluvial aquifers is intermittent, much of it having eroded away. Upstream of the Town of Dolores, the Quaternary alluvium lies along the Dolores River where surface water recharges the alluvial aquifer, making available water to many well users for domestic and stock purposes (Topper *et al.* 2003). Dolores County does not have extensive alluvial aquifers, though water is available at various depths where water well depths range from less than 10 to 1000 feet in the western and central part of the county. Many of these wells access bedrock aquifers (described below) providing groundwater for domestic and stock purposes (Topper *et al.* 2003). Groundwater is typically not used for agricultural purposes.

Groundwater in Dolores County is associated with two principal regional aquifers of the Colorado Plateau and smaller local alluvial aquifers (this discussion on groundwater is almost entirely based on USGS 1995, unless otherwise referenced). Discharge from these aquifers is mainly associated with small seep and spring wetlands, such as within the Dolores River Canyon and springs of the The Glade area, slope wetlands such as along Snow Spur Creek and tributaries, and depressional wetlands such as at Bolam Pass.

- (1) Dakota-Glen Canyon aquifer – this aquifer contains four permeable zones that are referred to as the Dakota aquifer (associated with the Dakota Sandstone), Morrison aquifer (associated with sandstone portions of the Morrison Formation), Entrada aquifer (associated with Entrada sandstone), and Glen Canyon aquifer (associated with sandstones in the Glen Canyon Group). This aquifer underlies most of Dolores County except the southeastern part. The Chinle Formation is the lower confining unit of most of the Dakota-Glen Canyon aquifer in Dolores County. The Mancos Shale forms the confining bed topping the aquifer. The Colorado Geologic Survey, Colorado Department of Natural Resources, **Groundwater Atlas of Colorado** (Topper, *et al.* 2003) defines the [Dakota-Glen Canyon] aquifer by a different name by delineating groundwater into smaller units or basins, where Dolores County is underlain by the “Paradox Basin”. The stratigraphic units (associated rock formations) and confining beds are described much the same. The Paradox Basin in Dolores County is comprised of the hydrogeologic unit, Mesozoic sandstone aquifer (Dakota-Glen Canyon aquifer in Dolores County) associated with the four permeable stratigraphic units including Dakota Sandstone-Burrow Canyon Formations; Morrison Formation (Saltwash member); Entrada Sandstone; Wingate Sandstone (of

the Glen Canyon group). Further, the Chinle Formation is described as one of several lowermost confining beds of the aquifer but discharges in fractures through the rock (Topper *et al.* 2003). Recharge of the Dakota-Glen Canyon aquifer occurs through fractures in the rocks in the higher elevations, while discharge occurs in the lower, deeply incised canyons (Dolores River Canyon) or spring discharges especially in the Wingate and Navajo sandstones. CNHP ecologists observed spring discharge occurring near the interface of Mancos Shale and Dakota Sandstone in the region between the physiographic provinces or ecoregions – Colorado Plateau and Southern Rocky Mountains.

- (2) Coconino-DeChelly aquifer – this aquifer is contained in rocks of Early Permian age and underlies most of the southern part of the Colorado Plateau. It is the major groundwater aquifer in the southeastern portion of Dolores County. The only rock formation that is associated with the Coconino-DeChelly aquifer in Dolores County is the Cutler Formation. The Cutler Formation yields small amounts of water only in fractures (Topper, *et al.* 2003), and is located in the southeast portion of Dolores County (Tweto 1979). Recharge for this aquifer is minimal and takes place at higher elevations within fractures that continue through the thick salt beds within the confining unit of the Hermosa Formation (Topper *et al.* 2003). Discharge is described as within the Colorado River and Green River lower elevations. Water is high in salinity and not useful for human consumption. This aquifer as described by The Colorado Geologic Survey, Colorado Department of Natural Resources, **Groundwater Atlas of Colorado** (Topper, *et al.* 2003) as within the Paradox Basin, and lies below the lowest confining unit of the Mesozoic sandstone aquifer (Dakota-Glen Canyon). It is described as the Lower Paleozoic carbonate aquifer which transmits saltwater through fractures and is associated with the Leadville Limestone and Ouray, Elbert, and Ignacio Formations (Topper *et al.* 2003).

Upland Vegetation

Dolores County can be classified into seven broad vegetation types, each containing several plant communities. These types more or less correspond to elevation: from lowest to highest, 1) semi-desert shrubland; 2) sagebrush; 3) pinyon-juniper woodlands; 4) mountain shrublands; 5) montane; 6) subalpine 7) alpine tundra. Within each of these zones, the addition of water (streams, rivers, or springs) creates additional vegetation types. Although distribution of vegetation in Dolores County is mostly determined by elevation, topography, soils, and local climatic factors all contribute to the distribution patterns.

Semi-desert shrubland is found in the Disappointment Creek area in the north central part of Dolores County. Although this vegetation type is common on the Colorado Plateau, it covers only a small part of Dolores County. Soils are typically high in salinity. Dominant shrubs include but are not limited to shadscale (*Atriplex confertifolia*), saltbush (*Atriplex* spp.), and greasewood (*Sarcobatus vermiculatus*), all members of the goosefoot family. This vegetation type occurs mostly on private property where land uses vary, including cattle ranching and restoration efforts (rest from past grazing; noxious shrub removal).

Sagebrush in Dolores County is often found on the mesas and cuernas of the Colorado Plateau ecoregion in the western and central part of the county. It is also found in deep sandy valley benches where the adjacent higher slopes are dominated by pinyon pine - juniper (*Pinus edulis* – *Juniperus* spp.) forests and Gambel oak (*Quercus gambelii*) woodlands. Dominant sagebrush species include basin big sagebrush (*Artemisia tridentata* var. *tridentata*) and Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*). Silver sage (*Artemisia cana*) is not a

common species but was found dominating the upland area near The Glade at Glade Lake.

Rubber rabbitbrush (*Chrysothamnus nauseosus*) is a common associate in the semi desert and sagebrush dominated vegetation types. Arizona mule's ears (*Wyethia arizonica*) is a common herbaceous plant often mixing with sagebrush or grasslands, and forms dense stands within Dolores County. Non-native pasture grasses appear to dominate grasslands more so than native grasses, whereas smooth brome (*Bromus inermis*), has apparently been seeded in privately held grazing allotments on the San Juan National Forest. Native grasses of the area include Thurber fescue (*Festuca thurberi*), muttongrass (*Poa fendleriana*), Indian ricegrass (*Achnatherum hymenoides*), meadow barely (*Hordeum brachyantherum*), Jame's galleta grass (*Hilaria jamesii*), and blue grama (*Bouteloua gracilis*).

Pinyon-Juniper Woodlands are well known in Dolores County's Colorado Plateau region. Rocky Mountain juniper (*Juniperus scopulorum*) and Utah juniper (*Juniperus osteosperma*) are common in the western part of the county, where Rocky Mountain juniper may be more likely to occur in riparian areas than the latter. Rocky Mountain juniper often outnumbers the pinyon pine (*Pinus edulis*) in woodlands and then mixes into the lower reaches of ponderosa pine stands. The pinyon pine has suffered large stand losses due to beetle kill (in some cases followed by fire).

Mountain Shrub vegetation type is a discontinuous band of vegetation occurring as patches of serviceberry (*Amelanchier* spp.) and Gambel oak (*Quercus gambelii*) intermixed with Douglas fir (*Pseudotsuga menziesii*), ponderosa pine (*Pinus ponderosa*) and pinyon pine – juniper (*Pinus edulis* – *Juniperus* spp.) woodlands. Also within the mountain shrubs in Dolores County are cliff fendlerbush (*Fendlera rupicola*), Squaw-apple (*Peraphyllum ramosissimum*), mountain mahogany (*Cercocarpus montanus*), banana yucca (*Yucca baccata*), and roundleaf snowberry (*Symphoricarpos rotundifolius*).

Montane woodlands consist of ponderosa pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menziesii*) and Gambel's oak (*Quercus gambelii*) throughout this zone. Ponderosa pine (*Pinus ponderosa*) and Gambel's oak (*Quercus gambelii*) are more likely found on the south facing slopes whereas quaking aspen (*Populus tremuloides*) and Douglas fir (*Pseudotsuga menziesii*) occupy the moist, shady north facing slopes. In the upper part of this zone, quaking aspen (*Populus tremuloides*) forests are intermixed and continue to intermix with conifer forests in higher elevations (up to at least 10,000ft.). Quaking aspen is the only upland deciduous forest tree in the region, and is the most widespread tree in North America due to its great genetic variability. Quaking aspen often occupies riparian areas within the montane and subalpine vegetation zones.

Subalpine vegetation is dominated by a continuous band of conifer forests, dominated by subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*). Bristlecone pine (*Pinus aristata*), lodgepole pine (*Pinus contorta*), Douglas fir, and quaking aspen are also found throughout the zone. Thurber fescue (*Festuca thurberi*) is common in parklands in the uppermost elevations in the zone. More mesic meadows may be occupied by open stands of Porter's licorice root (*Ligusticum porteri*), false hellebore (*Veratrum tenuipetalum*), bistort (*Bistorta bistortoides*), showy alpine ragwort (*Ligularia amplexans*), thickleaf ragwort (*Senecio crassulus*), and king's crown (*Rhodiola integrifolia*).

Alpine vegetation typically consists of low herbaceous species such as alpine avens (*Geum rossii*), elephant head lousewort (*Pedicularis groenlandica*), and tufted hairgrass (*Deschampsia cespitosa*). Erosion processes such as freeze-thaw and talus slides are frequent within this zone.

Wetland and Riparian Vegetation: Wetland/riparian vegetation is found within all of the zones discussed above. At the lowest elevations, along the major rivers, the dominant native vegetation is narrowleaf cottonwood (*Populus angustifolia*), box-elder (*Acer negundo*), thinleaf alder (*Alnus incana* ssp. *tenuifolia*), river birch (*Betula occidentalis*), river hawthorn (*Crataegus rivularis*) and several willow species (e.g., *Salix monticola*, *S. geyeriana*, *S. bebbiana*, *S. drummondiana*, *S. exigua*, *S. lucida* var. *caudata*, *S. ligulifolia*). Associated upland shrubs often encountered at lower elevations are silver buffalo berry (*Shepherdia argentea*) and skunkbush sumac (*Rhus trilobata*). It is common for the understory to contain hay grasses and native graminoids as well, such as fringes of Baltic rush (*Juncus balticus*), field horsetail (*Equisetum arvense*) and scouring rush (*Equisetum laevigata*). At higher elevations, narrowleaf cottonwood is replaced by thinleaf alder, Colorado blue spruce (*Picea pungens*), Engelmann spruce (*Picea engelmannii*), quaking aspen (*Populus tremuloides*), bog birch (*Betula glandulosa*), and low stature willows such as Wolf's willow (*Salix wolfii*), planeleaf willow (*S. planifolia*) and shortfruit willow (*S. brachycarpa*). Riparian forbs can make a lush thicket with tall growing plants such as Porter's licorice root (*Ligusticum porteri*), cow parsnip (*Heracleum sphondylium* subsp. *montanum*), Columbian monk's hood (*Aconitum columbianum*), cut leaf coneflower (*Rudbeckia ampla*), and many others. Mesic sedges can form dense stands, often associated with beaver ponds (e.g., *Carex utriculata*, *C. aquatilis*).

Groundwater supported middle elevation wetlands in Dolores County occur in the fringes of stock reservoirs, or spring fed depressions such as Glade Lake or Corral Lake. These areas are dominated by broadleaf cattail (*Typha latifolia*), softstem bulrush (*Schoenoplectus tabernaemontani*) and various aquatic species including smartweeds (*Persicaria* spp.), burreeds (*Sparganium* spp.), water crowfoot (*Batrachium* sp.), bladderworts (*Utricularia* spp.), common mare's tail (*Hippuris vulgaris*) and water plantain (*Alisma triviale*). Sedges (e.g., *Carex utriculata*, *C. atherodes*, *C. pellita*; *C. praegracilis*) and common spikerush (*Eleocharis palustris*) are common along the shorelines or in shallow water.

High elevation emergent wetlands typically occur on limestone or granite glaciated surfaces. These subalpine wetlands are fed by snowmelt and precipitation. Dominant plants include tufted hairgrass (*Deschampsia cespitosa*), several sedges (*Carex canescens*, *C. illota*, *C. aquatilis*, *C. ebenea*) and cottongrasses (*Eriophorum angustifolium*; *E. altaicum* var. *neogaeum*).

Groundwater depressions and slope wetlands in the higher elevations often develop peat soils such as at The Meadows, on slopes beneath Sheep Mountain, and at the lakes near Bolam Pass.

Middle elevation emergent wetlands, such as the wetlands found along Fish Creek and Morrison Creek are fed by surface water, groundwater, and overland sheetflow from neighboring hill slopes. Beaver activity has enhanced the emergent wetlands that are commonly occupied by beaked sedge (*Carex utriculata*) and aquatic species are often present in the more stable ponds. Emergent wetlands occur at lower elevations in patches, greatly influenced by agriculture, residential and commercial development, and irrigation water. Cattails and bulrush are the most common native plants observed.

Much of the riparian zone in the western part of the county has been invaded by non-native species. Russian olive (*Elaeagnus angustifolia*) and saltcedar or tamarisk (*Tamarix ramosissima*) occurs around stock ponds, along irrigation ditches and ephemeral streams in the draws and canyons of the lower elevations, such as in Cross Canyon, Squaw Canyon, Cahone Canyon, and Alkali Canyon. Saltcedar (*Tamarix ramosissima*) has invaded the Disappointment Creek in what may be considered heavy to light invasion. Saltcedar is also found along the lower Dolores River canyon in sparse cover within Dolores County, but is found in dense thickets within San Miguel County. Eradication and monitoring are required to effectively manage for this extremely aggressive species. Other common invasive, non-native herbaceous species include Canada thistle (*Cirsium arvense*), knapweeds (*Centaurea* spp.), sweet clover (*Melilotus officinalis*; *M. alba*), and smooth brome (*Bromus inermis*). Reed canarygrass (*Phalaroides*

arundinacea) is an aggressive native grass that has been introduced in lower elevation wetlands fed by irrigation ditches, reservoir tail waters or backwater channels.

Disruption of the natural flood regime by dams and alteration of the river channel has severely impacted regeneration of cottonwoods. Large cottonwood trees are important for nesting and roosting of Bald Eagles, Great Blue Herons, and other birds. Protection of young cottonwoods, and planting new trees may be necessary to ensure replacement of older trees. Smaller streams in the canyons and mountains are essential for wildlife. It has been estimated that riparian areas, which account for only 1% of the landscape, are used by greater than 70% of wildlife species (Knopf *et al.* 1988). In Colorado, 27% of the breeding bird species depend on riparian habitats for their viability (Pague and Carter unpublished). Dense riparian vegetation provides a protected corridor for migration of deer and elk, as well as cover for smaller animals. Riparian areas generally have a greater diversity of plant species than surrounding uplands. Along the smaller streams, grazing has altered much natural riparian vegetation. Fencing riparian habitat is a successful strategy for restoration, e.g., restoration of severely degraded sections of Plateau Creek by the Colorado Division of Wildlife.

OBSERVATIONS ON MAJOR THREATS TO WETLAND BIODIVERSITY

Table 8 lists the threats that were observed at or near the Potential Conservation Areas and were thought to potentially impact the elements of concern.

Table 8. Threats observed at the Potential Conservation Areas.

Potential Conservation Area	B -rank	Hydrologic Modification	Residential Development	Mining impacts	Incompatible Grazing	Logging	Recreation	Roads	Non-native Species
Lakes at Bolam Pass	B2						X		
Snow Spur Tributary	B2						X		
Beaver Creek at Willow Spring	B3								
Cottonwood Draw	B3	X			X			X	X
Dawson Draw Canyon East	B3	X			X			X	X
Dolores River at Snow Spur	B3						X	X	
Fish Creek at Black Mesa	B3						X		
Glade Canyon Spring	B3				X		X	X	X
Lower Coal Creek	B3						X	X	
Morrison Creek at Lone Cone	B3				X		X		X
Silver Creek and Johnny Bull Creek	B3			X	X			X	
Upper Fish Creek Below Dunn Peak	B3						X	X	
Upper Plateau Creek	B3	X			X			X	
West Dolores River at Deadman Draw	B3		X	?	X		X	X	X
West Dolores River at Dunton	B3				X		X	X	X
West Dolores Campground	B3		X		X		X	X	X
Barlow Creek	B4	X			X		X	X	X
Dolores River at Peterson Slide	B4		X	X			X	X	X
Glade Lake	B4				X			X	X
Mavreso Canyon and Cottonwood Creek	B4			X			X	X	X
Navajo Basin	B3						X		

Potential Conservation Area	B –rank	Hydrologic Modification	Residential Development	Mining impacts	Incompatible Grazing	Logging	Recreation	Roads	Non-native Species
Navajo Lake Trail	B4						X		
Willow Creek at Groundhog Mountain	B4				X	X	X	X	X
The Coal Creek Meadows	B5				X		X	X	
Fish Creek at Dunn Peak	B5						X		

Some general threats to biodiversity were not observed specifically at sites but rather have an effect on biodiversity on a larger landscape-level scale. These threats are discussed in the following text.

Hydrological Modifications

Hydrological alteration in the form of reservoirs and irrigation ditches or canals can affect aquatic dependent plants and animals (Chien 1985). Annual flooding is a natural ecological process that has been severely altered by the construction of dams, reservoirs, and other water diversions. These actions have altered the normal high peak flows that were once a part of the natural hydrologic regime of the rivers and smaller tributaries in Dolores County. These natural flows are necessary for continued viability of most riparian vegetation. For example, many plants can only reproduce with flooding events, e.g., cottonwood trees (Rood and Mahoney 1993). As plant composition changes in response to alterations in the flooding regime, the composition of the aquatic and terrestrial fauna may also change. Thus, floodplain dynamics along the rivers and smaller tributaries, which are necessary for continued development of wetland habitat, have been greatly altered in Dolores County. New, naturally occurring wetlands are not being created within the floodplains and aquatic habitat has been reduced.

In addition to river impoundments, rivers have also been altered by stream bank stabilization projects (e.g., placement of rip-rap, channelization) (Rosgen 1996). Most streams and rivers are dynamic and inherently move across the land. Stabilizing or channelizing stream banks forces the river to stay in one place and often leads to changes in riparian ecology and more serious destruction downstream. It is also well known that different plant associations require different geomorphologic settings, e.g., point bars are required for some species of willows to regenerate, mature cottonwood/shrubland forests occur on terraces, and old oxbow reaches may eventually provide habitat for many wetland associations. By stabilizing a river, the creation of these geomorphic settings is often eliminated. Thus, the plant associations that require such fluvial processes are no longer able to regenerate or survive. In general, the cumulative affects from dams, reservoirs, and channelization on plant associations, have caused a gradual shift from diverse multi-aged riparian woodlands to mature single aged forest canopies.

Many wetlands, not associated with fluvial processes, have been altered by irrigation practices, water diversions, and well pumping. The increase of irrigated agriculture in Dolores County inadvertently created many new wetlands in areas where wetlands never existed and destroyed existing wetlands. For example, seepage from hundreds of miles of unlined canals and earthen ditches and much of the water applied in irrigation contributes to groundwater recharge and surface water runoff. As a result, many areas have developed wetland characteristics where none existed prior to irrigation. Conversely, many historic wetlands, such as seeps and springs, have been lost or altered due to water “development” projects, such as water diversions and impoundments, to create stock ponds. Thus, as the quality and extent of historical wetlands diminished, some of the habitat loss was offset by irrigation-induced wetlands. It is debatable whether the biodiversity significance of an integrated network of river bottom wetlands, sinuous marshy streams, and extensive intact seep and spring wetlands can be equated to the dispersed

pattern of irrigation-induced wetlands across an agricultural landscape. However, irrigation-induced wetlands perform some of the functions performed by natural wetlands. For example, in addition to providing valuable wildlife habitat, irrigation-induced wetlands may be acting to remove nitrate, pesticides, and sediments from agricultural tail waters before entering major rivers and local aquifers.

Development

Residential development is an increasing threat to riparian areas in Dolores County. Development creates a number of stresses, including habitat loss and fragmentation, introduction of non-native species, fire suppression, and domestic animals (dogs and cats) (Oxley *et al.* 1974; Coleman and Temple 1994). Habitat loss to development is considered irreversible and should therefore be channeled to areas with less biological significance. Since development tends to occur adjacent to watercourses, wetland and riparian habitats are highly susceptible to development stresses.

Mining

Historic mining operations were widespread throughout the San Juans, and Dolores County is no exception. Silver mining has seen major booms in the past, especially around the Town of Rico. The most recent mining effort in the Town of Rico was the sulfuric acid mine that closed in 1964 (Blair *et al.* 1996). The settling ponds remain north of town. Impacts from mines, both past and present affect many areas, especially wetland and riparian areas via degradation of water quality.

Gravel mining is a noticeable industry in the region, and its impacts are of concern for wetland and riparian areas. Floodplain gravel mines remove riparian vegetation and shallow, bottomland habitat and replace them with deepwater ponds. The removal of riparian vegetation coupled with the increase in non-native plant species has decreased essential habitat for numerous species, especially avian species (Macalady 2000). Alternatives exist to minimize impacts associated with gravel mining such as improved reclamation efforts, targeting terrace deposits, utilizing crushed stone, and recycled material such as asphalt (Macalady 2000).

Livestock Grazing

Today, many riparian areas and seeps and springs in Dolores County are utilized for rangeland. Most of the springs located in the western portion of the San Juan National Forest in Dolores County are developed for stock ponds and reservoirs. Especially at lower elevations in the county, livestock tend to congregate near wetland and riparian areas for shade, lush browse, and access to water. Long-term, improper livestock use of wetland and riparian areas can potentially erode stream banks, cause streams to incise, lower the water table, alter channel morphology, impair plant regeneration, establish non-native species, shift community structure and composition, degrade water quality, and diminish general riparian and wetland functions (Windell *et al.* 1986). Depending on grazing practices and local environmental conditions, impacts can be minimal and largely reversible (slight shifts in species composition) to severe and irreversible (extensive channel incision, introduction of non-native forage species).

Logging

Most logging operations require a large network of roads. The impacts from roads can result in threats to biodiversity (see “Roads” below for more detailed discussion). The Forest Service monitors logging closely, however, it merits managerial attention.

Recreation

Recreation is increasing and becoming a threat to natural ecosystems in Dolores County. Easily accessible public lands offer residents and visitors a plethora of areas to choose from. Different

types of recreation (e.g., motorized versus non-motorized activities) typically have different effects on ecosystem processes. ATVs can disrupt migration and breeding patterns, and fragment habitat for native resident species. ATVs have also been identified as a vector for the invasion of non-native plant species.

Non-motorized recreation, mostly hikers but also mountain biking and rock climbing, presents a different set of issues (Cole and Knight 1990; Knight and Cole 1991). Wildlife behavior can be significantly altered by repeat visits of hikers/bicyclists. Alpine areas, mountain lakes, and riparian zones are routes and destinations for many established trails. Thus, impacts to native vegetation (mainly trampling and subsequent weed invasion) in these areas could potentially be high.

Roads

There is a complex, dense network of roads in many parts of Dolores County due to livestock activities, past timber harvests, mining operations, recreation and new developments. Expansion of the existing road network in some areas will detrimentally affect the natural heritage values of the region. Roads are associated with a wide variety of impacts to natural communities, including invasion by non-native plant species, increased depredation and parasitism of bird nests, increased impacts of pets, fragmentation of habitats, erosion, pollution, and road mortality (Noss *et al.* 1997).

Roads will function as conduits, barriers, habitats, sources, and sinks for some species (Forman 1995). Road networks crossing landscapes can increase erosion and alter local hydrological regimes. Runoff from roads may impact local vegetation via contribution of heavy metals and sediments. Road networks interrupt horizontal ecological flows, alter landscape spatial pattern, and therefore inhibit important interior species (Forman and Alexander 1998).

Effects on wildlife can be attributed to road avoidance (a species avoids crossing a road) and occasionally roadkill. Traffic noise appears to be the most important variable in road avoidance, although visual disturbance, pollutants, and predators moving along a road are alternative hypotheses as to the cause of avoidance (Forman and Alexander 1998). Songbirds appear to be sensitive to remarkably low noise levels, even to noise levels similar to that of a library reading room (Reijnen *et al.* 1995).

Non-native Species

Invasion of non-native and aggressive species, and their replacement of native species, is one of the biggest threats to Dolores County's natural diversity (James 1993; D'Antonio and Vitousek 1992). Non-native plants and animals can have wide-ranging impacts increasing dramatically under the right conditions and essentially dominate a previously natural area (e.g., seeding of scraped roadsides with non-native plants). This can generate secondary effects on animals (particularly invertebrates) that depend on native plant species for forage, cover, or propagation.

Although complete eradication of non-native aggressive species is not possible, some control efforts can pay off. One important guideline is that when a plant is removed, something will take its place. "Ecological voids do not exist" (Young 1981). Simply killing aggressive species, unless there is a seed source for desirable replacements, will result in more unwanted species, perhaps even more noxious than those removed. Seeding of desirable plant species is usually necessary. When seeding, it is important to consider seedbed characteristics including rock cover, and the potential of the soil to support the planted species. A first step is to assess the current vegetation, in relation to the potential of the site. For example, former attempts to control salt lover (*Halogeton glomeratus*) were given up because land managers were unable to come up with a desirable species to replace it, especially on saline or alkaline soils (Young 1981). One approach is to experiment on a small scale to determine the potential success of a weed control/seeding project, using native plant species. Ideally, seed should be harvested locally. A

mixture of native grasses and forbs is desirable, so that each species may succeed in the microhabitat for which it is best suited.

In general, lower elevations of the county are more affected by non-native and aggressive plant species than higher elevations and level valley bottoms more than steep slopes. Most of the major river corridors, and many of their tributaries have been invaded by pasture grasses. Non-native species that are prevalent in Dolores County wetlands include:

Smooth brome	<i>Bromus inermis</i>
Timothy	<i>Phleum pratense</i>
Redtop	<i>Agrostis gigantea</i>
Kentucky bluegrass	<i>Poa pratensis</i>
Orchard grass	<i>Dactylis glomerata</i>
Canada thistle	<i>Cirsium arvense</i>
Oxeye daisy	<i>Chrysanthemum leucanthemum</i>
Hounds tongue	<i>Cynoglossum officinale</i>
Musk thistle	<i>Cardus nutans</i>
Russian knapweed	<i>Centaurea repens</i>
Common dandelion	<i>Taraxacum officinale</i>
White sweet clover	<i>Melilotus alba</i>
Yellow sweet clover	<i>Melilotus officinalis</i>
Black medic	<i>Medicago lupulina</i>
White-Dutch clover	<i>Trifolium repens</i>
Red clover	<i>Trifolium pratense</i>
Burdock	<i>Arctium minus</i>

Fragmentation and Edge Effects

Edges are simply the outer boundary of an ecosystem that abruptly grades into another type of habitat (e.g., edge of a conifer forest adjacent to a meadow) (Forman and Godron 1986). Edges are often created by naturally occurring processes such as floods, fires, and wind recovering naturally over time. Edges can also be created by human activities such as roads, timber harvesting, agricultural practices, rangeland, etc. Human induced edges are often dominated by plant species that are adapted to disturbance. As the landscape is increasingly fragmented by large-scale, rapid anthropogenic conversion, these edges become increasingly abundant. The overall reduction of large landscapes jeopardizes the existence of specialist species, may increase non-native species, and limits the mobility of species that require large landscapes or a diversity of landscapes for their survival (e.g., large mammals or migratory waterbirds).

Natural Processes

The region's drought culminated in 2002, after several years of below average precipitation in Dolores County. The subsequent effects of drought are many and varied and were taken into consideration when observing wetland sites in 2004. However, it is unknown how severe or limiting the stress from drought is on wetland vegetation in Dolores County.

Beetle killed and damaged trees are common in the west and central portions of Dolores County. Although no Potential Conservation Area sites profiled in this report contain severe beetle damaged tree stands, Dolores County is experiencing this devastating ecological process. Bark beetles target stressed, weakened or dying trees (Day 1996), and after years of drought conditions, Dolores County's pinyon pine (*Pinus edulis*) trees have been affected the most.

METHODS

Focusing on private lands, site selection was based on the objective of visiting every wetland type at various geomorphic positions and elevations within Dolores County. The highest quality occurrences of each wetland type were targeted during the field season. Wetland types were defined using plant associations. CNHP classifies wetland and riparian plant associations, not wetland types. Plant associations reflect the broad nature of wetlands in the study area (e.g., willow carr, sedge meadow, cottonwood riparian forest, etc.), while also mirroring the local nature of wetlands in the watershed. Most other classifications applied to wetlands in Colorado, and across the nation, discriminate wetlands based primarily on the physiognomy (physical structure) of the vegetation. Broad structural classes, however, do not recognize the relative rarity of the plant species or associations contained in Dolores County.

A Proper Functioning Condition (PFC) form was completed for every Bureau of Land Management parcel according to Process for Assessing Proper Functioning Condition for Lotic and Lentic Riparian-Wetland Areas (USDI BLM 1994, 1998). PFC is a qualitative method for assessing the condition of riparian-wetland areas. It enables a consistent approach for considering hydrology, vegetation, and erosion attributes to assess riparian health. (USDI BLM 1993). This method categorized wetlands-riparian areas into three major types:

- **Proper Functioning Condition (PFC)**— a wetland area that supports adequate vegetation, unaltered hydrology, and erosion/deposition features to dissipate floodwaters, stabilize streambanks, etc.
- **Functioning At Risk (FAR)**— a wetland area that is in functional condition but an existing soil, water, or vegetation attribute makes it susceptible to degradation.
- **Nonfunctional (NF)**— a wetland area that does not provide adequate vegetation, landform attributes to dissipate floodwaters, improve water quality, etc

Collect Available Information

CNHP databases were updated with information regarding the known locations of species and significant plant associations within Dolores County. A variety of information sources were searched for this information. The Colorado State University museums and herbarium were searched, as were plant and animal collections at the University of Colorado, Rocky Mountain Herbarium, Fort Lewis College, and local private collections. Both general and specific literature sources were incorporated into CNHP databases as either locational information or as biological data pertaining to a species in general. Such information covers basic species and community biology including range, habitat, phenology (timing), food sources, and substrates. This information was entered into CNHP's Biodiversity Tracking and Conservation System (Biotics).

Identify rare or imperiled species and significant plant associations with potential to occur in Dolores County

The list of plant associations thought to occur in Dolores County was derived from the Colorado Statewide Wetland Classification and Characterization (CSWCC) project (Carsey *et al.* 2003) which is based on the US National Vegetation Classification (USNVC) (Anderson *et al.* 1998), the accepted national standard for vegetation. The CSWCC utilized and integrated previously collected data from the Classification of Riparian Wetland Plant Associations of Colorado (Kittel *et al.* 1999), CNHP wetland surveys, and Colorado State University. The CSWCC incorporated all these data on riparian and other wetlands collected during the past 15 years as well as data from other researchers to avoid duplication of effort.

The information collected in the previous step was used to refine the potential element list and to refine our search areas. In general, species and plant associations that have been recorded from Dolores County, or from adjacent counties, are included in this list. Species or plant associations which prefer habitats that are not included in this study area were removed from the list. The list includes those elements currently monitored by CNHP that were thought to potentially occur in Dolores County and were therefore targeted in CNHP field inventories.

The amount of effort given to the inventory for each of these elements was prioritized according to the element's rank. Globally rare (G1 - G3) elements were given highest priority; state rare (S1-S3) elements were secondary.

Identify Targeted Inventory Areas

Survey sites or Targeted Inventory Areas (TIAs) were chosen based on their likelihood of harboring rare or imperiled species or significant plant associations. Known locations were targeted, and additional potential areas were chosen using a variety of information sources, such as aerial photography. Precisely known element locations were always included so that they could be verified and updated. Many locations were not precisely known due to ambiguities in the original data, e.g., "headwaters of Cataract Creek." In such cases, survey sites for that element were chosen in likely areas in the general vicinity. Areas with potentially high natural values were chosen using aerial photographs, geology maps, vegetation surveys, personal recommendations from knowledgeable local residents, and numerous roadside surveys by our field scientists. Aerial photography is perhaps the most useful tool in this step of the process.

General habitat types can be discerned from the aerial photographs, and those chosen for survey sites were those that appeared to be in the most natural condition. In general, this means those sites that are the largest, least fragmented, and mostly free of visible disturbances such as roads, trails, fences, quarries, etc.

The above information was used to delineate over 59 survey areas that were believed to have high probability of harboring natural heritage resources.

Roadside surveys were useful in further resolving the natural condition of these areas. The condition of wetlands is especially difficult to discern from aerial photographs, and a quick survey from the road can reveal such features as weed infestation or overgrazing.

Because of the overwhelming number of potential sites and limited resources, surveys for all elements were prioritized by the degree of imperilment. For example, all species with Natural Heritage ranks of G1-G3 were the primary target of our inventory efforts. Although species with lower Natural Heritage ranks were not the main focus of inventory efforts, many of these species occupy similar habitats as the targeted species, and were searched for and documented as they were encountered.

Landowner Contacts

Attaining permission to conduct surveys on private property was essential to this project. Once survey sites were chosen, land ownership of these areas was determined using records at the Dolores County assessor's office. Landowners were then contacted by mail and followed up by telephone. If landowners could not be contacted, or if permission to access the property was denied, this was recorded and the site was not visited. **Under no circumstances were properties surveyed without landowner permission.**

Conduct Field Surveys

Survey sites, where access could be attained, were visited at the appropriate time as dictated by the phenology of the individual elements. It is essential that surveys take place during a time when the targeted elements are detectable. For instance, breeding birds cannot be surveyed outside of the breeding season and plants are often not identifiable without flowers or fruit which are only present during certain times of the season.

Wetland plant associations were collected by visual canopy cover estimates, collection by qualitative or quantitative composition, soil, hydrological, and function data

When necessary and permitted, voucher specimens were collected and deposited in Fort Lewis College herbarium. Bird information was collected from past surveys conducted by CNHP and other agency personnel.

When a rare species or significant natural community was discovered its precise location and known extent was recorded on 1:24,000 scale topographic maps. Other data recorded at each occurrence included numbers observed, breeding status, habitat description, disturbance features, observable threats, and potential protection and management needs. The overall significance of each occurrence, relative to others of the same element, was estimated by rating the quality (size, vigor, etc.) of the population or community, the condition or naturalness of the habitat, the long-term viability of the population or community, and the defensibility (ease or difficulty of protecting) of the occurrence. These factors are combined into an element occurrence rank, which is useful in refining conservation priorities. See the previous section on Natural Heritage Network for more about element occurrence ranking.

Field surveys also included a wetland functional evaluation. Some of the PCAs profiled in this report were not visited by the author of this report but rather by previous CNHP ecologists. For these PCAs, no functional evaluation is given. For those PCAs visited by an author, a qualitative wetland functional evaluation is detailed in the PCA profile. Site visits and assessments were conducted on the following two 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 road assessments determined the extent of human and livestock impacts on the survey area, which included ditching, adventive plant species, indicator plant species of intensive livestock use, stream bank destabilization, major hydrologic alterations, excessive cover of non-native plant species, or new construction. Sites with one or more of these characteristics were generally excluded as potential conservation areas and no extensive data were gathered at these areas.

(2) **On-Site assessments.** On-site assessment was the preferred method, as it is 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 associations. On-site assessments are also the most resource intensive because of the effort required to contact landowners. In several cases where on-site assessments were desired, they could not be conducted because either field personnel were denied access to the property by the landowner, or CNHP was unable to contact the landowner during the time frame of this study.

The following information was collected for the PCAs in this report:

General Field Information

- 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 within CNHP's Statewide Wetland Classification. However, on rare occasions a plant association was encountered which could not be easily classified based on the stands that had been previously sampled.
- vegetation data for each major plant association in the wetland were collected using visual ocular estimates of species cover in a representative portion of the plant association.
- sketch of the site layout, with distribution of community types indicated (this was generally done on the 7.5-min. USGS topographic map, but occasionally for clarity a separate map was drawn on the site survey form)

- UTM coordinates collected from Garmin GPS 12 Personal Navigator
- 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
- indicators 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 conservation area boundaries

General Wetland Information

- proposed HGM Class and Subclass
- Cowardin System and Subsystem
- water source
- hydroperiod
- general soils description (these are based on either a detailed description of a soil profile in the field (e.g., horizons, texture, color, cobble size, percent mottling) or from information from the county soil surveys.

Qualitative Functional Assessment

- hydrological functions (e.g., groundwater recharge/discharge, flood storage, shoreline anchoring)
- biogeochemical functions (e.g., elemental cycling, sediment trapping, and toxicant retention/removal)
- biological functions (e.g., foodchain support, production export, fish and wildlife habitat, habitat diversity)

Restoration Potential

- cause of disturbances, if any (e.g., alteration of hydrology, peat removal, fill material, presence of non-native species, etc.)
- feasibility of rectifying the disturbance (re-establishing natural hydrological regime, remove fill material, plant native species, etc.)
- discussion of possible methods for restoration.

Delineate Potential Conservation Area Boundaries

Finally, since the objective for this inventory is to prioritize specific areas for conservation efforts, potential conservation area boundaries were delineated. Such a boundary is an estimation of the minimum area needed to assure persistence of the element. Primarily, in order to insure the preservation of an element, the ecological processes that support that occurrence must be preserved. The preliminary potential conservation area boundary is meant to include features on the surrounding landscape that provide these functions. Typically, a minimal buffer of at least 1,000 feet was incorporated into the boundaries. Data collected in the field are essential to delineating such a boundary, but other sources of information such as aerial photography are also used. These boundaries are considered preliminary and additional information about the site or the element may call for alterations of the boundaries.

RESULTS

CNHP ecologists identified 59 wetland/riparian Targeted Inventory Areas (TIAs) that merited on-site investigation (Figure 5 and Figure 6). Of the 59 TIAs, 42% are encompassed within Potential Conservation Areas. An effort was made to select sites that potentially had natural hydrology, native species composition, and vegetation structure intact. However, on-site inspection revealed that many of the wetland TIAs (44%) were heavily impacted by roads, buildings, non-native species, agriculture, and/or grazing or were considered to be common types and were dropped from the inventory. Due to time limitations, 11% of the TIAs were not visited; most of these were located on BLM or US Forest Service lands, and finally only a small percentage of TIAs (3%) were not visited due to permission to survey being denied. Figure 5 depicts TIAs identified in the county that are found within PCAs; were visited but not within PCAs; those not visited; and those denied permission.

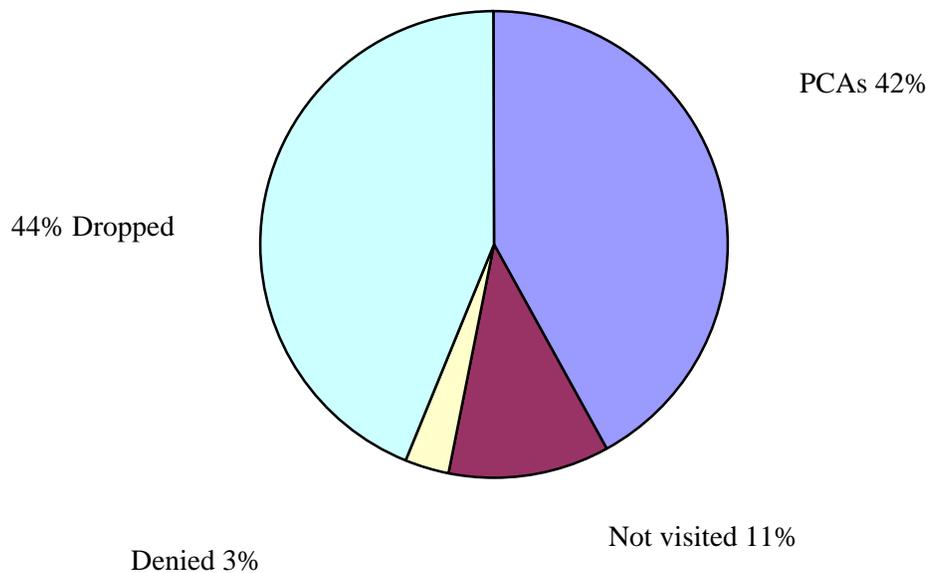


Figure 5. Summary of Targeted Inventory Areas

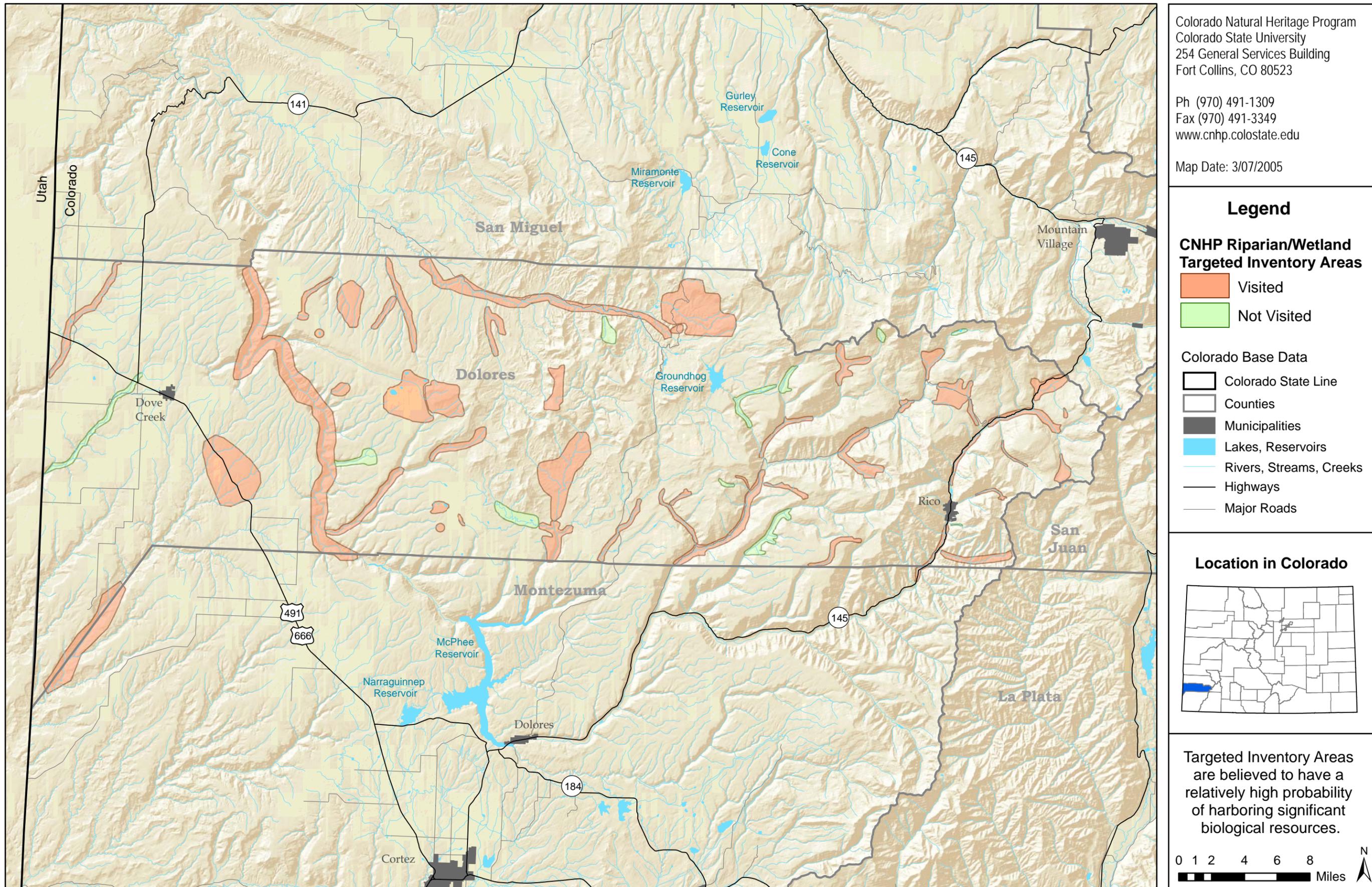


Figure 6. Riparian/Wetland Targeted Inventory Areas in Dolores County

SIGNIFICANT ELEMENTS ASSOCIATED WITH WETLANDS AND RIPARIAN AREAS

Table 9 presents CNHP elements of biological significance known to occur in or associated with wetlands in the Potential Conservation Areas in this report. This is not a comprehensive list of the elements known to occur in or associated with wetlands in Dolores County, but rather only includes those elements deemed significant enough to be archived in CNHP's Biological Conservation Data System.

Table 9. Known elements of concern found within PCAs, by taxonomic group alphabetically. Elements with the highest global significance (G1-G3) are in bold type. Detailed descriptions of the wetland elements listed below can be found in the Natural History section.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status
Birds/Fish				
<i>Empidonax trailii extimus</i>	Southwest willow flycatcher	G5	T1T2	USFS; LE
<i>Gila robusta</i>	Roundtail Chub	G3	S2	BLM; USFS
<i>Cypseloides niger</i>	Black Swift	G4	S3B	USFS
<i>Aegolius funereus</i>	Boreal Owl	G5	S2	
Plants				
<i>Botrychium echo</i>	Reflected moonwort	G3	S3	USFS
<i>Eriophorum altaicum</i> var. <i>neogaeum</i>	Altai cottongrass	G4?	T3T4	USFS
<i>Trifolium kingii</i>	Kings' clover	G5	S1	
Plant Communities				
<i>Abies lasiocarpa</i> – <i>Picea engelmannii</i> / <i>Salix drummondiana</i>	Subalpine fir – Colorado blue spruce / Drummond's willow	G5	S4	
<i>Alnus incana</i> - <i>Salix drummondiana</i>	Thinleaf alder – Drummond's willow	G3	S3	
<i>Alnus incana</i> / Mesic Forbs	Thinleaf alder / Mesic Forbs	G3	S3	
<i>Alnus incana</i> / Mesic Graminoids	Thinleaf alder / Mesic graminoids	G3	S3	
<i>Aquilegia micrantha</i> – (<i>Mimulus eastwoodiae</i>)	Mancos columbine (Eastwood monkey-flower) Hanging gardens	G2G3	S2S3	
<i>Betula occidentalis</i> / Mesic Forbs	River birch / Mesic Forbs	G3	S2	
<i>Cardamine cordifolia</i> – <i>Mertensia ciliata</i> – <i>Senecio triangularis</i>	Heartleaf bittercress – tall fringed bluebells – arrowleaf ragwort Alpine wetlands	G4	S4	
<i>Carex aquatilis</i>	Water sedge herbaceous	G5	S4	
<i>Carex atherodes</i>	Awned sedge herbaceous vegetation	G3G5	S2?	

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status
<i>Carex illota</i>	Small head sedge herbaceous vegetation	G2	S2	
<i>Carex pellita (=lanuginosa)</i>	Woolly sedge herbaceous vegetation	G3	S3	
<i>Carex utriculata</i>	Beaked sedge herbaceous vegetation	G5	S4	
<i>Crataegus rivularis</i> shrubland	River hawthorn	G2Q	S2	
<i>Deschampsia caespitosa</i>	Tufted hairgrass herbaceous vegetation	G4	S4	
<i>Picea pungens / Alnus incana</i>	Colorado blue spruce / thinleaf alder	G3	S3	
<i>Populus angustifolia - Picea pungens / Alnus incana</i>	Narrowleaf cottonwood – Colorado blue spruce / thinleaf alder	G4	S4	
<i>Populus angustifolia / Alnus incana</i>	Narrowleaf cottonwood / thinleaf alder	G3	S3	
<i>Populus angustifolia / Cornus sericea</i>	Narrowleaf cottonwood / red-osier dogwood	G4	S3	
<i>Populus angustifolia / Mixed Salix species</i>	Narrowleaf cottonwood / mixed willows	G3	S3	
<i>Populus angustifolia / Rhus trilobata</i>	Narrowleaf cottonwood / skunkbush	G3	S3	
<i>Populus angustifolia / Salix ligulifolia – Shepherdia argentea</i>	Narrowleaf cottonwood / strapleaf willow – silver buffalo berry	G2	S2	
<i>Rhus trilobata</i> shrubland	Skunkbush shrubland	G2	S2	
<i>Salix bebbiana</i> shrubland	Bebb's willow	G3?	S2	
<i>Salix brachycarpa</i> / Mesic Forbs	Shortfruit willow	G4	S4	
<i>Salix drummondiana / Calamagrostis canadensis</i>	Drummond willow / bluejoint reedgrass	G3	S3	
<i>Salix drummondiana</i> / Mesic Forbs	Drummond willow/ Mesic Forbs	G4	S4	
<i>Salix exigua</i> / Barren Ground	Coyote willow/ barren ground	G5	S5	
<i>Salix geyeriana</i> / Mesic Forbs	Geyer willow / Mesic Forbs	G3	S3	
<i>Salix geyeriana – Salix monticola</i> / Mesic Forbs	Geyer willow – mountain willow / Mesic Forbs	G3	S3	
<i>Salix ligulifolia</i> shrubland	Strap leaf willow shrubland	G2G3	S2S3	
<i>Salix geyeriana – Salix monticola</i> / Mesic Forbs	Geyer willow – mountain willow / Mesic Forbs	G3	S3	

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status
<i>Salix monticola</i> / <i>Carex utriculata</i>	Mountain willow / beaked sedge	G3	S3	
<i>Salix monticola</i> / Mesic Forbs	Mountain willow / Mesic Forbs	G4	S3	
<i>Salix monticola</i> / Mesic Graminoids	Mountain willow / Mesic Graminoids	G3	S3	
<i>Salix planifolia</i> / <i>Caltha leptosepala</i>	Plane leaf willow / marsh marigold	G4	S4	
<i>Salix wolfii</i> / <i>Carex aquatilis</i>	Wolf willow / water sedge	G4	S3	

SITES OF BIODIVERSITY SIGNIFICANCE

The 25 most important wetland sites in Dolores County are profiled in this section as Potential Conservation Areas (PCAs) with biodiversity ranks (Table 10). These PCAs include the wetlands with the highest biodiversity significance, as well as the best examples of common wetland types present in the study area. Three are identified as being nearly irreplaceable biodiversity significance (B2), 13 of high biodiversity significance (B3), eight of moderate biodiversity significance (B4), and one of general biodiversity significance (B5). The highest ranking PCAs are the highest priorities for conservation action.

Following the PCAs are four Sites of Local Significance (SLS).

Each Potential Conservation Area (PCA) is described in a standard PCA profile report that reflects data fields in CNHP's Biodiversity Tracking and Conservation System (Biotics). The contents of the profile report are outlined and explained below:

PCA Profile Explanation Biodiversity Rank: B#

The overall significance of the PCA in terms of rarity of the Natural Heritage resources and the quality (condition, abundance, etc.) of the occurrences. Please see *Natural Heritage Ranking System* section for more details.

Protection Urgency Rank: P#

A summary of major land ownership issues that may affect the long-term viability of the PCA and the element(s).

Management Urgency Rank: M#

A summary of major management issues that may affect the long-term viability of the PCA and the element(s).

Location: General location.

Legal Description: USGS 7.5-minute Quadrangle name(s) and Township Range Section(s).

Size: Expressed in acres.

Elevation: Expressed in feet.

Redders, 2003, Community Type: Jeffery S. Redders, Ecologist for the San Juan National Forest completed **A Classification of Riparian Area and Wetland Vegetation Of the San Juan National Forest** in September 2003. Using this classification, canopy cover from field data collected in 2004 or canopy cover from data recorded in CNHP's database were used to determine the community type. In some instances, percent cover was not high enough to satisfy the percent cover criteria in this classification. In these instances, the most dominant species were taken into consideration or the classification was considered not applicable.

General Description: A brief narrative of the topography, hydrology, vegetation, and current use of the potential conservation area.

Biodiversity Rank Comments: A synopsis of the rare species and significant plant communities that occur within the proposed conservation area. A table within the area profile lists each element occurrence found in the PCA, global and state ranks of these elements, the occurrence ranks and federal and state agency special designations. See Table 2 for explanations of ranks and Table 3 for legal designations.

Boundary Justification: Justification for the location of the proposed conservation area 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 Rank Comments: Discussion of major land ownership issues that may affect the long-term viability of the PCA and the element(s).

Management Rank Comments: Discussion of major management issues that may affect the long-term viability of the PCA and the element(s).

Soils Description: Soil profile descriptions were generally conducted at each PCA. Soil profiles sampled are given. Soil descriptions found in the county soil surveys are given when available.

Restoration Potential: A brief summary describing the feasibility of or resources for restoring ecosystem processes at each PCA.

Wetland Functional Assessment: A summary of the functions and the proposed HGM classification, Cowardin system, and the plant community derived from CNHP's Statewide Wetland Classification for the wetlands occurring within each Potential Conservation Area. (Note: Some of the PCAs profiled in this report were not visited by an author but rather by previous CNHP ecologists. For these PCAs, no functional evaluation is given. For those PCAs visited by an author, a wetland functional evaluation is detailed in the PCA profile.)

Table 10. Potential Conservation Areas contained within Dolores County, arranged by biodiversity rank (B-rank) and alphabetical order.

<i>Potential Conservation Areas</i>
B2
Lakes at Bolam Pass
Snow Spur Tributary
Navajo Basin
B3
Beaver Creek at Willow Spring
Cottonwood Draw
Dawson Draw Canyon East
Dolores River at Snow Spur
Fish Creek at Black Mesa
Glade Canyon Spring
Lower Coal Creek
Morrison Creek at Lone Cone
Upper Fish Creek Below Dunn Peak
Upper Plateau Creek
West Dolores River at Deadman Draw
West Dolores River at Dunton
West Dolores Campground
B4
Barlow Creek
Dolores River at Peterson Slide
Fish Creek at Dunn Peak
Glade Lake
Mavreso Canyon and Cottonwood Creek
Navajo Lake Trail
Silver Creek and Johnny Bull Creek
Willow Creek at Groundhog Mountain
B5
The Coal Creek Meadows

These PCAs alone do not represent a complete wetland conservation program; they represent only the rare and imperiled elements.



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Map Date: 3/21/2005

Legend

CNHP Potential Conservation Areas by Biodiversity Significance Rank

- B2: Very High Biodiversity Significance
- B3: High Biodiversity Significance
- B4: Moderate Biodiversity Significance
- B5: General Biodiversity Interest

Colorado Base Data

- Colorado State Line
- Counties
- Municipalities
- Lakes, Reservoirs
- Rivers, Streams, Creeks
- Highways
- Major Roads



Potential Conservation Areas represent CNHP's best estimate of the primary area supporting long-term survival of targeted species, subspecies and natural communities.

0 1 2 4 6 8 Miles

Figure 7. Riparian/Wetland Potential Conservation Areas in Dolores County

Lakes at Bolam Pass Potential Conservation Area

Biodiversity Rank: B2. Nearly irreplaceable. The site supports a good (B-rank) occurrence of the globally imperiled (G2S2) subalpine wet meadow, *Carex illota* herbaceous vegetation; and a good (B-ranked) occurrence of the apparently globally secure (G4S4) subalpine wet meadow, *Deschampsia caespitosa* herbaceous vegetation.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The site is within the San Juan National Forest.

Management Urgency Rank: M3. New management action may be needed within 5 years to maintain the current quality of the element occurrences in the PCA. Recreation impacts are the main threat.

Location: The Lakes at Bolam Pass PCA surrounds the small ponds west of Bolam Pass on the east border of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Hermosa Peak

Legal Description: T40N R9W Section 19
T40N R10W Section 24, 25

Elevation: 11,300 ft.

Size: Approximately 184 acres.

Redders, 2003, Community Type: *Deschampsia caespitosa* herbaceous type

General Description: The Lakes at Bolam Pass PCA is located near Bolam Pass in the San Juan National Forest within the Dolores River watershed. The PCA is situated near the east flank of Hermosa Peak adjacent to the divide between the Dolores River and Hermosa Creek. The lakes are small, groundwater and sheet flow fed ponds of various shapes. The largest lake contains approximately 1 acre of open water. In addition to the lakes there are seasonally wet depressions throughout the PCA. Fringe areas adjacent to some of the ponds are solegenous (groundwater fed) fens (peatlands). Fens form in areas where water accumulates and plant decomposition is less than plant productivity due to saturated and anaerobic soils.

The PCA contains a dynamic mosaic of herbaceous wetland plant communities. Water sedge (*Carex aquatilis*) and beaked sedge (*Carex utriculata*) form tall, narrow stands along the pond shores. Two ponds support aquatic plants, including narrowleaf burreed (*Sparganium emersum*) and tall cottongrass (*Eriophorum angustifolium*). Bluejoint reedgrass (*Calamagrostis canadensis*) is the dominant plant that occupies the terraces and hummocks adjacent to the ponds as well as forms long rib-like terraces along the downward slope within the mesic depressions. The mesic depressions are composed of mud and dominated by common spikerush (*Eleocharis palustris*) or are un-vegetated.

The meadows immediately adjacent to the ponds are dominated by tufted hairgrass (*Deschampsia caespitosa*) or sheep sedge (*Carex illota*). The soils adjacent to the ponds (extending to 8-10 meters out from the water's edge) are peaty (42+ cm). There are areas within the fen that quake or shake when walked across, indicating a floating vegetation mat. These areas are dominated by sheep sedge with a sparse cover of mosses. In addition to tufted hairgrass and sheep sedge, mesic forbs occupy the surrounding meadows, including marsh marigold (*Caltha leptosepala*), elephant head lousewort (*Pedicularis groenlandica*), rose crown (*Clemensia rhodantha*) and others. Numerous tadpoles were present in three of the five ponds during the

2004 survey. This fen merits more research earlier in the growing season due to plant phenology at the time of visit in 2004 (August 31, 2004).

Uplands surrounding the site are dominated by meadows dominated by Thurber's fescue (*Festuca thurberi*) and spruce-fir (*Picea engelmannii* – *Abies lasiocarpa*) forests. A four-wheel drive jeep trail is near the PCA, and a small portable cabin or hut equipped with propane and water jugs is adjacent to the meadow. Recreation can be heavy in the general area and ATV use is a threat to the integrity of this wetland system due to disturbing the immediate hydrology with trails that create ruts, ultimately draining the peatland. Other recreational uses include hunting, horse riding, bicycling, camping, hiking, and winter recreation such as snow machine riding.

Biodiversity Rank Justification and Comments: The site supports a good (B-rank) occurrence of the globally imperiled (G2S2) sheep sedge (*Carex illota*) subalpine wet meadow. The presence of this plant association can indicate undisturbed conditions, with no introduced species, no advanced soil erosion or signs of soil compaction (Carsey *et al.* 2003). A good (B-ranked) occurrence of the apparently globally secure (G4S4) tufted hairgrass (*Deschampsia caespitosa*) montane wet meadow also occurs within this PCA. This plant association is common in Colorado and typically occupies sites indefinitely under relatively stable conditions (Carsey *et al.* 2003).

Table 11a. Natural Heritage element occurrences at Lakes at Bolam Pass PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Carex illota</i> herbaceous vegetation	Small head sedge herbaceous vegetation	G2	S2		B
<i>Deschampsia caespitosa</i> herbaceous vegetation	Tufted hairgrass herbaceous vegetation	G4	S4		B

Boundary Justification: The boundary encompasses the element occurrences and immediate area to buffer hydrologic processes necessary to the viability of the elements. The boundary also provides a buffer from trails, the road, and campsites where direct disturbance to the soil may cause dewatering and organic soil loss, and where surface runoff may contribute excess nutrients, sediment and weed invasion. It should be noted that all hydrologic processes necessary for wetland viability are not contained within the PCA boundaries.

Protection Comments: The San Juan National Forest owns the PCA.

Management Comments: The most observable threat identified in the PCA is ATV use in the wetland area. Recent trails were observed meandering through the site in 2004. It is suggested to consider restricting off road vehicle use in the wetland area and to evaluate recreation impacts such as snow machines in winter and horse use/camps, especially during hunting season. The USGS quadrangle map, Hermosa Peak, delineates a pack trail that cuts across the wetland area. Although this trail is difficult to detect on the ground, it may invite off road enthusiasts to drive through the wetland area, unless otherwise posted. An indicator of disturbance of the fen would be the invasion of increaser species such as Kentucky bluegrass (*Poa pratensis*), Baltic rush (*Juncus balticus*), and common dandelion (*Taraxacum officinale*).

Soils Description: Soils sampled in the quaking area dominated by sheep sedge and mosses contain 42+cm of mucky peat. The soil was sampled 8 meters from shoreline. Soils in the outer edges of the mesic meadow, away from the lakeshores are gravelly.

Mapped soil units describe soils including rock outcrops and mountain hillslopes, but does not include saturated organic soils located in the wetland area. This is possibly due to the small size area with organic soils. The mapped soil unit in the open meadow is delineated as Dystrocryept – Rock outcrop complex 15 – 30 percent slopes. The remaining area is mapped as Needleton-Snowdon Complex, 15 – 30 percent slopes, where Needleton is classified as Loamy-skeletal, mixed, superactive Eutric Haplocryalf and Snowdon is classified as Loamy-skeletal, mixed, superactive Lithic Haplocryalf. (USDA, NRCS 2002)

Restoration Potential: The Lakes at Bolam Pass PCA wetlands are functioning at potential.



Wetland at Lakes at Bolam Pass PCA. Photograph © CNHP 2004.

Wetland Functional Assessment for the Lakes at Bolam Pass PCA:

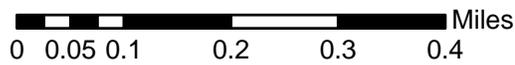
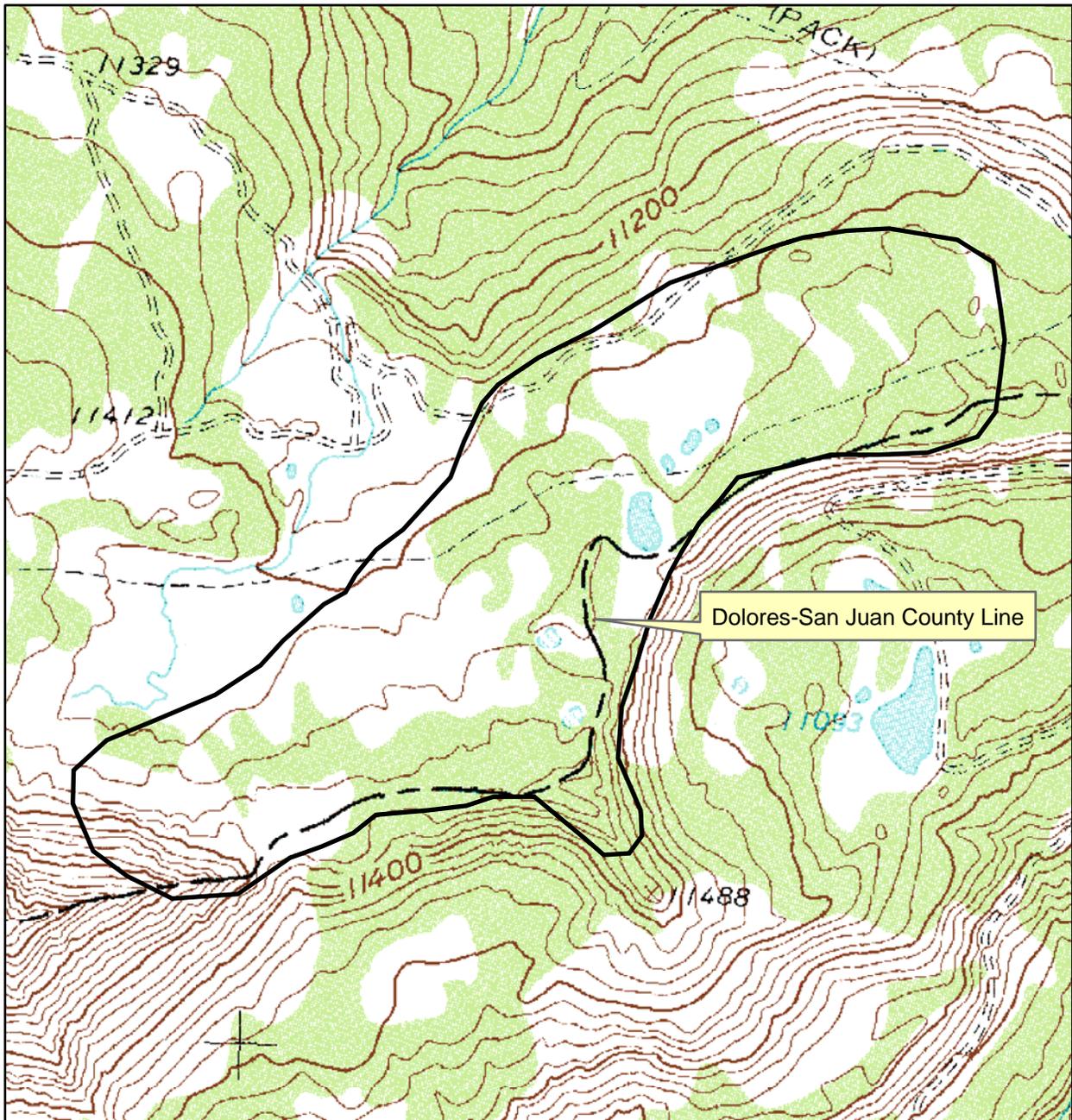
Proposed HGM Class: Depressional **Subclass:** D1

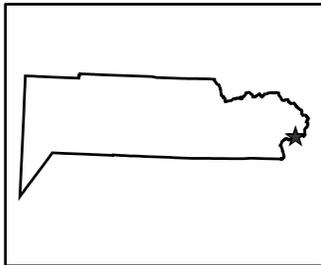
Cowardin System: Palustrine

CNHP's Wetland Classification: *Carex illota* and *Deschampsia caespitosa* herbaceous vegetation

Table 11b. Wetland functional assessment for the subalpine wet meadow fen at Lakes at Bolam Pass PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	The wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	Low	The wetland is not located in a floodplain.
Sediment/Shoreline Stabilization	High	If water fluctuation should occur, shorelines are stabilized by dense vegetation.
Groundwater Discharge/Recharge	Yes	Ponds are fed by snowmelt and groundwater; not recharging due to saturated peat layer.
Dynamic Surface Water Storage	Moderate	Approximately ½ - 3 acres of saturated, peaty soils, depressions receiving sheetflow, precipitation, and snowfall.
Biogeochemical Functions		
Elemental Cycling	Normal	Dense, native vegetation; deep peat soil (42+cm), little disturbance to soil surface except where the ATV tracks have compacted vegetation/soil.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Moderate to dense vegetation, peaty soils, emergent vegetation. There are two ponds with submerged vegetation.
Biological Functions		
Habitat Diversity	Low	One Cowardin class present.
General Wildlife Habitat	High	Deer sign, song birds
General Fish/Aquatic Habitat	Moderate	Tadpoles present, good amphibian habitat. No inlet/outlet for fish.
Production Export/Food Chain Support	Moderate	There is no outlet. Lakes support tadpoles.
Uniqueness	Very High	The PCA supports a G2 plant community and organic soils (fen).



<p>Colorado Natural Heritage Program Colorado State University 254 General Services Building Fort Collins, CO 80523</p> <p>Ph (970) 491-1309 Fax (970) 491-3349 www.cnhp.colostate.edu</p> <p>Map Date: 3/02/2005</p>	<p>Legend</p> <p> PCA Boundary</p> <p>Hermosa Peak, 37107-F8</p> <p>7.5 Minute Digital Raster Graphic produced by the U.S. Geological Survey</p>	<p>Location in Dolores County</p> 
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Map 1. Lakes at Bolam Pass Potential Conservation Area, B2: Very High Biodiversity Significance

Snow Spur Tributary Potential Conservation Area

Biodiversity Rank: B2. Nearly irreplaceable. Very high biodiversity significance. The site supports a good (B-ranked) occurrence of the globally imperiled (G2S2) subalpine wet meadow, sheep sedge (*Carex illota*) herbaceous vegetation; and a good (B-ranked) occurrence of the apparently globally secure (G4S4) subalpine wet meadow, tufted hairgrass (*Deschampsia caespitosa*) herbaceous vegetation.

Protection Urgency Rank: P4. No Protection actions are needed in the foreseeable future. The PCA is within the San Juan National Forest and private in holding.

Management Urgency Rank: M4. Current management seems to favor the persistence of the elements in the PCA, but management actions may be needed in the future to maintain the current quality of the element occurrences.

Location: The Snow Spur Tributary PCA is located southwest of Sheep Mountain in the northeast portion of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Mount Wilson

Legal Description: T41N R9W Section 30, 31

Elevation: 11,000 – 11,400 ft. **Size:** Approximately 302 acres

Redders, 2003, Community Type: *Deschampsia caespitosa* herbaceous type

General Description: The Snow Spur Tributary PCA encompasses an unnamed tributary to Snow Spur Creek southwest of Sheep Mountain, in the northeast portion of Dolores County. Springs discharge at the base of talus slopes forming several small channels that eventually converge. Organic soils have formed in the meadow as a result of the perennial water.

This subalpine wet meadow forms a fen (groundwater-fed peatland) and is dominated by a shrub layer consisting of plane leaf willow (*Salix planifolia*) and wolf willow (*Salix wolfii*) occurring in low stature (prostrate to 35cm tall). The herbaceous layer is dominated by tufted hairgrass (*Deschampsia caespitosa*) and sheep sedge (*Carex illota*). Associated graminoids include bluejoint reedgrass (*Calamagrostis canadensis*), inland bluegrass (*Poa interior*), water sedge (*Carex aquatilis*), and alpine timothy (*Phleum alpinum*). Associated forbs include fringed gentian (*Gentianopsis thermalis*), elephant head lousewort (*Pedicularis groenlandica*), star gentian (*Swertia perennis*), rose crown (*Clementsia rhodantha*), alpine false spring parsley (*Pseudocymopterus montanus*), Fendler's cowbane (*Oxyopolis fendleri*), and Jacob's ladder (*Polemonium foliosissimum*). Mosses are frequent on the surface of the soil. The soil pit documented peat accumulation of 42cm with muck below.

Uplands are dominated by spruce – fir (*Picea engelmannii* – *Abies lasiocarpa*) forests and talus slopes.

Biodiversity Rank Justification and Comments: The site supports a good (B-ranked) occurrence of the globally imperiled (G2S2) sheep sedge (*Carex illota*) herbaceous vegetation. This plant association usually occurs under high quality conditions as supported by this PCA. *Carex illota* is sensitive to disturbances e.g., grazing and trampling (Carsey *et al.* 2003). A good (B-ranked) occurrence of the apparently globally secure (G4S4) tufted hairgrass (*Deschampsia caespitosa*) herbaceous vegetation also occurs within the PCA boundaries. *Deschampsia*

caespitosa plant association is common in Colorado. Since this occurrence is associated with a montane fen, that is uncommon in Colorado, it warrants management's attention.

Table 12. Natural Heritage element occurrences at Snow Spur Tributary PCA.

Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Carex illota</i>	Small head sedge	G2	S2		B
<i>Deschampsia caespitosa</i>	Tufted hairgrass	G4	S4		B

Boundary Justification: The boundary encompasses the element occurrences and immediate adjacent area to buffer hydrologic processes necessary to the viability of the elements. It should be noted that the hydrologic processes necessary to the viability of the element are not fully contained by the PCA boundary. The boundary is thought to provide a buffer from direct disturbance, such as heavy grazing, where surface runoff may contribute excess nutrients, sediment and weed invasion.

Protection Comments: The PCA is owned by the San Juan National Forest and private in holdings. It bears to mention that landowners are in negotiation with The Nature Conservancy for the placement of a conservation easement.

Management Comments: The current management within the PCA has not negatively affected the elements. Recreation uses are horse riding and snow machine tours. Horse pastures are well managed by utilizing portable solar powered electric fencing. It is recommended to monitor for the dispersal of non-native plants from the horse pasture.

Soils Description: Mosses are frequent on the surface of the soil. Soils sampled are saturated to the surface and exhibit fibrous peat in the upper 2cm, a mucky peat horizon to 42cm depth, and muck beneath this. Water collected within the soil pit at 35cm depth. The mapped soil unit within the wet meadow is described as Typic Cryaquent-Cryaquoll-Cryofibrists complex, 0 – 5 percent slopes (USDA, NRCS 2002).

Restoration Potential: The wetland is functioning at its potential.

Wetland Functional Assessment for the Snow Spur Tributary PCA:

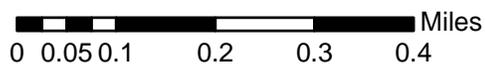
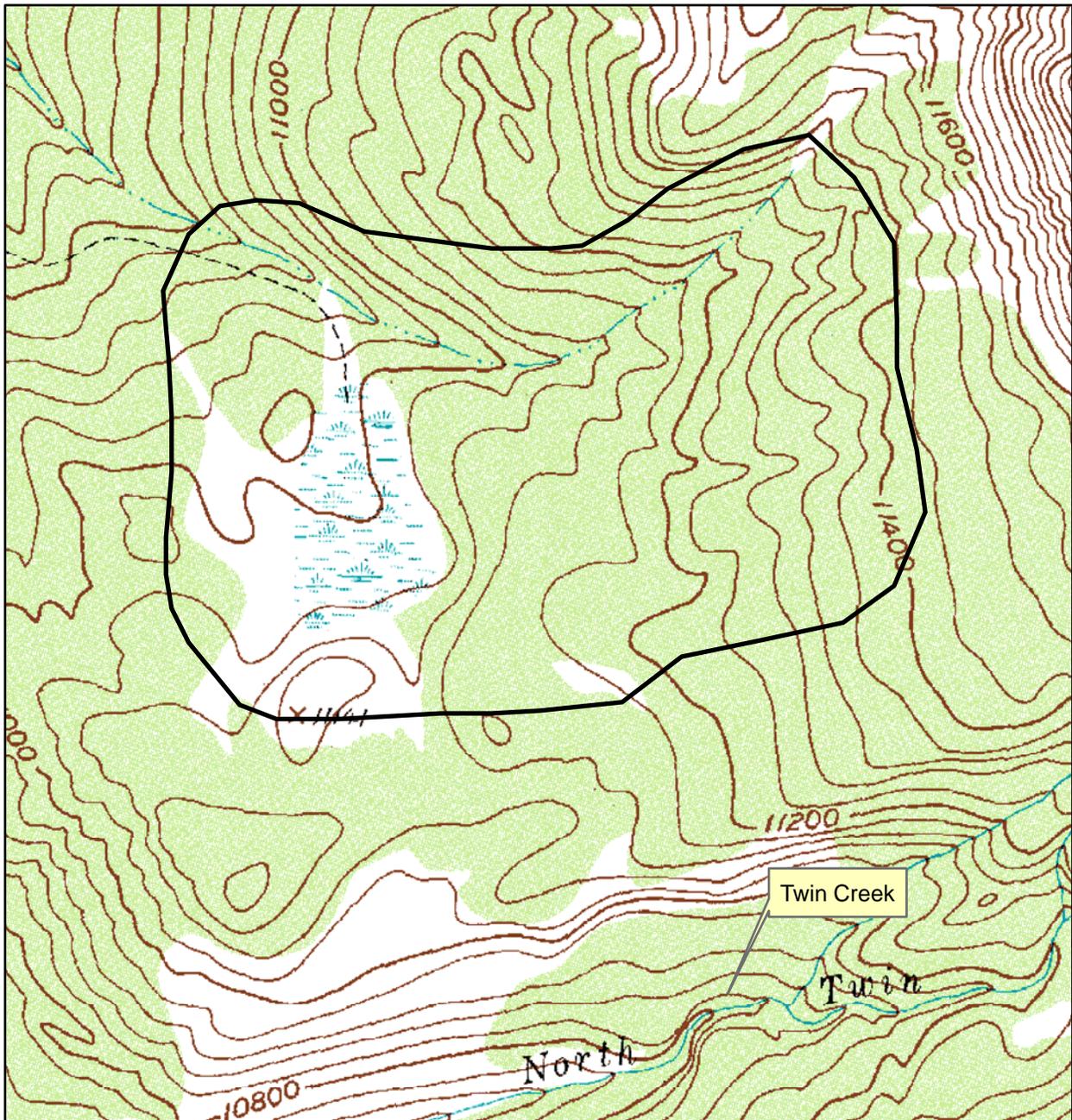
Proposed HGM Class: Riverine; Slope **Subclass:** R1; S1

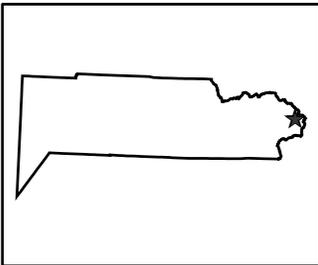
Cowardin System: Palustrine

CNHP's Wetland Classification: *Deschampsia caespitosa* and *Carex illota* subalpine wet meadow

Table 13. Wetland functional assessment for the wet meadow at Snow Spur Tributary PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	This wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	The area has saturated, peaty soil; very small channel below talus head water area, overland sheet flow, snow melt and ground water contribute to hydrology, moderate gradient.
Sediment/Shoreline Stabilization	High	The small channel is very densely vegetated.
Groundwater Discharge/Recharge	Yes	Water discharging from base of talus slope; free standing water in soil pit at 35cm.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	No disturbance to soils, functioning as compared to other peat accumulating wet meadows; outhouse uphill from occurrence, however well maintained.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Large area of peat soils, dense vegetation and consistently flowing water.
Biological Functions		
Habitat Diversity	Low	One Cowardin class present.
General Wildlife Habitat	Moderate	Wildlife sign noted; high elevation, isolated area. Not all areas are open to the public in the PCA.
General Fish/Aquatic Habitat	Low	No fish habitat; aquatic invertebrate habitat.
Production Export/Food Chain Support	Moderate	Headwaters with organic soils and dense vegetation; little flushing flows.
Uniqueness	High	The site contains a G2 association with deep organic soils.



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Map 2. Snow Spur Tributary Potential Conservation Area, B2: Very High Biodiversity Significance

Navajo Basin PCA

Biodiversity Rank: B2: Very high biodiversity significance. The PCA supports the globally imperiled (G2) *Draba graminea* in good condition (B ranked), two globally vulnerable plants, *Draba streptobrachia* and *Alisanthe macrantha* in good (B-ranked) condition, and three plants that are apparently globally secure (G4).

Protection Urgency Rank: P4: Low urgency. No protection actions are needed in the foreseeable future. The PCA is within the Lizard Head Wilderness.

Management Urgency Rank: M3: Moderate urgency. New management actions may be needed within 5 years to maintain the current quality of the element occurrences in the PCA. Continued monitoring to assess impacts of hiker travel will inform future management needs.

Location: Northern Dolores County, about 11 miles north of Rico. To reach the site, drive north past Dunton on the West Fork of the Dolores River to the Navajo Lake trailhead. Hike to Navajo Lake and continue on the trail through talus toward El Diente Peak.

U.S.G.S. 7.5 minute quadrangle: Dolores Peak and Mount Wilson

Legal Description: T41N,R10W, Sections 5 and 6; T42N R10W Sections 31 and 32; T41N R11W, Section 1; T42n R11W, Section 36.

Elevation: 11,200 to 12,800 feet

Size: Approximately 712 acres

General Description: This PCA is in a high alpine region north of El Diente Peak and Mount Wilson, which contains the headwaters of the West Dolores River. The site encompasses a steep upper basin of talus slopes, rocky outcrops and small patches of vegetation. Snow fields feed a high alpine lake and wetland below the talus slopes. Three species of alpine *Draba*: San Juan whitlow-grass, Boreal whitlow-grass and Colorado Divide whitlow-grass (*Draba graminea*, *D. borealis* and *D. streptobrachia*) are found in the sparsely vegetated crevices of rock outcrops. Altai cottongrass (*Eriophorum altaicum* var. *neogaenum*) occurs in the flat boggy area at the upper end of the lake with *Salix planifolia* and *Carex aquatilis*, and in another wet area farther up the drainage. Other associated taxa include: thistle groundsel, elephantella, subalpine fleabane, dwarfed Engelmann spruce, black sedge, bistort, Eastwood's podistera, marsh marigold, tufted hairgrass and different leaved groundsel (*Senecio crassulus*, *Pedicularis groenlandica*, *Erigeron peregrinus*, *Picea engelmannii*, *Carex nova*, *Bistorta vivipara*, *Podistera eastwoodiae*, *Caltha leptosepala*, *Deschampsia cespitosa* and *Senecio dimorphophyllus*.) Altai chickweed (*Stellaria irrigua*) is found in the talus with sparse vegetation including harbour Penstemon, wallflower, Colorado columbine, Rocky Mountain clover and purple fringe (*Penstemon harbourii*, *Erysimum capitatum*, *Aquilegia coerulea*, *Trifolium attenuatum*, and *Phacelia sericea*.)

Biodiversity Rank Justification and Comments: The Navajo Basin PCA supports a good (B) occurrence of San Juan whitlow-grass, a globally imperiled (G2) plant that is endemic to the San Juan Mountains in Colorado. There are also good occurrences of the globally vulnerable (G3) Colorado Divide whitlow-grass and House's stitchwort (*Alsinanthe macrantha*), state rare (S2) boreal whitlow-grass, Altai chickweed and Altai cottongrass.

Table 14. Natural Heritage element occurrences at Navajo Basin PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plants					
<i>Draba graminea</i>	San Juan whitlow-grass	G2	S2		B
<i>Alsinanthe macrantha</i>	House's stitchwort	G3	S3		B
<i>Draba streptobrachia</i>	Colorado Divide whitlow-grass	G3	S3		B
<i>Draba borealis</i>	Boreal whitlow-grass	G4	S2		B
<i>Stellaria irrigua</i>	Altai Chickweed	G4?	S2		C
<i>Eriophorum altaicum</i> var. <i>neogaeum</i>	Altai Cotton-grass	G4?T3?	S2		B
<i>Eriophorum altaicum</i> var. <i>neogaeum</i>	Altai Cotton-grass	G4?T3?	S2		B

*EO=Element Occurrence. Multiple listings represent separate locations.

Boundary Justification: The boundary is drawn to take in the alpine basin above Navajo Lake, including the location of six rare plant occurrences. All five species are dependent on hydrologic and geologic processes within the basin such as snow accumulation and melting and weathering of bedrock. The mosaic of microsites within the basin includes talus slopes that support Altai chickweed, small rock outcrops that are home to the two drabas, and the wetlands that support Altai cotton-grass.

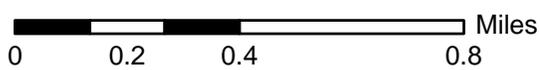
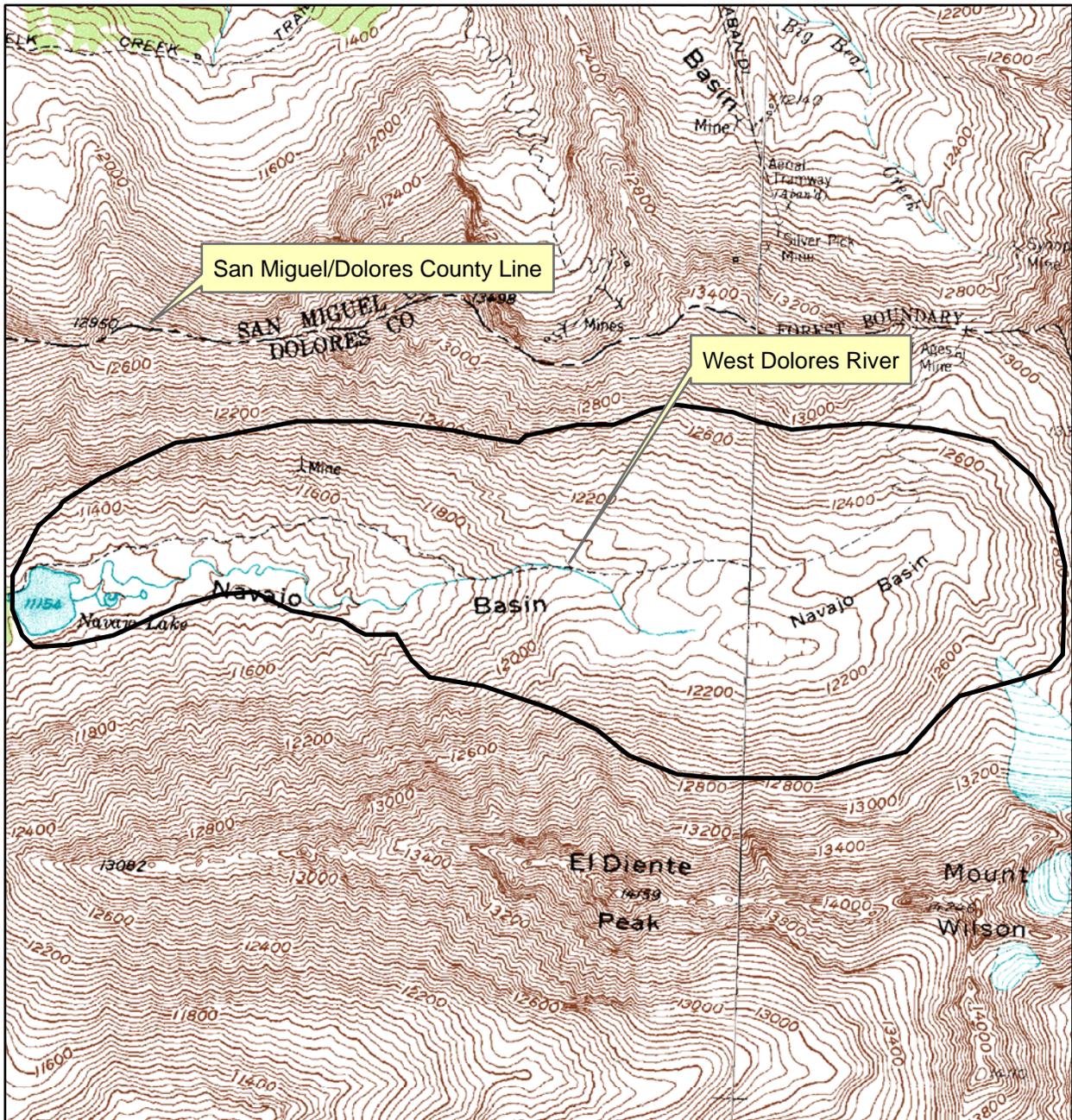
Protection Comments: The PCA is well protected within the Lizard Head Wilderness of the San Juan National Forest.

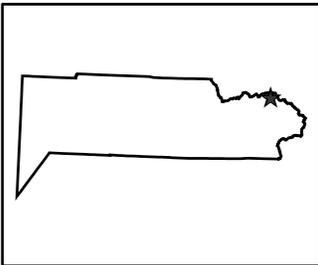
Management Comments: The area is popular as a hiking destination and access route to high peaks. Colorado Fourteeners Initiative members are monitoring effects of hiker use along the access trail to Wilson Peak, Mount Wilson and El Diente Peak. Monitoring trails and the camping areas around Navajo Lake will help to determine whether any management actions are necessary.

Wetlands Functional Assessment: CNHP wetland ecologists did not visit this PCA in 2004. No functional assessment was completed.



Navajo Lake, with Altai cottongrass. Photograph © CNHP 2004.



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Map 3. Navajo Basin Potential Conservation Area, B2: Very High Biodiversity Significance

Beaver Creek at Willow Spring Potential Conservation Area

Biodiversity Rank: B3. High Biodiversity Significance. The site supports a fair (C-ranked) occurrence of the globally imperiled (G2?S2) narrowleaf cottonwood/river hawthorn (*Populus angustifolia* / *Crataegus rivularis*) woodland; a fair (C-ranked) occurrence of the globally imperiled (G2G3S2S3) strap leaf willow (*Salix ligulifolia*) shrubland; and a fair (C-ranked) occurrence of the globally imperiled (G2QS2) river hawthorn (*Crataegus rivularis*) shrubland.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The PCA is owned by the San Juan National Forest.

Management Urgency Rank: M3. New management action may be needed within 5 years to maintain the current quality of the element occurrences in the PCA. Road maintenance and cattle grazing threaten the condition of the PCA.

Location: The Beaver Creek at Willow Spring PCA is located in south central Dolores County, surrounding Beaver Creek at the intersection of the Dolores/Norwood Road and Forest Road 514.

U.S.G.S. 7.5-min. quadrangles: Willow Spring

Legal Description: T39N R14W Section 4, 8, 9

Elevation: 7,800 – 8,000 ft **Size:** Approximately 455 acres

Redders, 2003, Community Type: *Crataegus rivularis* / *Salix* species willow shrubland; *Salix eriocephala* var. *ligulifolia* willow shrubland

General Description: Beaver Creek is a small perennial stream that flows through rolling hills in a montane setting. The stream channel is deeply incised in some areas, as well as braided, due to clayey soils with crumb structure and fine loams, derived in part from Mancos Shale. Trees and shrubs form a dense canopy cover (totaling 75%), protecting bank erosion in some areas. The site is bisected by a well-used road (Dolores – Norwood Road). In summer of 2004, a temporary mud dam was installed to trap water in Beaver Creek for road construction/maintenance purposes (water was pumped from the creek, into trucks and used for road construction in the vicinity.) This affected water turbidity downstream of the small dam, creating a visible brownish milky color.

Narrowleaf cottonwood (*Populus angustifolia*) occurs in an open canopy, associated with river hawthorn (*Crataegus rivularis*). This plant community is located in a willow mosaic dominated by strapleaf willow (*Salix ligulifolia*) and mountain willow (*Salix monticola*) with a sparse herbaceous understory. River hawthorn also forms dense shrublands above the willow carr on drier soils. The riparian zone also exhibits areas devoid of vegetation where bedrock is exposed within the stream channel from seasonal flooding. Coyote willow (*Salix exigua*), an early successional willow, commonly forms narrow thickets on point bars.

Associated species in the riparian area include shining willow (*Salix lasiandra*), Wood's rose (*Rosa woodsii*), serviceberry (*Amelanchier alnifolia*), snowberry (*Symphoricarpos rotundifolius*), whitestem gooseberry (*Ribes inerme*), beaked sedge (*Carex utriculata*), woolly sedge (*Carex lanuginosa*), Baltic rush (*Juncus balticus*), common spikerush (*Eleocharis palustris*), rush species (*Juncus* spp.), western wheat (*Pascopyrum smithii*), smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*), and a trace amount of forbs e.g., starry false lily of the valley (*Maianthemum stellatum*), wild iris (*Iris missouriensis*), black medic (*Medicago lupulinus*), common plantain (*Plantago major*), blue flax (*Linum lewisii*), red clover

(*Trifolium pratense*), golden banner (*Thermopsis montana*), wild licorice (*Glycyrrhiza lepidota*), common dandelion (*Taraxacum officinale*), Canada thistle (*Cirsium arvense*), and fleabane (*Erigeron* sp.)

Beaver have naturalized an historic, destroyed impoundment by creating dams in the opening, resulting in a large pond. The beaver activity has flooded substantial areas, throughout the site, creating extensive wildlife habitat. Willow regeneration is vigorous on old beaver dams where soil is building and cut twigs have sprouted. Several bird species were observed utilizing the habitat such Black-crowned Night Heron (*Nycticorax nycticorax*), nesting pair of Mountain Bluebirds (*Sialia currucoides*), Yellow Warbler (*Denroica petechia*), Red-wing Blackbird (*Agelaius phoeniceus*), Killdeer (*Charadrius vociferus*), Spotted Sandpiper (*Tringa solitaria*), American Kestrel (*Falco sparverius*) and others. CNHP documents an occurrence of the Southwest Willow Flycatcher (*Empidonax trailii extimus*) in 1996, in the immediate surrounding area, however was not relocated in 2004 (CNHP 2005).

Pinyon pine (*Pinus edulis*) – Rocky Mountain juniper (*Juniperus scopulorum*) – Utah juniper (*Juniperus osteosperma*) and ponderosa pine (*Pinus ponderosa*) forests dominate the uplands interspersed with Gambel’s oak (*Quercus gambelii*) woodlands and open rangelands. Upland vegetation is encroaching the riparian area in places with species such as ponderosa pine, shrubby cinquefoil (*Dasiphora fruticosa* subsp. *floribunda*), broom snakeweed (*Gutierrezia sarothrae*), pasture grasses (*Bromus inermis*; *Poa pratensis*) and several forb species (see above list).

Biodiversity Rank Justification and Comments: The PCA supports a fair (C-ranked) occurrence of the globally imperiled (G2?S2) narrowleaf cottonwood / river hawthorn (*Populus angustifolia* / *Crataegus rivularis*) woodland. An abundance of *Crataegus rivularis* may indicate a late seral stage of the cottonwood stand and a drop in the water table (Carsey *et al.* 2003). The globally imperiled (G2G3 S2S3) strap leaf willow (*Salix ligulifolia*) shrubland was ranked with a fair estimated viability (C-rank). This plant association appears to be a long-lived mid- to late-seral type since it is associated with beaver activity and saturated soils throughout the growing season (Carsey *et al.* 2003). A fair (C-ranked) occurrence of the globally imperiled (G2QS2) river hawthorn (*Crataegus rivularis*) shrubland can be an indicator that seasonal flooding has been reduced or removed. *Crataegus rivularis* can be browsed heavily thus creating environmental conditions conducive to increaser species such as Wood’s rose (*Rosa woodsii*) and Kentucky bluegrass (*Poa pratensis*) (Carsey *et al.* 2003).

Table 15. Natural Heritage element occurrences at Beaver Creek at Willow Spring PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plant Community					
<i>Populus angustifolia</i> / <i>Crataegus rivularis</i>	Narrowleaf cottonwood / river hawthorn	G2?	S2		C
<i>Crataegus rivularis</i>	River hawthorn	G2Q	S2		C
<i>Salix ligulifolia</i>	Strap leaf willow	G2G3	S2S3		C

Boundary Justification: The boundary encompasses the element occurrences and buffers the immediate watershed that is essential for the viability of the riparian plant associations. Natural fluvial activity such as flooding events and sediment deposition contribute to the perpetuity of riparian systems, such as the cottonwood system (Hansen *et al.* 1995; TNC 1996). The boundaries also provide a small buffer from nearby roads and rangeland where runoff may

contribute excess nutrients, sediment and weed invasion. It should be noted that the hydrological processes necessary to the element are not fully contained by the PCA boundaries.

Protection Comments: The San Juan National Forest owns the PCA; a county road is within the site and is managed by Dolores and Montezuma counties.

Management Comments: The temporary dam for road maintenance affects the natural flow and may cause excessive sedimentation, which may possibly have subsequent effects on invertebrate and aquatic species. Heavy grazing is a threat in the area, evidenced by stream bank erosion and weed invasion. It is suggested to evaluate grazing practices on private property upstream, on the adjacent uplands, and within the PCA (USFS land).

Soils Description: Soils in the area are clay, gleyed in some areas, but vary according with the geomorphic position. Mapped soil units within the PCA are classified primarily as Bradfield – Narraguinnep complex: Bradfield is fine, smectitic, frigid Udic Haplusterts; and Narraguinnep is fine, smectitic, frigid, Vertic Haplustolls. (USDA, NRCS 2002)

Restoration Potential: Restoration opportunities may include non-native plant eradication and monitoring, evaluating grazing practices, and minimizing affects from road maintenance and use. Condition of the Beaver Creek wetlands and riparian areas varies throughout the site, however the majority of the PCA is ranked as fair. Direct impacts from road maintenance and heavy traffic on dirt roads may be negatively affecting the adjacent ecosystem, especially water quality downstream. Further, it is suggested to revegetate the stream banks where heavy equipment has accessed to make the dam and water trucks are accessing the water. Unfavorable grazing practices may be contributing to weed invasion. Common dandelion and Canada thistle are common throughout the site. Referring to such resources as the Nature Conservancy's web site on invasive species (<http://tncweeds.udcavis.edu/index.html>) or <http://www.invasivespecies.gov/> may provide some assistance with control and eradication of non-native species. Whole range grazing concepts may be beneficial when evaluating grazing rotation methods, which consider uplands as well as riparian areas within one plan, benefiting the entire range (Leonard *et al.* 1997).

Wetland Functional Assessment for the Beaver Creek at Willow Spring PCA:

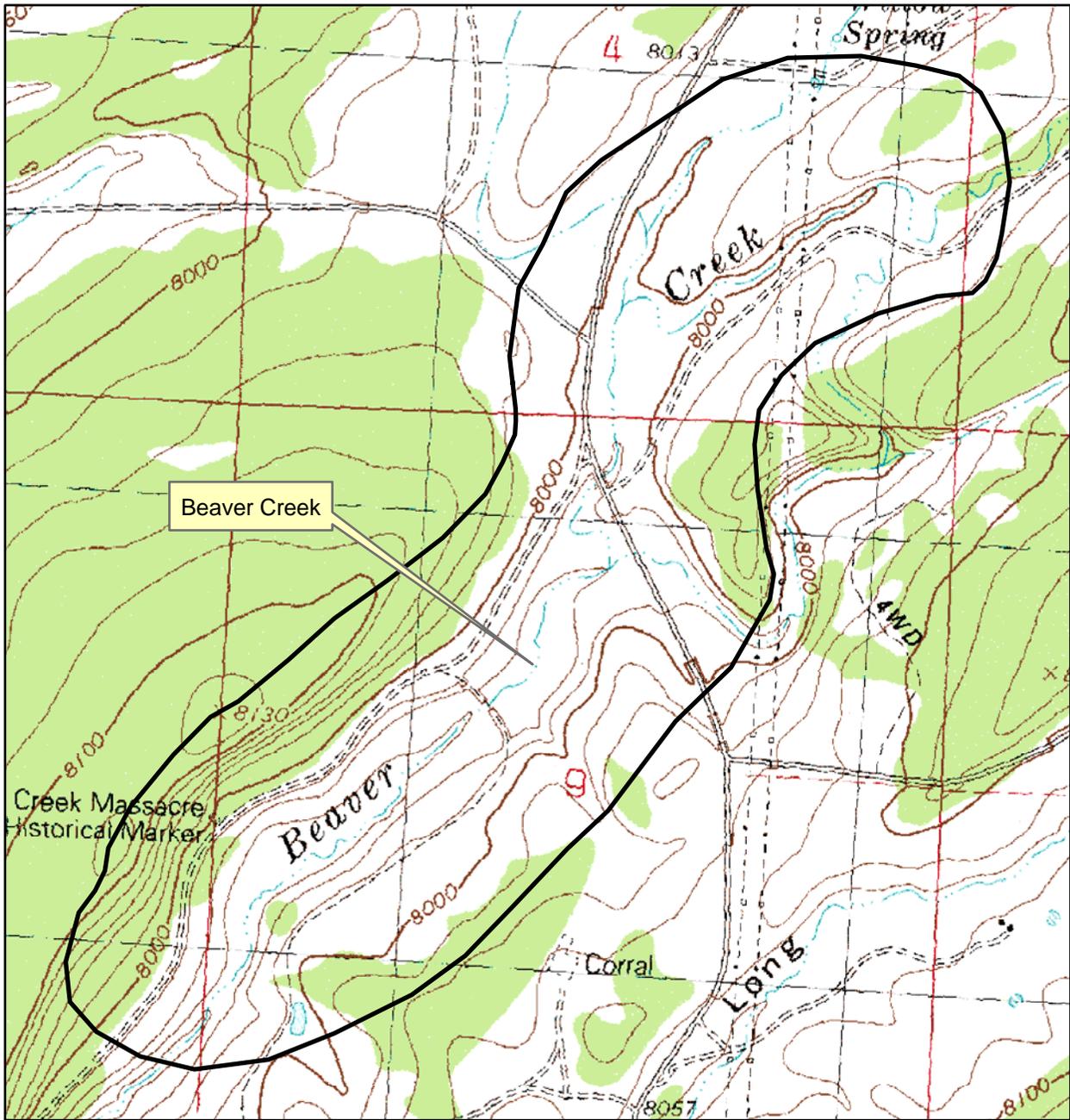
Proposed HGM Class: Riverine **Subclass:** R2

Cowardin System: Palustrine

CNHP's Wetland Classification: *Populus angustifolia* / *Crataegus rivularis*; *Salix ligulifolia*; *Crataegus rivularis*

Table 16. Wetland functional assessment for the riverine woodlands and shrublands at Beaver Creek at Willow Spring PCA.

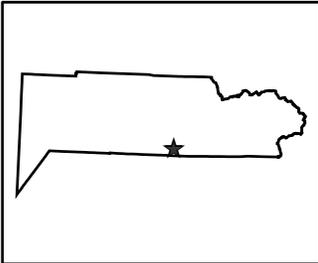
Function	Rating	Comments
Overall Functional Integrity	Below Potential	This wetland is affected by grazing, temporarily altered hydrology, and well-used roads adjacent creating fragmentation, dust and sedimentation due to maintenance.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Beaver activity creates good storage area, otherwise a limited floodplain with arroyo type bank incising.
Sediment/Shoreline Stabilization	Moderate	Low function in some areas where upland and non-native understory – poor soil stabilization; functioning in areas with dense woody vegetation and beaver activity.
Groundwater Discharge/Recharge	Yes	Springs discharging upstream. Deep clay-based soils may inhibit recharge.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Native graminoids and expected amounts of organic matter in the upper part of the soil horizon Nearly disrupted in localized areas -- soil compaction and erosion by cattle where there is little detritus, weed invasion, exotics and non-native grass understory.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Native herbaceous vegetation, ponds and sediment trapping perform this function.
Biological Functions		
Habitat Diversity	Moderate	Two Cowardin classes, scrub shrub and woodland.
General Wildlife Habitat	Moderate	Song birds, water fowl (Black-crowned Night Heron observed) beaver activity, Western Bluebird nest, deer sign, raccoon tracks. Well-used road in PCA.
General Fish/Aquatic Habitat	Moderate	Low flows in creek; several pools for aquatics other than large fish (small fish observed).
Production Export/Food Chain Support	Moderate	Sign of high water along channel, dense but patchy woody vegetation overhanging channel, especially in beaver enhanced wetlands.
Uniqueness	Moderate	Site supports three G2 plant associations.



Beaver Creek

Creek Massacre
Historical Marker



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Map 4. Beaver Creek at Willow Spring Potential Conservation Area, B3: High Biodiversity Significance

Cottonwood Draw Potential Conservation Area

Biodiversity Rank: B3. High Biodiversity Significance. The site supports a fair (C-ranked) occurrence of the globally imperiled (G2QS2) river hawthorn (*Crataegus rivularis*) shrubland; and a fair (C-ranked) occurrence of the apparently globally secure (G4) but vulnerable in Colorado (S3) narrowleaf cottonwood / red-osier dogwood (*Populus angustifolia* / *Cornus sericea*) woodland.

Protection Urgency Rank: P3. Protection action may be needed, but probably not within the next 5 years. It is estimated that current stressors may reduce the viability of the elements in the PCA if protection action is not taken. The PCA is within the San Juan National Forest with heavily impacted grazing allotments.

Management Urgency Rank: M2. New management actions may be needed within 5 years to prevent the loss of the element occurrences within the PCA. Heavy grazing, especially on uplands adjacent to the riparian area are negatively affecting the viability of the elements.

Location: The Cottonwood Draw PCA is located in the northwest central part (north of The Glade) of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: The Glade

Legal Description: T41N R16W Section 6, 7

Elevation: 7,800 – 8,000 ft.

Size: Approximately 135 acres

Redders, 2003, Community Type: *Crataegus rivularis* / *Salix* species willow shrubland

General Description: Cottonwood Draw is a spring fed, intermittent draw, draining northward into the Disappointment Creek drainage. The headwaters of Cottonwood Draw are located between high plateaus and mountains. The creek flows through a quaking aspen (*Populus tremuloides*) grove down into a steep sandstone canyon with ponderosa pine (*Pinus ponderosa*) and pinyon pine (*Pinus edulis*) upland forests. Upstream of the element occurrences, a stock pond berm is delaying water flow.

Downstream from the stock pond, the area is fenced and consists of open meadows interspersed with ponderosa pine and Gambel's oak (*Quercus gambelii*) woodlands with several ephemeral tributary creeks. Springs discharge downstream of the stock pond, and create isolated mesic pockets where riparian vegetation flourishes, otherwise the riparian zone is interspersed with upland species. Soils in the PCA are clay and clay loams and vary greatly within the site.

The dominant natural plant association, river hawthorn (*Crataegus rivularis*) shrublands, occurs in dense, extensive stands. Willows occur in dense patches and include mountain willow (*Salix monticola*), plane leaf willow (*Salix planifolia*) and Bebb's willow (*Salix bebbiana*). Understory is sparse within the shrubland and includes pasture grasses and sedges (*Carex praegracilis*; *Carex microptera*). The isolated spring discharge sites are confined to moist and shady areas, dominated by mesic forbs, e.g., cutleaf coneflower (*Rudbeckia ampla*), Richard's geranium (*Geranium richardsonii*), alpine false spring parsley (*Pseudocymopterus montanus*), large leafed avens (*Geum macrophyllum*), Rocky Mountain iris (*Iris missouriensis*), and chiming bells (*Mertensia* sp.). Other associated natural plant communities in the riparian area are narrowleaf cottonwood / red-osier dogwood (*Populus angustifolia* / *Cornus sericea*) riparian woodland and quaking aspen stands.

Currently, the area is fenced and grazing impacts are low or recovering (e.g., few exotics and cattle trailing observed), even though the area is widely used for cattle grazing. The overall condition in the riparian area is fair and improving.

Biodiversity Rank Justification and Comments: The site supports a fair (C-ranked) occurrence of the globally imperiled (G2QS2) river hawthorn (*Crataegus rivularis*) shrubland that can be an indicator that seasonal flooding has been reduced or removed. *Crataegus rivularis* can be browsed heavily thus creating environmental conditions conducive to increase species such as Woods' rose (*Rosa woodsii*) and Kentucky bluegrass (*Poa pratensis*) (Carsey *et al.* 2003). The PCA supports a fair (C-ranked) occurrence of the apparently globally secure (G4) but vulnerable in Colorado (S3) narrowleaf cottonwood / red-osier dogwood (*Populus angustifolia* / *Cornus sericea*) woodland. This plant association can be an indicator of mid- to late-seral cottonwood forests that have become isolated from frequent flooding and sediment deposition. The presence of *Cornus sericea* indicates a seasonally high water table or the disappearance of *Cornus sericea* indicates a drop in the water table (Carsey *et al.* 2003).

Table 17. Natural Heritage element occurrences at Cottonwood Draw PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Crataegus rivularis</i>	River hawthorn	G2Q	S2		C
<i>Populus angustifolia</i> / <i>Crataegus rivularis</i>	Narrowleaf cottonwood/ red-osier dogwood	G2?	S2		C

Boundary Justification: The boundary is drawn to encompass the element occurrences and areas that are identified as a buffer that reflect the ecological processes that support the wetland. Natural fluvial disturbances such as seasonal flooding are important to the maintenance of a dynamic, multi-aged cottonwood riparian system (Hansen *et al.* 1995; TNC 1996). The boundaries also identify an area that can provide a buffer from nearby trails, roads and open range where surface runoff may contribute excess nutrients, sediment and weed invasion. It should be noted that the hydrologic processes necessary to the element are not fully contained by the PCA boundaries.

Protection Comments: The land is owned by the San Juan National Forest.

Management Comments: It is suggested to continue or improve grazing practices within the riparian area (the area appears to be recovering), and to evaluate and improve grazing practices on adjacent uplands. The stock pond berm seeps water into the drainage, which is beneficial for riparian vegetation, however, the berm is built very high, limiting possible seasonal flooding events in the riparian area. It may be beneficial to monitor and manage off road vehicle use especially where the road is rough, or muddy, especially as new roads are being formed upstream of the occurrences.

Soils Description: Soils vary with geomorphic position and moisture levels; soils observed are clay and silty clay loam, with little organic matter. Fughes loam dominates the mapped soil units in the riparian area, classified as, smectitic, frigid Pachic Argiustoll (USDA, NRCS 2002).

Restoration Potential: Restoration opportunities could include whole pasture concepts in grazing management practices. Riparian area management is more effective when considered along with upland pasture management, as adjacent uplands can affect watershed condition with excessive sedimentation, erosion, runoff (Leonard *et al.* 1997), and weed invasion. Referring to such resources as the Nature Conservancy’s web site on invasive species (<http://tncweeds.ucdavis.edu/index.html>) or <http://www.invasivespecies.gov/> may provide some assistance with control and eradication of non-native species.

Wetland Functional Assessment for the Cottonwood Draw PCA:

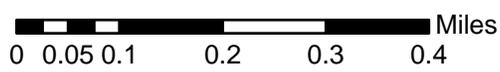
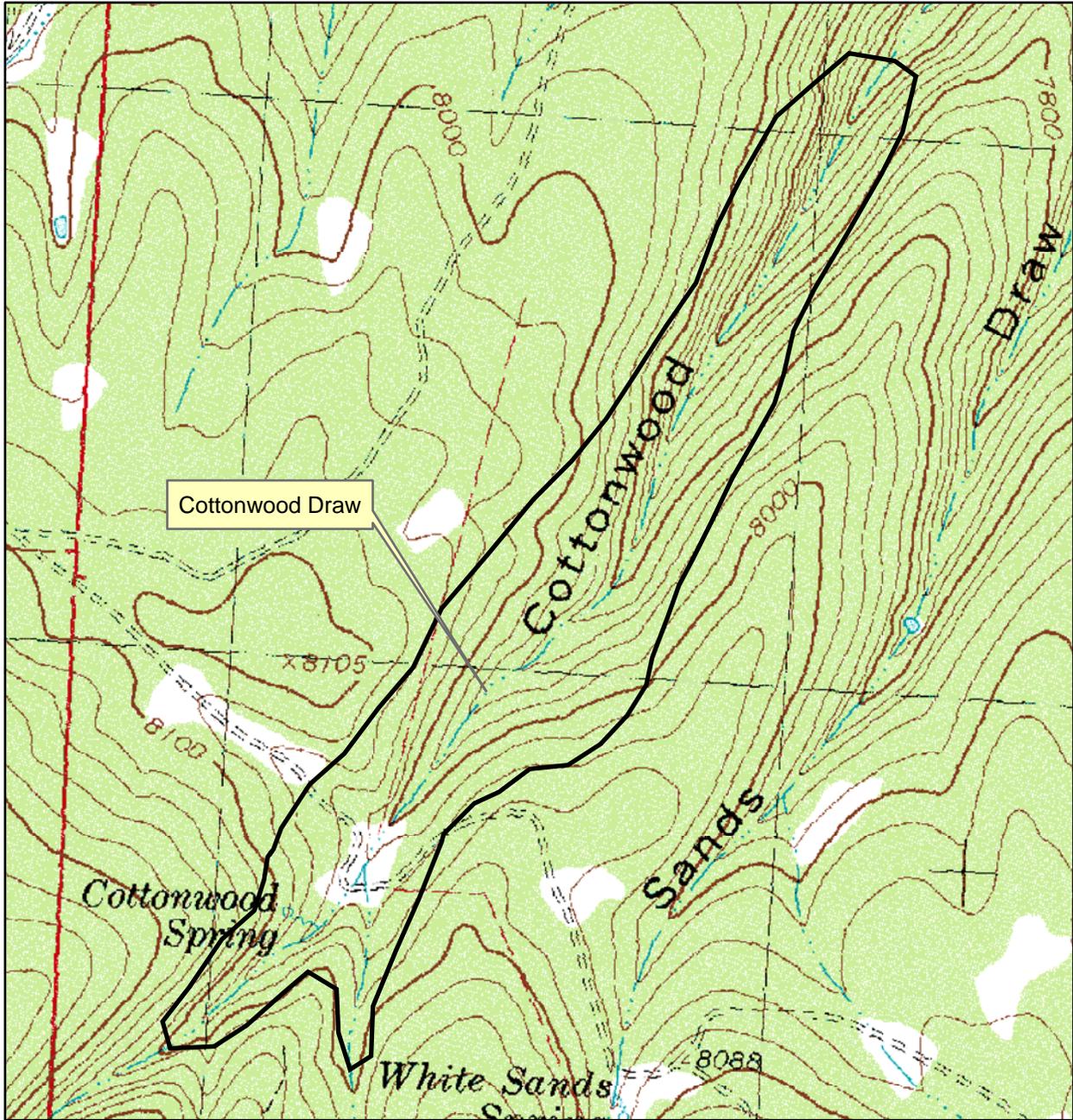
Proposed HGM Class: Riverine **Subclass:** R2/R3

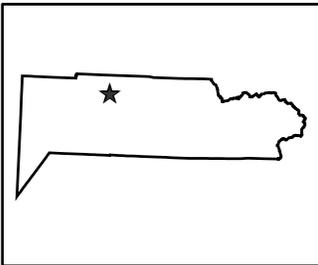
Cowardin System: Palustrine

CNHP's Wetland Classification: *Populus angustifolia* / *Crataegus rivularis* montane riparian woodland; *Crataegus rivularis* montane riparian shrubland

Table 18. Wetland functional assessment for the montane riparian shrublands and woodlands at Cottonwood Draw PCA.

Function	Rating	Comments
Overall Functional Integrity	Below Potential	The wetland appears to be functioning below its potential due to impacts from altered hydrology and adjacent grazing.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Dense shrublands and native mesic forbs are accessible in the floodplain, in a possible flooding event. Floodplain is limited in steep areas in the lower reaches of the PCA.
Sediment/Shoreline Stabilization	Moderate	Dense woody vegetation and native understory in patches. Otherwise upland and weedy vegetation in the herbaceous understory with patches of bare soil.
Groundwater Discharge/Recharge	Yes	Springs present. Clay and silty clay loam soils may limit recharge.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Disrupted	Understory has high cover of pasture grasses. There are cattle impacts to soil (hoove prints; erosion) in some areas, however appears to be recovering.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Vigorous shrubs and mesic forbs in patches. Low flows in stream channel.
Biological Function		
Habitat Diversity	Moderate	Contains two Cowardin classes; scrub shrub and forested wetland types
General Wildlife Habitat	High	Diversity of shrubs; songbirds, wildlife sign.
General Fish/Aquatic Habitat	Low	Small reservoir upstream, no fish habitat.
Production Export/Food Chain Support	Low	Stock pond berm inhibits this function.
Uniqueness	Moderate	The PCA supports a G2 plant community.



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Map 5. Cottonwood Draw Potential Conservation Area, B3: High Biodiversity Significance

Dawson Draw Canyon East Potential Conservation Area

Biodiversity Rank: B3. The site supports the globally imperiled (G2?S2) narrowleaf cottonwood/river hawthorn (*Populus angustifolia* / *Crataegus rivularis*) woodland in fair (C-ranked) condition; and the apparently globally secure (G4) vulnerable in the state (S3) mountain willow (*Salix monticola*) / Mesic Forbs shrubland in fair (C-ranked) condition.

Protection Urgency Rank: P3. Protection action may be needed, but probably not within the next 5 years. It is estimated that current stressors may reduce the viability of the elements in the PCA if protection action is not taken. The PCA is owned by the San Juan National Forest where there are heavily used grazing allotments.

Management Urgency Rank: M2. New management action may be needed within 5 years to prevent the loss and further degradation of the element occurrences in the PCA. Altered hydrology, weed invasion and grazing impacts threaten the condition within the PCA.

Location: The Dawson Draw Canyon East PCA is located in the northwest central part of Dolores County surrounding Dawson Draw.

U.S.G.S. 7.5-min. quadrangles: The Glade

Legal Description: T41N R16W Section 9, 16

Elevation: 7,600 – 7,700 ft.

Size: Approximately 148 acres

Redders, 2003, Community Type: *Populus angustifolia* / *Crataegus rivularis* deciduous forests and *Salix monticola* / Mesic Forbs willow shrubland

General Description: Dawson Draw Canyon East is part of a series of canyons draining northward into the Disappointment Creek from the high plateau/lower montane region north of The Glade in the San Juan National Forest. The PCA encompasses a narrow valley where springs add to the hydrology of an otherwise intermittent stream. Initially the gradient is gentle as the draw flows through ponderosa pine (*Pinus ponderosa*) forests and Gambel's oak (*Quercus gambelii*) woodlands. Eventually, the channel gradient increases as it flows into a steep sandstone canyon before its confluence with Dawson Draw, and the Disappointment Creek. A small reservoir is upstream of dense willow shrublands within a mosaic of narrowleaf cottonwoods (*Populus angustifolia*). A four-wheel drive road is located adjacent to the creek bed for a short distance, however, appears to be little used and eventually fades.

The willow shrubland is dominated by mountain willow / mesic forb (*Salix monticola*) plant association with a mixture of other shrubs, including strap leaf willow (*Salix ligulifolia*), Bebb's willow (*Salix bebbiana*), river hawthorn (*Crataegus rivularis*), and shrubby cinquefoil (*Dasiphora floribunda*). There is a native and non-native mixture of graminoids in the understory such as field sedge (*Carex praegracilis*), small winged sedge (*Carex microptera*), silvery sedge (*Carex canescens*), Baltic rush (*Juncus balticus*), and hay grasses (*Poa pratensis*; *Bromus inermis*). Mesic forbs mix with upland forbs and weeds including, northern bedstraw (*Galium septentrionalis*), cutleaf coneflower (*Rudbeckia ampla*), Richardson's geranium (*Geranium richardsonii*), alpine false springparsley (*Pseudocymopterus montanus*), black medic (*Medicago lupulina*), golden banner (*Thermopsis montana*), red clover (*Trifolium pratense*), common dandelion (*Taraxacum officinale*) and other forbs in trace amounts in the herbaceous canopy

cover. The narrowleaf cottonwood (*Populus angustifolia*) gallery has an open to sparse canopy cover, with a dense cover of river hawthorn (*Crataegus rivularis*) in the shrub layer. The shrub layer has a variety of species including roundleaf snowberry (*Symphoricarpos rotundifolius*), serviceberry (*Amelanchier alnifolia*), Woods' rose (*Rosa woodsii*), shrubby cinquefoil (*Dasiphora floribunda*), and chokecherry (*Prunus virginiana*). Little evidence of cottonwood regenerating indicates that the river hawthorn (*Crataegus rivularis*) shrubland seral stage is succeeding the previous cottonwood seral stage.

Grazing impacts are moderate; some bank erosion has occurred from hoof shearing, and there is trailing within the shrublands. Non-native species include common dandelion (*Taraxacum officinale*), red clover (*Trifolium pratense*) and pasture grasses (*Bromus inermis*, *Poa pratensis*). Non-native species are common but never dominate the herbaceous understory.

Biodiversity Rank Justification and Comments: The site supports the globally imperiled (G2?S2) narrowleaf cottonwood / river hawthorn (*Populus angustifolia* / *Crataegus rivularis*) woodland in fair (C-ranked) condition. An abundance of *Crataegus rivularis* may indicate a late seral stage of the cottonwood stand and a drop in the water table (Carsey *et al.* 2003). The apparently globally secure (G4) vulnerable in the state (S3) mountain willow (*Salix monticola*) / Mesic Forbs shrubland is ranked as being in fair (C-ranked) condition. *Salix monticola* dominated plant associations appear to be long-lived and stable, typically occurring with a diverse understory of forbs (Carsey *et al.* 2003).

Table 19. Natural Heritage element occurrences at Dawson Draw Canyon East PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plant Community					
<i>Populus angustifolia</i> / <i>Crataegus rivularis</i>	Narrowleaf cottonwood / river hawthorn	G2?	S2		C
<i>Salix monticola</i> / Mesic Forbs	Mountain willow / Mesic Forbs	G4	S3		C

Boundary Justification: The boundary encompasses the element occurrences and an area that buffers immediate ecological and hydrologic processes e.g., flooding. Seasonal flooding, sediment deposition, and new channel formation would help maintain the riparian system, such as the cottonwood plant community (Hansen *et al.* 1995; TNC 1996). It should be noted that the hydrologic processes necessary to the elements are not fully contained by the PCA boundaries.

Protection Comments: The PCA is owned by the San Juan National Forest where there are heavily used grazing allotments.

Management Comments: It is suggested to evaluate and improve grazing practices in the Dawson Draw area, both within the riparian area and on adjacent uplands. The presence of river hawthorn (*Crataegus rivularis*) can indicate a drop in water levels, however mountain willow (*Salix monticola*) typically indicates a persistent water table. *Salix monticola* is nearest the reservoir where water releases and seepage may not advance far enough to affect the *Crataegus rivularis* dominated area. Threats include weed invasion, including non-native pasture grasses, and excessive erosion. It may be beneficial to monitor and manage off road vehicles to reduce erosion.

Soils Description: Soils sampled within the PCA are clay loams. Mapped soils within the PCA riparian area is delineated as Fughs Loam, classified as fine, smectitic, frigid Pachic Argiustolls (USDA, NRCS 2002).

Restoration Potential: Restoration opportunities include monitoring for the dispersal of weeds and improving grazing rotation. If it is possible, allowing water into the stream channel from the stock pond berm may be beneficial to the riparian vegetation. Referring to such resources as the Nature Conservancy's web site on invasive species (<http://tncweeds.ucdavis.edu/index.html>) or <http://www.invasivespecies.gov/> may provide some assistance with control and eradication of non-native species. The Colorado Natural Areas Program has a native plant revegetation guide available on their website at <http://www.parks.state.co.us/cnap/index.html> which may provide helpful information about using native plants for revegetation projects.

Wetland Functional Assessment for the Dawson Draw Canyon East PCA:

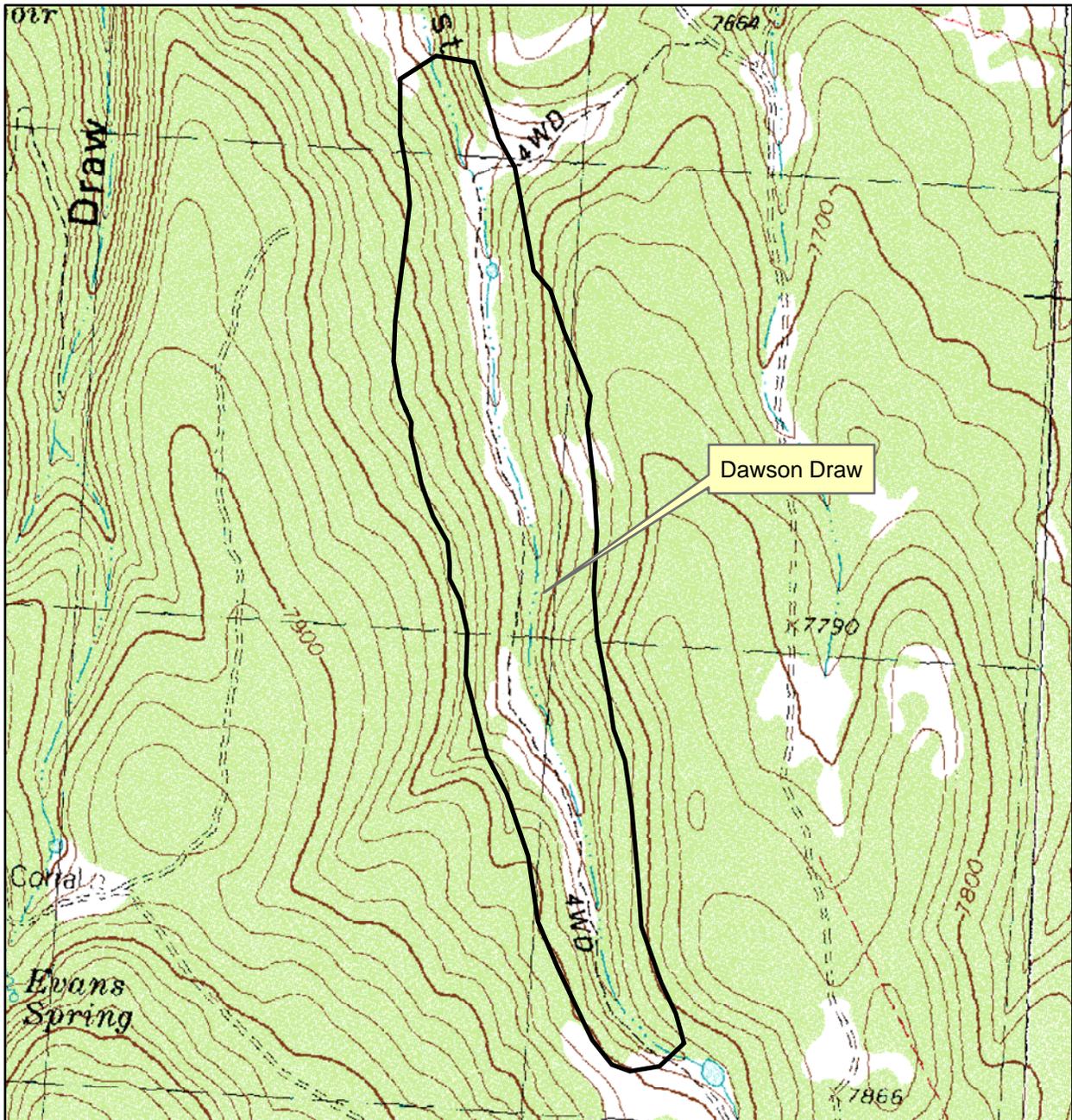
Proposed HGM Class: Riverine **Subclass:** R2

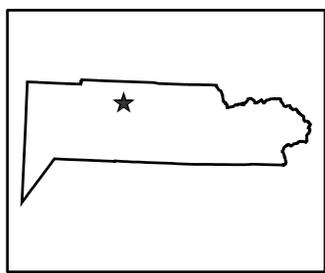
Cowardin System: Palustrine

CNHP's Wetland Classification: *Populus angustifolia/Crataegus rivularis* montane riparian woodland; *Salix monticola*/Mesic Forbs montane riparian shrubland

Table 20. Wetland functional assessment for the montane riparian woodland and shrubland at Dawson Draw Canyon East PCA.

Function	Rating	Comments
Overall Functional Integrity	Below Potential	Due to altered hydrology and impacts from a long history of grazing, this wetland appears to be functioning below its potential.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Dense woody vegetation, accessible floodplain, non-natives in understory, some native and hydrophytes.
Sediment/Shoreline Stabilization	Low	Excessive erosion in places, hay grasses at channel's edge, although, woody vegetation increases function.
Groundwater Discharge/Recharge	Yes	Springs discharging in the area. Little recharge due to clayey soils.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Disrupted	Clay, silty clay loam with some organic matter; visible cattle impacts to soil, erosion.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Dense, vigorous woody vegetation, non-native and sparse understory; erosion and bare soil.
Biological Functions		
Habitat Diversity	Moderate	Two Cowardin classes present: scrub shrub; forested.
General Wildlife Habitat	Moderate	Diverse shrubs species provides habitat. Wildlife sign, song birds.
General Fish/Aquatic Habitat	Low	Reservoir upstream, little in stream flow, poor fish habitat.
Production Export/Food Chain Support	Low	Altered hydrology, little flushing flows.
Uniqueness	Moderate	The area supports a G2 plant community.



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Map 6. Dawson Draw Canyon East Potential Conservation Area, B3: High Biodiversity Significance

Dolores River at Snow Spur Potential Conservation Area

Biodiversity Rank: B3. High biodiversity significance. The site supports a good (B-ranked) occurrence of the globally vulnerable (G3S3) Geyer's willow (*Salix geyeriana*) / Mesic Forbs montane riparian willow carr; a fair (C-ranked) occurrence of the globally vulnerable (G3S3) Drummond willow/bluejoint reedgrass (*Salix drummondiana/Calamagrostis canadensis*) willow carr; a good (B-ranked) occurrence of the apparently globally secure (G4) vulnerable in Colorado (S3) mountain willow (*Salix monticola*) / Mesic Forbs willow carr; a good (B-ranked) occurrence of the apparently globally secure (G4) vulnerable in Colorado (S3) wolf willow/water sedge (*Salix wolfii / Carex aquatilis*) willow carr; a good to fair (BC-ranked) occurrence of the apparently globally secure (G4S4) shortfruit willow (*Salix brachycarpa*) / Mesic Forbs shrubland; and a good (B-ranked) occurrence of the demonstrably globally secure (G5) apparently secure in the state (S4)water sedge (*Carex aquatilis*) wet meadow.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The PCA is owned by the San Juan National Forest.

Management Urgency Rank: M4. Current management seems to favor the persistence of the elements in the PCA, but management actions may be needed in the future to maintain the current quality of the element occurrences.

Location: The Dolores River at Snow Spur PCA is located near Lizardhead Pass, surrounding Snow Spur Creek, a high elevation reach of the Dolores River and sections of several tributaries, in the northeast portion of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Mount Wilson

Legal Description: T41N R9W Section 18, 19
T41N R10W Section 13, 14, 23, 24, 25, 26, 27, 32, 33,
34, 35, 36

Elevation: 9,300 - 10,800 ft.

Size: Approximately 2,534 acres

Redders, 2003, Community Type: *Carex aquatilis* herbaceous type; *Salix wolfii/Carex aquatilis* willow shrubland; *Salix drummondiana – Salix monticola*/Mesic Forbs willow shrubland; *Salix geyeriana*/Mesic Forbs willow shrubland; *Salix brachycarpa*/Mesic Forbs willow shrubland

General Description: Dolores River at Snow Spur is a large PCA encompassing a variety of wetland plant associations from subalpine to montane settings. Snow Spur Creek at Lizardhead Pass is surrounded by the high peaks of the San Miguel Mountains, Yellow Mountains, and Sheep Mountain ranges. Near the pass, along Snow Spur Creek, water sedge (*Carex aquatilis*) dominates a large wet meadow. The headwater creek within the meadow supports narrow to wide, thickets of low-growing wolf willow (*Salix wolfii*). Highway 145 is located adjacent the majority of the PCA providing a pass between the Towns of Rico and Telluride. Because of the beauty and accessibility, the wet meadow is surrounded with roads, campsites and horse camps. The soggy soils in the meadow provide intrinsic protection from severe direct impacts. Soils in the meadow have a shallow organic horizon and oxidized root channels and mottles below this horizon, indicating periods of both saturation and drying.

Downstream, Snow Spur Creek joins the Dolores River. Willow carrs dominate the riparian vegetation in a mosaic with coniferous dominated stands. Mountain willow (*Salix*

monticola) / Mesic Forbs is the dominant riparian willow shrubland on the Dolores River. Steeper, more narrow tributaries support willow carrs such as the shortfruit willow (*Salix brachycarpa*) / Mesic Forbs and the Geyer’s willow (*Salix geyeriana*) / Mesic Forbs plant associations. Soils in these areas are alluvial.

The area has a history of mining and an historic railroad grade can still be discerned. Weeds sparsely occupy the old railroad grade, as well as throughout the rest of the PCA. The mountain willow wetland, located near the Barlow Creek and Dolores River confluence, is the most severely impacted due to the proximity to the highway and several legal and illegal public land accesses.

Biodiversity Rank Justification and Comments: The site supports a good (B-ranked) occurrence of the globally vulnerable (G3S3) Geyer’s willow / Mesic Forbs (*Salix geyeriana* / Mesic Forbs) montane riparian willow carr. This plant association is considered to be a long-lived, late-seral community that will remain dominant as long as there are saturated soils from a high water table (Carsey *et al.* 2003). Large, pristine occurrences without introduced species in the understory are rare. A fair (C-ranked) occurrence of the globally vulnerable (G3S3) Drummond willow – bluejoint reedgrass (*Salix drummondiana* – *Calamagrostis canadensis*) willow carr connotes the presence of active flooding and alluvial soils. Only a few stands representing this association have been found in Colorado (Carsey *et al.* 2003). A good (B-ranked) occurrence of the apparently globally secure (G4) but vulnerable in Colorado (S3) mountain willow / Mesic Forbs (*Salix monticola* / Mesic Forbs) willow carr is also documented. *Salix monticola* dominated plant associations appear to be long-lived and stable, typically occurring with a diverse understory of forbs (Carsey *et al.* 2003). A good (B-ranked) occurrence of the apparently globally secure (G4) vulnerable in the state (S3) wolf willow – water sedge (*Salix wolfii* / *Carex aquatilis*) subalpine riparian willow carr indicates stable hydrologic conditions. *Carex aquatilis* occurs only in saturated soils evidence of a high water table. A good to fair (BC-ranked) occurrence of the apparently globally secure (G4S4) shortfruit willow (*Salix brachycarpa* / Mesic Forbs) shrubland attest to the presence of well-drained soils as documented in this PCA. A good (B-ranked) occurrence of the demonstrably globally secure (G5) water sedge (*Carex aquatilis*) wet meadow also indicates saturated soils with a high water table necessary for the viability and persistence of water sedge (Carsey *et al.* 2003).

Table 21. Natural Heritage element occurrences at Dolores River at Snow Spur PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Salix geyeriana</i> / Mesic Forbs	Geyer’s willow shrubland	G3	S3		B
<i>Salix drummondiana</i> / <i>Calamagrostis canadensis</i>	Drummond willow – bluejoint reedgrass	G3	S3		C
<i>Salix monticola</i> / Mesic Forbs	Mountain willow / Mesic Forbs	G4	S3		C
<i>Salix wolfii</i> / <i>Carex aquatilis</i>	Wolf willow / water sedge	G4	S3		B
<i>Salix brachycarpa</i> / Mesic Forbs	Shortfruit willow / Mesic Forbs	G4	S4		BC
<i>Carex aquatilis</i>	Water sedge	G5	S4		B

Boundary Justification: The boundaries incorporate an area that encompasses the element occurrences, and immediate upstream watershed that buffer hydrologic processes such as

seasonal flooding, necessary for the viability of the element occurrences. Natural fluvial processes such as seasonal flooding, sediment deposition and beaver activity will help maintain succession and viable populations of the elements along Dolores River (Sanderson and Kettler 1996.). The boundary also delineates a buffer that surrounds the highway, campsites and trails where direct disturbance may cause excessive erosion, sedimentation and weed invasion. It should be noted that all hydrologic processes necessary for the viability of the elements are not contained within the PCA boundary.

Protection Comments: The PCA is owned by the San Juan National Forest.

Management Comments: The PCA is threatened by trespass parking and short roads that lead to dispersed camping sites, and social trails. Direct disturbance to the soil causes erosion and may lead to excessive sedimentation and weed invasion. Much of the PCA is isolated and has intrinsic protection due to challenging accessibility.

Soils Description: Soils in the PCA are mostly derived from alluvium and vary according with geomorphic position. In the water sedge (*Carex aquatilis*) dominated wet meadow, along Snow Spur Creek, the soil has an organic soil horizon (6 cm mucky peat), and oxidized root channels and mottles below this horizon, indicating periods of both saturation and drying. Within the wolf willow carr, soils are alluvial (cobble and gravels) with a very shallow mineral horizon (silty clay loam). Mapped soil units along Snow Spur Creek consist of a complex of Typic Cryaquent, Cryaquoll, Cryofibrists, and Hourglass – Wander complex. Hourglass is fine-loamy, mixed, superactive Typic Argicryoll and Wander is loamy-skeletal, mixed, superactive Typic Argicryoll, finally, Frisco loam is mapped on the adjacent slopes. (USDA, NRCS 2002)

Restoration Potential: The majority of the wetlands within the Dolores River at Snow Spur PCA and are in good condition and functioning as expected. Unofficial parking and short roads, social trails and unofficial campsites are common throughout the site, especially in the lower elevations (adjacent Highway 145). These direct disturbances may cause excessive erosion, sedimentation and weed invasion. The potential for restoration or conservation may be possible by the minimization of the impacts from highway maintenance and recreation with designated pullouts and restroom facilities. The large PCA merits interpretive education for the public to gain a better understanding of riparian and wetland ecology.

Wetland Functional Assessment for the Dolores River at Snow Spur PCA:

Proposed HGM Class: Riverine; Slope **Subclass:** R1R2; S2

Cowardin System: Palustrine

CNHP's Wetland Classification: *Salix wolfii* / *Carex aquatilis* subalpine riparian shrubland;
Carex aquatilis upper montane wet meadow

Table 22. Wetland functional assessment for the herbaceous (*Carex aquatilis*) wetland at Dolores River at Snow Spur PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	The wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	High	Shallow peat horizon in sedge meadows. The small channel is moderately sinuous with willows in an open to dense canopy.
Sediment/Shoreline Stabilization	High	Dense herbaceous understory along the stream channel. Relatively steep gradient. Woody vegetation along channel with small gravel bars present.
Groundwater Discharge/Recharge	Yes	Sub surface water discharge in slope wetlands. Recharge may occur in alluvial soils.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Disturbance to the soil confined to areas at the edge of the wet meadow. Expected amounts of detritus and vegetative productivity.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Dense native vegetation and peat accumulation. Otherwise moderate sinuosity in stream channel and a moderate to steep gradient.
Biological Functions		
Habitat Diversity	Moderate	Two Cowardin classes present: scrub shrub and emergent.
General Wildlife Habitat	Moderate	Wildlife sign, large wetland; edge effect by highway adjacent.
General Fish/Aquatic Habitat	Moderate	Headwater, small creek channel, narrow, deep in some areas – no fish but, invertebrates observed.
Production Export/Food Chain Support	High	Dense native herbaceous and woody vegetation. Spring run off (flushing flows) occurs.
Uniqueness	Low	The PCA contains common plant associations. The wet meadow is very large.

Wetland Functional Assessment for the Dolores River at Snow Spur PCA:

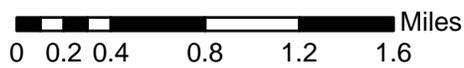
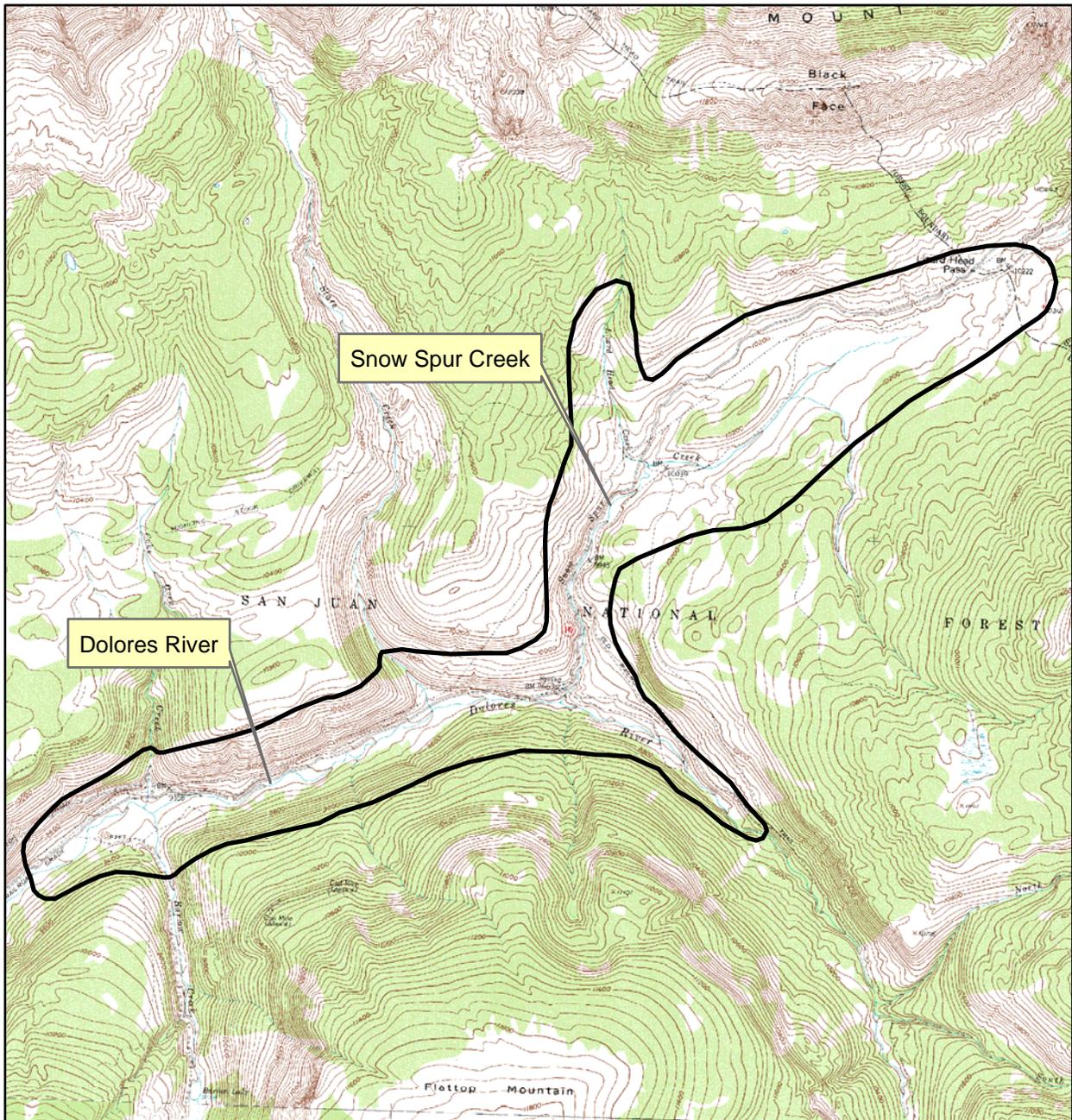
Proposed HGM Class: Riverine **Subclass:** R2

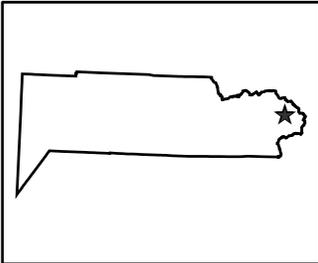
Cowardin System: Palustrine

CNHP's Wetland Classification: *Salix monticola* / Mesic Forbs montane riparian shrubland

Table 23. Wetland functional assessment for the montane riparian shrubland at Dolores River at Snow Spur PCA.

Function	Rating	Comments
Overall Functional Integrity	Below Potential	This wetland appears to be functioning below its potential, due to multiple impacts.
Hydrological Functions		
Flood Attenuation and Storage	High	Dense woody vegetation and uneven land surface composed of alluvium.
Sediment/Shoreline Stabilization	Moderate	Willow carr lines banks, erosion at sites of intense impact (unofficial road, earth movement). Gravel bars present.
Groundwater Discharge/Recharge	Yes	Springs noted in the general area, but not within plant association. Recharge may occur due to backwater channels and alluvial soils.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Disrupted	Multiple river accesses both official and unofficial, and dispersed campsites, have caused soil erosion. Non-natives in understory (<i>Taraxacum officinale</i>); very sparse understory. Human waste noted in area near Barlow Creek parking/recreational vehicle access.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Sparse understory with exotics present. The wetland contains a dense woody shrubland and gravel bars. Sediment trapping is evident.
Biological Functions		
Habitat Diversity	Low	One Cowardin class present at site.
General Wildlife Habitat	Moderate	Highway is adjacent to the wetland. Habitat (diverse woody species) present to support wildlife.
General Fish/Aquatic Habitat	Moderate	Fishermen present; back water channels and areas of narrow deep water. Mining drains may affect water quality.
Production Export/Food Chain Support	High	The wetland contains overhanging vegetation and signs of flushing flows.
Uniqueness	Low	The PCA supports a common wetland type and plant association.



<p>Colorado Natural Heritage Program Colorado State University 254 General Services Building Fort Collins, CO 80523</p> <p>Ph (970) 491-1309 Fax (970) 491-3349 www.cnhp.colostate.edu</p> <p>Map Date: 3/02/2005</p>	<p>Legend</p> <p> PCA Boundary</p> <p>Mount Wilson, 37107-G8</p> <p>7.5 Minute Digital Raster Graphic produced by the U.S. Geological Survey</p>	<p>Location in Dolores County</p> 
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Map 7. Dolores River at Snow Spur Potential Conservation Area, B3: High Biodiversity Significance

Fish Creek at Black Mesa Potential Conservation Area

Biodiversity Rank: B3. High Biodiversity Significance. The site supports a good (B-ranked) occurrence of the globally vulnerable (G3S3) riparian willow carr, *Salix monticola* / Mesic Graminoids, and a good (B-ranked) occurrence of the globally vulnerable (G3S3) riparian shrubland, *Alnus incana* – *Salix drummondiana*.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The PCA is owned by the San Juan National Forest and the State of Colorado, Division of Wildlife.

Management Urgency Rank: M3. New management action may be needed within 5 years to maintain the current quality of the element occurrences in the PCA. Exotic weed invasion and impacts from recreation are the main threats.

Location: The Fish Creek at Black Mesa PCA is located along Fish Creek within and upstream of the Fish Creek State Wildlife Area, in the east central part of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Groundhog Mountain; Clyde Lake

Legal Description: T40N R13W Section 1, 12
T40N R12W Section 4, 5, 6
T41N R12W Section 34, 33

Elevation: 8,200 – 8,700 ft.

Size: Approximately 708 acres

Redders, 2003, Community Type: *Salix drummondiana*/*Alnus incana* willow shrubland; *Salix drummondiana*-*Salix monticola*/Mesic Forbs

General Description: The Fish Creek at Black Mesa PCA surrounds the middle reach of Fish Creek. It is a montane stream surrounded by grass and sedge meadows and multiple beaver enhanced wetlands. Adjacent areas are steep mountain slopes dominated by spruce-fir (*Picea* spp. – *Abies lasiocarpa*) forests or talus slides. The riparian area is a mosaic with dense willow carrs, water and bare soil from breached beaver ponds. Along the steeper gradients of Fish Creek, mixed riparian shrubs and coniferous riparian forests form a mosaic. Scattered Colorado blue spruce (*Picea pungens*) stands are located within willow-dominated wetlands. Mountain willow (*Salix monticola*) dominates the shrub layer with associated shrubs including Drummond's willow (*Salix drummondiana*), thinleaf alder (*Alnus incana*), gooseberry (*Ribes* spp.), twinberry honeysuckle (*Lonicera involucrata*), serviceberry (*Amelanchier alnifolia*), and Woods' rose (*Rosa woodsii*). Graminoids are more common than forbs in the herbaceous understory (20 – 30%) and adjacent meadows. Beaked sedge (*Carex utriculata*) dominates the herbaceous understory with associated species including but not limited to wooly sedge (*Carex lanuginosa*), common horsetail (*Equisetum arvense*), bluejoint reedgrass (*Calamagrostis canadensis*), mannagrass (*Glyceria striata*), Merten's rush (*Juncus mertensianus*), rush species (*Juncus* spp.), and hay grasses, Kentucky bluegrass and timothy (*Poa pratensis* and *Phleum pratense*). Forbs are very diverse, but found in trace canopy cover within the herbaceous understory. In the upper reaches of the PCA, thinleaf alder (*Alnus incana*) co-dominates the shrub canopy with Drummond's willow (*Salix drummondiana*). Coniferous forests dominate along the steeper gradients of Fish Creek upstream of the PCA.

The dynamic riparian habitat structure provides excellent wildlife habitat, evidenced by several signs noted in 2004 including deer, elk, raccoon, beaver, coyote, a variety of small

mammals, songbirds and birds of prey. Fish were observed in ponds as well as aquatic insects in ripples including may fly, stone fly and caddis fly larvae.

Biodiversity Rank Justification and Comments: The site supports a good (B-ranked) occurrence of the globally vulnerable (G3S3) riparian willow carr, mountain willow / Mesic Graminoids (*Salix monticola* / Mesic Graminoids). This association appears to be a stable, long-lived association. Stands with an abundance of Kentucky bluegrass or creeping bentgrass (*Agrostis stolonifera*) may be grazing-induced disclimax (Carsey *et al.* 2003). The relatively common (G3S3) thinleaf alder – Drummonds willow (*Alnus incana* – *Salix drummondiana*) shrubland also occurs within the PCA. This plant association is an early- to mid-seral association that is restricted to active stream channels. Both species are prolific seed producers that are the first to colonize streambanks and floodplains. These riparian shrubs will continue to dominate due to the ability of *Alnus incana* to fix atmospheric nitrogen and *Salix drummondiana* taking advantage of the now nitrogen-rich soils (Carsey *et al.* 2003).

Table 24. Natural Heritage element occurrences at Fish Creek at Black Mesa PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Salix monticola</i> / Mesic Graminoids	Mountain willow / Mesic Graminoids	G3	S3		B
<i>Alnus incana</i> – <i>Salix drummondiana</i>	Thinleaf alder / Drummond's willow	G3	S3		B

Boundary Justification: The boundary encompasses the element occurrences and immediate areas buffering hydrologic processes necessary to the viability of the elements. Natural fluvial processes such as seasonal flooding, sediment deposition and beaver activity will help maintain succession and viable populations of the elements along Fish Creek (Sanderson and Kettler 1996.). The boundary also provides a buffer from adjacent trail, campsites and road in the lower portion, where surface runoff may contribute excess nutrients, sediment and weed invasion. It should be noted that all hydrologic processes necessary for wetland viability are not contained within the PCA boundaries.

Protection Comments: The PCA is owned by the San Juan National Forest and the State of Colorado, Fish Creek State Wildlife Area.

Management Comments: CNHP records (1993) report multiple impacts from camping and visitation in the State Wildlife Area (CNHP 2005). Condition has greatly improved as reflected in the occurrence rank change from fair to good. Threats to the site include exotic weed invasion and recreational use, such as horses, hunting, hiking, camping and bicycling. Weed invasion is more evident in the State Wildlife Area, although there is evidence of weed control (several poisoned thistle individuals). Exotics include Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), and pasture grasses (*Poa pratensis*, *Bromus inermis*, *Phleum pratense*). Exotic species in the herbaceous layer do not reach high canopy cover within PCA.

Soils Description: Soils are derived from alluvium and vary according with geomorphic position. Soils sampled are sandy loam with little organic matter over alluvium. The dominant mapped soil unit in the PCA wetland area is Typic Cryaquent and Cryaquoll complex (USDA, NRCS 2003).

Restoration Potential: The wetlands along Fish Creek are functioning as expected. Referring to such resources as the Nature Conservancy's web site on invasive species (<http://tncweeds.ucdavis.edu/index.html>) or <http://www.invasivespecies.gov/> may provide some assistance with control and eradication of non-native species.



Beaver enhanced wetland within Fish Creek at Black Mesa PCA. Photograph © CNHP, 2004.

Wetland Functional Assessment for the Fish Creek at Black Mesa PCA:

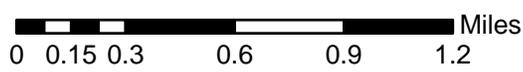
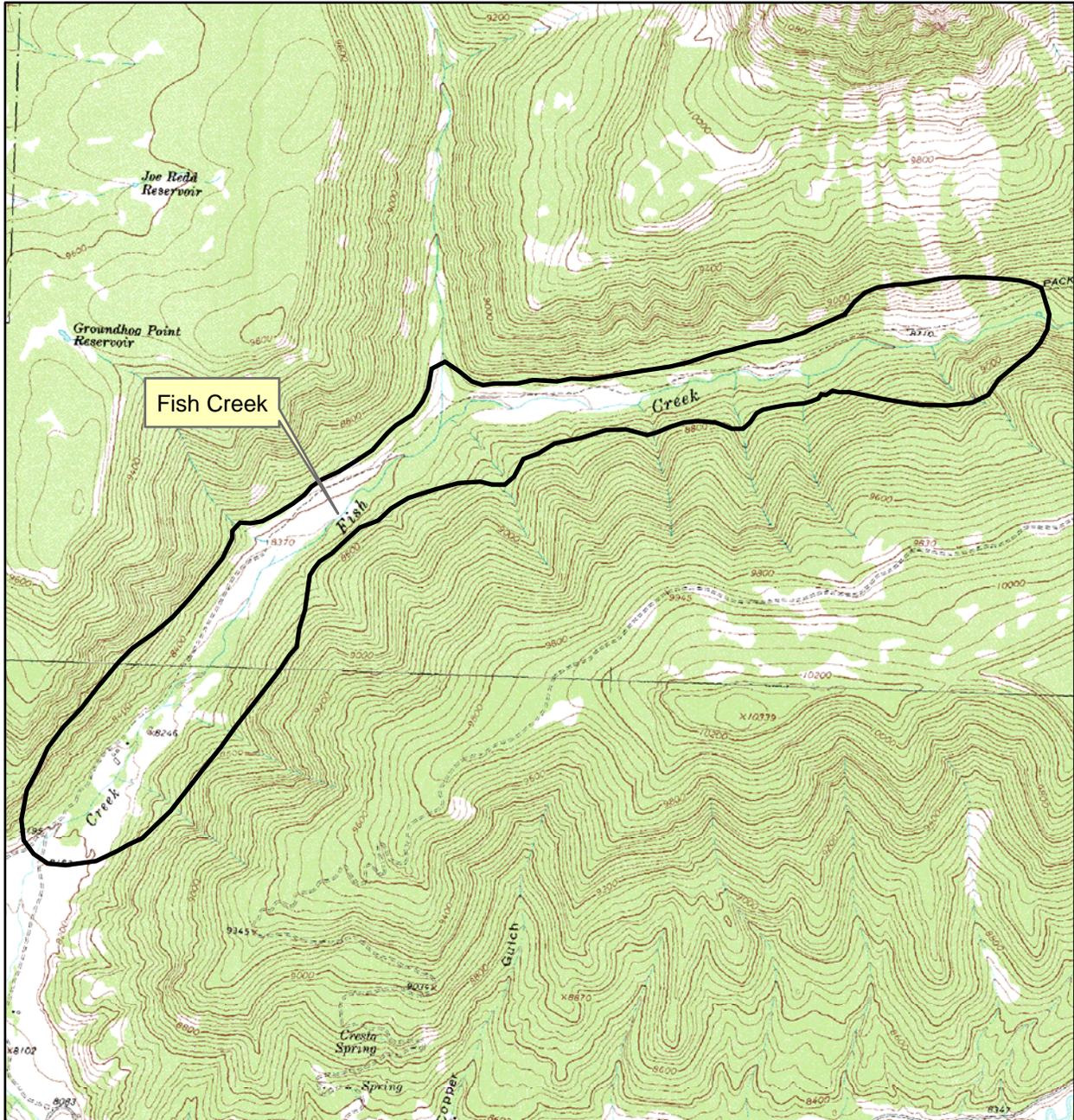
Proposed HGM Class: Riverine **Subclass:** R2

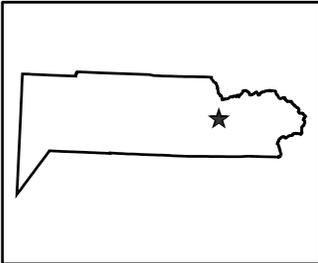
Cowardin System: Palustrine

CNHP's Wetland Classification: *Salix monticola* / Mesic Graminoids montane riparian shrubland

Table 25. Wetland functional assessment for the montane riparian shrublands at Fish Creek at Black MesaPCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	The wetland appears to be functioning at its potential. The lower portion of the PCA has mesic meadows adjacent, enhanced with irrigation water, however this did not affect the evaluation of the wetlands in the PCA.
Hydrological Functions		
Flood Attenuation and Storage	High	The PCA contains several active beaver ponds. There is dense native vegetation in the site. Uneven land surface and vegetation hummocks disperse floodwater energy.
Sediment/Shoreline Stabilization	High	Dense woody vegetation anchors shorelines.
Groundwater Discharge/ Recharge	Yes	Recharge may occur in pools and alluvial soils.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Dense native herbaceous cover with thin layer of organic soils present. There are scattered exotics present, especially in the lower reaches of the PCA.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Large wetland area with native understory, open water, woody vegetation and evidence of sediment trapping.
Biological Functions		
Habitat Diversity	Moderate	Site supports scrub shrub and emergent Cowardin classes.
General Wildlife Habitat	High	Wildlife signs (raccoon, beaver, deer, small mammals) and songbirds present. Large, diverse, contiguous habitat.
General Fish/Aquatic Habitat	High	Excellent fish / aquatic habitat (e.g., pools, riffles, overhanging and emergent vegetation). Fish and aquatic insects observed.
Production Export/Food Chain Support	High	Signs of flushing flows (breached beaver dams); overhanging and emergent vegetation contributes carbons to downstream systems.
Uniqueness	Moderate	The PCA contains a large wetland complex with extensive beaver activity and two G3 plant associations.



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Map 8. Fish Creek at Black Mesa Potential Conservation Area, B3: High Biodiversity Significance

Glade Canyon Spring Potential Conservation Area

Biodiversity Rank: B3. High Biodiversity Significance. The site supports a fair (C-ranked) occurrence of the globally imperiled (G2G3) strapleaf willow (*Salix ligulifolia*) shrubland; and a good/fair (BC) example of the globally secure (G4), but vulnerable in Colorado (S3) narrowleaf cottonwood / red-osier dogwood (*Populus angustifolia* / *Cornus sericea*) woodland.

Protection Urgency Rank: P3. Protection action may be needed, but probably not within the next 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA if protection action is not taken. The PCA is within the San Juan National Forest where there are grazing allotments.

Management Urgency Rank: M3. New management action may be needed within 5 years to maintain the current quality of the element occurrences in the PCA. Extensive hydrologic alterations, weed invasion and agricultural practices are the main threats.

Location: The Glade Canyon Spring PCA is located along Glade Creek and Glade Canyon Spring in the west central portion of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: The Glade

Legal Description: T41N R17W Section 15, 16

Elevation: 7,600 – 7,800 ft.

Size: Approximately 89 Acres

Redders, 2003, Community Type: *Salix eriocephala* var. *ligulifolia* willow shrubland;
Crataegus rivularis/*Salix* Species willow shrubland

General Description: The Glade Canyon Spring PCA is located at Glade Creek within Glade Canyon, San Juan National Forest. Glade Creek, located on a high plateau, is an intermittent stream, with several ephemeral tributaries. It eventually drops into a steep box canyon and drains into the Dolores River.

Strap leaf willow (*Salix ligulifolia*) and river hawthorn (*Crataegus rivularis*) dominate the ephemeral creek in a mosaic interspersed with open areas commonly used as rangeland. Grazing impacts are moderate to heavy, yet shrub vigor is high. The herbaceous understory is dominated by upland plant species and pasture grass species including Arizona mule-ears (*Wyethia arizonica*; *W. x magna* [*amplexicaulis x arizonica*]), wild iris (*Iris missouriensis*), green gentian (*Frasera speciosa*), American vetch (*Vicia americana*), Kentucky bluegrass (*Poa pratensis*), Fendler's muttongrass (*Poa fendleriana*), slender wheatgrass (*Elymus trachycaulus*), and smooth brome (*Bromus inermis*).

Glade Canyon Spring flows into Glade Creek, located in a steep narrow canyon, comprised of sandstone, shale and conglomerate (Dakota sandstone, Entrada sandstone, and Morrison formation) (Tweto 1979). This area is dominated by a variety of shrubs including red-osier dogwood (*Cornus sericea*), serviceberry (*Amelanchier alnifolia*), strap leaf willow (*Salix ligulifolia*), roundleaf snowberry (*Symphoricarpos rotundifolius*), gooseberry (*Ribes* sp.), chokecherry (*Prunus virginiana*), Rocky Mountain Maple (*Acer glabrum*), and coyote willow (*Salix exigua*). The tree canopy throughout the canyon is open. At the Glade Canyon spring, the tree canopy is closed due to the constant water supply. Narrowleaf cottonwood (*Populus angustifolia*), quaking aspen (*Populus tremuloides*) and ponderosa pine (*Pinus ponderosa*) dominate the tree layer and Douglas fir (*Pseudotsuga menziesii*) occurs in high canopy cover at the spring location. The herbaceous understory is sparse throughout most of the PCA, except

where the Glade Canyon Spring discharges. The herbaceous understory includes starry false lily of the valley (*Maianthemum stellatum*), feathery false lily of the valley (*M. amplexicaule*), fewflower meadow rue (*Thalictrum sparsiflorum*), Porter's licorice root (*Ligusticum porteri*), northern bedstraw (*Galium septentrionale*), alpine spring parsley (*Pseudocymopterus montanus*), fireweed (*Chamerion danielsii*), Wyoming Indian paintbrush (*Castilleja linariifolia*), and wild iris (*Iris missouriensis*).

Uplands are dominated by ponderosa pine (*Pinus ponderosa*) forests, quaking aspen (*Populus tremuloides*) and Gambel's oak (*Quercus gambelii*) woodlands, and open rangelands. The general vicinity is widely used for cattle grazing. Condition in the majority of the canyon is good, mainly due to its inaccessibility. The ephemeral creek within the PCA is accessible, therefore is in fair condition due to grazing impacts and subsequent altered hydrology. Recreation including four wheel and ATV use is confined to the upland areas. Other recreational uses include horses, hunting, hiking, and camping.

Biodiversity Rank Justification and Comments: The site supports a fair (C-ranked) occurrence of the globally imperiled (G2G3), strapleaf willow (*Salix ligulifolia*) montane riparian shrubland. This plant association appears to be a long-lived mid- to late-seral type since it is associated with beaver activity and saturated soils throughout the growing season (Carsey *et al.* 2003). The presence of river hawthorn (*Crataegus rivularis*) in high density may indicate a drop in the water table. The narrowleaf cottonwood / red-osier dogwood (*Populus angustifolia* / *Cornus sericea*) montane riparian woodland is in good\fair condition (B\C). This plant association can be an indicator of mid- to late-seral cottonwood forests that have become isolated from frequent flooding and sediment deposition. The presence of *Cornus sericea* indicates a seasonally high water table or the disappearance of *Cornus sericea* indicates a drop in the water table (Carsey *et al.* 2003).

Table 26. Natural Heritage element occurrences at Glade Canyon Spring PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Salix ligulifolia</i>	Strap leaf willow	G2G3	S2S3		C
<i>Populus angustifolia</i> / <i>Cornus sericea</i>	Narrowleaf cottonwood / red-osier dogwood	G4	S3		BC

Boundary Justification: The boundary encompasses the element occurrences and immediate areas buffering hydrologic processes e.g., flooding, necessary for the viability of the elements. The boundary also identifies a buffer including the road and rangelands where direct disturbance and impacts from recreation and heavy grazing may contribute to excessive nutrients, sediment, and weed invasion. It should be noted that the boundary does not contain all hydrologic processes necessary to the elements.

Protection Comments: The PCA is owned by the San Juan National Forest where moderate to heavy cattle grazing occurs within the privately held leases.

Management Comments: Threats to the PCA are grazing, recreation and altered hydrology in the Glade Creek. It is suggested to evaluate grazing practices where improper grazing can contribute to excessive erosion, soil compaction and weed invasion. Recreation in the area is dominated by off road vehicle use and hunting.

Soils Description: Soils in the willow shrubland are silty clay loam. Soils in the canyon vary with geomorphic position. Mapped soil units in the PCA are delineated as Fughs Loam, Fughs – Granath complex and Fughs – Sheek complex. Fughs is classified as fine, smectitic, frigid Pachic Argiustoll. Granath is classified as fine-silty, mixed, superactive, frigid Typic Argiustoll. Sheek is classified as loamy, skeletal, mixed, superactive, frigid Typic Haplustalf. (USDA, NRCS 2002)

Restoration Potential: Restoring water, or increasing water releases into the stream will benefit the long term viability of riparian vegetation in Glade Creek. There are several stock pond reservoirs along Glade Creek, upstream of the PCA. Restoration opportunities may include revegetation plans that include native plants as opposed to non-native pasture grasses that are commonly used locally (i.e. *Bromus inermis*). The Colorado Natural Areas Program has a native plant revegetation guide available on their website at <http://www.parks.state.co.us/cnap/indes.html> which may provide helpful information about using native plants for revegetation projects.

Wetland Functional Assessment for the Glade Canyon Spring PCA:

Proposed HGM Class: Riverine **Subclass:** R2

Cowardin System: Palustrine

CNHP's Wetland Classification: *Salix ligulifolia* shrubland

Table 27. Wetland functional assessment for the montane riparian shrubland at Glade Canyon Spring PCA.

Function	Rating	Comments
Overall Functional Integrity	Below Potential	The wetland appears to be functioning below its potential due to altered hydrology.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Intermittent stream channel with patches of shrublands. Non-native mixed with native herbaceous species in open areas. Little sinuosity. Bedrock exposed in some areas.
Sediment/Shoreline Stabilization	Moderate	Woody vegetation anchors shoreline interspersed with herbaceous species (non-native and native).
Groundwater Discharge/Recharge	Yes	Springs discharge in the area.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Disrupted	No severe disturbances to the soil. Expected amounts of detritus and shrub growth. Herbaceous understory dominated by upland species and non-native species. Above ground productivity of riparian vegetation may be stressed due to altered hydrology upstream.
Removal of Imported Nutrients, Toxicants, and Sediments.	Low	Vigorous woody vegetation. Clay loams within shrublands. Herbaceous understory contains non-native pasture grasses and upland species. Water gathers in isolated pools, otherwise hydrology is altered.
Biological Functions		
Habitat Diversity	Low	One Cowardin class present, scrub shrub.
General Wildlife Habitat	Moderate	Wildlife sign e.g., deer sign, songbirds, birds of prey. Open range lands adjacent.
General Fish/Aquatic Habitat	Low	Intermittent water. Isolated small pools provide some aquatic habitat.
Production Export/Food Chain Support	Low	No sign of flushing flows or major flooding events. In the event of flushing flows, shrubs are within stream channel and would add carbons/detritus to downstream ecosystem. Isolated pools support insect larvae, including mosquito.
Uniqueness	High	The PCA contains a G2G3 plant community.

Wetland Functional Assessment for the Glade Canyon Spring PCA:

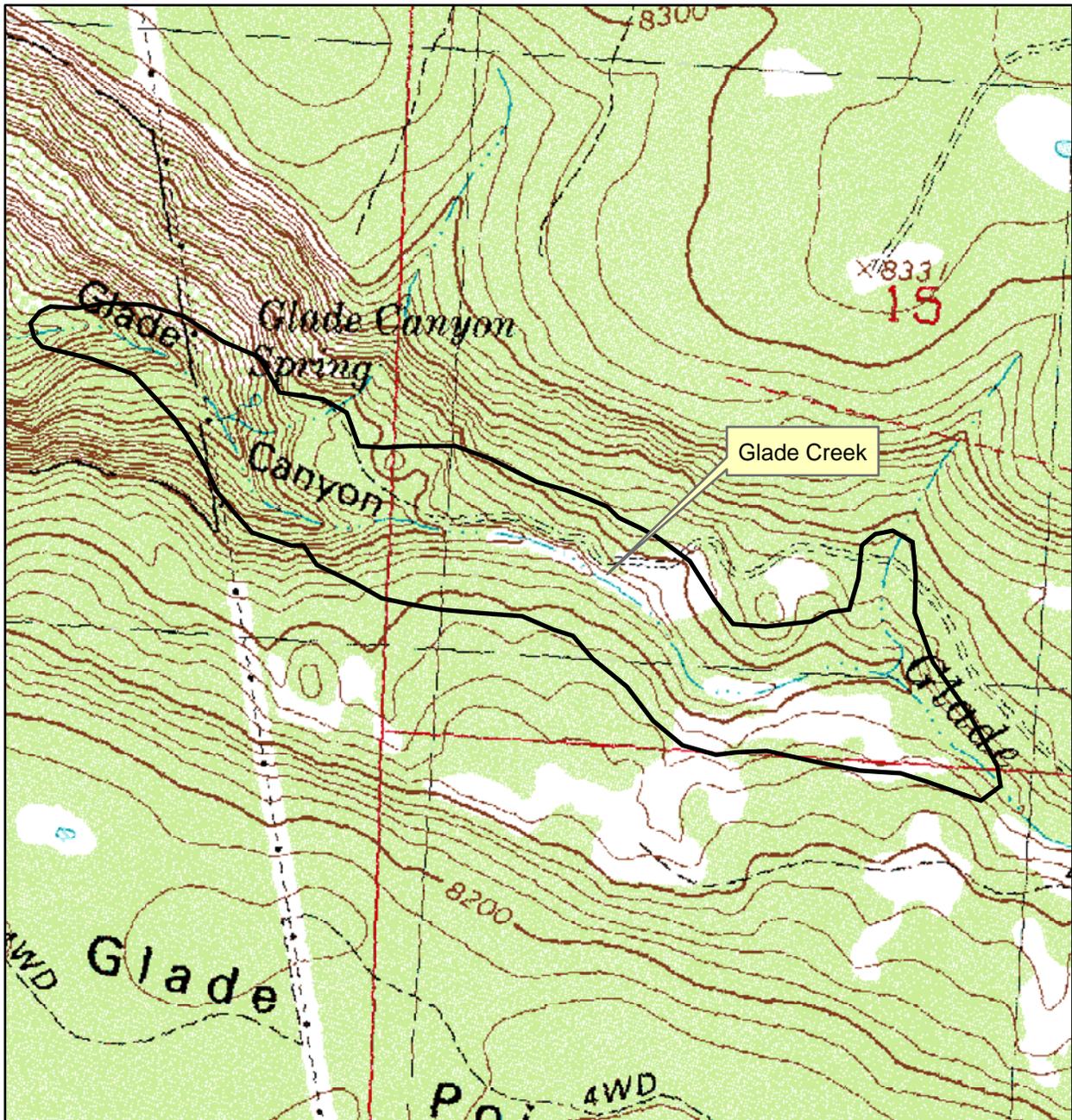
Proposed HGM Class: Riverine **Subclass:** R2/R3

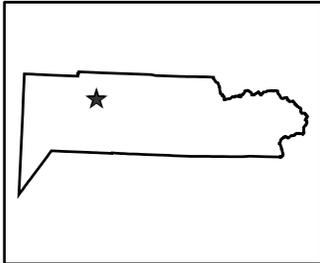
Cowardin System: Palustrine

CNHP's Wetland Classification: *Populus angustifolia/ Cornus sericea* montane riparian woodland

Table 28. Wetland functional assessment for the montane riparian woodland at Glade Canyon Spring PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	The wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	Low	Intermittent stream channel in steep canyon with an open to dense tree and shrub canopy. Steep areas with bedrock exposed. Large boulders choke the canyon and may disperse floodwater energy.
Sediment/Shoreline Stabilization	High	Woody vegetation anchors shoreline. Sheer sandstone walls. Slopes that can support vegetation are densely covered.
Groundwater Discharge/ Recharge	Yes	Springs discharge in the area.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Expected amounts of detritus and vigorous shrub growth. Dense herbaceous canopy in localized areas (downstream of spring discharge).
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Vigorous woody vegetation. Pockets of dense, native herbaceous understory with soil development. Otherwise, bedrock exposed with an open canopy of trees/shrubs and a sparse herbaceous canopy cover.
Biological Functions		
Habitat Diversity	Low	One Cowardin class present, forested.
General Wildlife Habitat	High	Wildlife sign e.g., deer sign, songbirds, birds of prey, lizards. Diverse shrub canopy provides wildlife habitat in an isolated canyon. Canyon is inaccessible to cattle.
General Fish/Aquatic Habitat	Low	Plunge pools (water gathering in a sandstone basin at the base of a steep drop) provide some habitat for insects, otherwise intermittent water in stream charged by groundwater discharge.
Production Export/Food Chain Support	Moderate	Little sign of high flushing flows. Spring water provides constant, small flow through detritus and overhanging vegetation.
Uniqueness	Low	The PCA contains a G4 plant community.



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Map 9. Glade Canyon Spring Potential Conservation Area, B3: High Biodiversity Significance

Lower Coal Creek Potential Conservation Area

Biodiversity Rank: B3. High biodiversity significance. The site supports a good (B-ranked) occurrence of the globally vulnerable (G3S3) Geyer's willow – mountain willow (*Salix geyeriana* – *Salix monticola*) / Mesic Forbs riparian shrubland; and a good (B-ranked) occurrence of the apparently globally secure (G4) vulnerable in the state (S3) mountain willow (*Salix monticola*) / Mesic Forbs riparian shrubland.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The site is within the San Juan National Forest.

Management Urgency Rank: M4. Although the area is not currently threatened, management may be needed in the future to maintain the current quality of the element occurrence.

Location: The Lower Coal Creek PCA is located along Coal Creek near Dunton Road in the northeast part of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Dolores Peak

Legal Description: T41N R10W Section 30, 31

Elevation: 9,600 – 10,000 ft. **Size:** Approximately 285 acres.

Redders, 2003, Community Type: *Salix monticola* / Mesic Forbs willow shrubland; *Salix monticola*/*Salix geyeriana* willow shrubland

General Description: The Lower Coal Creek PCA surrounds the middle reach of Coal Creek, a tributary to the Dolores River. The steep, upper montane stream originates on the south side of Mount Wilson before crossing The Meadows, where the PCA boundary begins. South of Forest Road 535 (Dunton Road) the riparian area is comprised of dense willow carrs interspersed with patches of graminoids and forbs. Soils are alluvial displaying a rough micro topography with large boulders, cobbles and gravels on the surface that facilitate groundwater recharge. Geyer's willow (*Salix geyeriana*) and mountain willow (*Salix monticola*) dominate the shrub layer in thickets confined to the narrow stream channel. Associated shrubs are short fruit willow (*Salix brachycarpa*), wolf willow (*Salix wolfii*) shrubby cinquefoil (*Dasiphora floribunda*), and plane leaf willow (*Salix planifolia*). Water sedge (*Carex aquatilis*) dominates hummocks where sediments have collected. The herbaceous understory is dominated by showy pussy toes (*Antennaria pulcherrima*), strawberry (*Fragaria* sp.), Porter's licorice root (*Ligusticum porteri*), marsh marigold (*Caltha leptosepala*), and white clover (*Trifolium repens*). The steep, shady part of the riparian zone is dominated by Columbian monks hood (*Aconitum columbianum*), arrowleaf ragwort (*Senecio triangularis*) and Fendler's meadow rue (*Thalictrum fendleri*).

Biodiversity Rank Justification and Comments: The site supports a good (B-ranked) occurrence of the globally vulnerable (G3S3) Geyer's willow – mountain willow (*Salix geyeriana* – *Salix monticola*) / Mesic Forbs montane riparian shrubland. This plant association can be indicative of intense grazing pressure by the presence of increasers e.g., Kentucky bluegrass (*Poa pratensis*) and common dandelion (*Taraxacum officinale*) (Carsey *et al.* 2003). The apparently globally secure (G4) but vulnerable in the state (S3) mountain willow (*Salix monticola*) / Mesic Forbs montane riparian shrubland is in good (B-ranked) condition. The presence of *Salix monticola* is evidence of a stable relatively high (1m to surface) water table (Carsey *et al.* 2003).

Table 29. Natural Heritage element occurrences at Lower Coal Creek PCA.
Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Salix geyeriana</i> – <i>Salix monticola</i> / Mesic Forbs	Geyer willow – mountain willow / mesic forbs	G3	S3		B
<i>Salix monticola</i> / Mesic forbs	Mountain willow / Mesic Forbs	G4	S3		B

Boundary Justification: The boundary encompasses the element occurrences as well as a projected buffer to identify the hydrologic processes required to sustain the elements. The boundary also provides a small buffer from the road where surface runoff may contribute excess nutrients, sediment and weed invasion. It should be noted that the hydrologic processes necessary to the element are not fully contained by the PCA boundary.

Protection Comments: The San Juan National Forest owns the PCA.

Management Comments: Threats to the PCA include sediment loading from road use and maintenance, recreation and grazing impacts. Coal Creek passes through a culvert at Forest Road 535, where excessive sedimentation may occur. Grazing was noted in upstream areas and may contribute to weed invasion (Kentucky bluegrass and common dandelion were noted within the PCA). Recreation in the area includes sight seeing, hiking, horse riding, hunting, camping and off road vehicle use. ATV trails were noted in the meadows within the general vicinity, however not within the PCA. There is limited accessibility by humans especially in the lower, steeper parts of the PCA.

Soils Description: Soils within the PCA are derived from alluvium. The mapped soil unit within the riparian area is delineated as the Wander-Hotter-Hourglass complex, 30 – 60 percent slopes. Wander is classified as loamy, skeletal, mixed, superactive Typic Argicryoll; Hotter is classified as loamy, skeletal, mixed, superactive Lithic Eutrocyrept; and Hourglass is classified as fine, loamy, mixed, superactive Typic Argicryoll. (USDA, NRCS 2002)

Restoration Potential: The wetlands are functioning at potential.

Wetland Functional Assessment for the Lower Coal Creek PCA:

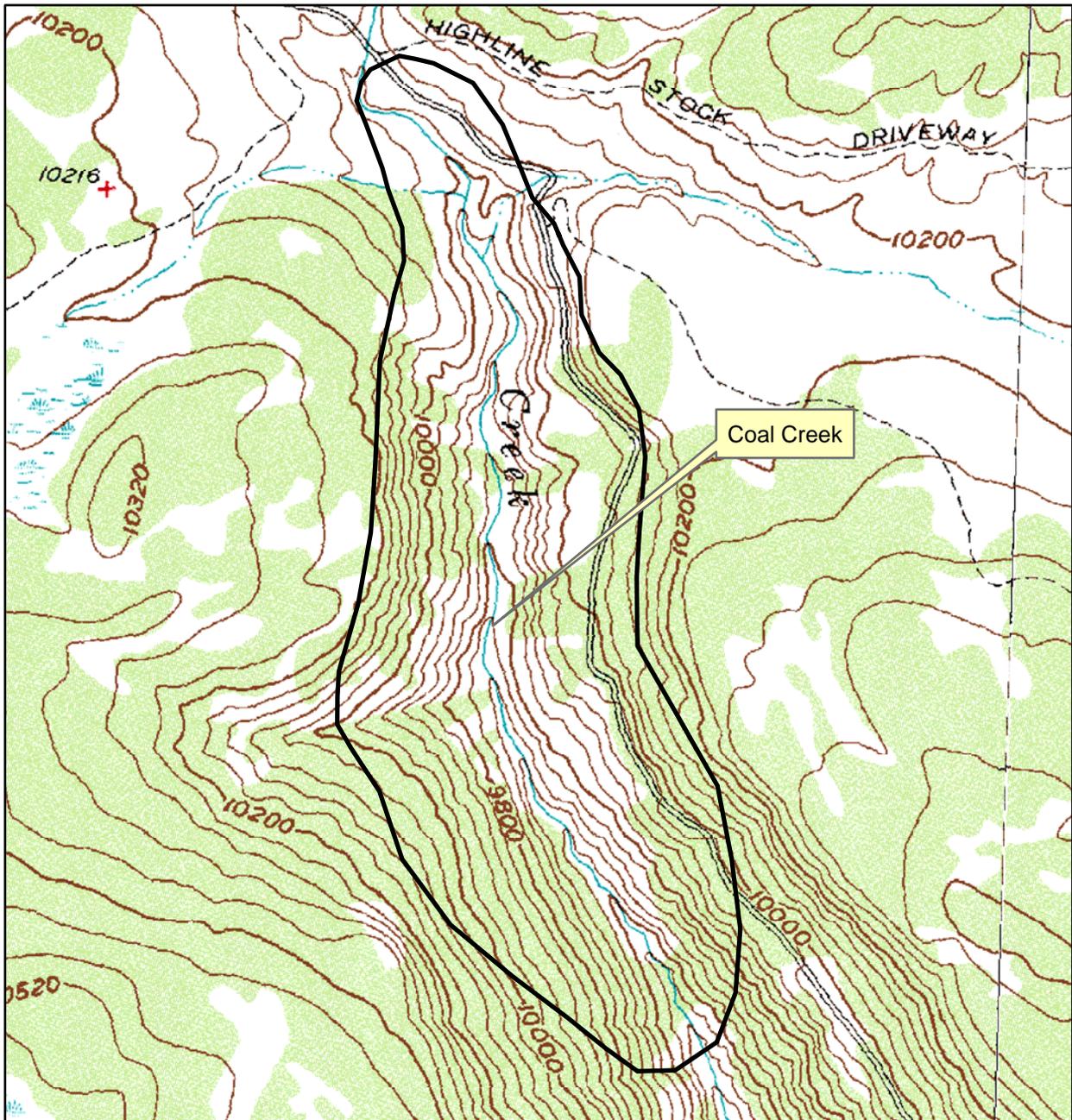
Proposed HGM Class: Riverine **Subclass:** R2

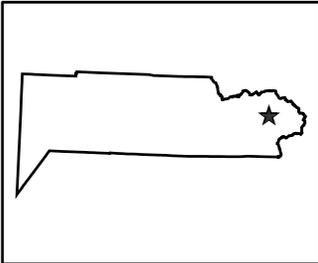
Cowardin System: Palustrine

CNHP's Wetland Classification: *Salix geeyeriana* – *Salix monticola* / Mesic Forbs and *Salix monticola* / Mesic Forbs montane riparian shrublands

Table 30. Wetland functional assessment for the montane riparian shrubland at Lower Coal Creek PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	The wetland is functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	Low	The floodplain is limited. The stream is within a steep gradient and straight channel. There is dense vegetation and some pools.
Sediment/Shoreline Stabilization	High	There is dense woody vegetation as well as large boulders.
Groundwater Discharge/Recharge	Yes	Seeps in the area upstream of occurrence. Coarse alluvium indicates recharge.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Vegetation is vigorous and dense, native graminoids in dense fringes where soil is developing over alluvium. Impacted area at road crossing.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Dense vegetation with fringes of native sedges; few sediment deposits, straight channel, some banks with soil exposed (natural erosion).
Biological Functions		
Habitat Diversity	Low	Site supports one Cowardin class, scrub shrub.
General Wildlife Habitat	High	Diverse vegetation, dense willow thicket. Deer sign.
General Fish/Aquatic Habitat	High	Overhanging vegetation, narrow deep channels with pools.
Production Export/Food Chain Support	High	More than 5 acres vegetated, overhanging vegetation, narrow band of riparian vegetation, seasonal flushing flows.
Uniqueness	High	PCA supports a G3 plant community in good condition.



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Map 10. Lower Coal Creek Potential Conservation Area, B3: High Biodiversity Significance

Morrison Creek at Lone Cone Potential Conservation Area

Biodiversity Rank: B3. High Biodiversity Significance. The site supports a good (B-ranked) occurrence of the globally vulnerable (G3?) imperiled in the state (S2) Bebb's willow (*Salix bebbiana*) shrubland; a good (B-ranked) occurrence of the globally vulnerable (G3S3) mountain / beaked sedge (*Salix monticola* / *Carex utriculata*) shrubland; and a fair (C-ranked) occurrence of the globally imperiled (G2QS2) river hawthorn (*Crataegus rivularis*) shrubland.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The site is within the Lone Cone State Wildlife Area.

Management Urgency Rank: M2. New management actions may be needed within 5 years to prevent the loss of the element occurrences within the PCA. Impacts from grazing and dispersal of noxious weeds are the main threats.

Location: The Morrison Creek at Lone Cone PCA is located in the Lone Cone State Wildlife Area, surrounding Morrison Creek upstream of Arrowhead Lake, in the northern portion of Dolores County.

U.S.G.S. 7.5-min. quadrangles: Groundhog Reservoir

Legal Description: T41N R13W Section 4, 5, 6
T42N R13W Section 31, 32, 33

Elevation: 7,950 – 8,600 ft.

Size: Approximately 342 acres.

Redders, 2003, Community Type: *Salix bebbiana* willow shrubland; *Salix monticola* / Mesic Forbs shrubland; *Carex utriculata* herbaceous type

General Description: Morrison Creek at Lone Cone PCA encompasses Morrison Creek and an unnamed tributary within the Lone Cone State Wildlife Area. The PCA encompasses a moderately narrow montane valley that harbors multiple beaver ponds, an open meadow with drier soils, and shrublands.

The Morrison Creek Valley contains a lush riparian system where willow carrs form dense thickets with herbaceous vegetation and ponds interspersed. Colorado blue spruce (*Picea pungens*) individuals are scattered throughout the wetland, however, shrubs account for the majority of the vegetation canopy cover. Mountain willow (*Salix monticola*) dominates beaver enhanced wetlands interspersed with herbaceous vegetation dominated by beaked sedge (*Carex utriculata*). Associated graminoids include common spikerush (*Eleocharis palustris*), redtop (*Agrostis gigantea*), reed canary grass (*Phalaroides arundinacea*), common reed (*Phragmites australis*), and Baltic rush (*Juncus balticus*). Cattails (*Typha latifolia*) occur in patches in open water with mare's tail (*Hippuris vulgaris*), burreed (*Sparganium* sp.), and great bladderwort (*Utricularia macrorrhiza*). A dense stand of willows on drier soils is dominated by Bebb's willow (*Salix bebbiana*) with twinberry honeysuckle (*Lonicera involucrata*), Woods' rose (*Rosa woodsii*), and whitestem gooseberry (*Ribes inerme*). A diverse mix of forbs occur in patches up to 5% herbaceous canopy cover and include, American speedwell (*Veronica americana*), field mint (*Mentha arvensis*), checker mallow (*Sidalcea candida*), Richardson's geranium (*Geranium richardsonii*), orange sneezeweed (*Dugaldia hoopesii*), large leafed avens (*Geum macrophyllum*), Fendler's cowbane (*Oxypolis fendleri*), cutleaf coneflower (*Rudbeckia ampla*), alpine spring parsley (*Pseudocymopterus montanus*), starry false lily of the valley (*Maianthemum stellatum*), small grass of Parnassus (*Parnassia parviflora*), northern green orchid (*Limnorchis hyperborea*),

Jacob's ladder (*Polemonium foliosissimum*), autumn dwarf gentian (*Gentianella heterosepala*), woodland strawberry (*Fragaria vesca* subsp. *bracteata*), Canada goldenrod (*Solidago canadensis*) and others. Weedy species within the wetland area include Canada thistle (*Cirsium arvense*), hounds tongue (*Cynoglossum officinale*), and hay grasses, Kentucky bluegrass (*Poa pratensis*) and timothy (*Phleum pratense*).

Highlighting the biodiversity within the PCA, a small stand of tall (6 - 8 ft.) bog birch (*Betula glandulosa*), occupies the edge of a solid bulrush (*Schoenoplectus lacustris*) patch with Colorado blue spruce on the outer edge of the valley bottom.

Soils in the graminoid-dominated stand are saturated, exhibiting a thin layer of organic soils over gleyed clay. Otherwise, soils vary greatly, depending on geomorphic position throughout the PCA.

A tributary to Morrison Creek contained within the PCA boundaries, flows through an open valley. The stream is intermittent and dominated by river hawthorn (*Crataegus rivularis*) in a sparse canopy. The adjacent uplands are dominated by Gambel's oak (*Quercus gambelii*) woodlands interspersed with Thurber's fescue (*Festuca thurberi*) grasslands. The river hawthorn stands and herbaceous understory appear to be recovering from intense past grazing. For example, there are dense stands of Canada thistle (*Cirsium arvense*) interspersed with native vegetation and many of the shrubs are "mushroom-shaped" from intense browsing. The herbaceous understory is dominated by hay grasses, Kentucky bluegrass (*Poa pratensis*), and timothy (*Phleum pratense*). Associated forbs and graminoids include clustered field sedge (*Carex praegracilis*), wild iris (*Iris missouriensis*), American vetch (*Vicia americana*), hounds tongue (*Cynoglossum officinale*), and musk thistle (*Carduus nutans*). Seeps interspersed along the hill slopes are dominated by dense stands of Baltic rush (*Juncus balticus*) and beaked sedge (*Carex utriculata*).

Uplands surrounding the PCA are forested with ponderosa pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menziesii*) and white fir (*Abies concolor*) interspersed with Gambel's oak (*Quercus gambelii*) and quaking aspen (*Populus tremuloides*) woodlands with Thurber's fescue (*Festuca thurberi*) grasslands.

Biodiversity Rank Justification and Comments: The site supports a good (B-ranked) occurrence of the globally vulnerable (G3?) but imperiled in the state (S2) Bebb's willow (*Salix bebbiana*) shrubland. In Colorado, *Salix bebbiana* willow carrs are infrequent and rarely form large willow carrs. *Salix bebbiana* appears to be very sensitive to grazing, forming the "mushroom shape" when browsed intensively (Carsey *et al.* 2003). The globally vulnerable (G3S3) mountain willow / beaked sedge (*Salix monticola* / *Carex utriculata*) shrubland occurrence was documented being in good (B-ranked) condition typically occurring on the saturated soils associated with beaver dams. This plant association is an indicator of a high water table during much of the growing season (Carsey *et al.* 2003). A fair (C-ranked) occurrence of the globally imperiled (G2QS2) river hawthorn (*Crataegus rivularis*) shrubland occurs on the drier soils within the PCA. This plant association may be indicative of ephemeral streams associated with seeps (Carsey *et al.* 2003).

Table 31. Natural Heritage element occurrences at Morrison Creek at Lone Cone PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Salix bebbiana</i> shrubland	Bebb's willow shrubland	G3?	S2		B
<i>Salix monticola</i> / <i>Carex utriculata</i> shrubland	Mountain willow / beaked sedge	G3	S3		B

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
<i>Crataegus rivularis</i> shrubland	River hawthorn	G2Q	S2		C

Boundary Justification: The boundary encompasses the element occurrences and immediate adjacent area to buffer hydrologic processes necessary to the viability of the elements. Natural fluvial processes such as seasonal flooding, sediment deposition and beaver activity will help maintain succession and viable populations of the elements along Morrison Creek (Sanderson and Kettler 1996). The boundaries also provide a buffer from nearby trails, and roads where surface runoff may contribute excess nutrients, sediment and weed invasion. It should be noted that the hydrologic processes necessary to the elements are not fully contained by the PCA boundaries.

Protection Comments: The PCA is owned by the State of Colorado (Lone Cone State Wildlife Area).

Management Comments: Threats to the PCA include weed invasion, grazing and recreation impacts. Heavy grazing has occurred in the past, however the area is currently not grazed and appears to be recovering. Noxious weeds, especially Canada thistle (*Cirsium arvense*) are very abundant on trails once used as roads or ATV trails. Canada thistle is the dominant plant in the herbaceous layer, especially in the mesic swales and moist meadows. It is suggested to monitor and eradicate dense noxious weed stands. Weed seed free feed is strongly encouraged. Off road vehicle use is currently forbidden in the State Wildlife Area.

Soils Description: Soils vary greatly, depending on geomorphic position throughout the PCA. Soils sampled in the mountain willow / beaked sedge (*Salix monticola* / *Carex utriculata*) wetland are saturated and comprised of a thin layer of peat at the surface, 12cm of humus rich soil, and gleyed clay beneath this to an unknown depth (40+cm). The soils in the State Wildlife Area have not been mapped by the Natural Resources Conservation Service.

Restoration Potential: Restoration opportunities include eradicating extensive stands of non-native plants such as Canada thistle (*Cirsium arvense*). Grazing and off road vehicle use is currently restricted within the PCA. Referring to such resources as the Nature Conservancy's web site on invasive species (<http://tncweeds.ucdavis.edu/index.html>) or <http://www.invasivespecies.gov/> may provide some assistance with control and eradication of non-native species. For suggestions on native plant revegetation, the Colorado Natural Areas Program offers advice in their website, <http://www.parks.state.co.us/cnap/index.html>.

Wetland Functional Assessment for the Morrison Creek at Lone Cone PCA:

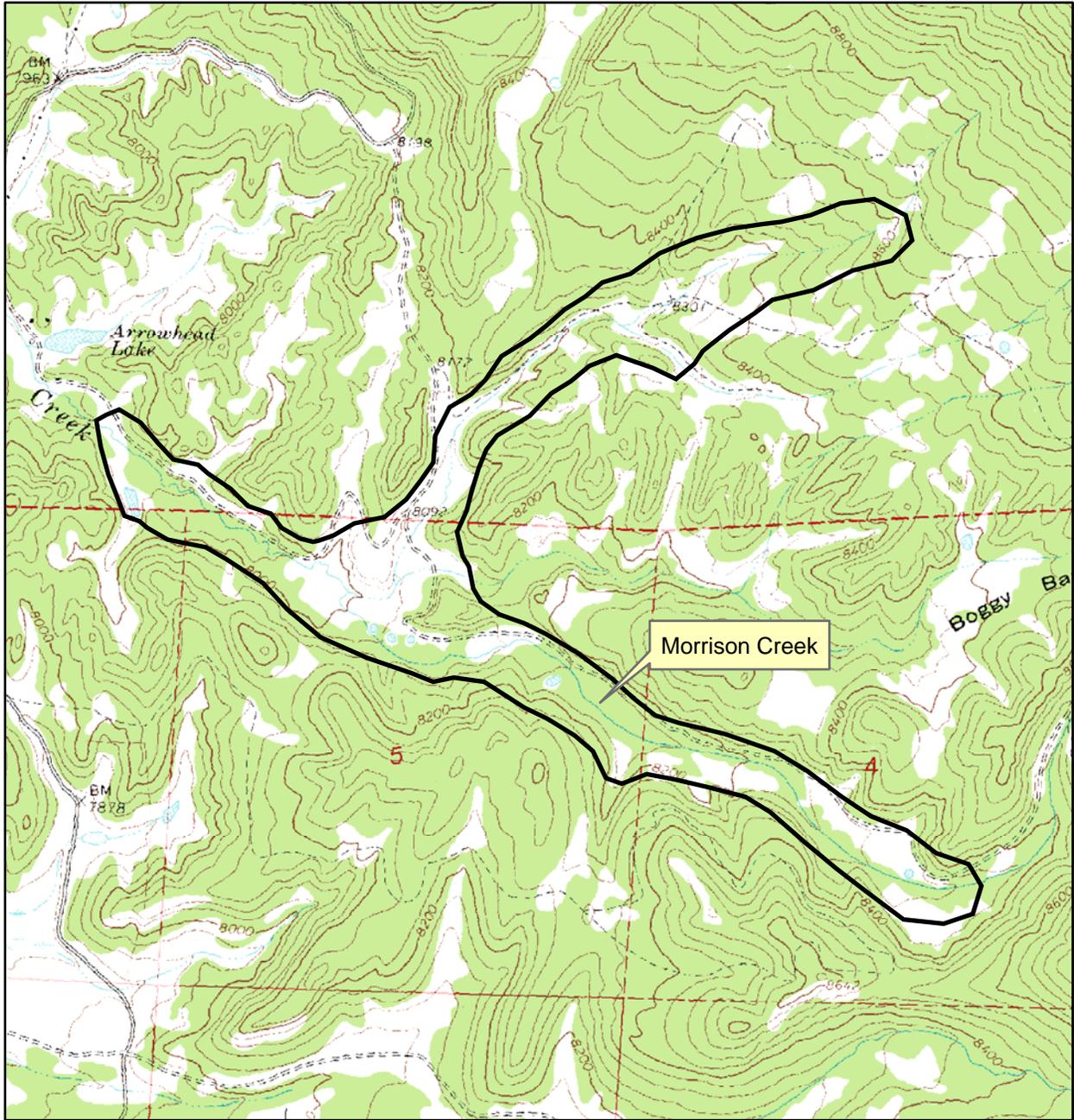
Proposed HGM Class: Riverine **Subclass:** R2

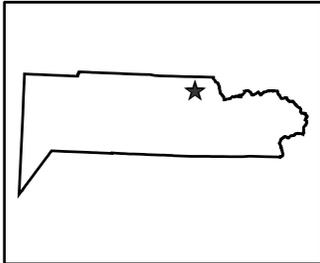
Cowardin System: Palustrine

CNHP's Wetland Classification: *Salix monticola* / *Carex utriculata* shrubland

Table 32. Wetland functional assessment for the montane riparian shrubland at Morrison Creek at Lone Cone PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	This wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	High	Wetland complex attenuates and stores floodwater (dense shrublands, native hydrophytes, ponds and breached beaver ponds).
Sediment/Shoreline Stabilization	High	Dense vegetation, gentle gradient. Bare soil exposed where beaver dams have been expelled.
Groundwater Discharge/ Recharge	Yes	Seeps noted in hillsides adjacent to the wetland, though within the wetland is saturated soils with clay (gley) mineral horizon.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	No disturbance to soils within the wetland, past grazing and past motorized vehicle use adjacent to the wetland are improving. Wetland displays vigorous vegetative growth, and expected amounts of detritus on soil surface.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Dense vegetation, variety in vegetation structure (scrub shrub, herbaceous, emergent, aquatic), shallow peat development, saturated and periodically saturated soils present. Sediment trapping evident.
Biological Functions		
Habitat Diversity	Moderate	Two Cowardin classes present -- scrub shrub and herbaceous vegetation.
General Wildlife Habitat	High	Wildlife sign, birds of prey, songbirds present. Variety of plant species and habitat structure.
General Fish/Aquatic Habitat	Moderate	Good fish habitat e.g., narrow deep channels, ponds, and riffles.
Production Export/Food Chain Support	High	The wetland has an inlet and outlet, containing large shrublands, overhanging vegetation, pools, and a high biodiversity.
Uniqueness	Moderate	Site supports a G3 plant community.



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Map 11. Morrison Creek at Lone Cone Potential Conservation Area, B3: High Biodiversity Significance

Upper Fish Creek below Dunn Peak PCA

Biodiversity Rank: B3: High biodiversity significance. The PCA supports good and fair occurrences of three riparian plant communities and an excellent occurrence of a critically imperiled plant (S1).

Protection Urgency Rank: P4: No protection actions are needed in the foreseeable future. The site is within the San Juan National Forest.

Management Urgency Rank: M3: New management actions may be needed within 5 years to maintain the current quality of the element occurrences in the PCA. Road maintenance activities could threaten the plant population.

Location: The Upper Fish Creek PCA is located in northern Dolores County, about 12 miles northwest of Rico. To access the site drive Forest Service Road 611 North from Dunton to Fish Creek.

U.S.G.S. 7.5 minute quadrangle: Groundhog Mountain

Legal Description: T41N,R12W, Sections 10, 11, 12, 14, and 15

Elevation: 9,600 to 10,600 feet

Size: Approximately 325 acres

General Description: With Dolores Peak as its headwaters, Fish Creek descends through a forest of Engelmann spruce and aspen (*Picea engelmannii* and *Populus tremuloides*) to a moderately wide valley with extensive willow carrs and beaver activity. Mesic graminoids, especially sedges, dominate the understory. Associated plants at the site of the King's clover occurrence include tufted hairgrass (*Deschampsia cespitosa*), elephant head lousewort (*Pedicularis groenlandica*), northern bog orchid (*Habenaria hyperborea*), water sedge (*Carex aquatilis*), cowbane (*Oxyopolis fendleri*), bittercress (*Cardamine cordifolia*), arrowleaf groundsel (*Senecio triangularis*), and chiming bells (*Mertensia ciliata*).

The beaver enhanced wetlands are dominated by mountain willow (*Salix monticola*) and form extensive habitat along Fish Creek. The habitat is dynamic evidenced by the change of one element occurrence from a mountain willow / Mesic Forbs (1993) plant association to mountain willow / beaked sedge association (CNHP 2005) possibly due to a higher water table caused by the inundation from beaver ponds. The PCA is in a popular recreation area, and is grazed.

Biodiversity Rank Justification and Comments: The site supports a good occurrence (B-ranked) of the globally vulnerable (G3S3) riparian willow carr, *Salix monticola* / Mesic graminoids. This association appears to be a stable, long-lived community (Carsey *et al.* 2003). The PCA also supports a good (B-ranked) occurrence of the globally vulnerable (G3S3) riparian willow carr *Salix monticola* / *Carex utriculata* plant association, where this association requires a high water table for much of the growing season (Carsey *et al.* 2003). The PCA supports an excellent (A-ranked) occurrence of the state rare (S1), globally secure (G5) king's clover (*Trifolium kingii*); and a fair (C-ranked) occurrence of the apparently globally secure (G4) riparian willow carr, *Salix monticola* / Mesic Forbs.

Table 33. Natural Heritage element occurrences at Upper Fish Creek Below Dunn Peak. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Communities					
<i>Salix monticola/Carex utriculata shrubland</i>	Montane Riparian Willow Carr	G3	S3		B
<i>Salix monticola/Mesic graminoids shrubland</i>	Montane Riparian Willow Carr	G3	S3		B
<i>Salix monticola/Mesic graminoids shrubland</i>	Montane Riparian Willow Carr	G4	S3		C
Plants					
<i>Trifolium kingii</i>	King's clover	G5	S1		A

Boundary Justification: The boundary was drawn to incorporate the king's clover occurrence, along with some additional area that is suitable for the plants, into which the population may expand. The boundary also encompasses immediate areas buffering hydrologic processes necessary to the viability of the elements. Natural fluvial processes such as seasonal flooding, sediment deposition and beaver activity will help maintain succession and viable populations of the elements along Fish Creek (Sanderson and Kettler 1996.). The boundary also provides a buffer from adjacent trail, campsites and road in the lower portion, where surface runoff may contribute excess nutrients, sediment and weed invasion. It should be noted that all hydrologic processes necessary for wetland viability are not contained within the PCA boundaries.

Protection Comments: The site is within the San Juan National Forest, but enjoys no further protection.

Management Comments: This occurrence is located close to a well traveled forest road. Alerting road crews to the presence of the plants and refraining from spraying the area would benefit the population.

Restoration Potential: The wetlands in the PCA are functioning as expected.

Wetland Functional Assessment for the Upper Fish Creek below Dunn Peak PCA:

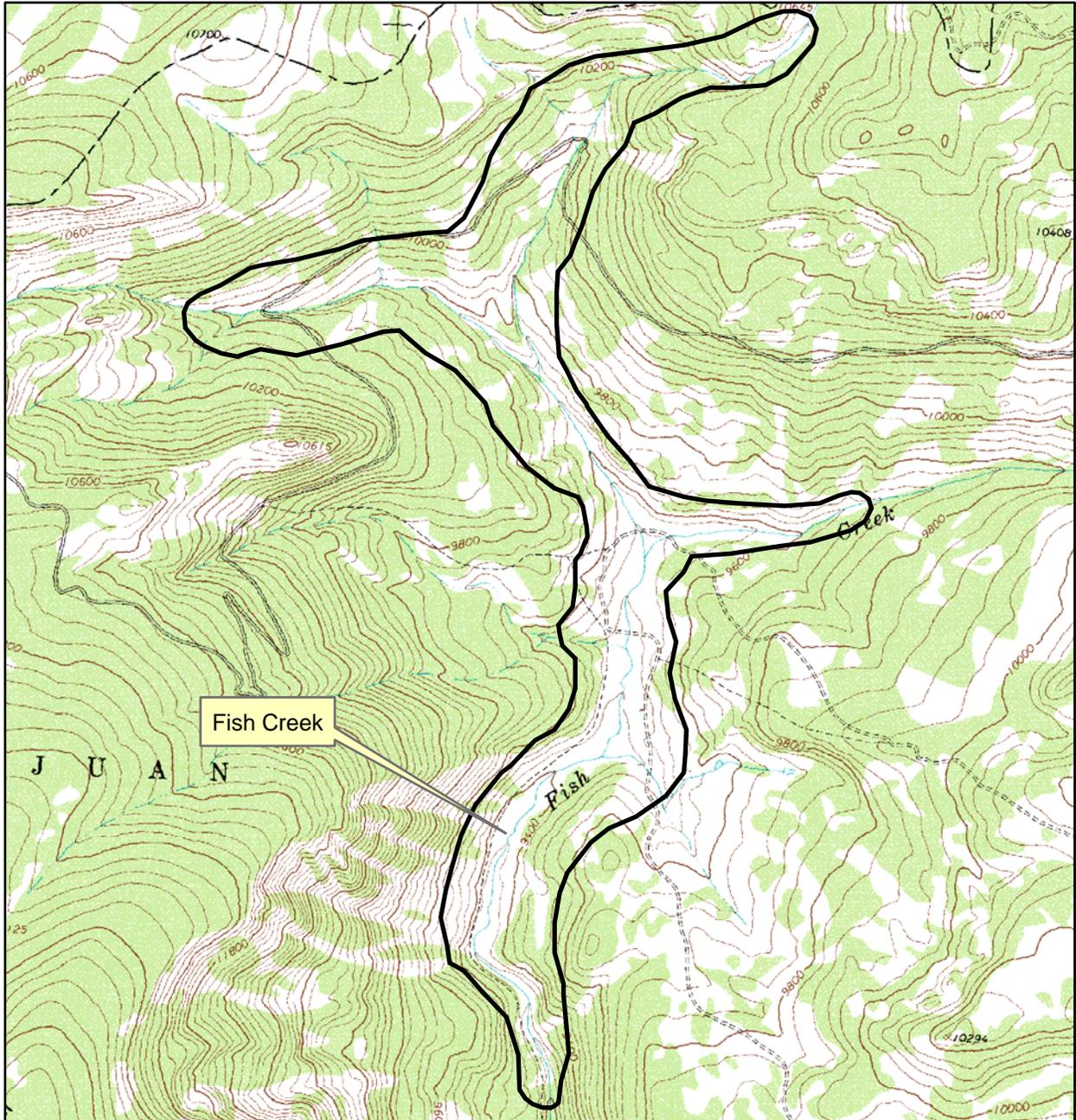
Proposed HGM Class: Riverine **Subclass:** R2

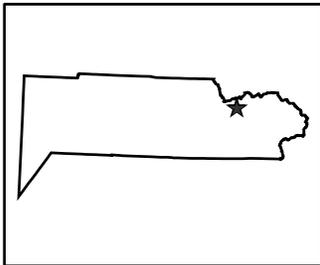
Cowardin System: Palustrine

CNHP's Wetland Classification: *Salix monticola* / Mesic Graminoids; *Salix monticola* / *Carex utriculata*

Table 34. Wetland functional assessment for the montane shrublands at Upper Fish Creek Below Dunn Peak PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	This wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	High	Beaver ponds; dense cover of native graminoids
Sediment/Shoreline Stabilization	Moderate	Dense woody vegetation in mosaic with naturally more barren areas where beaver dams have recently washed out – natural erosion.
Groundwater Discharge/Recharge	Yes	Seeps noted on adjacent hillslopes; beaver ponds in channel with coarse alluvial soils.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Normal soil development with mostly native vegetation and normal amounts of detritus.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Dense to open canopy of native vegetation, areas of dense native sedges.
Biological Functions		
Habitat Diversity	Moderate	Two Cowardin classes: scrub shrub; emergent
General Wildlife Habitat	High	Wildlife sign, beaver activity; healthy forest surrounding and mesic meadows with much forage
General Fish/Aquatic Habitat	High	Good fish habitat.
Production Export/Food Chain Support	High	Dynamic wetland structure, dense to open canopy of woody species, an outlet with signs of flushing flows
Uniqueness	Moderate	Site contains a G3 plant community, Fish Creek drainage is particularly active with beaver in comparison with other drainages.



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Map 12. Upper Fish Creek below Dunn Peak Potential Conservation Area, B3: High Biodiversity Significance

Upper Plateau Creek Potential Conservation Area

Biodiversity Rank: B3. High biodiversity significance. The site supports a good (B-ranked) occurrence of the globally vulnerable (G3?), imperiled in Colorado (S2) Bebb's willow (*Salix bebbiana*) shrubland.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The PCA is within the San Juan National Forest. The CDOW has recently purchased property directly upstream of the PCA.

Management Urgency Rank: M4. Current management seems to favor the persistence of the element within the PCA, but management actions may be needed in the future to maintain the current quality of the element occurrence. Management upstream of the PCA is improving evidenced by riparian fencing efforts by the CDOW.

Location: The Upper Plateau Creek PCA surrounds Plateau Creek and the canyon in south central Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Willow Spring

Legal Description: T39N R15W Section 2, 11

Elevation: 7,300 – 7,800 ft.

Size: Approximately 159 acres.

Redders, 2003, Community Type: *Salix bebbiana* shrubland

General Description: The Upper Plateau Creek PCA is located along the middle reach of Plateau Creek surrounding the northern part of Plateau Canyon. Plateau Creek flows across a high mountain plateau that is geologically comprised of Mancos Shale, Dakota Sandstone and Burrow Canyon Formation (sandstone shale and conglomerate) (Tweto 1979). This area has been heavily used for cattle grazing. As the stream enters the PCA boundary, it drops into a narrow sandstone canyon comprised of Jurassic period aged Morrison Formation (soft brightly colored shale), Wanakah and Endrada sandstones (Tweto 1979). The stream channel is moderately sinuous to straight. There are many springs discharging along the canyon walls supporting pockets of mesic vegetation and moss. Water in the stream was turbid at the time of the survey (June, 2004), evidenced by the deposition of sediments onto the floodplain.

Shrublands dominate the riparian area in a mosaic of dense thickets and open canopies. Bebb's willow (*Salix bebbiana*) and thinleaf alder (*Alnus incana*) dominate the shrub layer with associated species including shining willow (*Salix lasiandra*), strapleaf willow (*Salix ligulifolia*), twinberry honeysuckle (*Lonicera involucrata*), and chokecherry (*Prunus virginiana*). Early successional cottonwood (saplings) stands are scattered throughout the PCA. Narrowleaf cottonwood (*Populus angustifolia*) saplings and coyote willow (*Salix exigua*) dominate point bars. Colorado blue spruce (*Picea pungens*) occurs on higher benches adjacent to the stream channel on both sides of the canyon. Fringes of graminoids such as beaked sedge (*Carex utriculata*), wooly sedge (*Carex lanuginosa*), common spikerush (*Eleocharis palustris*), Baltic rush (*Juncus balticus*) and other sedge species (*Carex* spp.), occupy the shoreline and seeps. Associated forbs in the herbaceous understory include cut leaf coneflower (*Rudbeckia ampla*), starry false lily of the valley (*Maianthemum stellatum*), geranium (*Geranium* sp.), common dandelion (*Taraxacum officinale*) and others. Hay grasses occur in the herbaceous understory

throughout the PCA, including Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*).

Uplands surrounding the PCA are dominated by ponderosa pine (*Pinus ponderosa*) and pinyon pine – juniper (*Pinus edulis – Juniperus scopulorum*) forests and open rangelands. There is an irrigation diversion directly upstream of the PCA.

Biodiversity Rank Justification and Comments: The site supports a good (B-ranked) occurrence of the globally vulnerable (G3?), imperiled in Colorado (S2) Bebb’s willow (*Salix bebbiana*) riparian shrubland. In Colorado, *Salix bebbiana* stands are infrequent. *Salix bebbiana* typically is a minor component of montane willow carrs (Carsey *et al.* 2003).

Table 35. Natural Heritage element occurrences at Upper Plateau Creek PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Salix bebbiana</i> shrubland	Bebb’s willow shrubland	G3?	S2		B

Boundary Justification: The boundaries incorporate an area that encompasses the element occurrence, and immediate upstream watershed that buffer hydrologic processes necessary for the viability of the element occurrence. The boundary provides a small buffer from direct disturbance by cattle grazing that may cause excessive nutrients and sedimentation. It should be noted that all hydrologic processes necessary for wetland viability are not contained within the PCA boundaries.

Protection Comments: The PCA is owned by the San Juan National Forest. Colorado Department of Natural Resources, Division of Wildlife has purchased upstream land that is not within the PCA but affects the PCA condition e.g., sedimentation increased by heavy grazing.

Management Comments: Threats to the PCA are grazing impacts such as erosion, sedimentation, and weed invasion. Heavy grazing upstream (offsite) may have lead to excessive sedimentation within the PCA. The Division of Wildlife is currently improving grazing practices e.g., fenced enclosures around selected portions of Plateau Creek upstream of the PCA. Hay grasses such as Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*) occur in the herbaceous understory throughout the PCA.

Soils Description: Soils within the riparian area have a shallow mineral horizon and finer sediments over alluvium. Bedrock is also exposed from scouring. The mapped soil unit in the PCA describes the canyon soils as Argiustoll – Haplustalfs – Rock outcrop complex, 30 – 80 percent slopes (USDA, NRCS 2002).

Restoration Potential: The riparian area is functioning at its potential. Restoration opportunities include weed eradication and monitoring. Referring to such resources as the Nature Conservancy’s web site on invasive species (<http://tncweeds.ucdavis.edu/index.html>) or <http://www.invasivespecies.gov/> may provide some assistance with control and eradication of non-native species. Improving grazing practices and increasing plant productivity on upstream floodplains off site, will help reduce sedimentation within the PCA.

Wetland Functional Assessment for the Upper Plateau Creek PCA:

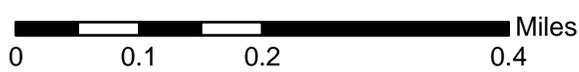
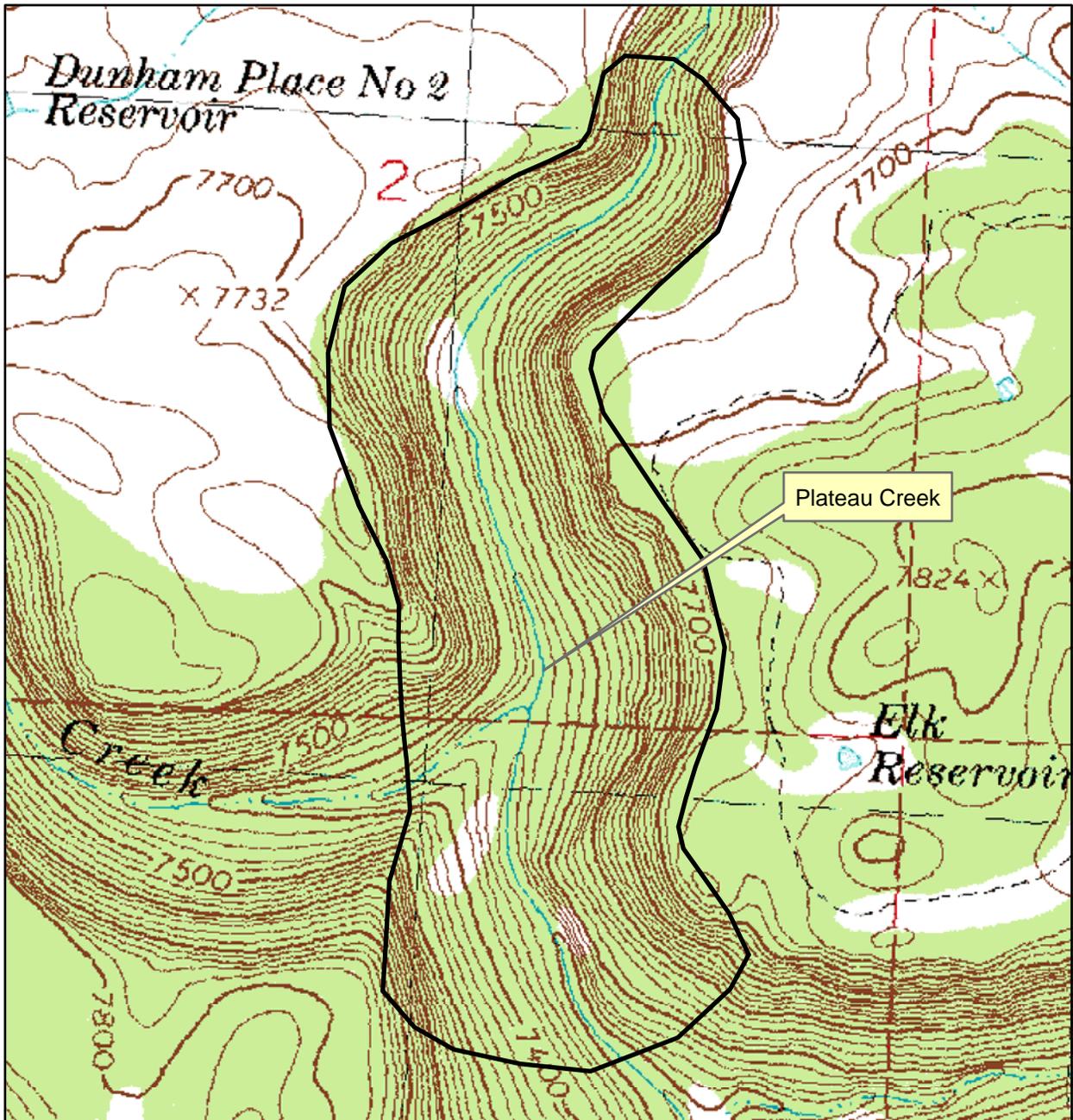
Proposed HGM Class: Riverine **Subclass:** R2

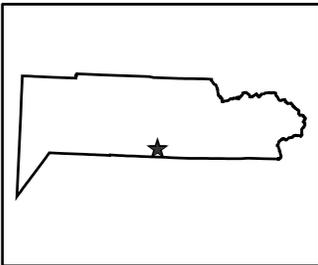
Cowardin System: Palustrine

CNHP's Wetland Classification: *Salix bebbiana* shrubland

Table 36. Wetland functional assessment for the montane riparian shrubland at Upper Plateau Creek PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	The wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Limited floodplain in canyon. Native hydrophytes (grasses, sedges). Vegetated point bars and shrublands.
Sediment/Shoreline Stabilization	High	Woody vegetation is abundant, stabilizing the shoreline and trapping sediments. Increased sedimentation due to upstream erosion.
Groundwater Discharge/Recharge	Yes	Seeps present.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Sedimentation may be adversely affecting this function, otherwise detritus present and expected above ground productivity (vigorous plant growth).
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Native plants in understory, including hydrophytes. Shrublands exhibit ~50% canopy cover. Increased sedimentation may stress system balance.
Biological Functions		
Habitat Diversity	Low	One Cowardin class present (scrub shrub).
General Wildlife Habitat	High	Deer sign, song birds present. Diverse woody vegetation provides habitat in a somewhat isolated canyon.
General Fish/Aquatic Habitat	Moderate	Fish observed (small minnows), invertebrates present. Low stream flow. Pools, riffles and overhanging vegetation.
Production Export/Food Chain Support	High	Flushing flows, overhanging woody vegetation and detritus supply nutrients and carbons to downstream ecosystems.
Uniqueness	Moderate	The site contains a G3?S2 plant association in good condition.



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Map 13. Upper Plateau Creek Potential Conservation Area, B3: High Biodiversity Significance

West Dolores Campground Potential Conservation Area

Biodiversity Rank: B3. High biodiversity significance. The site supports a good (B-ranked) occurrence of the globally vulnerable (G3S3) Colorado blue spruce / thinleaf alder (*Picea pungens* / *Alnus incana*) riparian forest; a good (B-ranked) occurrence of the apparently globally secure (G4S4) narrowleaf cottonwood – Colorado blue spruce / thinleaf alder (*Populus angustifolia* – *Picea pungens* / *Alnus incana*) riparian woodland; and a good (B-ranked) example of the globally vulnerable (G3) narrowleaf cottonwood (*Populus angustifolia*) / mixed willow (*Salix* spp.) riparian woodland.

Protection Urgency Rank: P3. Protection action may be needed, but probably not within the next 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA if protection action is not taken.

Management Urgency Rank: M3. New management action may be needed within 5 years to maintain the current quality of the element occurrences in the PCA. Recreation, agriculture and weed invasion are the main threats.

Location: The West Dolores Campground PCA surrounds the West Dolores River in the southern part of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Nipple Mountain

Legal Description: T39N R13W Section 2, 3, 8, 9, 10, 17
T40N R13W Section 26, 35

Elevation: 7,700 – 8,400 ft.

Size: Approximately 1,289 acres.

Redders, 2003, Community Type: *Picea pungens* / *Alnus incana* evergreen forest; *Populus angustifolia* – *Picea pungens* / *Salix* species deciduous-evergreen forest; *Populus angustifolia* – *Picea pungens* / *Alnus incana* deciduous – evergreen forest

General Description: West Dolores Campground PCA surrounds the West Dolores River from its confluence with Goble Creek downstream to its confluence with Cottonwood Creek. This montane reach of the West Dolores River is within a wide red canyon, comprised of the Dolores Formation (red siltstone, sandstone, shale and limestone-pellet conglomerate) (Tweto 1979). The PCA contains contiguous vegetation dominated by mixed deciduous – coniferous riparian forests in a riparian shrubland mosaic. The dynamic fluvial processes in the stream channel facilitate lush, vigorous woody vegetation representing all age classes. Colorado blue spruce (*Picea pungens*) dominates the tree layer, often associated with narrowleaf cottonwood (*Populus angustifolia*). Thinleaf alder (*Alnus incana*) dominates the shrub layer, associated with twinberry honeysuckle (*Lonicera involucrata*), serviceberry (*Amelanchier alnifolia*), chokecherry (*Prunus virginiana*) and others. A diverse assemblage of willows associate with narrowleaf cottonwoods or occur in monotypic dense carrs. Mountain willow (*Salix monticola*) dominates the shrub layer with coyote willow (*Salix exigua*), shining willow (*Salix lasiandra*), and strap leaf willow (*Salix ligulifolia*). The herbaceous understory is dominated by mesic forbs in sparse to moderate cover. Herbaceous species include cut leaf coneflower (*Rudbeckia ampla*), cow parsnip (*Heracleum sphondylium* subsp. *montanum*), stary false lily of the valley (*Maianthemum stellatum*), smooth horsetail (*Equisetum laevigata*), and field horsetail (*Equisetum arvense*). Upland or weedy species encroach from disturbed areas and include common dandelion (*Taraxacum officinale*), black medic (*Medicago lupulina*), red clover (*Trifolium pratense*) and orchard grass (*Dactylis*

glomerata). Scattered individuals of oxeye daisy (*Leucanthemum vulgare*) were noted within the PCA as well as occurring in dense patches upstream of the PCA.

Property ownership is a patchwork of private parcels within National Forest lands. Land uses include recreation, hay fields, horse pasture and cattle grazing. Two campgrounds are included within the PCA.

Biodiversity Rank Justification and Comments: The site supports a good (B-ranked) occurrence of the globally vulnerable (G3S3) Colorado blue spruce / thinleaf alder (*Picea pungens* / *Alnus incana*) riparian forest. This plant association appears to be a climax riparian species and will remain until removed or damaged by a catastrophic flood (Carsey *et al.* 2003). The good condition of this plant association is indicative of nominal flooding along this reach of the West Dolores River. A good (B-ranked) occurrence of the apparently globally secure (G4S4) narrowleaf cottonwood – Colorado blue spruce / thinleaf alder (*Populus angustifolia* – *Picea pungens* / *Alnus incana*) riparian forest indicates consistent water levels and frequent, albeit minor, flooding (Carsey *et al.* 2003). Additionally, a good (B-ranked) example of the globally vulnerable (G3) narrowleaf cottonwood (*Populus angustifolia*) / mixed willow (*Salix* spp.) riparian woodland occurs within the PCA. This plant association also occurs on active floodplains, stream benches and low terraces. The presence of this and the other two plant associations is characteristic of a changing alluvial environment where riparian vegetation is constantly being “re-set” by flooding disturbance (Carsey *et al.* 2003).

Table 37. Natural Heritage element occurrences at West Dolores Campground PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Picea pungens</i> / <i>Alnus incana</i>	Blue spruce / thinleaf alder	G3	S3		B
<i>Populus angustifolia</i> – <i>Picea pungens</i> / <i>Alnus incana</i>	Narrowleaf cottonwood - blue spruce / thinleaf alder	G4	S4		B
<i>Populus angustifolia</i> / mixed <i>Salix</i> species	Narrowleaf cottonwood / mixed willows	G3	S3		B

Boundary Justification: The boundaries incorporate an area that encompasses the element occurrences, and immediate upstream watershed that buffer hydrologic processes necessary for the viability of the element occurrences. Natural fluvial disturbances such as seasonal flooding are important to the maintenance of a dynamic, multi-aged cottonwood riparian system (TNC 1996; Hansen *et al.* 1995). The boundaries also provide a small buffer from nearby social trails, the highway, and hay fields where surface runoff may contribute excess nutrients, sediment and weed invasion. It should be noted that the hydrologic processes necessary to the element are not fully contained by the PCA boundaries.

Protection Comments: The PCA is within the San Juan National Forest and several private in holdings. Wetland education and conservation easements may benefit the landowners and protect riparian areas.

Management Comments: Threats to the PCA include impacts from grazing, recreation and agricultural activities. Oxeye daisy (*Leucanthemum vulgare*) is an increasing threat in the general vicinity. Weeds encroach from disturbed areas in the campgrounds, agricultural fields and from the highway. Recreation includes camping, fishing and sight seeing.

Soils Description: Soils are derived from alluvium and vary with geomorphic position throughout the PCA. Soils sampled have a shallow mineral horizon of sandy loam or loam over alluvium.

Mapped soils units within the PCA are delineated as Dalmation – Apmay - Schrader complex, 0 – 5 percent slopes; Endoaquolls – Ustifluent complex, 0 – 5 percent slopes; and Mavreeso loam, 5 – 30 percent slopes. Dalmation is classified as fine-loamy, mixed, superactive, frigid Cumulic Haplustoll; Apmay is classified as coarse-loamy, mixed, superactive, frigid Aquic Cumulic Haplustoll; and Schrader is classified as coarse-loamy, mixed, superactive, frigid Cumulic Endoaquoll. Mavreeso loam is classified as fine-loamy, mixed, superactive, frigid Entic Haplustolls. (USDA, NRCS 2002)

Restoration Potential: Restoration opportunities include weed eradication and monitoring. Referring to such resources as the Nature Conservancy’s web site on invasive species (<http://tncweeds.ucdavis.edu/index.html>) or <http://www.invasivespecies.gov/> may provide some assistance with control and eradication of non-native species. If weeds are removed, it is beneficial to plant bare soils with native plants. The Colorado Natural Areas Program has a native plant revegetation guide available on their website at <http://www.parks.state.co.us/cnap/indes.html> which may provide helpful information about using native plants for revegetation projects.

Wetland Functional Assessment for the West Dolores Campground PCA:

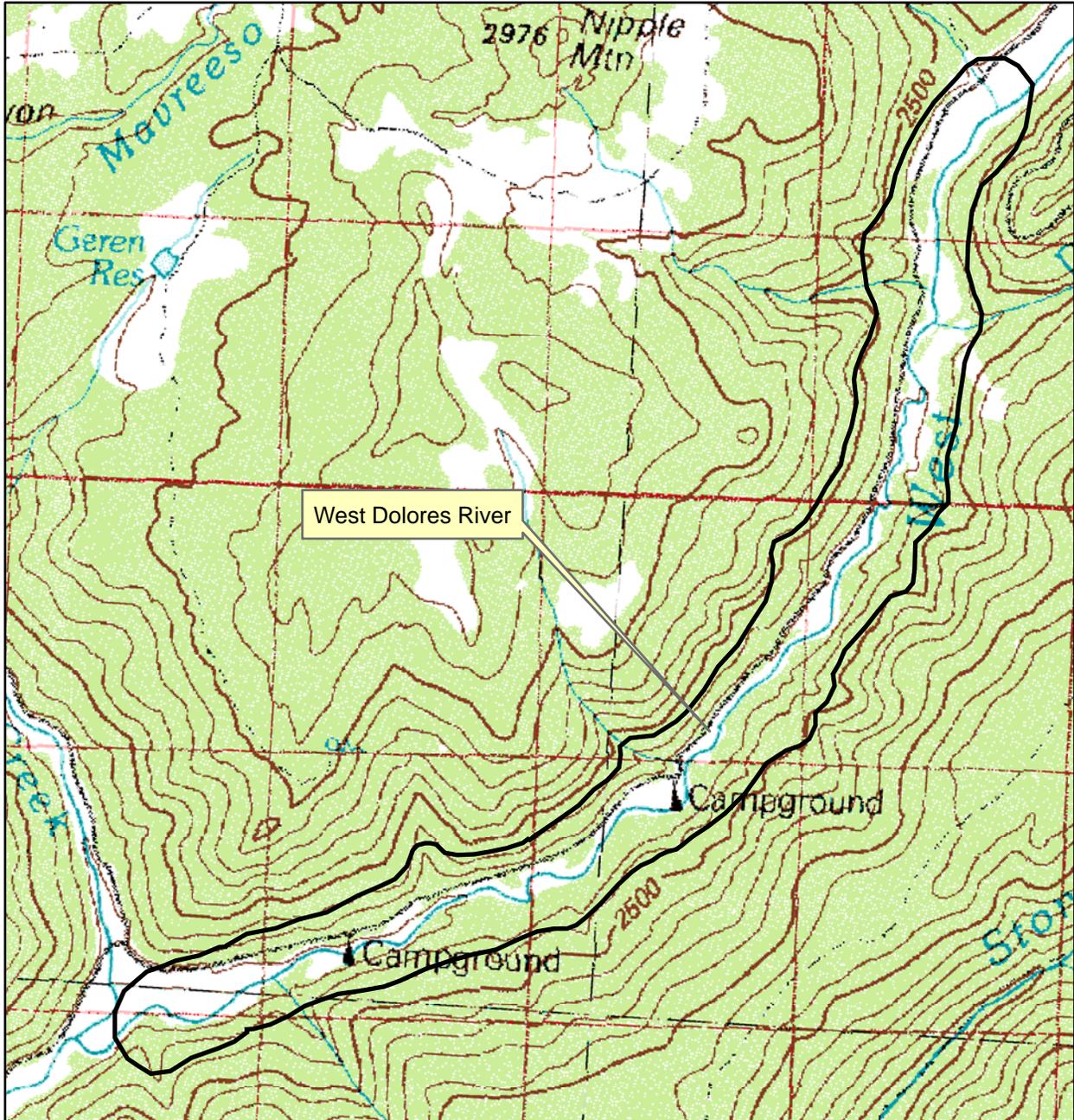
Proposed HGM Class: Riverine **Subclass:** R3

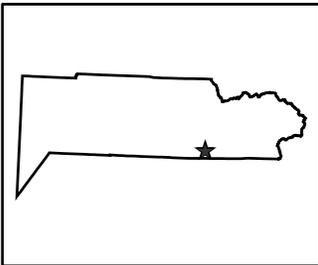
Cowardin System: Palustrine

CNHP's Wetland Classification: *Populus angustifolia* – *Picea pungens* / *Alnus incana*; *Picea pungens* / *Alnus incana* riparian forests

Table 38. Wetland functional assessment for the riparian forests at West Dolores Campground PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	The wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	High	Many large point bars and terraces with woody vegetation. Willow shrublands in broad floodplain areas. Large debris and alluvium increase roughness and dissipate floodwater energy.
Sediment/Shoreline Stabilization	Moderate	Riprap at campground site -- otherwise natural stream latitude has created balanced stability. Dense woody vegetation anchors banks. Localized impacts cause erosion to shoreline.
Groundwater Discharge/Recharge	Yes	Coarse alluvial material with multiple pools (log jams, back flow channels) indicate groundwater recharge.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Alluvial material and loams with abundant detritus. Large, contiguous vegetation stand. Soil compaction and disturbance is confined to localized areas.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Herbaceous understory is native mixed with non-native and upland species. Vigorous woody vegetation on wide floodplains and point bars perform this function.
Biological Functions		
Habitat Diversity	Moderate	PCA contains two Cowardin classes (scrub shrub and forested types).
General Wildlife Habitat	Moderate	Wildlife signs noted. Diverse tree and shrub layer provides habitat. Highway adjacent.
General Fish/Aquatic Habitat	High	Good fish habitat (overhanging vegetation, pools and riffles, backwater channels). Several fishermen noted.
Production Export/Food Chain Support	High	Signs of high flushing flows. Detritus and overhanging vegetation present.
Uniqueness	High	The PCA supports a G3 plant community. The PCA contains a large, contiguous riparian forest in good condition.



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Map 14. West Dolores Campground Potential Conservation Area, B3: High Biodiversity Significance

West Dolores River at Deadman Draw Potential Conservation Area

Biodiversity Rank: B3. High biodiversity significance. The site supports a fair (C-ranked) occurrence of the globally imperiled to globally vulnerable (G2G3S2S3) strapleaf willow (*Salix ligulifolia*) shrubland.

Protection Urgency Rank: P3. Protection action may be needed, but probably not within the next 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA if protection action is not taken.

Management Urgency Rank: M3. New management action may be needed within 5 years to maintain the current quality of the element occurrences in the PCA. Recreation, grazing and weed invasion are the main threats.

Location: The West Dolores River at Deadman Draw surrounds the West Dolores River in the east central part of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Clyde Lake; Groundhog Mountain

Legal Description: T40N R12W Section 1, 2, 10, 11, 12

Elevation: 8,600 – 8,800 ft.

Size: Approximately 376 acres.

Redders, 2003, Community Type: *Salix monticola* / Mesic Forbs willow shrubland; *Salix eriocephala* var. *ligulifolia* willow shrubland

General Description: West Dolores River at Deadman Draw PCA surrounds the West Dolores River from Geyser Creek to Johnny Bull Creek. The West Dolores River flows through a moderately wide valley at the base of steep slopes. The river is moderately sinuous with large point bars, beaver enhanced wetlands and a wide floodplain. Tall, mature clusters of Colorado blue spruce (*Picea pungens*) are scattered throughout the PCA. Strapleaf willow (*Salix ligulifolia*) and mountain willow (*Salix monticola*) dominate the large riparian shrubland. Thinleaf alder (*Alnus incana*) is abundant with associated species such as Geyer's willow (*Salix geyeriana*), whitestem gooseberry (*Ribes inerme*), roundleaf snowberry (*Symphoricarpos rotundifolius*), twinberry honeysuckle (*Lonicera involucrata*), and river hawthorn (*Crataegus rivularis*). The herbaceous understory is dominated by non-native grasses such as Kentucky bluegrass (*Poa pratensis*), timothy (*Phleum pratense*), and smooth brome (*Bromus inermis*). Other native graminoids include Baltic rush (*Juncus balticus*), beaked sedge (*Carex utriculata*), small wing sedge (*Carex microptera*), and reedtop (*Agrostis* sp.). Mesic forbs are abundant including cut leaf coneflower (*Rudbeckia ampla*), starry false lily of the valley (*Maianthemum stellatum*), Virginia strawberry (*Fragaria virginiana*), Richardson's geranium (*Geranium richardsonii*), large leafed avens (*Geum macrophyllum*), fleabane (*Erigeron* sp.), Jacob's ladder (*Polemonium foliosissimum*), and Fendler's cowbane (*Oxypolis fendleri*). Scouringrush horsetail (*Equisetum hyemale*) and field horsetail (*Equisetum arvense*) occupy the bare gravelly soils within the floodplain. Common dandelion (*Taraxacum officinale*) occurs frequently in the herbaceous understory as well as other weedy species including black medic (*Medicago lupulina*), red clover (*Trifolium pratense*), and oxeye daisy (*Leucanthemum vulgare*).

The area is used for grazing and recreation including hiking, camping and fishing. Agricultural fields are downstream of the PCA supporting dense stands of oxeye daisy (*Leucanthemum vulgare*).

Biodiversity Rank Justification and Comments: The site supports a fair (C-ranked) occurrence of the globally imperiled to globally vulnerable (G2G3S2S3) strapleaf willow (*Salix ligulifolia*) shrubland. This association appears to be a long-lived mid- to late-seral type since it is associated with beaver activity and saturated soils throughout the growing season (Carsey *et al.* 2003).

Table 39. Natural Heritage element occurrences at West Dolores River at Deadman Draw PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Salix ligulifolia</i> shrubland	Strap leaf willow shrubland	G2G3	S2S3		B

Boundary Justification: The boundaries incorporate an area that encompasses the element occurrence, and immediate upstream watershed that buffer hydrologic processes necessary for the viability of the element occurrence. Natural fluvial processes such as seasonal flooding, sediment deposition and beaver activity will help maintain succession and viable populations of the elements along West Dolores River (Hansen *et al.* 1995; The Nature Conservancy 1996; Sanderson and Kettler 1996; Cooper and Cottrell 1990). The boundary also provides a buffer from trails, the road, hay meadows, and campsites where surface runoff may contribute excess nutrients, sediment and weed invasion. It should be noted that all hydrologic processes necessary for wetland viability are not contained within the PCA boundaries.

Protection Comments: The PCA is within the San Juan National forest and private in holdings. Education regarding wetland ecology and conservation easements may benefit the landowners.

Management Comments: Threats to the PCA include grazing, weed invasion and recreation. Grazing impacts include intensely browsed shrubs, weed invasion and trailing. Impacts from recreation are social trailing and shoreline erosion. Oxeye daisy (*Leucanthemum vulgare*) is dense on private property adjacent to the willow shrubland. Much of the PCA is inundated or saturated providing protection from direct disturbance. It may be beneficial to evaluate grazing practices within the wetlands and to monitor weed invasion.

Soils Description: Soils within the PCA are derived from alluvium and vary throughout the site. Soil sampled has a shallow mineral horizon of clay loam with little organic matter, over alluvium. Mapped soil units within the riparian zone are delineated as Cryaquoll – Typic Cryaquent complex, 1 – 5 percent slope; and Hourglass – Wander complex, 5 – 30 percent slope. Hourglass is classified as fine-loamy, mixed, superactive Typic Argicryoll; and Wander is classified as loamy-skeletal, mixed, superactive Typic Argicryoll. (USDA, NRCS 2002)

Restoration Potential: Restoration opportunities include weed eradication and monitoring. Referring to such resources as the Nature Conservancy's web site on invasive species (<http://tncweeds.ucdavis.edu/index.html>) or <http://www.invasivespecies.gov/> may provide some assistance with control and eradication of non-native species. If weeds are removed, or areas are eroded, it is beneficial to plant bare soils with native riparian plants. The Colorado Natural Areas Program has a native plant revegetation guide available on their website at <http://www.parks.state.co.us/cnap/index.html> which may provide helpful information about using

native plants for revegetation projects. This resource is organized according with ecosystem type and suggests the appropriate plant species.

Wetland Functional Assessment for the West Dolores at Deadman Draw PCA:

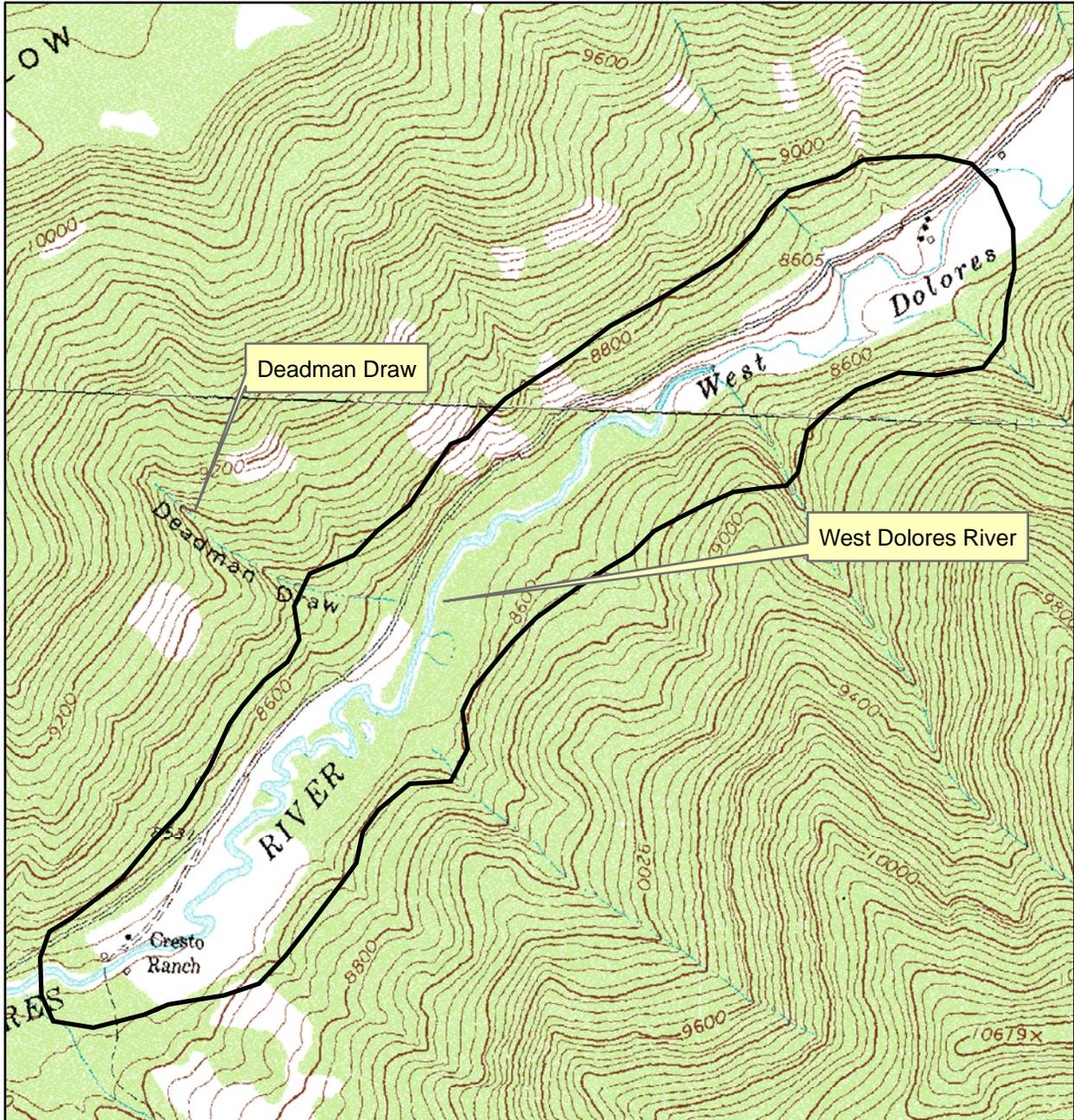
Proposed HGM Class: Riverine **Subclass:** R2/R3

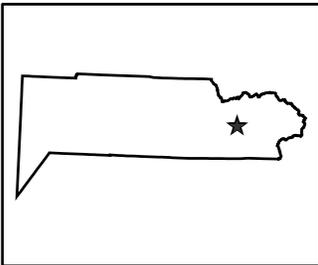
Cowardin System: Palustrine

CNHP's Wetland Classification: *Salix ligulifolia* shrubland

Table 40. Wetland functional assessment for the montane willow shrubland at West Dolores River at Deadman Draw PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	This wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Large, dense shrubland, ponds, vegetated point bars, and alluvial soils perform this function. Rough land surfaces disperse floodwater energy.
Sediment/Shoreline Stabilization	Moderate	Dense shrub layer anchors shoreline. Recreation and road maintenance cause localized erosion. Point bars with regenerating shrubs and trees.
Groundwater Discharge/Recharge	Yes	Beaver ponds and backwater channels in coarse alluvial soils indicate recharge.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Detritus on surface of soils. Vigorous vegetative growth and regeneration. Direct impacts to the soil and vegetation caused by recreation and cattle grazing are confined to a small portion of the PCA.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Herbaceous understory comprised of a mixture of non-native and native species. Dense, vigorous woody vegetation and beaver ponds – sediment trapping evident.
Biological Functions		
Habitat Diversity	Low	The PCA supports one Cowardin class (scrub shrub).
General Wildlife Habitat	Moderate	Wildlife signs (deer, beaver), songbirds present. Road adjacent. Large area.
General Fish/Aquatic Habitat	High	Good fish habitat (pools and riffles, overhanging vegetation).
Production Export/Food Chain Support	High	Overhanging vegetation, signs of flushing flows, large area (>20acres vegetated).
Uniqueness	Moderate	The PCA supports a G2 plant association in good condition.



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Map 15. West Dolores River at Deadman Draw Potential Conservation Area, B3: High Biodiversity Significance

West Dolores River at Dunton Potential Conservation Area

Biodiversity Rank: B3. High biodiversity significance. The site supports a good (B-ranked) occurrence of the globally vulnerable (G3S3) Geyer's willow – mountain willow (*Salix geyeriana* – *Salix monticola*) / Mesic Forbs shrubland; and a fair (C-ranked) breeding colony of the apparently globally secure (G4) but vulnerable in Colorado (S3B) Black Swift (*Cypseloides niger*).

Protection Urgency Rank: P3. Protection action may be needed, but probably not within the next 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA if protection action is not taken.

Management Urgency Rank: M3. New management action may be needed within 5 years to maintain the current quality of the element occurrences in the PCA. Impacts from road maintenance, grazing and recreation are the main threats.

Location: The West Dolores River at Dunton surrounds the West Dolores River in the east central part of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Dolores Peak

Legal Description: T41N R11W Section 27, 28, 32, 33

Elevation: 8,800 – 9,200 ft.

Size: Approximately 550 acres.

Redders, 2003, Community Type: *Salix monticola*/*Salix geyeriana* willow shrubland

General Description: The West Dolores River at Dunton PCA surrounds the West Dolores River upstream and downstream of the Town of Dunton. The PCA is in a moderately wide river valley with steep canyon side drainages. The riparian zone is occupied by a large willow shrubland dominated by Geyer's willow (*Salix geyeriana*) and mountain willow (*Salix monticola*), with other shrubs including shining willow (*Salix lasiandra*), coyote willow (*Salix exigua*), river hawthorn (*Crataegus rivularis*), and wolf willow (*Salix wolfii*). Plants in the herbaceous understory include small wing sedge (*Carex microptera*), wooly sedge (*Carex pellita*), Merten's rush (*Juncus mertensianus*), Kentucky bluegrass (*Poa pratensis*), smooth brome (*Bromus inermis*), timothy (*Phleum pratense*), Canada thistle (*Cirsium arvense*), and common dandelion (*Taraxacum officinale*). The floodplain is characterized with uneven micro-topography as well as beaver activity. The alluvial soils are sandy and silty clay loam.

Several waterfalls located on the adjacent steep canyon slopes provide breeding habitat for the Black Swift (*Cypseloides niger*) (CNHP 2005). Black Swifts are aerial feeders that forage in forested and open areas for insects (NatureServe Explorer 2005). This PCA provides the Black Swift with the required unobstructed flight paths between their nesting colony and foraging habits (Knorr and Knorr 1990). The occurrence of Black Swift was last observed in 2001 (CNHP 2005).

Uplands surrounding the PCA are dominated by spruce – fir (*Picea engelmannii* – *Abies lasiocarpa*) forests and open Thurber's fescue (*Festuca thurberi*) grasslands. Forest Road 535 is adjacent to the wetlands.

Biodiversity Rank Justification and Comments: The site supports a good (B-ranked) occurrence of the globally vulnerable (G3S3) Geyer's willow – mountain willow (*Salix geyeriana* – *Salix monticola*) / Mesic Forbs shrubland. This plant association can be grazing induced. The

good condition of this plant association may be indicative of moderate to intense grazing. It is thought that with the removal of season-long grazing, *Salix geyeriana-Salix monticola/ Calamagrostis canadensis* plant association would be dominant (Carsey *et al.* 2003). A fair (C-ranked) breeding colony of the apparently globally secure (G4) vulnerable in the state (S3B) Black Swift (*Cypseloides niger*) is located on the steep cliffs within the PCA boundaries.

Table 41. Natural Heritage element occurrences at West Dolores River at Dunton PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Salix geyeriana</i> – <i>Salix monticola</i> / Mesic Forbs	Geyer’s willow – mountain willow / mesic forbs	G3	S3		B
Animals					
<i>Cypseloides niger</i>	Black Swift	G4	S3B	USFS	C

Boundary Justification: The boundaries incorporate an area that encompasses the element occurrences, and immediate upstream watershed that buffer hydrologic processes necessary for the viability of the element occurrences. Natural fluvial processes such as seasonal flooding, sediment deposition and beaver activity will help maintain succession and viable populations of the elements along West Dolores River (Sanderson and Kettler 1996.). The boundary also provides a buffer from adjacent road and social trails that may contribute excess sediment, nutrients and weed invasion to the riparian system. The boundary is drawn to include foraging habits and unobstructed flight paths for the Black Swift colony. It should be noted that the area needed to ensure the viability of the elements are not fully contained by the PCA boundaries.

Protection Comments: The PCA is located within the San Juan National Forest and private in holdings. The Town of Dunton is primarily a privately owned resort with natural hot springs. The town is gated and open only for resort members and their guests. Wetland education and conservation easements may benefit the landowner and provide some protection from the threats listed below.

Management Comments: Threats to the PCA include road maintenance, grazing, recreation and direct disturbance to the habitat from activities such as construction e.g., homes, driveways. Road maintenance/creation may cause erosion and excessive sedimentation. Grazing impacts include trailing and weed invasion. Exotic plant species noted within the riparian area include pasture grasses such as Kentucky bluegrass (*Poa pratensis*), timothy (*Phleum pratense*), and smooth brome (*Bromus inermis*), as well as common dandelion (*Taraxacum officinale*). Oxeye daisy (*Leucanthemum vulgare*) occurs in dense stands several miles downstream. Monitoring annually for weeds is important to riparian vegetation vigor and viability.

Soils Description: Soils are derived from alluvium and vary within the PCA. Soils sampled have a mineral horizon with texture of sandy clay loam and silty clay loam over alluvium. Mapped soil units within the riparian zone are delineated as Cryaquoll – Typic Cryaqueut complex, 1 – 5 percent slope; and Hourglass – Wander complex, 5 – 30 percent slope; and Teedown loam, 0 – 20 percent slope. Hourglass is classified as fine-loamy, mixed, superactive Typic Argicryoll; and Wander is classified as loamy-skeletal, mixed, superactive Typic Argicryoll. Teedown is classified as fine, smectitic Pachic Argicryolls. (USDA, NRCS 2002)

Restoration Potential: Restoration opportunities include weed eradication and monitoring. Referring to such resources as the Nature Conservancy’s web site on invasive species (<http://tncweeds.ucdavis.edu/index.html>) or <http://www.invasivespecies.gov/> may provide some assistance with control and eradication of non-native species. If weeds are removed, it is beneficial to plant bare soils with native plants. It is beneficial to revegetate recent road cuts as construction takes place, to reduce sedimentation to the river. The Colorado Natural Areas Program has a native plant revegetation guide available on their website at <http://www.parks.state.co.us/cnap/indes.html> which may provide helpful information about using native plants for revegetation projects.



Geyer’s willow – mountain willow dominated wetland at West Dolores River at Dunton PCA. Photograph © CNHP, 2004.

Wetland Functional Assessment for the West Dolores River at Dunton PCA:

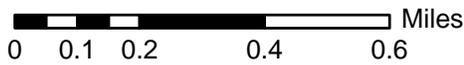
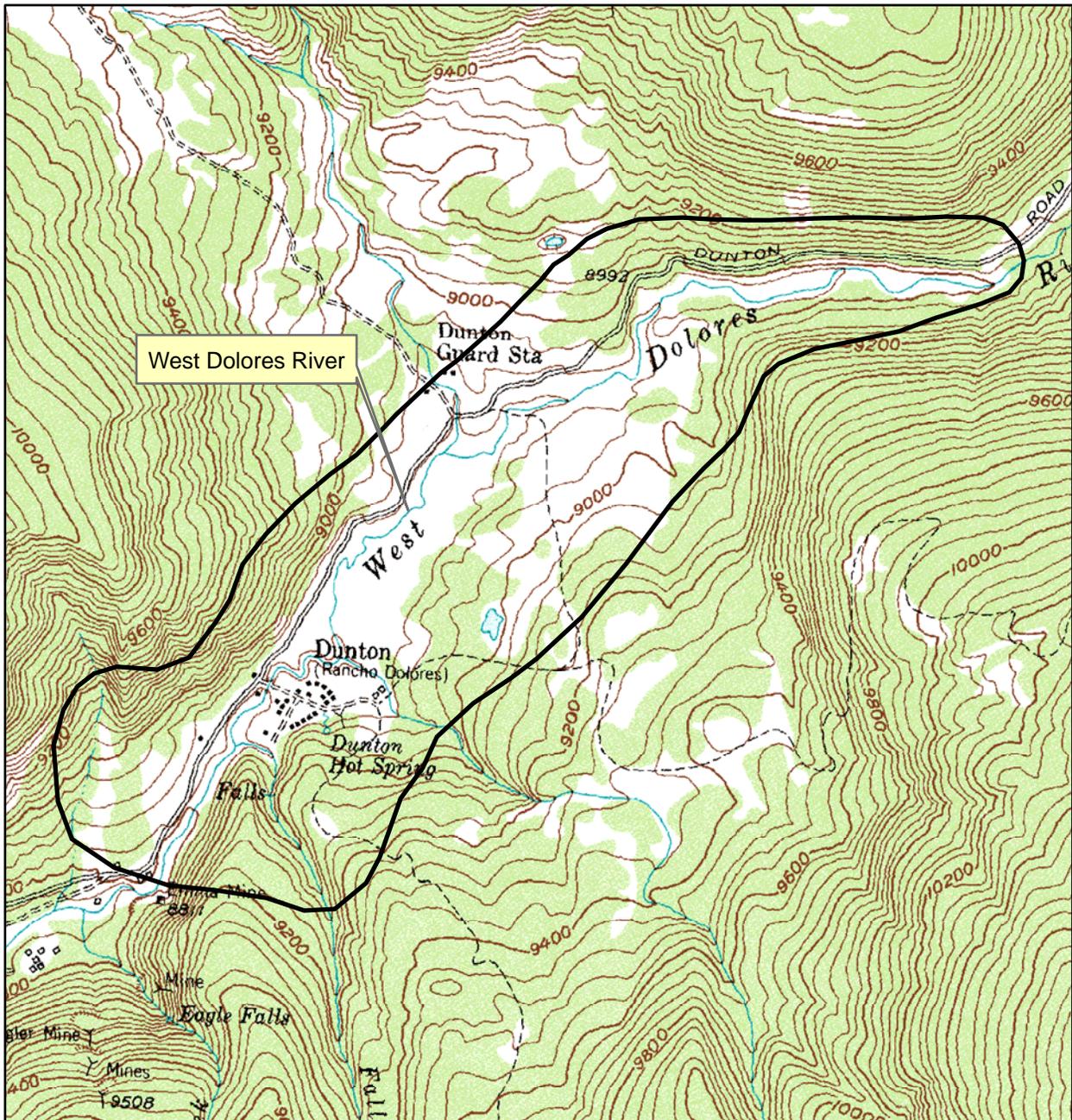
Proposed HGM Class: Riverine **Subclass:** R2/R3

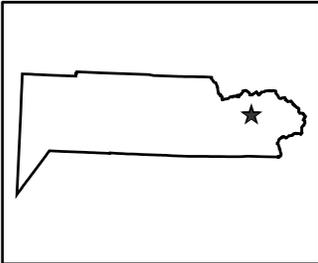
Cowardin System: Palustrine

CNHP's Wetland Classification: *Salix geyeriana* – *Salix monticola* / Mesic Forbs

Table 42. Wetland functional assessment for the montane riverine shrubland at West Dolores River at Dunton PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	The wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	High	Beaver ponds and abandoned beaver ponds present. Back water channels and uneven land surface. Dense woody vegetation.
Sediment/Shoreline Stabilization	High	Dense woody vegetation anchors shoreline.
Groundwater Discharge/Recharge	Yes	Hot springs discharge in the area. Recharge occurs within coarse alluvium.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Detritus present. Open areas contain vigorous stands of herbaceous plants.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Beaver ponds and dense willows trap sediments. Large, vigorous willow dominated wetland occurs on gentle gradient.
Biological Functions		
Habitat Diversity	Low	One Cowardin class present (scrub shrub).
General Wildlife Habitat	Moderate	Diverse vegetation species for wildlife habitat. Deer sign, songbirds present. Habitat is near road, and cattle graze in the area.
General Fish/Aquatic Habitat	Moderate	Good fish habitat e.g., overhanging vegetation, pools, riffles.
Production Export/Food Chain Support	High	Overhanging vegetation, large area, signs of flushing flows (breached beaver dams; trapped debris 1 meter above ground)
Uniqueness	Moderate	The site supports a G3 community and an S3B bird.



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Map 16. West Dolores River at Dunton Potential Conservation Area, B3: High Biodiversity Significance

Barlow Creek Potential Conservation Area

Biodiversity Rank: B4. Moderate Biodiversity Significance. The site supports a globally vulnerable (G3S3) mountain willow / beaked sedge (*Salix monticola* / *Carex utriculata*) plant association in fair (C-ranked) condition.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The PCA is owned by the San Juan National Forest.

Management Urgency Rank: M4. Although the area is not currently threatened, management may be needed in the future to maintain the current quality of the element occurrence. Weed invasion and recreation use are the main threats to the PCA.

Location: Barlow Creek PCA is located in the northeast portion of Dolores County, surrounding Barlow Creek.

U.S.G.S. 7.5-min. quadrangles: Hermosa Peak

Legal Description: T40N R10W sections 23, 15, 9

Elevation: 9,800 – 10,400 ft.

Size: Approximately 520 acres

Redders, 2003, Community Type: *Salix monticola* / Mesic forbs willow shrubland; *Carex utriculata* herbaceous type

General Description: Barlow Creek is a moderately steep, subalpine stream with little sinuosity. A four-wheel drive road is located adjacent to the creek. The headwaters originate on the north slope of Hermosa Peak, a prominent peak on the divide between the Dolores River and Hermosa Creek drainages. Barlow Creek Valley is narrow, broadening occasionally where the channel braids and dense stands of sedges occur on gentle gradients. Otherwise, willows line the stream in dense carrs in narrow to wide thickets. A rock impoundment is downstream of the site, where rocks were apparently used from the Flattop Mountain slide adjacent the creek. The impoundment creates a small water body, Barlow Lake, where water appears to flow through easily. Beaver dams account for the remainder of the ponds located throughout the floodplain. Beaked sedge (*Carex utriculata*) dominates stands adjacent to active beaver dams with mountain willow (*Salix monticola*) dominating the dense shrub canopy. The remaining riparian area is dominated by Drummond's willow (*Salix drummondiana*) and wolf willow (*Salix wolfii*) in the shrub layer. Graminoids in the herbaceous layer are dominated by small winged sedge (*Carex microptera*), water sedge (*Carex aquatilis*), smallflowered woodrush (*Luzula parviflora*), fowl mannagrass (*Glyceria striata*), bluejoint reedgrass (*Calamagrostis canadensis*), tufted hairgrass (*Deschampsia caespitosa*), smooth brome (*Bromus inermis*), timothy (*Phleum pratense*), field horsetail (*Equisetum arvense*). Common mesic forb examples are heartleaf bittercress (*Cardamine cordifolia*), tall fringed blue bells (*Mertensia ciliata*), Porter's licorice root (*Ligusticum porteri*) and several others in the herbaceous layer.

Soils in the riparian area have a shallow mineral horizon over alluvium, and vary throughout the PCA. Soils are saturated silty clay in the emergent wetland area where sediment is building due to beaver activity and willow establishment.

The area surrounding Barlow Creek is used for recreation. The four-wheel drive road is popular for ATV and motorcycle use in the summer and snow machine travel in winter. CNHP biologists reported high impacts from sheep grazing in 1993 (CNHP 2005) and hypothesized this impact to be detrimental to the long-term survival of the plant association. During this survey it

was observed that grazing practices have apparently improved since 1993, evidenced by the recovery of beaked sedge plant association's vigor. Exotics are present in the understory, though none dominate the herbaceous layer within the wetland area.

Biodiversity Rank Justification and Comments: The site supports the globally vulnerable (G3S3) mountain willow/beaked sedge (*Salix monticola* / *Carex utriculata*) plant association in fair (C-ranked) condition. Carsey *et al.* (2003) state that *Salix monticola* dominated plant associations appear to be long-lived and stable. They occur on mesic sites that support a diversity of graminoids and forbs, similar to the herbaceous layer at Barlow Creek PCA. *Salix monticola* is typically an indicator that the water table does not drop below 1 meter (3 feet).

Table 43. Natural Heritage element occurrences at Barlow Creek PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Salix monticola</i> / <i>Carex utriculata</i>	Mountain willow / beaked sedge	G3	S3		C

Boundary Justification: The boundary incorporates a portion of the immediate upper watershed to allow hydrologic processes such as seasonal flooding and sediment deposition to operate unimpeded. It should be noted that the hydrologic processes necessary to the elements are not fully contained by the PCA boundaries.

Protection Comments: The San Juan National Forest owns the PCA.

Management Comments: Possible threats to the occurrence include expansion of non-natives e.g., common dandelion (*Taraxacum officinale*) and Canada thistle (*Cirsium arvense*) noted in the area. High impact recreation may encourage weed expansion and cause excessive erosion from the adjacent road (ATV; motorcycle; snow machines). Grazing impacts have improved since 1993 (CNHP 2005).

Soils Description: Soils sampled within the emergent wetlands are saturated silty clay, with very little organic matter. Soils in the riparian area are derived from alluvium and vary with geomorphic position within the PCA. Mapped soils units in the PCA wetlands are classified as a complex of Cryaquolls and Typic Cryaquents (USDA, NRCS 2002).

Restoration Potential: Restoration opportunities may include monitoring recreation impacts (i.e. erosion, bank destabilization adjacent to the road) and weed invasion. Grazing impacts have improved and the wetland appears to be on an upward trend toward functioning at its potential. Referring to such resources as the Nature Conservancy's web site on invasive species (<http://tncweeds.ucdavis.edu/index.html>) or <http://www.invasivespecies.gov/> may provide some assistance with control and eradication of non-native species. The Colorado Natural Areas Program has a native plant revegetation guide available on their website at <http://www.parks.state.co.us/cnap/index.html> which may provide helpful information about using native plants for revegetation projects.

Wetland Functional Assessment for the Barlow Creek PCA:

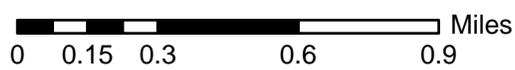
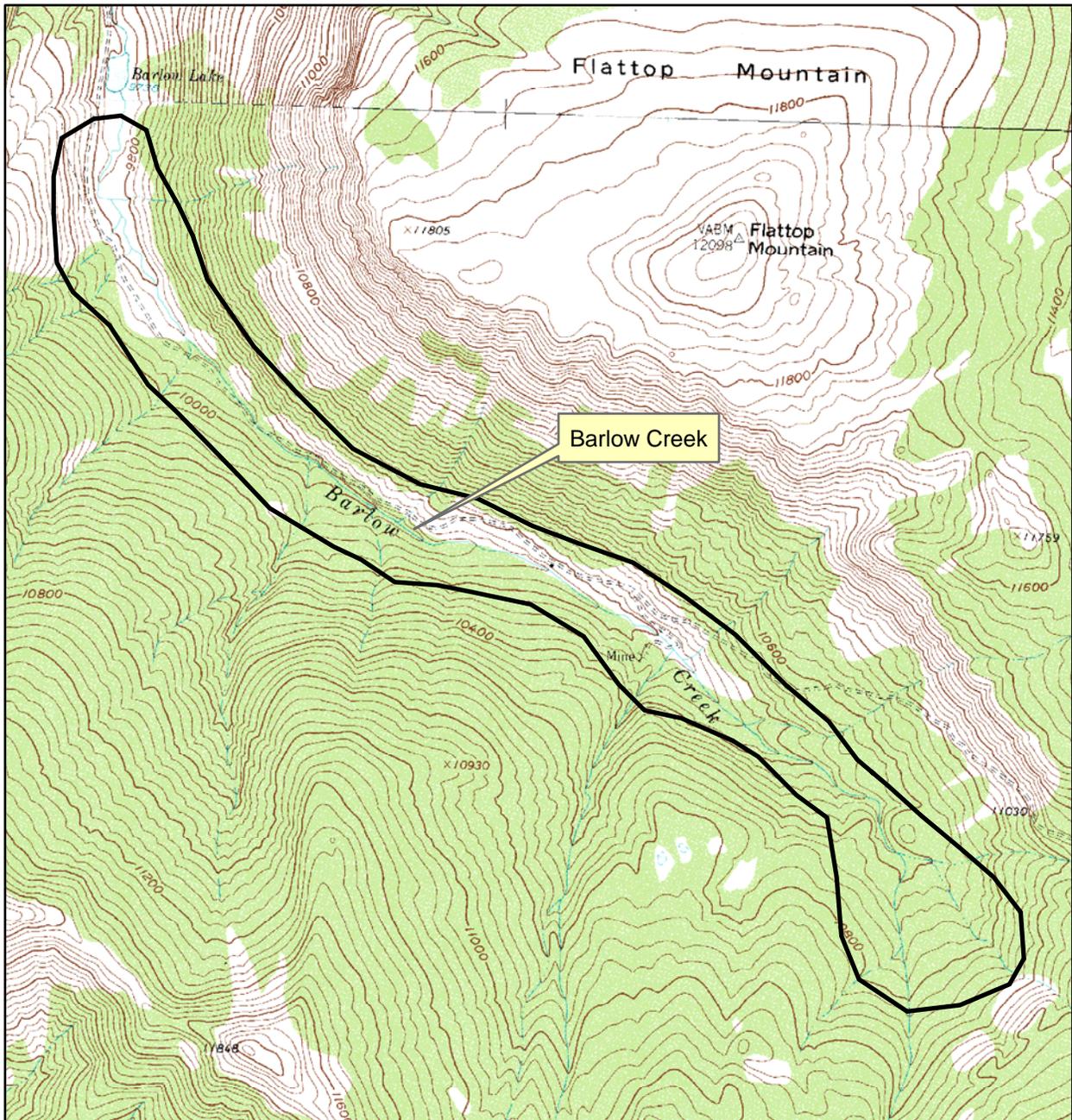
Proposed HGM Class: Riverine **Subclass:** R2/R3

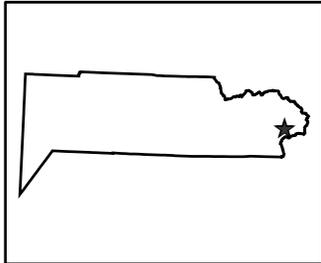
Cowardin System: Palustrine, scrub shrub and emergent

CNHP's Wetland Classification: *Salix monticola* / *Carex utriculata* montane riparian shrubland

Table 44. Wetland functional assessment for the montane riparian shrubland wetlands at Barlow Creek PCA.

Function	Rating	Comments
Overall Functional Integrity	Below potential	The wetland appears to be functioning below its potential due to impacts caused by recreation and the road adjacent to the wetland. The wetland condition appears to be in an upward trend as compared with past element occurrence records.
Hydrological Functions		
Flood Attenuation and Storage	High	Beaver dams, dense shrublands and dense herbaceous understory in a moderately broad floodplain.
Sediment/Shoreline Stabilization	High	Dense woody vegetation, natural erosion occurring. Eroding banks confined to localized areas due to road and recreation impact.
Groundwater Discharge/ Recharge	No	Clayey soils may inhibit recharge, however, water flowing over coarse alluvial material upstream of beaver ponds may recharge groundwater.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Dense native understory, no excessive impacts to the soil observed.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Sediment trapping is occurring. The PCA contains a dense cover of native hydrophytes in the herbaceous understory.
Biological Functions		
Habitat Diversity	Moderate	Two Cowardin classes present. Scrub shrub and emergent.
General Wildlife Habitat	High	Wildlife sign; birds; wildlife habitat.
General Fish/Aquatic Habitat	High	Fish habitat present (pools, riffles and overhanging vegetation). Impoundment inhibits local migration.
Production Export/Food Chain Support	Low	Historic rock impoundment downstream impedes this function
Uniqueness	Low	PCA supports G3 plant community that is common in the County.



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Map 17. Barlow Creek Potential Conservation Area, B4: Moderate Biodiversity Significance

Dolores River at Peterson Slide Potential Conservation Area

Biodiversity Rank: B4. Moderate Biodiversity Significance. The site supports the globally vulnerable (G3S3) narrowleaf cottonwood / thinleaf alder (*Populus angustifolia* / *Alnus incana*) plant association in fair (C-ranked) condition; and the globally vulnerable (G3S3) thinleaf alder – Drummond’s willow (*Alnus incana* – *Salix drummondiana*) shrubland in fair (C-ranked) condition.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The site is located in the San Juan National Forest.

Management Urgency Rank: M2. New management action may be needed within 5 years to prevent the loss and further degradation of the element occurrences in the PCA. Impacts from recreation and historic mining are the main threats.

Location: The Dolores River at Peterson Slide PCA is located along the Dolores River north of the town of Rico in Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Rico

Legal Description: T40N R11W Section 12, 13, 23, 24, 25

Elevation: 8,900 – 9,000 ft.

Size: Approximately 296 acres

Redders, 2003, Community Type: *Salix drummondiana*/*Alnus incana* willow shrubland; *Populus angustifolia*/*Alnus incana* deciduous forest

General Description: The Dolores River descends from the high elevations of Lizardhead Pass in the San Juan Mountains, in a southward direction through alpine to montane ecosystems. The Dolores River at Peterson Slide flows through a moderately wide valley with steep sparsely vegetated uplands. The stream channel is slightly sinuous to straight due to the confines of the topography, gradient, and geology. Surface geology in the PCA is composed of landslide deposits, which are locally either quaternary glacial rock (talus etc.) or colluvial material (Tweto 1970). This is evidenced by the roughness of the land surface and composition of the piles (cobbles, boulders, gravels, and alluvium).

The landslide located adjacent to the river affects the channel by creating braids and active point bars dominated by early successional riparian shrublands. Narrowleaf cottonwood (*Populus angustifolia*) and willows (*Salix* spp.) are regenerating on the immediate floodplain, point bars, and behind active beaver dams that are trapping sediments. Several immature Colorado blue spruce (*Picea pungens*) were documented on the floodplain. Typically Colorado blue spruce is considered a climax riparian species that does not withstand intense flooding, it is likely that this portion of the Dolores River does not experience intense flooding. The dominant plant association in this area is thinleaf alder – Drummond’s willow (*Alnus incana* – *Salix drummondiana*). There are fringes of mesic graminoids along the banks such as beaked sedge (*Carex utriculata*), water sedge (*Carex aquatilis*), swordleaf rush (*Juncus ensifolius*), Tracy’s rush (*Juncus tracyi*), and field horsetail (*Equisetum arvense*). The secondary floodplain has an open to closed canopy of mountain willow (*Salix monticola*), Drummond’s willow (*S. drummondiana*) and thinleaf alder (*Alnus incana*) with a mixed understory of mesic graminoids, mesic forbs, upland forbs, exotics and hay grasses.

The PCA also contains a cottonwood gallery in the willow mosaic dominated by narrowleaf cottonwood / thinleaf alder (*Populus angustifolia* / *Alnus incana*) plant association.

There is a wide age class represented here, with sapling, pole, mature and decadent cottonwoods. Other associated shrubs are Drummond's willow and mountain willow with shrubby cinquefoil (*Dasiphora floribunda*) on terraces. Uplands have been heavily disturbed in the past from mining activity. CNHP ecologists first visited the cottonwood gallery in 1993 (CNHP 2005) assessing its viability as fair and in 2004 the viability has remained unchanged from the fair ranking.

Biodiversity Rank Justification and Comments: The site supports the globally vulnerable (G3S3) *Populus angustifolia* / *Alnus incana* plant association in fair (C-ranked) condition. This plant association is indicative of an active floodplain. This plant association is considered mid-seral. With time and without flooding disturbance stands may become dominated by invading conifers as was observed with *Picea pungens* saplings on the floodplain (Carsey *et al.* 2003). The globally vulnerable (G3S3) *Alnus incana* – *Salix drummondiana* shrubland was documented in fair (C-ranked) condition. This plant community is an early- to mid-seral association that is restricted to active stream channels. Both species are prolific seed producers that are the first to colonize stream banks and floodplains. These riparian shrubs will continue to dominate due to the ability of *Alnus incana* to fix atmospheric nitrogen and *Salix drummondiana* taking advantage of the now nitrogen-rich soils (Carsey *et al.* 2003).

Table 45. Natural Heritage element occurrences at Dolores River at Peterson Slide PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Populus angustifolia</i> / <i>Alnus incana</i>	Narrowleaf cottonwood / thinleaf alder	G3	S3		C
<i>Alnus incana</i> – <i>Salix drummondiana</i>	Thinleaf alder / Drummond willow	G3	S3		C

Boundary Justification: The boundary encompasses the element occurrences as well as a projected buffer to identify the ecological and hydrologic processes that are required to sustain the elements. Natural fluvial activity such as flooding events and sediment deposition contribute to the perpetuity of riparian systems, such as the cottonwood system (Hansen *et al.* 1995; TNC 1996). The boundaries also provide a small buffer from nearby social trails, the highway and unofficial roads/campsites where surface runoff may contribute excess nutrients, sediment and weed invasion. It should be noted that the hydrologic processes necessary to the element are not fully contained by the PCA boundaries.

Protection Comments: The riparian area is owned by the San Juan National Forest.

Management Comments: Weed invasion, soil compaction and erosion, and in some cases littering, is taking place in localized areas where social trails, unofficial campsites and unofficial parking areas occur between Hwy 145 and the river. The dense shrublands offer some intrinsic protection. Exotics include common dandelion (*Taraxacum officinale*), smooth brome (*Bromus inermis*) and others in low canopy cover.

Soils Description: Soils are derived from alluvium and vary according with geomorphic position. Beaver dams trap sediments that are composed of mineral horizons with little organic matter, otherwise soils are very shallow mineral soils and alluvium. Mapped soil units within the riparian area in the PCA are: Rubbleland, Cryaquolls and Typic Cryaquent (USDA, NRCS 2002).

Restoration Potential: Wetlands and riparian areas are functioning below potential in the PCA. The functions can improve with management of recreation (control soil disturbance) and lessening of road maintenance impacts. The Colorado Natural Areas Program has a native plant revegetation guide available on their website at <http://www.parks.state.co.us/cnap/index.html> which may provide helpful information about using native plants for revegetation projects.

Wetland Functional Assessment for the Dolores River at Peterson Slide PCA:

Proposed HGM Class: Riverine **Subclass:** R2R3

Cowardin System: Palustrine

CNHP's Wetland Classification: *Alnus incana* - *Salix drummondiana* montane riparian shrubland

Table 46. Wetland functional assessment for the montane riparian shrubland at Dolores River at Peterson Slide PCA.

Function	Rating	Comments
Overall Functional Integrity	Below Potential	The functions can likely improve with management of recreation (control soil disturbance) and lessening of road maintenance impacts.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Soils are alluvial, land surface is rough e.g., coarse alluvium, sediments, active point bars, vegetated point bars. Shrublands present within the floodplain.
Sediment/Shoreline Stabilization	Moderate	Dense shrub layer anchors shoreline, recreation and road maintenance causing unnecessary erosion, point bars with regenerating shrubs and trees.
Groundwater Discharge/ Recharge	Yes	Beaver activity, back water channels, and coarse alluvial soils indicate recharge.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Expected amounts of detritus on soils. Vigorous vegetative growth. Regenerating woody species. Human-caused disturbance to the soil is confined to localized areas.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Understory can be sparse in places, where natives are present as well as hay grasses and exotics, fringes of hydrophytes, sediment trapping is evident.
Biological Functions		
Habitat Diversity	Moderate	Two Cowardin classes present: scrub shrub and forested.
General Wildlife Habitat	Moderate	Wildlife signs (deer, beaver), songbirds. There is a highway nearby the wildlife habitat.
General Fish/Aquatic Habitat	Moderate	Fish habitat present e.g., pools, riffles and overhanging vegetation.
Production Export/Food Chain Support	High	Overhanging vegetation, signs of flushing flows, large area (>20 acres vegetated).
Uniqueness	Low	This portion of the PCA supports a common wetland type.

Wetland Functional Assessment for the Dolores River at Peterson Slide PCA:

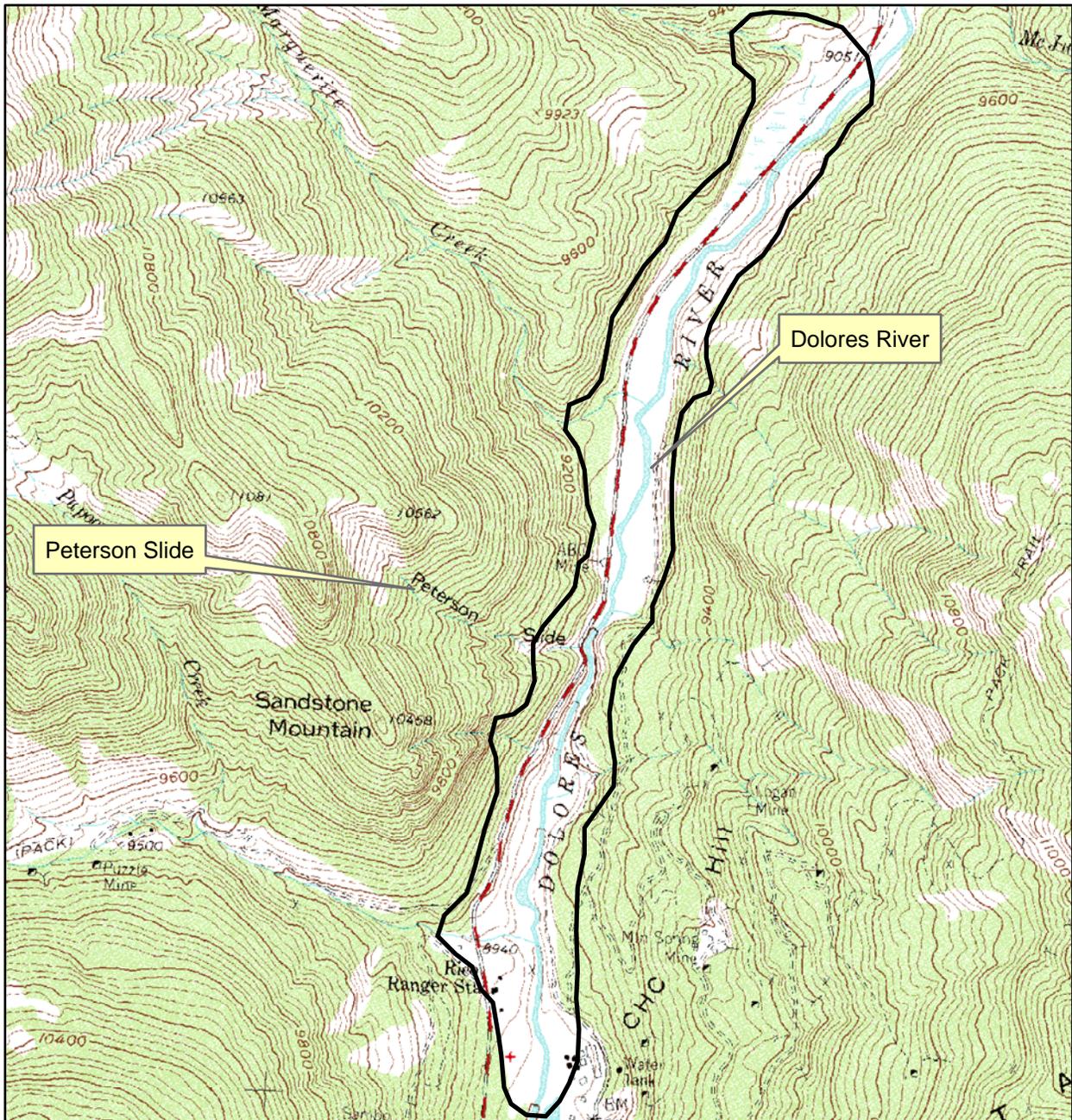
Proposed HGM Class: Riverine **Subclass:** R2R3

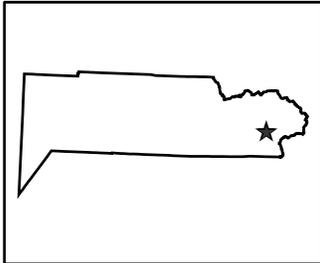
Cowardin System: Palustrine

CNHP's Wetland Classification: *Populus angustifolia* / *Alnus incana*

Table 47. Wetland functional assessment for the riparian woodland at Dolores River at Peterson Slide PCA.

Function	Rating	Comments
Overall Functional Integrity	Below Potential	This riparian woodland appears to be functioning below its potential due to fair condition and the landscape context (historic mining; settling ponds downstream; highway adjacent).
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Limited floodplain, channel enclosed in steep canyon, opening out occasionally, understory sparse, some point bar and island formation with vegetation establishment.
Sediment/Shoreline Stabilization	Moderate	Woody species anchoring banks, point bars forming with cottonwood regeneration, and conifers encroaching the riparian zone. Herbaceous understory is sparse and there is disturbance to the system by mining restoration activities, especially downstream.
Groundwater Discharge/Recharge	Yes	Reach is moderately steep in a straight channel with few back flow channels, however recharge may occur where water flows over coarse alluvial soils.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Localized impacts to the soil, however, the area appears to be functioning with expected amounts of detritus, alluvium and a shallow mineral soil horizon.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Sediment trapping evident. Very sparse herbaceous understory, moderately steep gradient, some exotics present. Dense, vigorous woody vegetation.
Biological Functions		
Habitat Diversity	Moderate	Two Cowardin classes within PCA: scrub shrub; forested.
General Wildlife Habitat	Moderate	Wildlife sign, highway adjacent, upstream from town.
General Fish/Aquatic Habitat	Moderate	Fish habitat available. Historic mining activity adjacent to the PCA may affect water quality, however, restoration activities are taking place (settling ponds downstream).
Production Export/Food Chain Support	Moderate	Signs of flushing flows, some sandy soils present. Moderate amounts of overhanging vegetation.
Uniqueness	Low	This portion of the PCA supports a common wetland type and plant association.



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Map 18. Dolores River at Peterson Slide Potential Conservation Area, B4: Moderate Biodiversity Significance

Fish Creek at Dunn Peak Potential Conservation Area

Biodiversity Rank: B4. Moderate biodiversity significance. The site supports the apparently globally secure (G4) heartleaf bittercress – tall fringed bluebells – arrowleaf ragwort (*Cardamine cordifolia* – *Mertensia ciliata* – *Senecio triangularis*) in excellent condition (A-ranked).

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The PCA is within the San Juan National Forest.

Management Urgency Rank: M5. No serious management needs are known or have been anticipated at the PCA.

Location: The Fish Creek at Dunn Peak PCA surrounds the headwater main stem of Fish Creek in the north east part of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Dolores Peak

Legal Description: T41N R11W Section 5, 6, 7, 8

Elevation: 10,800 – 11,600 ft. **Size:** Approximately 197 acres.

Redders, 2003, Community Type: *Cardamine cordifolia* – *Mertensia ciliata* – *Senecio triangularis* herbaceous type

General Description: Fish Creek at Dunn Peak PCA is located at the headwaters of Fish Creek situated between Dunn Peak and Middle Peak of the San Miguel Mountains. The north part of the PCA is within the Lizardhead Wilderness and the south part is within the San Juan National Forest. The first order stream flows south through a narrow subalpine valley. The valley opens wide enough to support a wet meadow dominated by a high percentage of forbs (94% - 100%) including heartleaf bittercress (*Cardamine cordifolia*), subalpine larkspur (*Delphinium barbeyi*), tall fringed bluebells (*Mertensia ciliata*), and arrowleaf ragwort (*Senecio triangularis*). The PCA is located within an isolated high elevation area where the wetland is little impacted evidenced by its excellent condition. The PCA is located near timberline where the surrounding area is dominated by rocky slopes and Engelmann spruce (*Picea engelmannii*) – subalpine fir (*Abies lasiocarpa*) forests. CNHP ecologists last observed the site in 1993 (CNHP 2005).

Biodiversity Rank Justification and Comments: The PCA supports an excellent (A-ranked) example of an apparently globally secure (G4/S4) heartleaf bittercress – tall fringed bluebells – arrowleaf ragwort (*Cardamine cordifolia* – *Mertensia ciliata* - *Senecio triangularis*) alpine wetland. This wetland type is an early-seral community that remains stable due to frequent fluvial disturbances that disallow conifers to establish (Carsey *et al.* 2003).

Table 48. Natural Heritage element occurrences at Fish Creek at Dunn Peak PCA.

Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Cardamine cordifolia</i> – <i>Mertensia ciliata</i> - <i>Senecio triangularis</i>	Heartleaf bittercress – tall fringed blue bells – arrowleaf ragwort	G4	S4		A

Boundary Justification: The boundary encompasses the element occurrence and immediate adjacent area to buffer hydrologic processes necessary to the viability of the element. It should be noted that the hydrologic processes necessary to the viability of the element are not fully contained by the PCA boundary.

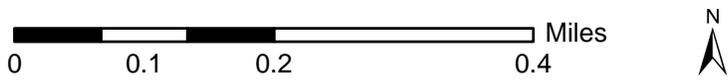
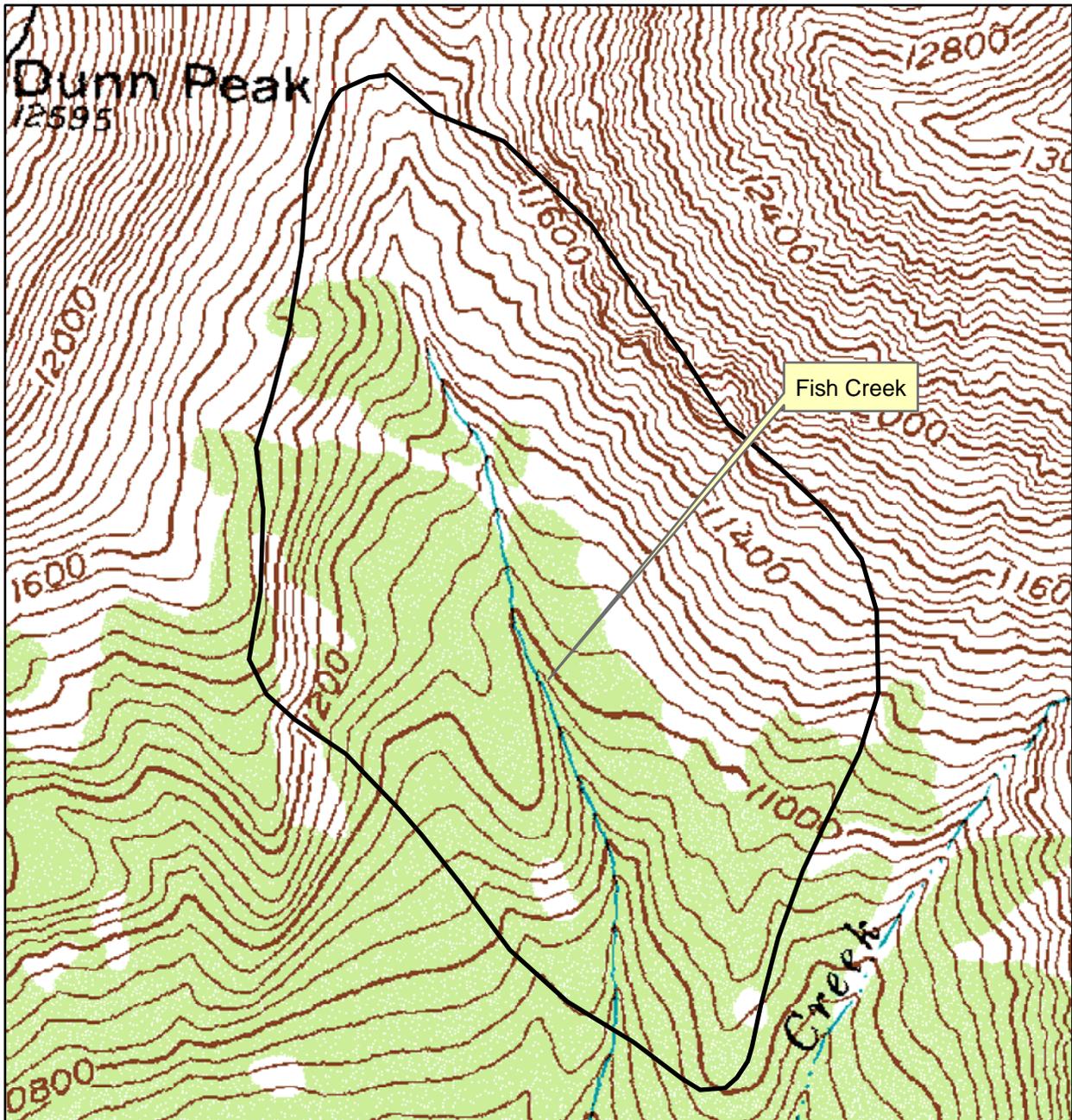
Protection Comments: The PCA is located within the San Juan National Forest and Lizardhead Wilderness.

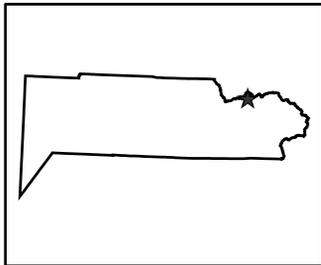
Management Comments: The PCA was recorded in excellent condition (1993) and there are very few threats to the area. Land use includes recreation where there are hunting camps located downstream of the site. Common dandelion (*Taraxacum officinale*) was located within the hunting camps, offsite from the PCA. Excessive grazing by sheep may threaten the integrity of the natural plant community by the eventual dominance of increaser species (Carsey *et al.* 2003).

Soils Description: Soils within the PCA are delineated as Scout silt loam, 30 – 60 percent slopes, and Rubbleland. Scout is classified as loamy-skeletal, mixed, superactive Typic Eutrocryepts. (USDA, NRCS 2002)

Restoration Potential: The wetland is in excellent condition and is apparently functioning as expected. More research is needed to update the information regarding the condition of the wetlands.

Wetland Functional Assessment for Fish Creek at Dunn Peak PCA: No wetland functional assessment was performed at this PCA. Wetland ecologists did not visit this site in 2004. CNHP ecologists last observed the PCA in 1993 (CNHP 2005).



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Map 19. Fish Creek at Dunn Peak Potential Conservation Area, B4: Moderate Biodiversity Significance

Glade Lake Potential Conservation Area

Biodiversity Rank: B4. Moderate biodiversity significance. The site supports a fair (C-ranked) occurrence of the globally vulnerable (G3S3) wooly sedge (*Carex pellita = lanuginosa*) herbaceous vegetation, and a fair (C-ranked) occurrence of the apparently globally secure (G3G5) imperiled in Colorado (S2?) awned sedge (*Carex atherodes*) herbaceous vegetation.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The site is within the San Juan National Forest.

Management Urgency Rank: M1. Management actions may be required within one year or the element occurrences could be lost or degraded. Grazing is the main threat to the vigor diverse native vegetation within the PCA.

Location: The Glade Lake PCA is located around the Glade Lake in central Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: The Glade

Legal Description: T41N R16W Section 32

Elevation: 8,300 ft **Size:** Approximately 252 acres.

Redders, 2003, Community Type: There are no community types that describe the element occurrences within this classification.

General Description: Glade Lake PCA is on a high, broad mountain plateau just south of The Glade in the San Juan National Forest. The Glade is an uplifted ridge of un-vegetated Mancos shale that extends along an east – west aspect. Recently, a fence was installed around Glade Lake in an effort to restore the vegetation after years of cattle grazing. Glade Lake is a spring-fed, supplemented with nominal precipitation, depression. There are rings or zones of vegetation that occur due to fluctuating water levels. The outermost zone is occupied by hay grasses (e.g., *Bromus inermis*, *Phleum pratense*) clustered field sedge (*Carex praegracilis*), slender beaked sedge (*Carex athrostachya*), foxtail barely (*Hordeum jubatum*), curvseed butterwort (*Ceratocephala orthoceras*), alpine spring beauty (*Claytonia megarhiza*), wild iris (*Iris missouriensis*), Scotch thistle (*Onopordum acanthium*) and various upland species. The next ring or draw-down zone is dominated by common spikerush (*Eleocharis palustris*) on the southeast side of the lake, and awned sedge (*Carex atherodes*) and wooly sedge (*Carex pellita*) on the north and west sides. Each sedge stand forms a solid swath or ring-shaped patch, the individual species not mixing, but occur as a mosaic along the outer edge of the open water. Weak mannagrass (*Torreyochloa pauciflora*) is in a mosaic with common spikerush and small patches of needle spikerush (*Eleocharis acicularis*). The open water contains aquatic species in the shallow parts and has at least two patches of cattail (*Typha latifolia*) in the deeper water. Aquatic species occupy the shallow water on the muddy soils. Water smartweed (*Persicaria amphibia*), water plantain (*Alisma triviale*), narrowleaf burreed (*Sparganium emersum*), great bladderwort (*Utricularia macrorhiza*), and buckbean (*Menyanthes trifoliata*) were documented. Soils in the draw-down zone are periodically saturated with a shallow horizon of mucky peat (hemic), over silty clay with dark chroma or oxidized root channels with gleyed clay underneath for at least 40cm. In 2004, waterfowl nests were noted such as American Coot (*Fulica americana*) and Mallard (*Anas platyrhynchos*).

The surrounding uplands are dominated by silver sagebrush (*Artemisia cana*). The slightly higher and drier areas are forested with ponderosa pine (*Pinus ponderosa*), pinyon pine (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*), and Rocky Mountain juniper (*Juniperus scopulorum*).

There is an historic mound or berm northwest of Glade Lake presumably utilized as a road access or drainage diversion that likely increased the size of Glade Lake. Currently, the berm appears to have no effect on present water levels. Cattle grazing dominates land use in the surrounding area.

Biodiversity Rank Justification and Comments: The site supports a fair (C-ranked) occurrence of the globally vulnerable (G3S3) woolly sedge (*Carex pellita = lanuginosa*) herbaceous vegetation. This plant association is characterized by nearly monotypic stands. It occurs in very wet conditions, generally at the saturated edge of the stream channel or in standing water as supported by the Glade Lake occurrence (Carsey *et al.* 2003). A fair (C-ranked) occurrence of the apparently globally secure (G3G5) imperiled in Colorado (S2?) awned sedge (*Carex atherodes*) herbaceous vegetation is an obligate wetlands species that is uncommon in Colorado and is Listed Endangered in four eastern states (USDA, NRCS. 2004).

Table 49. Natural Heritage element occurrences at Glade Lake PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Carex lanuginosa</i> herbaceous vegetation	Woolly sedge herbaceous vegetation	G3	S3		C
<i>Carex atherodes</i> herbaceous vegetation	Awned sedge herbaceous vegetation	G3G5	S2?		C

Boundary Justification: The boundary encompasses the element occurrences, the lake, and an immediate area buffering hydrological processes e.g., surface flow (sheetflow). The boundary provides a small buffer from nearby roads and open range where surface runoff may contribute excess nutrients, sediment and weed invasion. It should be noted that the hydrological processes necessary to the element are not fully contained by the PCA boundaries.

Protection Comments: The area is owned by the San Juan National Forest where there is a fenced enclosure to restrict grazing within the grazing allotment.

Management Comments: Threats to the PCA include cattle grazing impacts such as erosion, soil compaction and weed invasion. Both element occurrences require a consistent water table depth and heavy, cohesive clay soils, to remain viable (Carsey *et al.* 2003). Waterfowl utilize the wetland habitat, especially in spring. It is recommended to evaluate grazing rotation methods. Survey took place July 8, 2004, and was then revisited later due to vegetation phenology (it was not possible to identify some plant species). During the second visit (August 6, 2004), grazing had recently occurred within the fenced area, where previously 1 meter tall sedges were grazed to 1/3 meter. Trespass cattle were reported to the San Juan National Forest Dolores Ranger station.

Soils Description: Soils sampled in the wetland area are saturated, with a very shallow organic layer (5cm, hemic) in the surface horizon, 25cm of silty clay with oxidized root channels below this, and finally, 15+cm gleyed clay below this.

Restoration Potential: The fence surrounding Glade Lake provides restoration opportunities by enabling grazing rotation. Consideration given to waterfowl migration and nesting as well as vegetation response to grazing (Leonard *et al.* 1997) is recommended when considering rotation plans. The wetland area at Glade Lake is functioning at its potential.



Carex atherodes dominates the draw down zone at Glade Lake. Photograph © CNHP, 2004.

Wetland Functional Assessment for the Glade Lake PCA:

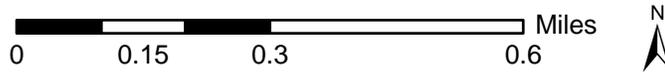
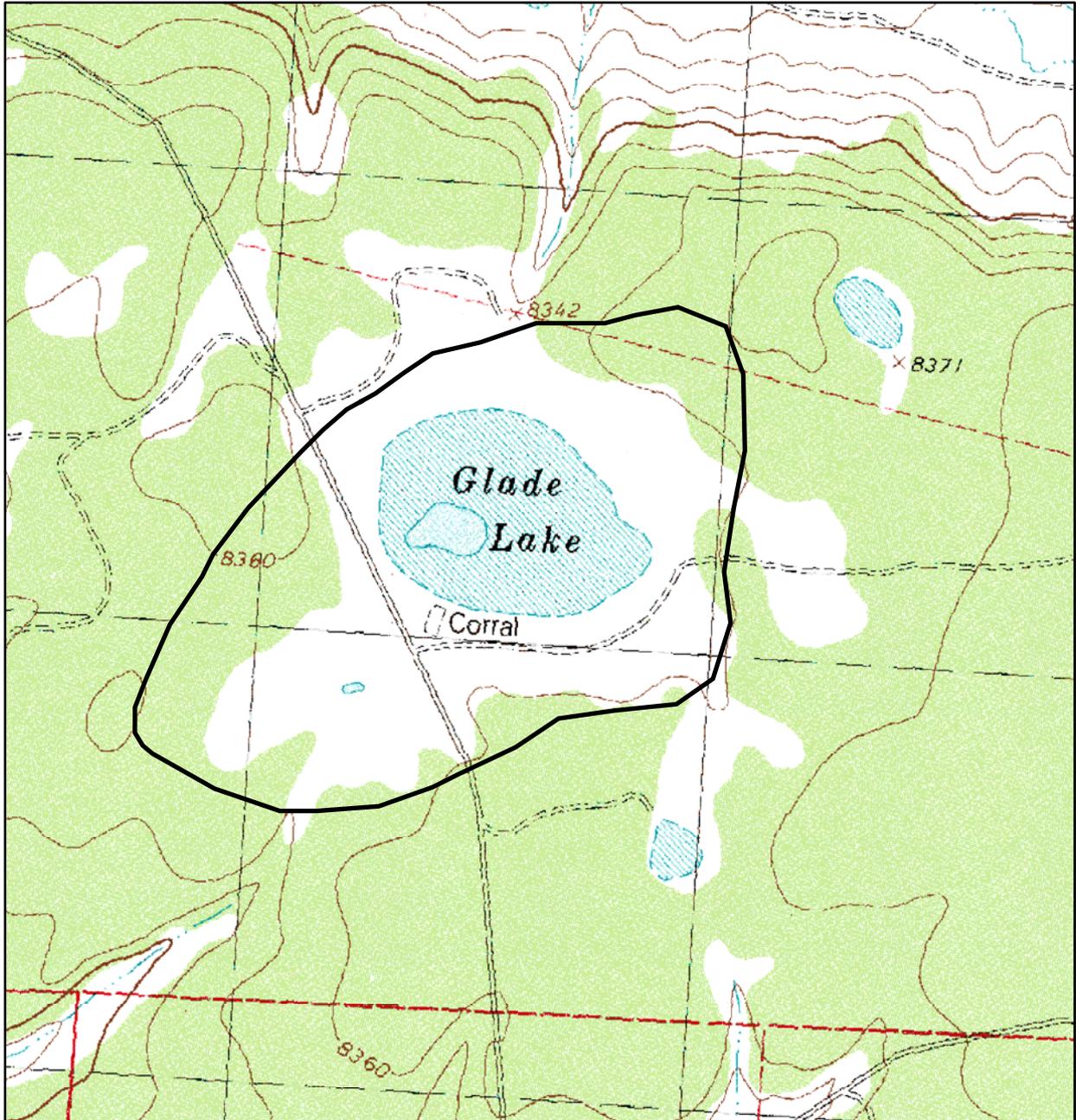
Proposed HGM Class: Depressional **Subclass:** D2

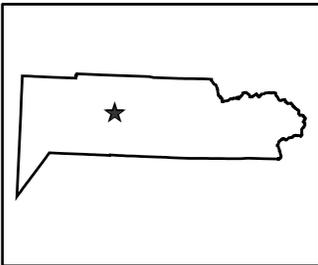
Cowardin System: Palustrine

CNHP's Wetland Classification: *Carex pellita* and *Carex atherodes* herbaceous vegetation

Table 50. Wetland functional assessment for the montane wet meadow wetland at Glade Lake PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	The wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	Low	Depressional wetland, ground water fed with some overland sheet flow from surrounding hillsides.
Sediment/Shoreline Stabilization	Moderate	Localized impacts to the shoreline from past cattle disturbance. Otherwise, dense herbaceous canopy cover.
Groundwater Discharge/Recharge	Yes	The lake is primarily groundwater fed.
Dynamic Surface Water Storage	High	Depression is greater than 5 acres with native, hydrophytic vegetation, an obvious draw down zone and clayey mineral horizons.
Biogeochemical Functions		
Elemental Cycling	Normal	Although some impacts to the soil were noted from cattle, the area is currently recovering. The native vegetation is dense, and soils have a shallow mucky layer, and expected amounts of detritus.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Dense native vegetation, aquatic vegetation present and a shallow layer of muck to peaty muck in the upper soil horizon. Weeds present and cattle impacts may negatively affect function by reducing above ground productivity.
Biological Functions		
Habitat Diversity	Low	One Cowardin class present
General Wildlife Habitat	Moderate	Waterfowl and nests present; deer sign. Forest road nearby and grazing allotments.
General Fish/Aquatic Habitat	Low	No inlet or outlet for fish. Snails were noted.
Production Export/Food Chain Support	N/A	No outlet.
Uniqueness	Moderate	Site supports a G3 plant community, unique in the County.



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Map 20. Glade Lake Potential Conservation Area, B4: Moderate Biodiversity Significance

Mavreeso Canyon -Cottonwood Creek PCA

Biodiversity Rank: B4. Moderate biodiversity significance. This PCA has an excellent occurrence (A ranked) and a good occurrence (B ranked) of a plant that is very rare (S1) in Colorado.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The PCA is within the San Juan National Forest.

Management Urgency Rank: M3. Weed control and monitoring of grazing and recreational impacts would help to maintain the quality of the riparian area that supports the rare plants.

Location: Mavreeso Creek-Cottonwood Canyon PCA is located in Dolores County, approximately 16 miles west of Rico. Access the PCA from Hwy 145 about 13 miles north of Dolores. Travel north on FR 535/West Dolores River Road 5 miles, then northwest on FR 532 about 1 mile.

U.S.G.S. 7.5-minute quadrangle: Nipple Mountain

Legal Description: T39N R13W, Sections 5 – 8;
T39N R14W, Section 1;
T40N R13W, Sections 30, 31;
T40N R14W, Sections 25, 36

Elevation: 7,700 to 8,600 feet.

Size: Approximately 747 acres

General Description: This PCA within the San Juan National Forest lies in a narrow valley formed by lower Mavreeso Creek and upper Cottonwood Creek and their associated floodplains.

Mavreeso Creek is a tributary to Cottonwood Creek. Just above the Cottonwood Guard Station, a trail follows the creek closely for about a mile before it climbs the slope above the creek and continues northeast atop a hill. Mavreeso Canyon is narrower and shadier than the canyon formed by Cottonwood Creek downstream, and provides excellent habitat for the state-rare King's clover (*Trifolium kingii*). The species occurs along both sides of the creek in moist, level areas, and especially along a small side drainage. Species associated with the King's clover occurrence include an overstory of narrowleaf cottonwood (*Populus angustifolia*), ponderosa pine (*Pinus ponderosa*), and aspen (*Populus tremuloides*), and an understory comprised of red osier dogwood (*Cornus sericea*), mountain snowberry (*Symphoricarpos oreophilus*), western sweetroot (*Osmorhiza occidentalis*), golden banner (*Thermopsis montana*), osha (*Ligusticum porteri*), and cutleaf coneflower (*Rudbeckia laciniata*). The riparian corridor along Mavreeso Creek is in good condition, with a combination of narrowleaf cottonwood, aspen, and Douglas fir (*Pseudotsuga menziesii*), and an understory comprised of black chokeberry (*Prunus virginiana* var. *melanocarpa*), red osier dogwood, twinberry honeysuckle (*Distegia involucrata* var. *involucrata*), thinleaf alder (*Alnus incana* ssp. *tenuifolia*), and mountain snowberry. The more xeric fringes of the riparian zone support ponderosa pine and Gambel oak (*Quercus gambelii*). Additional forb species associated with the riparian community include subalpine larkspur (*Delphinium barbeyi*), Canadian white violet (*Viola canada*), hookedspur violet (*Viola adunca*), orange sneezeweed (*Dugaldia hoopsii*), and western red columbine (*Aquilegia elegantula*).

Upland meadow areas within parts of Mavreeso Canyon support a variety of wildflowers. Species noted from a June 2004 site visit include mule-ears (*Wyethia x magna*), Rocky Mountain iris (*Iris missouriensis*), alsike clover (*Trifolium hybridum*), blue flax (*Linum lewisii*), black

medic (*Medicago lupulina*), Rocky Mountain groundsel (*Packera strepethanthifolia*), twolobe larkspur (*Delphinium nuttallianum*), and tailcup lupine (*Lupinus caudatus*).

Cottonwood Creek, in the lower portion of the PCA, is a tributary to the Dolores River. It is generally wider, and its banks tend to be drier and less shaded than Mavreeso Creek. Its riparian corridor runs parallel with and close to well-traveled Forest Service Road 532 on the north bank of the creek. A few shaded, flat, wet areas along Cottonwood Creek provide habitat for small populations of King’s clover. Narrowleaf cottonwood dominates this forested region, with an understory of twinberry honeysuckle, cutleaf coneflower, golden banner, red clover (*Trifolium pratense*), starry false Solomon seal (*Maianthemum stellatum*), feathery false Solomon seal (*Maianthemum racemosum* var. *amplexicaule*), osha, and wild mountain parsley (*Pseudocymopterus montanus*) are associated species. King’s clover is often found mixed with the other *Trifolium* species in the locality.

Biodiversity Rank Justification and Comments: The Mavreeso Creek-Cottonwood Canyon PCA supports excellent (A ranked) and good (B ranked) occurrences of King’s clover, a plant that is globally common, but very rare (S1) in Colorado. The species is likely present all along both creeks mentioned, in suitable habitat (level, moist, shady); however, this habitat is fairly scarce along the lower portion of the PCA. The larger population in Mavreeso Canyon is estimated to be over 1000 plants; the smaller population along Cottonwood Creek is roughly 100 plants.

Table 51. Natural Heritage element occurrences within Mavreeso Canyon - Cottonwood Creek PCA.

Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plants					
<i>Trifolium kingii</i>	King’s clover	G5	S1		A
<i>Trifolium kingii</i>	King’s clover	G5	S1		B

*EO=Element Occurrence. Multiple listings represent separate locations.

Boundary Justification: The boundary surrounds the riparian areas of Mavreeso Canyon and Cottonwood Creek where King’s clover was found, as well as the area between the two occurrences, allowing for expansion of the populations.

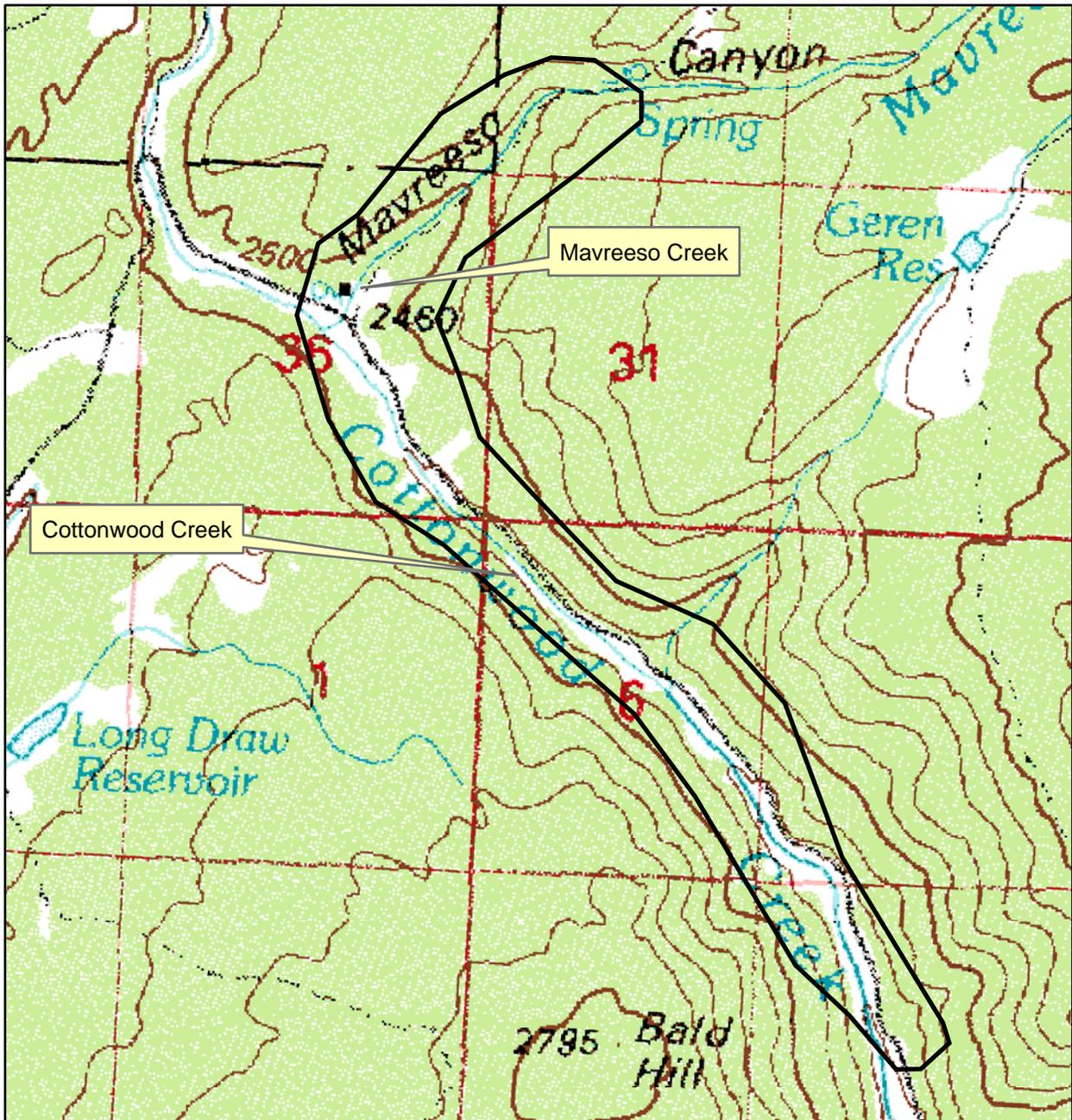
Protection Comments: The PCA is almost entirely within San Juan National Forest. There is a small 40 acre parcel of BLM land partially included in the northern part of the site, and a large area of private land abuts the PCA on the north. Development pressure in the local area may influence land use decisions on the private lands in the future.

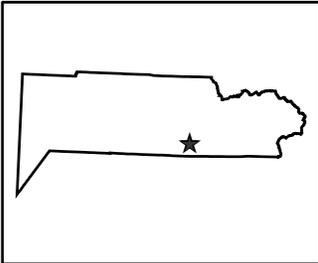
Management Comments: In Cottonwood Canyon the occurrence of King’s clover is found near the forest road, but on the opposite side of the creek. Some exotic species are found along the creek, likely introduced by road travel on the Forest Service roads, and other weed problems are known in the surrounding area. No exotic species were observed in the Mavreeso Creek riparian area, other than common dandelion (*Taraxacum officinale*). Adjacent upland areas showed impacts from cattle grazing and horse travel. Development on adjacent private lands and road improvements could impact the riparian communities. Population in the area is increasing, and recreation pressure may also increase.

Restoration Potential: Restoration opportunity for the wetlands occurring along Cottonwood Creek is to improve grazing practices on the adjacent uplands and within the riparian area.

Beaver activity on Cottonwood Creek has enhanced wetland function and size, however, the road and adjacent hill slope constricts any lateral movement of the wetlands and creek. Water in the beaver ponds is currently approaching the road, causing a possible management issue. The riparian area in Mavreeso Canyon is functioning as expected.

Wetland Functional Assessment: Although CNHP wetland ecologists visited the site in 2004, a functional assessment was not performed due to the lack of wetland element occurrences.



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Map 21. Mavreeso Canyon-Cottonwood Creek Potential Conservation Area, B4:
 Moderate Biodiversity Significance

Navajo Lake Trail Potential Conservation Area

Biodiversity Rank: B4: Moderate biodiversity significance. The PCA supports a good occurrence of a plant that is very rare in Colorado (S1) and an excellent occurrence of a common willow community.

Protection Urgency Rank: P4: Low urgency. No protection actions are needed in the foreseeable future. The site is within the Lizard Head Wilderness

Management Urgency Rank: M3: Moderate urgency. New management actions may be needed within 5 years to maintain the current quality of the element occurrences in the PCA. Monitoring for early detection of invasive species would allow timely management for their control.

Location: Northern Dolores County, Lizard Head Wilderness, about three miles northeast of Dunton. To reach the site, drive north past Dunton on the West Fork of the Dolores River to the Navajo Lake trailhead. Hike along the Navajo Lake Trail to the Lizard Head Wilderness boundary.

U.S.G.S. 7.5 minute quadrangle: Dolores Peak

Legal Description: T41N,R11W, Sections 14, 15 and 22

Elevation: 9,249 to 10,000 feet

Size: Approximately 300 acres

General Description: The Navajo Lake trail follows the meandering upper reaches of the West Dolores River at this PCA near the Lizard Head Wilderness boundary. The valley is moderately wide and largely undisturbed. A good condition riparian plant community dominated by Rocky Mountain willow was documented on the west side of the river in 1993 during the CNHP riparian survey. The ecologists noted that the community occurred in a lateral seep area with a gravelly, uneven ground surface. This occurrence was updated in 2004. Several hundred individuals of King's clover (*Trifolium kingii*) were found along the trail on the east side of the river, forming an almost solid ground cover with wild strawberry (*Fragaria virginiana*.) Other species in the area were Rocky Mountain willow, Engelmann spruce, aspen, Richardson's geranium, Douglas fir and horsetails (*Salix monticola*, *Picea engelmannii*, *Populus tremuloides*, *Geranium richardsonii*, *Pseudocymopterus montanus* and *Equisetum arvense*)

Biodiversity Rank Justification and Comments: This site contains good (B) examples of a riparian community which is apparently secure globally and in Colorado (G4S4), and a plant that is globally secure but very rare (S1) in Colorado.

Table 52. Natural Heritage element occurrences within Navajo Lake Trail PCA.
 Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plants					
<i>Trifolium kingii</i>	King's clover	G5	S1		B
Plant communities					
<i>Salix drummondiana/Mesic forbs</i>	Drummond's willow/Mesic forb	G4	S4		B

Boundary Justification: The boundary was drawn to incorporate the King's clover occurrence and the associated riparian community. The clover is dependent on the same hydrological processes that shape the riparian zone. Additional area upstream that is essential to maintain the good condition of the plant community is included.

Protection Comments: The site is well protected within the Lizard Head Wilderness.

Management Rank Comments: The Navajo Lake Trail receives high recreational use. A fairly large amount of common dandelion (*Taraxacum officinale*) was noted. Monitoring to detect further invasion of exotic species would benefit the site.

Restoration Potential: The PCA riparian area is functioning at its potential.

Wetland Functional Assessment for the Navajo Lake Trail PCA:

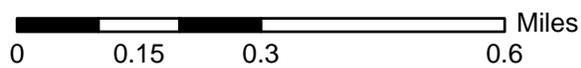
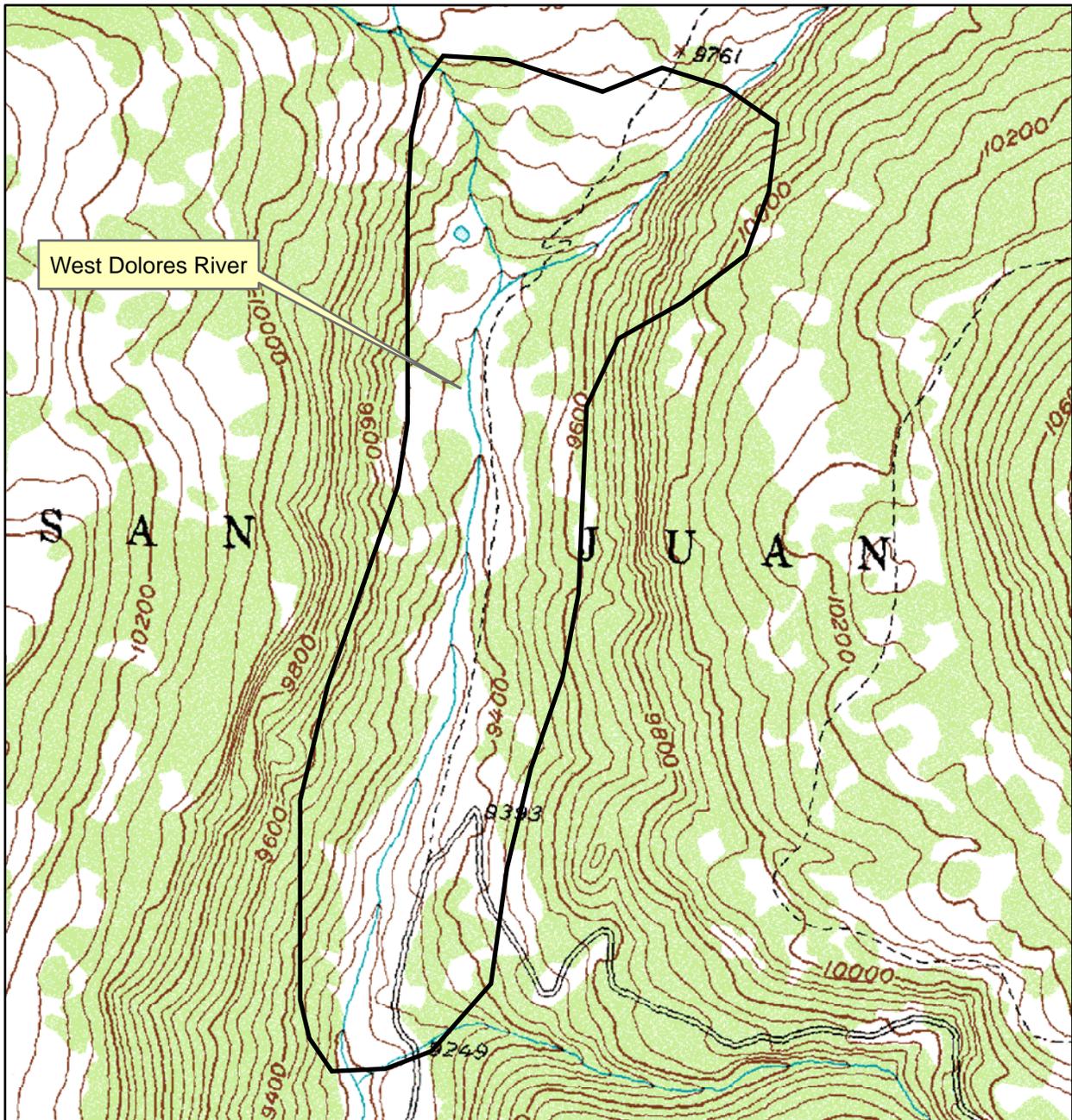
Proposed HGM Class: Riverine **Subclass:** R2

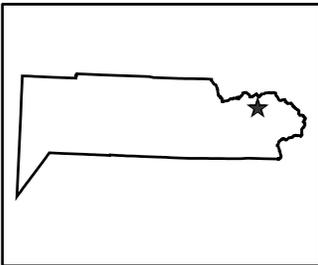
Cowardin System: Palustrine

CNHP's Wetland Classification: *Salix drummondiana* / Mesic Forbs

Table 53. Wetland functional assessment for the riparian shrubland at Navajo Lake Trail PCA

Function	Rating	Comments
Overall Functional Integrity	At Potential	The wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Limited floodplain. Moderate to steep gradient. Dense willow carr. Alluvium -- uneven land surface.
Sediment/Shoreline Stabilization	High	Dense woody vegetation anchors shoreline. Localized bank erosion from recreation impacts (near trail)
Groundwater Discharge/Recharge	Yes	Recharge occurs within coarse alluvium, pools.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Detritus present.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Vigorous above ground productivity in the shrub layer; moderate canopy cover in the understory – mostly native vegetation. Willow dominated wetland traps sediment.
Biological Functions		
Habitat Diversity	Moderate	Two Cowardin classes present (scrub shrub; forested).
General Wildlife Habitat	High	Diversity in shrubs and forbs species for wildlife habitat (structure and forage). Deer sign, songbirds present.
General Fish/Aquatic Habitat	High	Good fish habitat e.g., overhanging vegetation, pools, riffles.
Production Export/Food Chain Support	High	Overhanging vegetation, large area, signs of flushing flows.
Uniqueness	Low	The PCA contains common wetland types in good condition.



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Map 22. Navajo Lake Trail Potential Conservation Area, B4: Moderate Biodiversity Significance

Silver Creek and Johnny Bull Creek Potential Conservation Area

Biodiversity Rank: B4. Moderate biodiversity significance. The site supports a fair (C-ranked) occurrence of the globally vulnerable (G3S3) Colorado blue spruce / thinleaf alder (*Picea pungens* / *Alnus incana*) riparian forest; and a fair (C-ranked) occurrence of the globally vulnerable (G3S3) thinleaf alder (*Alnus incana*) / Mesic Forbs riparian shrubland.

Protection Urgency Rank: P4. No Protection actions are needed in the foreseeable future. The site is within the San Juan National Forest.

Management Urgency Rank: M2. New management actions may be needed within 5 years to prevent the loss of the element occurrences within the PCA. Unstable stream banks and accelerated erosion are the main threats.

Location: The Silver Creek and Johnny Bull Creek PCA surrounds the creeks at their confluence near West Dolores River in the northeast part of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Clyde Lake

Legal Description: T40N R13W Section 13, 14, 23, 24

Elevation: 8,800 – 9,400 ft.

Size: Approximately 237 acres

Redders, 2003, Community Type: *Picea pungens* / *Alnus incana* evergreen forest; *Alnus incana* / Mesic Forbs shrubland

General Description: This PCA is located at the confluence of Silver Creek and Johnny Bull Creek that descend from the steep mountain flanks. The geology is described as follows; Triassic period Dolores Formation (red siltstone, shale, sandstone, and limestone-pellet conglomerate); and Permian period Cutler Formation (arkosic sandstone, siltstone, and conglomerate) (Tweto 1979). Water in Silver Creek is turbid (orange) and tan sediments were observed on the shore. Severe erosion is occurring on stream banks as evidenced by numerous dead trees that have toppled over in response to a changing water table. CNHP ecologists previously documented this impact in 1993 (CNHP 2005). An historic mining prospect upstream is likely affecting water quality and sediment loading due to leaching. There is a jeep trail adjacent to the stream channel that is apparently accessed by private property owners downstream, but there is no public access to this road. The jeep trail, indicated on the topographic map (Clyde Lake), is not passable to the upper reaches of the PCA.

Colorado blue spruce (*Picea pungens*) dominates the tree layer in the riparian area with a sparse canopy cover of white fir (*Abies concolor*). Many of the Colorado blue spruce are visibly diseased e.g., leaf mortality (red needles), likely from spruce bud worm (*Choristoneura occidentalis*) infestation (see <http://www.ext.colostate.edu/pubs/insect/05543.html>). Thinleaf alder (*Alnus incana*) dominates the shrub layer in dense patches that in turn stabilize stream banks. Associated shrubs in the riparian area include twinberry honeysuckle (*Lonicera involucrata*), red-osier dogwood (*Cornus sericea*), and prickly currant (*Ribes lacustre*). The sparse herbaceous understory is interspersed with scoured bare soils or bedrock. Forbs account for most of the understory and include threepetal bedstraw (*Galium trifidum*), Fendler's meadow rue (*Thalictrum fendleri*), bluntseed sweetroot (*Osmorhiza depauperata*), fireweed (*Chamerion angustifolium*), and chiming bells (*Mertensia* sp.). Several thick patches of field horsetail (*Equisetum arvense*) or scouringrush horsetail (*Equisetum hyemale*) occur on the floodplain.

Exotic plant cover is low, however, there is a sparse canopy cover of common dandelion (*Taraxacum officinale*) in the lower part of the PCA.

Uplands surrounding the PCA are dominated by spruce – fir (*Picea pungens* – *Abies lasiocarpa*) forests interspersed with quaking aspen (*Populus tremuloides*) woodlands and Thurber’s fescue (*Festuca thurberi*) grasslands. Heavy grazing by cattle occurs on private land adjacent to the PCA, overall grazing impacts are moderate within the PCA boundaries.

Biodiversity Rank Justification and Comments: The site supports a fair (C-ranked) occurrence of the globally vulnerable (G3S3) Colorado blue spruce / thinleaf alder (*Picea pungens* / *Alnus incana*) montane riparian forest. *Picea pungens* appears to be a climax riparian species, that will be long-lived in the absence of catastrophic floods (Carsey *et al.* 2003). A fair (C-ranked) occurrence of the globally vulnerable (G3S3) thinleaf alder (*Alnus incana*) / Mesic Forbs montane riparian shrubland is located within the PCA. *Alnus incana* is an early-seral, but long-lived species. It is tolerant of flooding events. As it matures the shrubs will slow flood waters and trap sediment, that continues to build up soils, eventually raising the floodplain (Carsey *et al.* 2003).

Table 54. Natural Heritage element occurrences at Silver Creek and Johnny Bull Creek PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Picea pungens</i> / <i>Alnus incana</i>	Blue spruce / thinleaf alder	G3	S3		C
<i>Alnus incana</i> / Mesic Forbs	Thinleaf alder / Mesic Forbs	G3	S3		C

Boundary Justification: The PCA boundary begins upstream of the confluence of Johnny Bull Creek and the West Dolores River. The boundary encompasses the element occurrences and immediate adjacent area to buffer hydrologic processes necessary to the viability of the elements. The boundaries also provide a small buffer from nearby trails, roads, grazing allotments and campsites where surface runoff may contribute excess nutrients, sediment and weed invasion. It should be noted that the hydrologic processes necessary to the element are not fully contained by the PCA boundaries.

Protection Comments: The PCA is owned by the San Juan National Forest. Large private property in holdings are adjacent to the PCA.

Management Comments: Threats to the PCA include impacts from grazing, sedimentation and run off from mine tailings. Uplands adjacent to the riparian area have been moderately grazed. Observed impacts include weed invasion, trailing and accelerated stream bank erosion. Dispersed camping impacts were reported by CNHP ecologists in 1993 (CNHP 2005), however the situation appears to have improved as little impacts were noted in 2004.

Non-commercial tree cutting was documented but is not considered a threat. Silviculture practices are not considered practical for managing spruce budworm outbreaks. The preferred host for the spruce budworm is Douglas fir (*Pseudotsuga menziesii*), where severe impacts occur in pure stands (USDA 1982). The PCA is likely not threatened by severe impacts from the spruce budworm, due to the diversity of coniferous species within and surrounding the PCA.

Soils Description: Soils in the riparian areas are derived from alluvium and vary with geomorphic position. Soils sampled have a shallow mineral horizon and transported fine

sediments over coarse alluvium. The mapped soil unit within the riparian area is Behanco-Powderhorn family complex, 0 – 15 percent slopes. Behanco is classified as loamy-skeletal, mixed, superactive Pachic Haplocryoll. The Powderhorn family is classified as fine, smectitic Alfic Argicryoll. (USDA, NRCS 2002)

Restoration Potential: Restoration opportunities include improving grazing practices on adjacent lands, providing streambank stabilization restoration, and identifying/managing the source of the unusual turbidity and sedimentation.

Decreasing sedimentation and restoring the stream banks may benefit the condition of the PCA and downstream ecosystems. The scope of a restoration project merits research to define specific methods for the situation at Silver Creek and Johnny Bull Creek. Given the limited accessibility to the PCA, “soft” engineering methods may be most beneficial for streambank stabilization. Soft engineering utilizes tools such as erosion control fabrics and riparian vegetation plantings as opposed to the traditional “hard” engineering methods that utilize large rip rap and in channel structures (http://www.tellusnews.com/ahr/report_chapter11.html). Successful stream bank stabilization (little to no erosion after spring run off) on the Upper Clark Fork River in Montana used mostly soft engineering methods including erosion control fabrics installed on exposed stream banks. After two consecutive years of monitoring, an 88% survival rate was recorded for willow cuttings planted vertically within the floodplain. Further, a 90% success rate was reported for containerized seedlings and a 100% success rate for large tree transplants (DeFrancesco *et al.* 2000).

David Rosgen utilizes “the natural stable channel” to assess necessary methods that target restoration conditions. Rosgen’s methods are available through reaching Wildland Hydrology in Pagosa Springs or by contacting their website at www.wildlandhydrology.com. The National Parks Service has several river restoration examples and resources available online at <http://www.nps.gov/ncrc/portals/rivers/projjpg/restoration/.htm> including examples from Colorado. Colorado Riparian Association has several successful river restoration examples as well as resources that can be reviewed online at www.coloradoriparian.org. The Colorado Natural Areas Program has a native plant revegetation guide available on their website at <http://www.parks.state.co.us/cnap/indes.html> which may provide helpful information about using native plants for revegetation projects. This resource is organized according with ecosystem types, suggesting the appropriate plant species.

Wetland Functional Assessment for the Silver Creek and Johnny Bull Creek PCA:

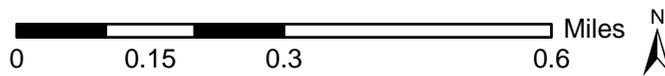
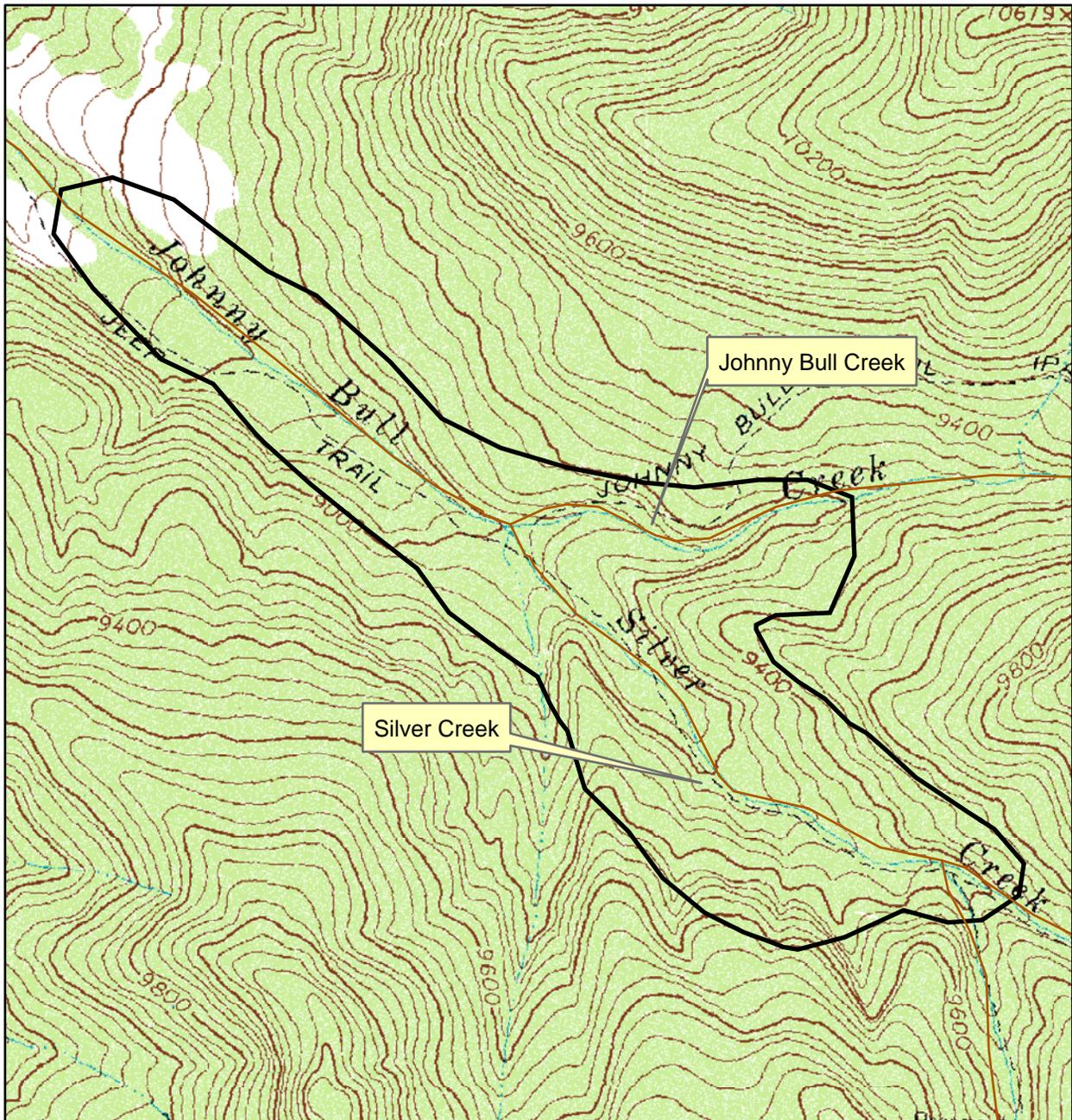
Proposed HGM Class: Riverine **Subclass:** R2

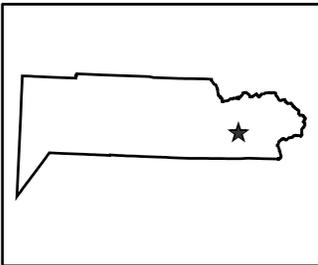
Cowardin System: Palustrine

CNHP's Wetland Classification: *Picea pungens* / *Alnus incana* montane riparian forest; *Alnus incana* montane riparian shrubland

Table 55. Wetland functional assessment for the riparian wetlands at Silver Creek and Johnny Bull Creek PCA.

Function	Rating	Comments
Overall Functional Integrity	Below Potential	This wetland appears to be functioning below its potential.
Hydrological Functions		
Flood Attenuation and Storage	Low	Limited floodplain within an incised stream channel.
Sediment/Shoreline Stabilization	Low	Erosion is excessive, and the stream banks are unstable.
Groundwater Discharge/Recharge	No	No springs observed; steep straight channel with no back water channels. Possible mine prospect drain from upstream.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Disrupted	There is excessive erosion and scouring due to high amounts of sediment in stream. There is little soil development and a sparse herbaceous understory.
Removal of Imported Nutrients, Toxicants, and Sediments.	Low	Sparse understory, open canopy in overstory; very few hydrophytes stands established. Very little sediment trapping evident.
Biological Functions		
Habitat Diversity	Moderate	Two Cowardin classes: scrub shrub, forested.
General Wildlife Habitat	Moderate	Wildlife sign; birds.
General Fish/Aquatic Habitat	Low	Turbid (tan to orange colored) water indicates low aquatic life. No invertebrates observed at this location.
Production Export/Food Chain Support	Low	Plant material in stream exports carbons to downstream systems. Excessive erosion, poor water quality inhibits support of aquatic life.
Uniqueness	Low	Riparian elements in fair condition, G3.



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Map 23. Silver Creek and Johnny Bull Creek Potential Conservation Area, B4: Moderate Biodiversity Significance

Willow Creek at Groundhog Mountain PCA

Biodiversity Rank: B4: Moderate biodiversity significance. This PCA supports fair (C ranked) occurrences of riparian plant communities, and two occurrences (A and B ranked) of a riparian plant that is very rare (S1) in Colorado.

Protection Urgency Rank: P4: No protection actions are needed in the foreseeable future.

Management Urgency Rank: M4: Current management seems to favor the persistence of the elements in the PCA, but management actions may be needed in the future to maintain the current quality of the element occurrences.

Location: The Willow Creek at Groundhog Mountain PCA is located in northeastern Dolores County, about 9 miles NNW of Rico, 2 miles NW of Dunton, and 2.5 miles SSW of Dolores Peak. From Rico, drive nine miles north on Highway 145 to Forest Service Road 535 at Cayton Campground. Continue northwest on FR 535 about 9 miles and turn north onto FR 611. The PCA starts about 1.5 miles from the road junction.

U.S.G.S. 7.5 minute quadrangles: Groundhog Mountain, Dolores Peak

Legal Description: T41N R11W, Sections 7, 8, 17-20.

Elevation: 9,560 to 10,520 feet

Size: Approximately 565 acres

General Description: The Willow Creek at Groundhog Mountain PCA encompasses three drainages. The upper portion of Willow Creek approximately 2.5 miles above its confluence with Fish Creek, a tributary to the Dolores River, and an un-named branch of Cold Creek, also a tributary to the Dolores span the PCA site. Generally, the PCA is dominated by large stands of aspen (*Populus tremuloides*) on the hillsides, with Willow Creek lying in the bottom of the small valley, running southeast.

The upper stretch of Willow Creek was surveyed by CNHP during the wetland survey of the San Miguel and Dolores River drainages in 1991. It contains a series of beaver ponds, and supports an element occurrence of a beaked sedge (*Carex utriculata*) wet meadow plant community. Associated species found in the wet meadow include Drummond's willow (*Salix drummondiana*), Rocky Mountain willow (*Salix monticola*), Rocky Mountain rush (*Juncus saximontanus*), fewseeded bog sedge (*Carex microglochis*), fowl mannagrass (*Glyceria striata*), false hellebore (*Veratrum tenuipetalum*), water speedwell (*Veronica anagallis-aquatica*), willow herb (*Epilobium sp*), seep monkeyflower (*Mimulus guttatus*), Fendler's cowbane (*Oxypolis fendleri*), Rocky Mountain hemlockparsley (*Conioselinum scopulorum*), and arrowleaf groundsel (*Senecio triangularis*). A 1% cover of bristly locust (*Robinia hispida* var. *hispida*) was reported. This species, which is native to Appalachian Mountains, apparently is an escape from cultivation. Another riparian community surveyed by CNHP in 1991 is a dense montane riparian willow carr (*Salix monticola*/Mesic graminoid) association, on the un-named branch of Cold Creek. This extensive element occurrence is a good quality example of the community and, at the time of the survey, had not been heavily impacted by grazing practices. Dominant species within the occurrence include Rocky Mountain willow, whitestem gooseberry (*Ribes inerme*), chiming bells (*Mertensia ciliata*), and Richardson's geranium (*Geranium richardsonii*).

The old Groundhog Stock Driveway, which now serves predominantly as a hiking trail, passes through the PCA from east to west, and a well-maintained Forest Service road follows Willow Creek northward along the east bank. Impacts from historic cattle grazing in the area,

especially near the old stock trail, are still apparent, and hikers tend to trample areas near the trails; however, the wet meadows and willow carrs appear to be relatively intact.

Two element occurrences of king’s clover (*Trifolium kingii*) are located on the flat areas above the creek, in locations near the Forest Service road that follows Willow Creek. In the northern element occurrence, the species is exhibited in wet areas along the roadside, and additional patches are located nearby along a small tributary stream, continuing up the hillside on north-facing slopes. Taxa associated with the occurrence at this northern location include tufted hairgrass (*Deschampsia cespitosa*), elephant heads (*Pedicularis groenlandica*), northern bog orchid (*Habenaria hyperborea*), water sedge (*Carex aquatilis*), and Fendler’s cowbane (*Oxypolis fendleri*).

In the larger, southern occurrence of King’s clover, thousands of individuals are again located along the road, both sides, and continue up the hillside approximately 50 meters before transitioning into an adjacent false hellebore (*Veratrum tenuipetalum*) community. An overstory of Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), and aspen is associated with this King’s clover occurrence, intermixed with other taxa including wild mountain parsley (*Pseudocymopterus montanus*), false hellebore, large mountain fleabane (*Erigeron coulteri*), sulphur paintbrush (*Castilleja sulphurea*), and strawberry (*Fragaria virginiana*).

Biodiversity Rank Justification and Comments: The Willow Creek at Groundhog Mountain PCA supports a good to excellent occurrence of the globally vulnerable (G3) montane riparian willow carr plant community, and an excellent (A ranked) occurrence and good (B ranked) occurrence of King’s clover, a plant that is very rare (S1) in Colorado.

Table 56. Natural Heritage element occurrences within Willow Creek at Groundhog Mountain PCA.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Communities					
<i>Salix monticola</i> /Mesic graminoid	Montane riparian willow carr	G3	S3		C
<i>Carex utriculata</i>	Beaked sedge	G5	S4		C
Plants					
<i>Trifolium kingii</i>	King’s clover	G5	S1		A
<i>Trifolium kingii</i>	King’s clover	G5	S1		B

*EO=Element Occurrence. Multiple listings represent separate locations.

Boundary Justification: The PCA boundary includes the riparian areas of Willow Creek and an un-named tributary of Cold Creek, both of which support occurrences of King’s clover. The PCA also incorporates additional riparian habitat that is suitable for the expansion of these populations.

Protection Comments: The PCA is owned and managed by the San Juan National Forest. There is no other special designation.

Management Comments: Although a Forest Service road and a public trail used by hikers both run through the site, no exotic species were observed. However, other road maintenance activities on the Forest Service road have the potential to affect the riparian and wetland communities, including but not limited to road grading and roadside weed-control spraying.

Any alterations to the hydrology of the site, such as upstream water diversions, could have detrimental effects on the riparian and wetland communities as well as the King's clover populations. Although not currently threatened, a review of current management practices for grazing, recreation activities, and road maintenance activities may be warranted in the future to maintain current quality of the element occurrences.

Wetland Functional Assessment for the Silver Creek and Johnny Bull Creek PCA:

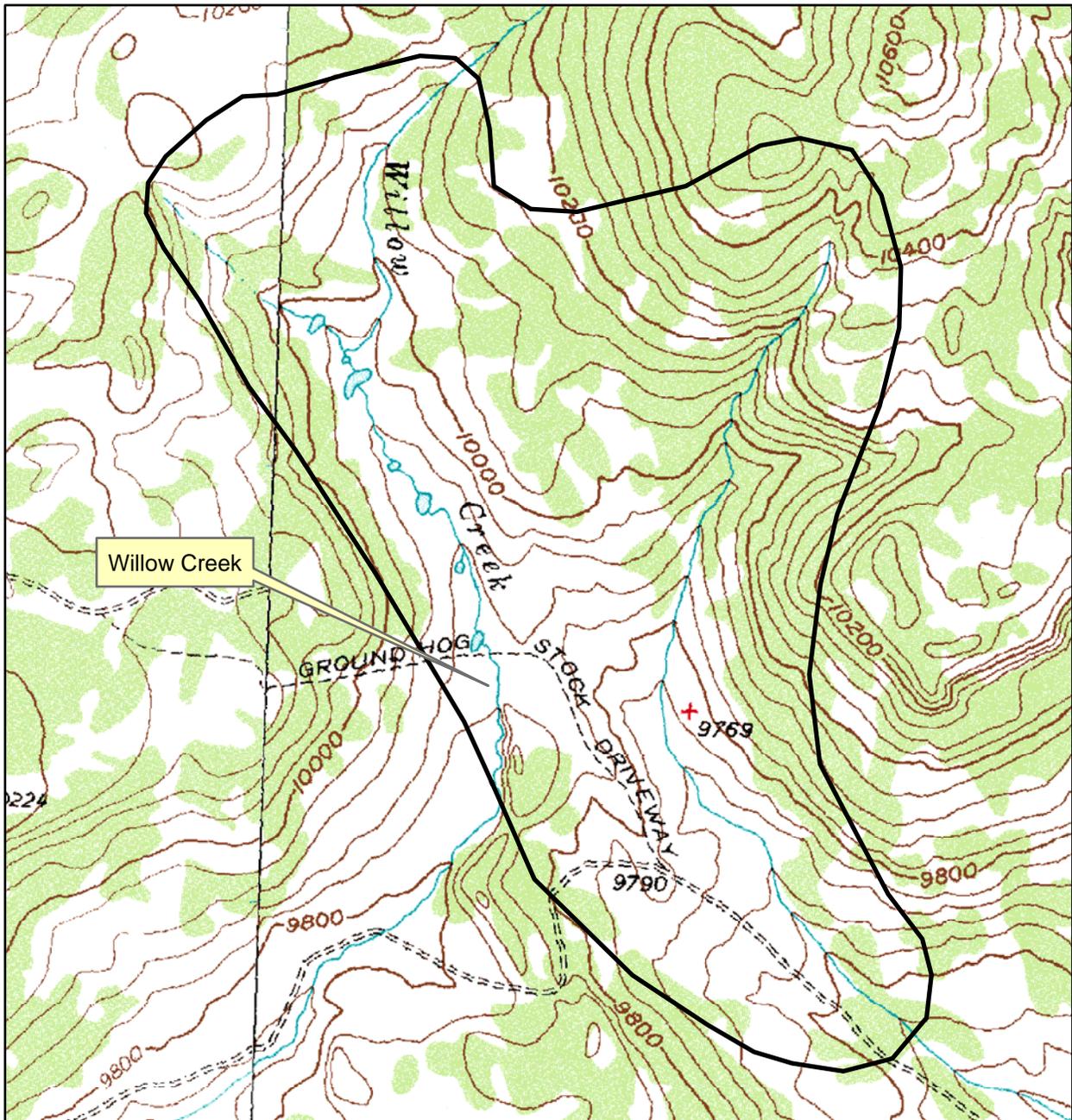
Proposed HGM Class: Riverine **Subclass:** R2

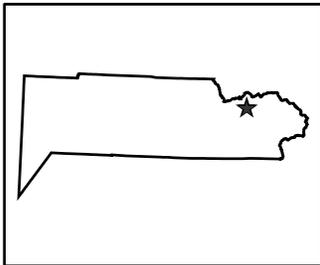
Cowardin System: Palustrine

CNHP's Wetland Classification: *Salix monticola* / Mesic Graminoid

Table 57. Wetland functional assessment for the montane riparian shrubland at Willow Creek at Groundhog Mountain PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	This wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Steep to moderate gradient, dense willows, native herbaceous layer.
Sediment/Shoreline Stabilization	High	Stable within channel – very dense woody vegetation.
Groundwater Discharge/Recharge	Yes	Coarse alluvium and pools recharge groundwater.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Expected detritus present. No disturbances to the soil within wetland area. Adjacent area impacted by grazing, recreation.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Dense to open canopy of native vegetation, areas of dense native sedges.
Biological Functions		
Habitat Diversity	Moderate	Two Cowardin classes: scrub shrub; emergent
General Wildlife Habitat	Moderate	Domestic cattle, sheep in the area. Wildlife sign, beaver activity.
General Fish/Aquatic Habitat	High	Good fish habitat. Overhanging vegetation, narrow deep channel and pools.
Production Export/Food Chain Support	High	Dense to open canopy of woody species, with signs of flushing flows.
Uniqueness	Moderate	The PCA contains a G3 wetland plant community and a state rare (S1) plant.



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Map 24. Willow Creek at Groundhog Mountain Potential Conservation Area, B4: Moderate Biodiversity Significance

The Coal Creek Meadows Potential Conservation Area

Biodiversity Rank: B5. General biodiversity significance. The site supports the apparently globally secure (G4S4) plane leaf willow / marsh marigold (*Salix planifolia* / *Caltha leptosepala*) plant community in good (B-ranked) condition; the demonstrably globally secure (G5) apparently secure in Colorado (S4) water sedge (*Carex aquatilis*) herbaceous vegetation in good condition (B-ranked); and the apparently globally secure (G4) but vulnerable in Colorado (S3) mountain willow (*Salix monticola*) / Mesic Forb shrubland in fair (C-ranked) condition.

Protection Urgency Rank: P3. Protection action may be needed, but probably not within the next 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA if protection action is not taken.

Management Urgency Rank: M4. Current management seems to favor the persistence of the elements in the PCA, but management actions may be needed in the future to maintain the current quality of the element occurrences.

Location: The Coal Creek Meadows PCA surrounds The Meadows, parts of Coal Creek and adjacent meadows in the northeast part of Dolores County.

U.S.G.S. 7.5-min. quadrangles: Dolores Peak

Legal Description: T41N R10W Section 19, 30
T41N R11W Section 23, 24, 25, 26

Elevation: 10,200 - 10,000 ft.

Size: Approximately 1,286 acres.

Redders, 2003, Community Type:

General Description: The Coal Creek Meadows PCA is located in the San Juan National Forest surrounding The Meadows, a portion of Meadow Creek and parts of the Coal Creek drainage. Several grassy mesic meadows are contained within the PCA. Water sedge (*Carex aquatilis*) dominates the large mesic areas, while tufted hairgrass (*Deschampsia caespitosa*) dominates drier soils. Associated species include muttongrass (*Poa fendleriana*), slender wheatgrass (*Elymus trachycaulus*), small wing sedge (*Carex microptera*), ebony sedge (*Carex ebenea*), Kentucky bluegrass (*Poa pratensis*), and sweetgrass (*Hierochloa odorata*). Marsh marigold (*Caltha leptosepala*) dominates the herbaceous canopy in ephemeral streams and swales. Associated forbs in the area include elephant head lousewort (*Pedicularis groenlandica*), Rocky Mountain fringed gentian (*Gentianopsis thermalis*), large leaf avens (*Geum macrophyllum*), beautiful potentilla (*Potentilla pulcherrima*), strawberry (*Fragaria* sp.), alpine goldenrod (*Solidago multiradiata*), Bigelow's groundsel (*Ligularia bigelovii*), and western yarrow (*Achillea lanulosa*). Soils within The Meadows are peaty to a depth of 26cm with silty clay loam underneath.

Willows dominate perennial drainages throughout the PCA. Mountain willow (*Salix monticola*) dominates the middle reaches of Meadow Creek and plane leaf willow (*Salix planifolia*) dominates Coal Creek as well as the mesic slopes adjacent to The Meadows. Uplands are dominated by spruce – fir (*Picea engelmannii* – *Abies lasiocarpa*) forests interspersed with open Thurber's fescue (*Festuca thurberi*) grasslands. A Boreal Owl (*Aegolius funereus*) occurrence has been documented (1995) in close proximity, not within the PCA. The Boreal Owl prefers multi-aged coniferous forests of Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) above 9000 feet, most commonly in proximity to open grassy situations (AOU 1983).

Forest Road 535 or Dunton road passes through the PCA and is utilized by residents of Dunton and National Forest visitors. The area is used for recreation including off road vehicles, hiking, hunting, and sight seeing.

Biodiversity Rank Justification and Comments: The PCA supports three common plant associations in Colorado. However, there are few undisturbed examples documented in Dolores County and in Colorado. The plant associations identified in this PCA are the best examples observed during the 2004 field season. The plant associations are; the apparently globally secure (G4S4) plane leaf willow / marsh marigold (*Salix planifolia* / *Caltha leptosepala*) riparian shrubland in good (B-ranked) condition, the demonstrably globally secure (G5) apparently secure in the state (S4) water sedge (*Carex aquatilis*) herbaceous vegetation in good condition (B-ranked), and the apparently globally secure (G4) vulnerable in the state (S3) mountain willow (*Salix monticola*) / Mesic Forb riparian shrubland in fair (C-ranked) condition.

Table 58. Natural Heritage element occurrences at The Coal Creek Meadows PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO Rank
Plant Community					
<i>Salix planifolia</i> / <i>Caltha leptosepala</i>	Plane leaf willow / marsh marigold	G4	S4		B
<i>Carex aquatilis</i>	Water sedge	G5	S4		B
<i>Salix monticola</i> / Mesic Forbs	Mountain willow / Mesic Forbs	G4	S3		C

Boundary Justification: The boundary encompasses the element occurrences and adjacent areas to buffer hydrologic processes necessary to the viability of the elements. The boundary also provides a small buffer from nearby trails and roads where surface runoff may contribute excess nutrients, sediment and weed invasion. It should be noted that all hydrologic processes necessary to the elements are not fully contained by the PCA boundary.

Protection Comments: The PCA is within the San Juan National Forest and a private in holding. Wetland and conservation easement education may benefit the landowner.

Management Comments: Threats to the PCA include improper use of off road vehicles, recreation and weed invasion. Horse use has impacted some areas within the PCA, however, not severely. Illegal ATV trails were noted within the PCA. Kentucky bluegrass (*Poa pratensis*) is present within the meadows and riparian areas.

Soils Description: Soils within steep riparian drainages are derived from alluvium and vary according with geomorphic position. Soils sampled in The Meadows have mucky peat to 26 cm depth, and silty clay loam with crumb structure and mottles beneath this. Soils sampled within the wet meadow at Calico Trail displayed 21cm of mucky peat, 6 cm of muck beneath this, and dark silty clay loam to a depth greater than 40cm.

The mapped soil unit within the wet meadow areas within the PCA is described as Typic Cryaquent-Cryaquoll-Cryofibrists complex, 0 – 5 percent slopes (USDA, NRCS 2002).

Restoration Potential: Restoration opportunities include restricting ATV use in the wetland areas and monitoring for non-native weed dispersal by horse use.

Wetland Functional Assessment for The Coal Creek Meadows PCA:

Proposed HGM Class: Slope **Subclass:** S2

Cowardin System: Palustrine

CNHP's Wetland Classification: *Carex aquatilis* herbaceous vegetation

Table 59. Wetland functional assessment for the sub alpine mesic meadow at The Coal Creek Meadows PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	The wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Peaty soil in upper horizon (26 cm), small ephemeral channel at west end of occurrence descending from moist meadow, drainages come into contact with meadow at each end where seasonal flooding occurs in limited portions of the site.
Sediment/Shoreline Stabilization	High	Ephemeral channel drains meadow at west end where there is little sign of cut banks and high canopy cover of native graminoids; for most of the area, this function is not applicable.
Groundwater Discharge/Recharge	Yes	Seeps from adjacent hillslope; no recharge due to peat soil in upper horizon over clay loam.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	26 cm peaty soil in the upper horizon; dense cover of native graminoids
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Dense native herbaceous vegetation.
Biological Functions		
Habitat Diversity	Low	One Cowardin class present, emergent.
General Wildlife Habitat	Moderate	Deer sign; adjacent well-used road.
General Fish/Aquatic Habitat	Low	No fish habitat
Production Export/Food Chain Support	N/A	No flushing flows; peat accumulating.
Uniqueness	Low	Although the plant association is common, it is a large example of a mesic meadow that displays organic soil accumulation.

HGM Class: Riverine **Subclass:** R1

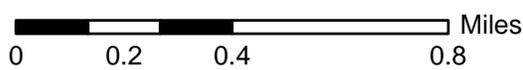
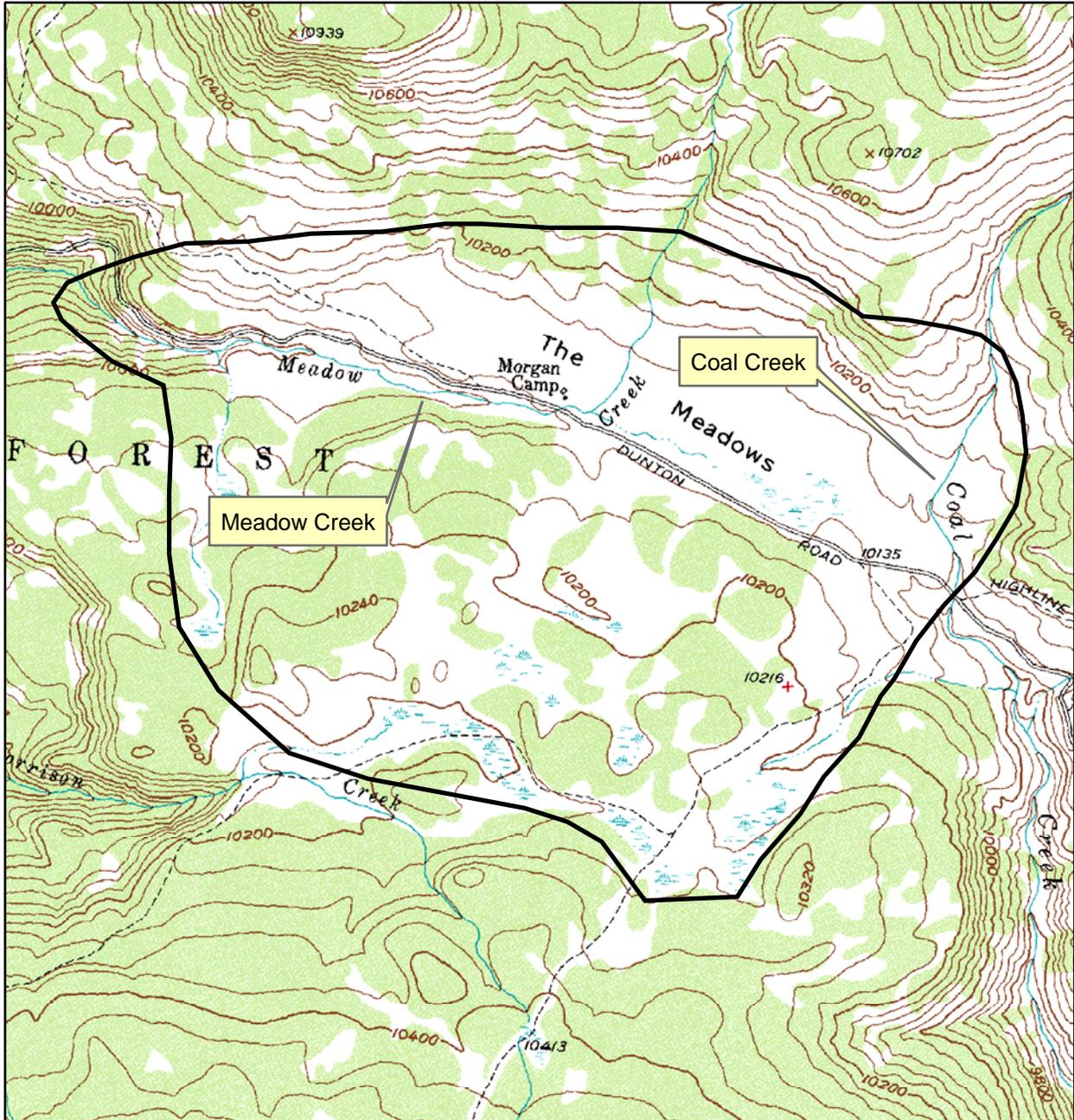
Cowardin System: Palustrine

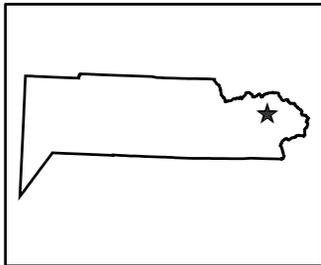
Wetland Functional Assessment for The Coal Creek Meadows PCA:

Proposed CNHP's Wetland Classification: *Salix planifolia* / *Caltha leptosepala* shrubland

Table 60. Wetland functional assessment for the subalpine riparian shrubland at The Coal Creek Meadows PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	The wetland appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Steep stream channel. Limited floodplain. Densely vegetated with coarse alluvial soils and boulders.
Sediment/Shoreline Stabilization	High	Dense shrublands anchor shoreline.
Groundwater Discharge/Recharge	Yes	Coarse alluvial soils indicate recharge.
Dynamic Surface Water Storage	N/A	
Biogeochemical Functions		
Elemental Cycling	Normal	Expected amounts of detritus. Soils are alluvial.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Vigorous plant growth. Native plant composition. Sediment trapping is moderate within steep riparian area.
Biological Functions		
Habitat Diversity	Low	One Cowardin class present, scrub shrub.
General Wildlife Habitat	Moderate	Deer sign; adjacent well-used road.
General Fish/Aquatic Habitat	Moderate	Narrow channel, overhanging vegetation. Near headwaters.
Production Export/Food Chain Support	High	High seasonal flushing flows. Overhanging vegetation and vegetation within channel. Aerated stream with invertebrates.
Uniqueness	Low	PCA contains a common plant community.



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Map 25. The Coal Creek Meadows Potential Conservation Area, B5: General Biodiversity Interest

Disappointment Creek Site of Local Significance

Location: The Disappointment Creek Site of Local Significance is located along the Disappointment Creek in north central part of Dolores County.

U.S.G.S. 7.5-min. quadrangles: McKenna Peak; Glade Mountain; South Mountain

Legal Description: T42N R14W Section 31, 32, 33, 34, 35
T42N R15W Section 26, 27, 30, 31, 32, 33, 34, 35, 36
T42N R16W Section 25, 26

Elevation: 5,900 – 7,600 ft.

Size: Approximately 2,680 acres

General Description: Disappointment Creek flows west/northwest across the north central part of Dolores County. The SLS is drawn around the creek's middle reach where the stream gradient is gentle. The creek's extreme sinuosity and alternating steep and shallow stream banks are partly determined by the substrate comprised of soft, naturally erosive soils, derived from Mancos shale. Mancos shale dominates the surface geology in the valley bottom with the Mesa Verde group exposed on higher peaks (Tweto 1979). Soils in the riparian area display deep layers with fine to medium crumb structure with silt loam and silty clay loam textures. Signs of seasonal high water (5 – 15 feet) are evident (the stream channel is incised). Erosion and reduction in vegetation caused by inappropriate grazing have also contributed to the stream bank's inability to withstand seasonal flooding. For example, large sections of the stream bank have broken off and fallen into the channel. Erosion is not as severe where the riparian area and adjacent upland are densely vegetated.

The tree layer within the SLS is an open to sparse canopy of narrowleaf cottonwood (*Populus angustifolia*) and plains cottonwood (*Populus deltoides* subsp. *wislizenii*) with Rocky Mountain juniper (*Juniperus scopulorum*) scattered throughout. Discontinuous thickets of shrubs dominate the riparian zone. Riparian and upland shrubs occupy the floodplain, abandoned channels, and terraces including river birch (*Betula occidentalis*), river hawthorn (*Crataegus rivularis*), silver buffalo berry (*Shepherdia argentea*), thinleaf alder (*Alnus incana*), twinberry honeysuckle (*Lonicera involucrata*), skunkbush sumac (*Rhus trilobata*), red-osier dogwood (*Cornus sericea*), Utah serviceberry (*Amelanchier utahensis*), rubber rabbitbrush (*Chrysothamnus nauseosus*), yellow rabbitbrush (*Chrysothamnus viscidiflorus*), Woods' rose (*Rosa woodsii*), whitestem gooseberry (*Ribes inerme*), Gambel's oak (*Quercus gambelii*), basin big sage (*Artemisia tridentata* var. *tridentata*), broom snakeweed (*Gutierrezia sarothrae*), fourwing saltbush (*Atriplex canescens*), winterfat (*Krascheninnikovia lanata*), and Colorado barberry (*Berberis fendleri*). Willows are common within the stream channel and include Bebb's willow (*Salix bebbiana*), mountain willow (*Salix monticola*), strapleaf willow (*Salix ligulifolia*), and coyote willow (*Salix exigua*). Coyote willow dominates the stream channel throughout, with very little vegetation in the herbaceous understory. Graminoids within the floodplain, occupying beaches or scoured channels include Baltic rush (*Juncus balticus*), wooly sedge (*Carex pellita*), field horsetail (*Equisetum arvense*), smooth horsetail (*Equisetum laevigata*), bulrush (*Schoenoplectus lacustris*), and common reed (*Phragmites australis*). Grasses occupying terraces in the riparian zone include crested wheatgrass (*Agropyron cristatum*), Indian ricegrass (*Achnatherum hymenoides*), smooth brome (*Bromus inermis*), prairie Junegrass (*Koeleria macrantha*), orchard grass (*Dactylis glomerata*), Kentucky bluegrass (*Poa pratensis*), tall wheatgrass (*Thinopyrum ponticum*), rye brome (*Bromus secalinus*), and cheatgrass (*Bromus tectorum*). Forbs are sparse to moderately dense within the herbaceous understory and include

riparian, upland, and non-native species. Due to the moist and shady condition, forbs are most numerous in areas where the tree canopy is thriving. Forbs observed include cutleaf coneflower (*Rudbeckia ampla*), Richardson's geranium (*Geranium richardsonii*), pony beebalm (*Monarda pectinata*), northern bedstraw (*Galium septentrionale*), showy milkweed (*Asclepias speciosa*), wild iris (*Iris missouriensis*), American vetch (*Vicia americana*), yellow sweetclover (*Melilotus officinale*), white sweetclover (*Melilotus albus*), alfalfa (*Medicago sativa*), common dandelion (*Taraxacum officinale*), Scotch cottonthistle (*Onopordum acanthium*), musk thistle (*Carduus nutans*), prickly Russian thistle (*Salsola tragus*), Russian knapweed (*Acroptilon repens*), Wyoming Indian paintbrush (*Castilleja linariifolia*), milkvetch (*Astragalus* sp.), Rocky Mountain milkvetch (*Astragalus scopulorum*), blazing star (*Mentzelia* sp.), scarlet gilia (*Ipomopsis aggregata*), and common yarrow (*Achillea millefolium*).

Riparian natural plant communities (Carsey *et al.* 2002) present within the SLS include coyote willow (*Salix exigua*) / barren ground shrubland, river birch (*Betula occidentalis*) / Mesic Forbs shrubland, river hawthorn (*Crataegus rivularis*) shrubland, narrowleaf cottonwood – Rocky Mountain juniper (*Populus angustifolia* – *Juniperus scopulorum*) woodland, and narrowleaf cottonwood / strapleaf willow – silver buffalo berry (*Populus angustifolia* / *Salix ligulifolia* - *Shepherdia argentea*) woodland.

Tamarisk (*Tamarix ramosissima*) has invaded the Disappointment Creek Valley occurring in light to dense canopy cover within Dolores County. The western portion of the SLS displays a high density of tamarisk within the riparian zone. The eastern portion displays scattered clusters where the shrubs occur in fields adjacent to the creek.

Uplands surrounding the SLS are dominated by rangeland fields, semi desert shrublands (*Atriplex* spp. -- *Sarcobatus vermiculatus*.), sagebrush (*Artemisia* spp.) shrublands, and pinyon pine – juniper (*Pinus edulis* – *Juniperus osteosperma* – *J. scopulorum*) forests.

Protection Comments: The SLS is located within private property and BLM land. The Nature Conservancy holds a conservation easement within the SLS.

Management Comments: Threats to the SLS are inappropriate grazing and noxious weed and shrub invasion. Most of the area within the SLS is grazed or has been grazed in the past. Intense grazing is evidenced by herbaceous understory stubble at 7 – 15 cm (3 – 6 inches), shrub thickets intensely browsed (“mushroom” shaped shrubs), and stream banks with hoof shearing and trailing. There are areas within the SLS that appear to be grazed more appropriately where riparian vegetation and stream bank stability are in good condition. There is a light to moderate invasion of herbaceous noxious weeds including cheatgrass (*Bromus tectorum*), musk thistle (*Carduus nutans*), and Russian knapweed (*Acroptilon repens*). Noxious shrub invasion by tamarisk (*Tamarix ramosissima*) is dense in the western portion of the SLS.

Soils Description: Soils in the riparian area are derived from alluvium. Soil horizons evaluated include 2cm root and organic matter at the surface with mineral horizons beneath this as follows: 20cm small crumb structure that has silty clay texture (little organic matter); 60cm thick platy and fine angular structure that is silty clay texture; 150cm very fine, fine, and medium crumb structure that has silt loam texture; and the lowermost horizon displays 20 cm silty clay mixed with cobble and gravel. Fine sediments and sand occur on beaches and point bars.

Restoration Potential: Restoration opportunities include noxious weed eradication, improved grazing regime and revegetation of bare soils and stream banks.

It is recommended to implement whole pasture concepts in grazing management practices. Riparian area management is more effective when considered along with upland pasture management, as adjacent uplands can affect watershed condition with excessive sedimentation, erosion, runoff (Leonard *et al.* 1997), and weed invasion.

Eradication of noxious shrubs and replanting of native riparian plant species is recommended. Influx of non-native species requires long-term monitoring. The current level of tamarisk invasion density varies within the site and represents a timely opportunity for eradication before invasion becomes overwhelming throughout the site. Locally, Rhea Environmental Consulting in Durango, and The Nature Conservancy in Telluride are succeeding in noxious shrub removal and may be able to provide advice or assistance. Referring to such resources as the Nature Conservancy's web site on invasive species (<http://tncweeds.ucdavis.edu/index.html>) or <http://www.invasivespecies.gov/> may provide some assistance with control and eradication of non-native species. The Colorado Natural Areas Program has a native plant revegetation guide available on their website at <http://www.parks.state.co.us/cnap/index.html> which may provide helpful information about using native plants for revegetation projects.

BLM Proper Functioning Condition Evaluation*: reach location on BLM property at T42N R14W Section 34

Checklist

Hydrology: 1) floodplain terraces not inundated in frequent events, shoreline and point bars inundated frequently; 3) width to depth ratio is low, the channel is extremely sinuous, the substrate is highly erosive (fine crumb structure shale, sand), erosion process accelerated by lack of vigorous vegetation (heavily grazed) 4) appears that riparian vegetation has reached its physical possible extent, though not widening and upland species encroaching in some areas, the presence of *Crataegus rivularis* indicates a possible drop in the water table (Carsey *et al.* 2002). 5) upland watershed is contributing to riparian degradation

Vegetation: 6) age class distribution is not diverse, most recruits are *Berberis fendleri*; 7) there is a diverse composition of riparian or hydrophytic vegetation (more than two species); 8) within the stream channel, there is a fringe of hydrophyte species indicating wetland soil maintenance; 9) dense woody vegetation (intensely grazed) -- where floodwater accesses terraces shrubs dissipate floodwater energy; 10) where vegetation is not grazed, it is vigorous; 11) herbaceous understory is not dense and is grazed and mixed with upland and weedy species; herbaceous understory stubble is very short (3 to 5 inches)

Erosion/Deposition: 13) stream has limited access to floodplain, erosion and high sinuosity; 14) point bars have vegetation; 15) high sinuosity, erosion is expected to be naturally high, however grazing impacts accelerate erosion process possibly adding to sinuosity; 16) system is vertically stable in this reach; 17) erosion and deposition appear to be high

Remarks

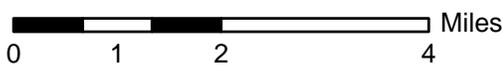
Extremely sinuous stream with loose shale (crumb structure) and sandstone present. Deep banks (4 – 12 feet). Naturally highly erosive, however appears excessive in some areas. Area is heavily grazed where stubble is 3 to 6 inches and riparian shrubs are intensely browsed to a “mushroom” shape.

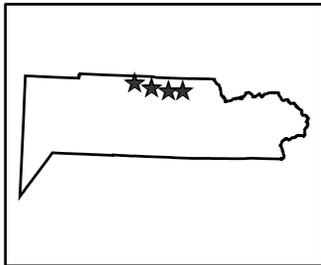
Summary Determination

PFC rating: functional at risk (key questions 3, 11, 16 were answered yes, question 11 is downward trending toward a no answer)

Trend: downward – due to grazed or overgrazed situation accelerating erosion. Grazing is occurring on BLM and private properties; BLM lands appear to be more heavily grazed than adjacent private land. Cattle are concentrating within the riparian zone (location of reach evaluation).

*evaluation completed without the presence of a hydrologist



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Map 26. Disappointment Creek Site of Local Significance

Dolores River at Rico Site of Local Significance

Location: The Dolores River at Rico Site of Local Significance surrounds the Dolores River riparian areas and wetlands at the Town of Rico in the eastern part of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Rico

Legal Description: T39N R11W Section 2
T40N R11W Section 25, 26, 35, 36

Elevation: 8,700 – 8,800 ft.

Size: Approximately 124 acres

General Description: The Town of Rico is situated along the Dolores River as it flows south through typical upper montane habitat. Numerous rock slides have occurred drastically changing the morphology of the river e.g., braiding, large point bars. Historic mining adits located above the Dolores River attest to past mining activities for silver and galena ore (Blair *et al.* 1996). The last active mine was located upstream of the Town of Rico where pyrite was extracted for the production of sulfuric acid. The mine closed in 1964, leaving behind several leach ponds (Blair *et al.* 1996). Past and present day developments have fragmented the riparian plant communities often leaving them completely disconnected from the active floodplain. Several intact wetlands do occur within the site that are valuable to people e.g., flood attenuation, toxicant and sediment removal and water quality improvement.

Downstream of the Town of Rico, a narrowleaf cottonwood (*Populus angustifolia*) gallery mixes with Colorado blue spruce (*Picea pungens*). Thinleaf alder (*Alnus incana*) dominates the streambanks upstream from the cottonwood gallery. Within the Town of Rico, mature narrowleaf cottonwoods occur in a scattered canopy with saplings regenerating along active point bars and floodplains. Additionally, a diverse assemblage of willows occur in dense, discontinuous thickets throughout the site, including isolated patches on high terraces often dominated by Bebb's willow (*Salix bebbiana*). Mountain willow (*Salix monticola*) with beaked sedge (*Carex utriculata*) occurs within the active, intact floodplain.

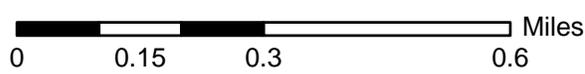
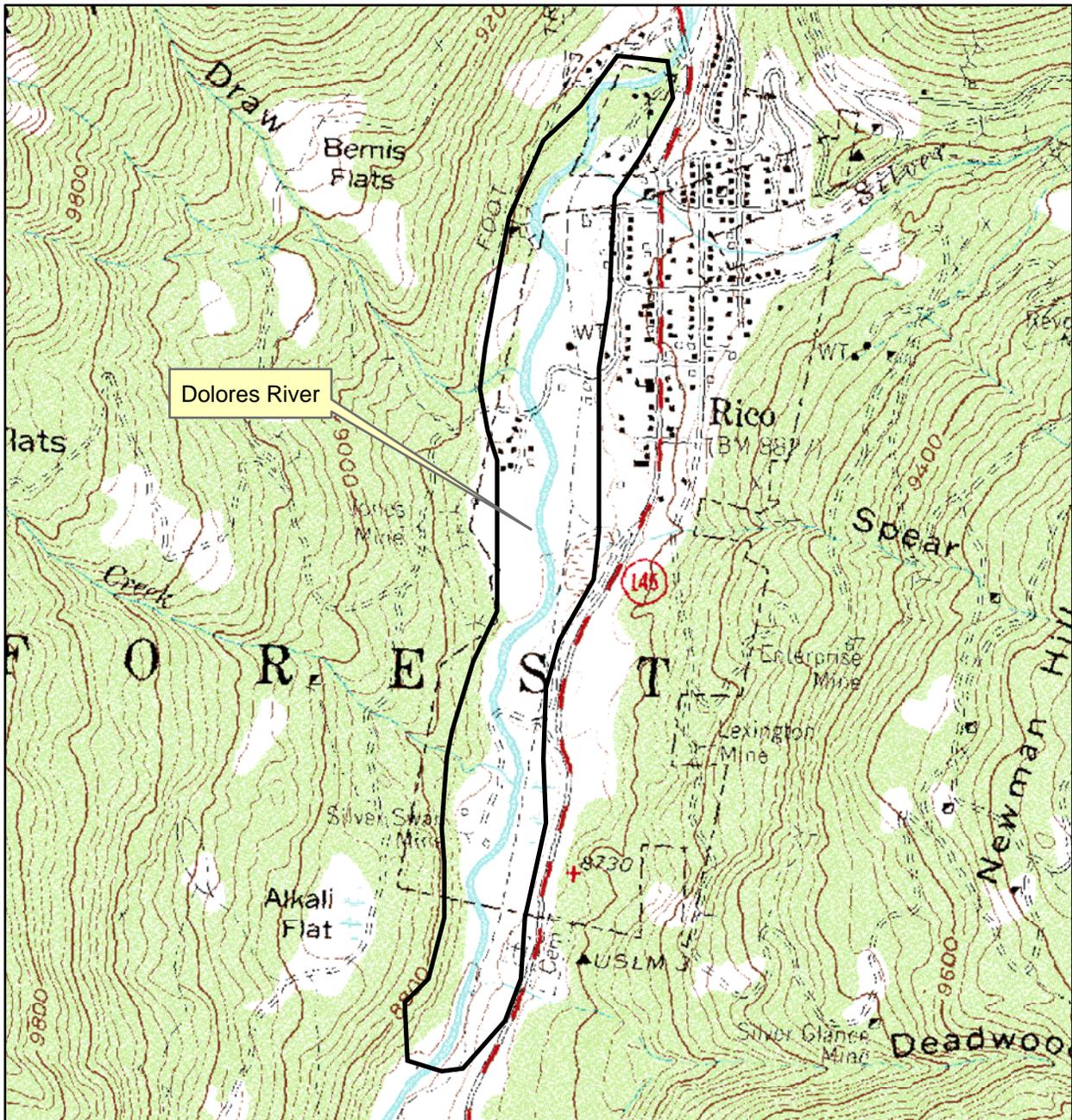
Along the west bank of the Dolores River's floodplain, a large wetland occurs dominated by thinleaf alder (*Alnus incana*), mountain willow (*Salix monticola*), Drummond's willow (*Salix drummondiana*), plane leaf willow (*Salix planifolia*), and shrubby cinquefoil (*Dasiphora floribunda*). The dense and diverse herbaceous understory include the following graminoids; beaked sedge (*Carex utriculata*), bluejoint reedgrass (*Calamagrostis canadensis*), field horsetail (*Equisetum arvense*), Baltic rush (*Juncus balticus*), fowl mannagrass (*Glyceria striata*), smooth horsetail (*Equisetum laevigatum*), variegated scouringrush (*Equisetum variegatum*), golden sedge (*Carex aurea*), woolly sedge (*Carex lanuginosa*), small winged sedge (*Carex microptera*), and timothy (*Phleum pratense*). Forbs account for a small percentage in the herbaceous canopy and include beautiful potentilla (*Potentilla pulcherrima*), Richardson's geranium (*Geranium richardsonii*), yellow avens (*Geum aleppicum*), tobacco root (*Valeriana edulis*), cut leaf coneflower (*Rudbeckia ampla*), wild mint (*Mentha arvensis*), largeleaf avens (*Geum macrophyllum*), starry false lily of the valley (*Maianthemum stellatum*), owl's claws (*Hymenoxys hoopesii*), and common yarrow (*Achillea lanulosa*). Evidence of mining leachates might account for the dead branches observed on several thinleaf alder and Colorado blue spruce.

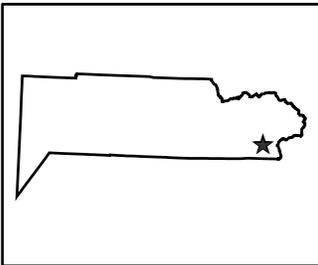
Protection Comments: The site is within private property owned by citizens and the Town of Rico.

Management Comments: Threats to the riparian and wetland system include erosion, corridor constriction, and wetland plant community fragmentation. To help reduce erosion from adjacent development projects and roads, it is recommended to revegetate or reclaim bare soil areas as needed. Given that the area contains many mining drains, it may be beneficial to the water quality to maintain existing wetland areas.

Soils: Soils in the wetland are saturated, with a thin layer (6cm) of organic matter at the surface, and shallow layers of sandy clay (5cm) and sandy clay loam (15cm) over alluvium. The mineral horizons display oxidized root channels. Mosses occur on the surface of the soil.

Restoration Potential: Actions have been taken to restore the river channel morphology and stabilize stream banks. It is recommended to revegetate bare soil areas as needed. Established vegetation will help mitigate erosion while construction takes place in the riparian corridor. The Colorado Natural Areas Program has a native plant revegetation guide available on their website at <http://www.parks.state.co.us/cnap/index.html> which may provide helpful information about using native plants for revegetation projects. Maintaining and encouraging riparian and wetland connectivity is recommended.



<p>Colorado Natural Heritage Program Colorado State University 254 General Services Building Fort Collins, CO 80523</p> <p>Ph (970) 491-1309 Fax (970) 491-3349 www.cnhp.colostate.edu</p> <p>Map Date: 3/02/2005</p>	<p>Legend</p> <p> SLS Boundary</p> <p>Rico, 37108-F1</p> <p>7.5 Minute Digital Raster Graphic produced by the U.S. Geological Survey</p>	<p>Location in Dolores County</p> 
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Map 27. Dolores River at Rico Site of Local Significance

Dolores River Canyon Site of Local Significance

Location: The Dolores River Canyon Site of Local Significance is located downstream of McPhee Dam in the Dolores River canyon in the west central portion of Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: Doe Canyon, The Glade, Secret Canyon, Joe Davis Hill

Legal Description: T40N R17W Section 4, 5, 9, 16, 21, 27, 28, 33
T41N E17W Section 18, 19, 29, 32, 33
T41N R18W Section 1, 11, 12, 13, 14, 23, 24, 26
T42N R18W Section 13, 14, 23, 26, 35, 36

Elevation: 5,700 – 7,000 ft.

Size: Approximately 10,000 acres

General Description: The Dolores River watershed is the primary drainage in Dolores County with numerous tributaries that range from alpine rivulets to low elevation canyon streams. This Site of Local Significance (SLS) is located along the Dolores River Canyon downstream from McPhee Reservoir. McPhee Reservoir is the largest component of the Dolores Water Project, generating electricity and delivering water to irrigators and municipalities in throughout southwestern Colorado. While the dam has given the area residents many benefits, there are severe downfalls for the downstream ecosystem and its natural functions (Collier 2000).

It is nearly impossible to determine the natural hydrological and ecological condition of the Dolores River since the water diversions began as early as the mid 1800s. By 1890, a large tunnel and canal system had been completed with the capacity to channel 1300 cfs from the Dolores River. Water was diverted from Dolores River near the present day McPhee dam site (completed 1989) to the Montezuma Valley, often leaving very little water in the stream channel. The diversion was created for agricultural development to make life possible in the then considered “wasteland” of southwestern Colorado (Dolores Water Conservancy, 2005). Downstream of the dam, floodplain dynamics necessary for continued development of wetland habitat have been greatly altered. As a result, new wetlands are not being created within the floodplains, and aquatic habitat has been reduced.

The Dolores River has carved a deep canyon through the Colorado Plateau, revealing the colorful sedimentary rock formations spanning the Mesozoic Era (Tweto 1979). The Dolores River is moderately sinuous to straight within the canyon while the canyon itself makes very large turns. The canyon opens wide enough to expose contiguous hillsides where pinyon pine – juniper (*Pinus edulis* – *Juniper* spp.) forests and Gambel’s oak (*Quercus gambelii*) woodlands dominate. The river channel is dominated by dense contiguous stands of coyote willow (*Salix exigua*) often with an understory consisting of thick carpets of smooth brome (*Bromus inermis*). Beaches and back flow channels harbor fringes of hydrophytes including water sedge (*Carex aquatilis*) and common spike rush (*Eleocharis palustris*). Several higher terraces are large (i.e. 3 or 4 acres) and approximately ¼ river mile long. These terraces contain box elder in open to sparse canopies often with dense patches of skunkbush sumac (*Rhus trilobata*). Narrowleaf cottonwood (*Populus angustifolia*) occurs mostly in sparse canopy within the site, however there are dense galleries located on few terraces. Sparse narrowleaf cottonwood regeneration (saplings) was noted on areas between the high terraces and beaches. The terraces harbor a mixture of upland and riparian plant species evidenced by the presence of Rocky Mountain juniper (*Juniperus scopulorum*). In addition to patches of skunkbush sumac, shrubs in the corridor include a diverse assemblage of riparian and upland species including mountain mahogany (*Cercocarpus montanus*), rubber rabbitbrush

(*Chrysothamnus nauseosus*), barberry (*Berberis fendleri*), choke cherry (*Prunus virginiana*), Gambel's oak (*Quercus gambelii*), western white clematis (*Clematis ligusticifolia*), and Utah juniper (*Juniperus osteosperma*). River birch (*Betula occidentalis*) occurs in isolated patches adjacent to the stream. The herbaceous understory on terraces is mostly dominated by cheatgrass occurring with orchard grass (*Dactylis glomerata*), Kentucky bluegrass (*Poa pratensis*), needle and thread (*Heterostipa comata*), Indian rice grass (*Achnatherum hymenoides*), and bulbous bluegrass (*Poa bulbosa*). Forbs in the herbaceous understory include a mixture of upland, native, and non-native species e.g., Canada thistle (*Cirsium arvense*), western poison ivy (*Toxicodendron rydbergii*) alyssum (*Alyssum parviflorum*), toadflax (*Linaria vulgaris*), yellow salsify (*Tragopogon dubius*), hairy false golden aster (*Heterotheca villosa*), and plains prickly pear (*Opuntia polyacantha*). Tamarisk (*Tamarix ramosissima*) has invaded the terraces in the SLS, currently in sparse and intermittent canopy. Downstream within San Miguel County, the noxious shrub occurs in dense thickets. Tamarisk also occupies the beaches of McPhee Reservoir, upstream of the SLS.

Three historic occurrences of roundtail chub were recorded within the Dolores River downstream of the McPhee dam. Two of these were last observed in 1979 before the dam was completed. One occurrence, within the SLS, was last observed in 1996 (CNHP 2005). Natural plant community element occurrences that do not merit a PCA due to poor condition ranks within the SLS are narrowleaf cottonwood – (box elder) / skunkbush sumac woodland {*Populus angustifolia* – (*Acer negundo*) / *Rhus trilobata*}, skunkbush (*Rhus trilobata*) shrubland, and coyote willow / mesic graminoids (*Salix exigua* / mesic graminoids) shrubland. Also within the Dolores River Canyon SLS is a thriving river otter (*Lontra canadensis*) population. Efforts are being made to maintain habitat for the reintroduced species (see http://wildlife.state.co.us/education/mammalsguide/river_otter.asp).

The canyon walls are as much a part of a dynamic ecosystem as the riparian corridor. Parts of the Dolores Canyon expose the sedimentary formations including Wingate sandstone and Chinle red siltstone. An unusual wetland type, Mancos columbine – Eastwood monkeyflower (*Aquilegia micrantha* – *Mimulus eastwoodiae*) hanging garden (G2G3/S2S3) is likely to occur where springs discharge at the joining of the Wingate sandstone and the underlying Chinle formation (Carsey *et al.* 2003). The seeps along the Dolores River Canyon walls provide the requirements for the globally rare hanging gardens. A small number (4 - 6) Mancos columbine (*Aquilegia micrantha*) was documented in 2004, however neither the Eastwood monkeyflower (*Mimulus eastwoodiae*) or stream orchid (*Epipactis gigantea*) were present. The stream orchid occurs upstream of the SLS in Montezuma County, downstream of McPhee dam (see Lyon and Hanson 2005). Although several seeps were located within the SLS, they did not harbor any rare plants or plant associations. It should be noted that the potential for these element occurrences merit more research within the Dolores Canyon.

Downstream of the SLS, within San Miguel County, several element occurrences are located within the river corridor, along the canyon walls, or areas adjacent to the canyon. These elements include Peregrine Falcon (*Falco peregrinus*), Mexican Spotted Owl (*Strix occidentalis*), Short-eared Owl (*Asio flammeus*), and coyote willow (*Salix exigua*) / mesic graminoids (CNHP 2005). Upstream of the SLS and downstream of the McPhee dam, element occurrences within Montezuma County include strapleaf willow – coyote willow (*Salix ligulifolia* – *Salix exigua*), box elder – narrowleaf cottonwood / red-osier dogwood (*Acer negundo* - *Populus angustifolia* / *Cornus sericea*), stream orchid (*Epipactis gigantea*), and an historic occurrence of round tail chub (*Gila robusta*) (CNHP 2005). The riparian plant community, narrowleaf cottonwood / strapleaf willow – silver buffalo berry (*Populus angustifolia* / *Salix ligulifolia* – *Shepherdia argentea*), was observed from the roadside in the riparian corridor on private and State land in Montezuma County during 2004.

Protection Comments: The SLS is owned by the Bureau of Land Management. The hydrologic processes are controlled and managed by the Dolores Water Conservancy District.

Management Comments: Threats to the Dolores River Canyon include extensive noxious weed and shrub invasion, streambank destabilization, upland vegetation invasion, and loss of wetland and aquatic habitat.

Riparian and wetland ecosystems are dynamic, often unpredictable systems that have adapted to natural fluvial processes. These abiotic processes include water and sediment movement, magnitude of flow, duration of inundation, frequency of inundation, and geomorphology (Mitsch and Gosselink 1993; Cushing and Allen 2001). Little consideration has been given to downstream ecosystems in the history of dam building in the United States, and as dams are getting older the downstream ecosystems are revealing deleterious effects (Collier 2000). These altered ecosystems sometimes lead to catastrophic events, such as river channels no longer able to abate unexpected flooding events, depleted alluvial aquifers, aquatic (native fish) habitat loss, river aggradation or degradation (Collier *et al.* 2000). The McPhee dam is relatively young (<20 years), however, the effects of very low in stream flow, and several seasons lacking seasonal flow releases is proving to be stressing riparian and wetland habitat. The stream channel is becoming covered with riparian and non-native vegetation, the terraces are invaded by upland and noxious plant species, streambanks are destabilizing, and aquatic habitat is reduced.

Soils and Geology Description: Soils sampled are clay loam and alluvium.

In the lower Dolores River Canyon, the southern most reach in Dolores County exposes sandstones from the Entrada and Wanakah formations and the soft shale and sandstone of the Morrison Formation. Farther north in the canyon, the formations shift slightly to the Morrison Formation, Entrada sandstone and the Summerville Formation comprised of shale and siltstone. As the Dolores River exits the county, the Glen Canyon group is revealed. The Glen Canyon Group is comprised of Navajo Sandstone, Kayenta Formation of red siltstone, shale and sandstone and Wingate Sandstone. This area also displays the red siltstone of the Chinle Formation (Tweto 1979).

Restoration Potential: Restoration opportunities include a shift in hydrologic management, channel morphology restoration, streambank stabilization, noxious weed eradication and native plant revegetation. Obtaining and properly managing more water for in stream flow below McPhee dam may benefit the success of restoration efforts. Action has been taken within the Lone Dome SWA immediately below the dam in Montezuma County where channel morphology has been modified.

When addressing the problem of accurately predicting the cause and effect in fluvial systems it is reasonable to state that hydrologic and geologic processes, and morphological position sustain living things in fluvial ecosystems (Ligon *et al.* 1995; McBain, S. and B. Trush 1997; Poff *et al.* 1997). When managing rivers downstream of dams, restoring the hydrologic and sediment regime to the most natural state as possible may be a positive start up strategy for restoration (McBain and Trush 1997). Rivers move water and sediments -- as the water shifts in volume and magnitude, the sediments are scoured, and deposited, and essentially are kept in a balance (Cushing and Allen 2001). Below dams, this balance is altered. Timing of flow, duration, frequency of flooding events, amounts of transported sediments are the abiotic factors that effect the biotic outcome and viability of the natural ecosystem. Riparian vegetation and aquatic species have adapted to this dynamic system. In turn, healthy and contiguous riparian and wetland ecosystems benefit people by simply performing their natural functions. Some of these values (from natural functions) include improved water quality, flood attenuation, aquatic fisheries/habitat, recharging alluvial aquifers, habitat for wildlife, and recreation and academic opportunities (Mitsch and Gosselink 1993).

The challenges of restoring the Dolores River downstream of McPhee dam are many. A very important step is recognizing the ecological impacts the dam has had downstream. It needs to be assessed if restoration is a desired goal by the majority of the stakeholders and society.

Restoration targets need to be assessed as to whether they are practical or feasible. For example, if restoration is targeted for a single species' habitat (e.g., river otter or trout) or if restoration is targeted for holistic management of the entire fluvial system, hopefully benefiting all species. It is recommended to consider the latter while recognizing that restoring the river for a few species will not automatically restore the ecosystem. Further, attempting to holistically restore the river will not automatically restore *all* species' habitat (Poff *et al.* 1997). Morphological changes to the stream channel is not a sufficient method alone, water allocated to in stream flow needs to be managed over the course of a season in such a way as to precipitate positive results for the biota. Hydrology needs to be restored as much as possible to the natural flow regime (Poff *et al.* 1997). A restoration project of this magnitude merits much research to assess the target results within the available water and sediment movement constraints.

CNHP recognizes that several agency and private citizens are concerned about the restoration below McPhee Reservoir and encourage continuing research and holistic restoration.

BLM Proper Functioning Condition Evaluation*: River reach location is along the Dolores River at Doe Canyon. T41N R17W section 21 and 28

Checklist

Hydrology: 1) floodplain is not inundated recently, floodplain is inaccessible by water from channel; 3) width to depth ratio and gradient are in balance with the landscape, but there is a low amount of water flowing down the channel; 4) riparian/wetland area is lessening, not widening; 5) upland watershed is contributing to riparian-wetland degradation

Vegetation: 6) age class distribution is limited; 7) there is a diverse composition of riparian or hydrophytic vegetation (more than two species); 8) there are only fringes of hydrophytes indicating wetland soil maintenance; 9) species within channel can withstand high-streamflow; 10) vegetation is generally not vigorous; 11) limited areas where dense live woody vegetation helps dissipate flood water energy, streambank vegetation is mixed upland and riparian species

Erosion/Deposition: 13) channel characteristics are adequate to dissipate energy; 14) point bars are revegetated with pasture grasses and fringes of hydrophytes; 15) stream has limited to no access to the floodplain, very little water in a very large channel, no lateral movement recently; 16) system is vertically stable in this reach; 17) stream is not in balance with sediments supplied – turbid water, sedimentation

Remarks

Reach is within a large river canyon with very little water in the channel. The woody riparian vegetation has leaf and branch mortality. There are fringes of hydrophytic vegetation – point bars, islands with vegetation (non-native and native). No sign of persistent or seasonal scouring – smooth brome well established within the channel. River otter sign, fish, crayfish, and invertebrates observed.

Summary Determination

PFC rating: functional at risk (key questions 3, and 16 were answered yes and 11 was answered no, close to yes)

Trend: downward – due to altered hydrology and subsequent effects

Flow regulations are outside of the manager's control.

*evaluation made with no hydrologist present

BLM Proper Functioning Condition Evaluation*: River reach location is along the Dolores River at Box Elder Recreation Area. T41N R18W section 18, 23

Checklist

Hydrology: 1) floodplain is not inundated recently, floodplain is inaccessible; 2) N/A, although old beaver lodges in banks occupied by river otter; 3) width to depth ratio and gradient are in balance with the landscape, but not with the amount of water flowing down the channel, morphology is present, hydrology is not; 4) riparian/wetland area is lessening; 5) upland watershed is contributing to riparian-wetland degradation by a large impoundment upstream

Vegetation: 6) age class distribution is limited; there is a diverse composition of riparian or hydrophytic vegetation (more than two species) there is some regeneration of riparian vegetation; 7/8) there are fringes of hydrophytes indicating wetland soil maintenance, also a good source for restoration; 9) sparse herbaceous understory dominated by upland and noxious species (cheatgrass) scattered tamarisk present; 10) riparian shrub species are not vigorous – there is mortality in some cases, fringes of sedges along stream are vigorous; 11) stressed, mixed riparian and upland woody vegetation along with upland and weedy understory may not be enough to dissipate energy in high flows

Erosion/Deposition: 13) channel characteristics are adequate to dissipate energy, morphology is evident; 14) point bars and channel revegetated with coyote willow and non-native pasture grass, smooth brome; 15) there are areas where it appears stream is trying to “fix” itself and create a new channel within the existing channel, otherwise, no lateral movement; 16) vertically stable; 17) turbid, thick sediments in channel -- stream is not in balance with sediments supplied

Remarks

Large river canyon with very little water in stream. River otter sign is noted. Bankful channel is lowering and there is no recent sign of floodwater accessing floodplains, terraces. Pasture grasses within channel indicates lack of scouring for several seasons. Terraces may severely erode in a flooding event due to upland, non-native and sparse vegetation.

Summary Determination

PFC rating: functional at risk (key questions 3, and 16 were answered yes and 11 was answered no)

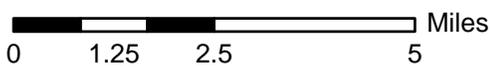
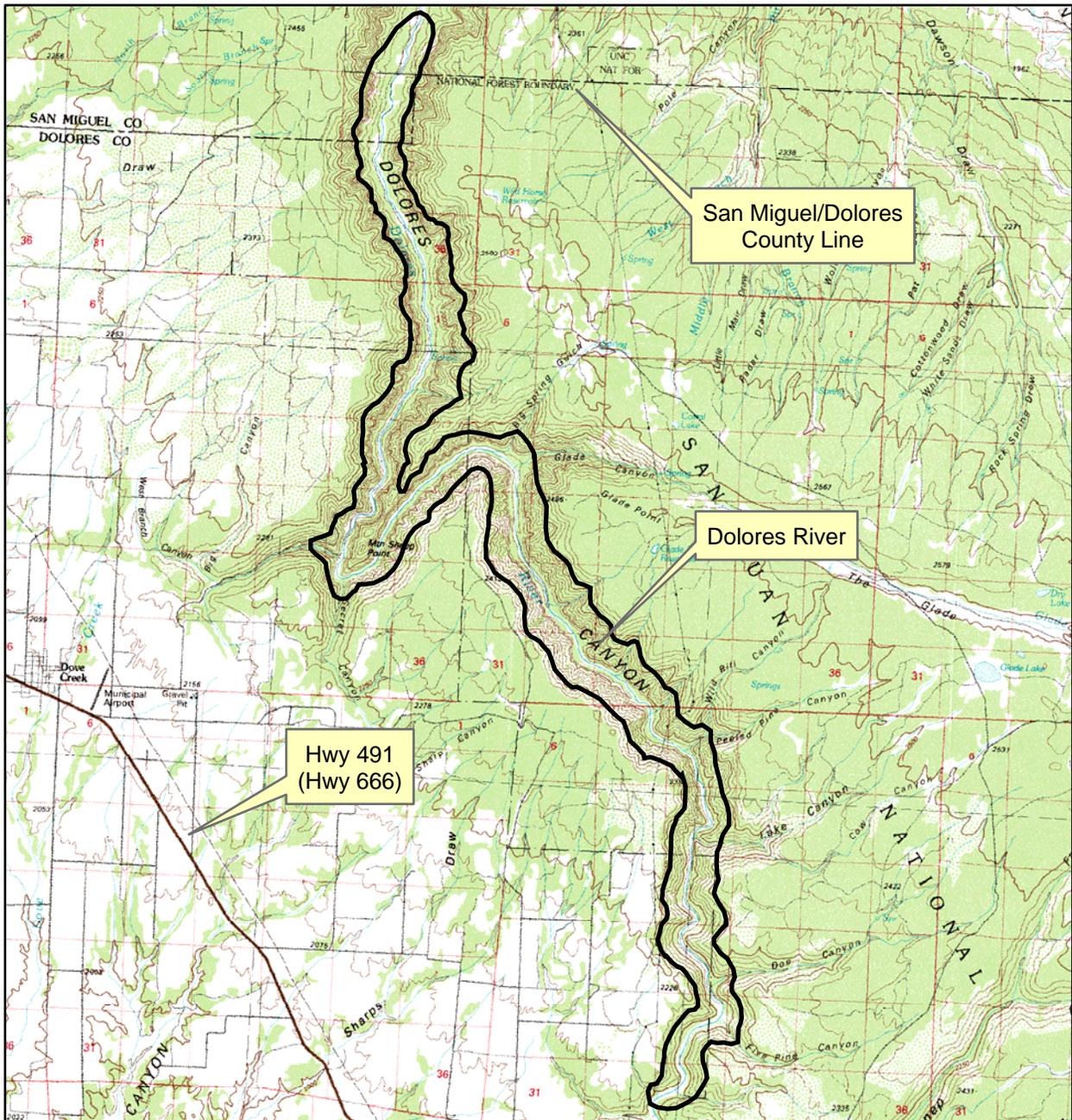
Trend: downward – due to altered hydrology and subsequent effects

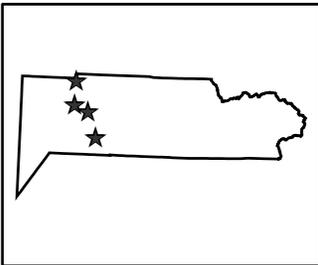
Flow regulations are outside the control of the manager.

*evaluation made with no hydrologist present



Salix exigua dominates the shoreline along Dolores River near the Dove Creek Pump Station. Photograph © CNHP 2004.



<p>Colorado Natural Heritage Program Colorado State University 254 General Services Building Fort Collins, CO 80523</p> <p>Ph (970) 491-1309 Fax (970) 491-3349 www.cnhp.colostate.edu</p> <p>Map Date: 3/07/2005</p>	<p>Legend</p> <p> SLS Boundary</p> <p>Dove Creek, 37108-E1</p> <p>30x60 Minute Digital Raster Graphic produced by the U.S. Geological Survey</p>	<p>Location in Dolores County</p> 
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Map 28. Dolores River Canyon Site of Local Significance

San Juan National Forest Reservoir Sites of Local Significance, Dolores County

Location: The San Juan National Forest Reservoir Sites of Local Significance are located in the west portion of the San Juan National Forest, in central Dolores County, Colorado.

U.S.G.S. 7.5-min. quadrangles: The Glade; Glade Mountain; Narraguinnep Mountain

Legal Description: T39N R16W Section 10
 T40N R16W Section 34, 35
 T41N R16W Section 27, 28
 T41N R17W Section 9, 10

Elevation: 8,160 ft.– 8,320 ft.

Size: Wetlands range from 1 to 12 acres

General Description: Springs are common in the western portion of the San Juan National Forest within the central part of Dolores County. The surface geology is dominated by Dakota sandstone/Burrow Canyon formation and Mancos shale (Tweto 1979). Spring discharges appear to correlate near the meeting or intermingling of these geologic formations. Since this area is rich in groundwater discharges, in addition to the gentle gradient and grasslands and sage flats, it is widely used for seasonal cattle grazing. Therefore, most of the springs have been developed for stock use as reservoirs. The reservoirs exhibit wetland characteristics e.g., hydrophytic vegetation and hydric soils. Wildlife, especially waterfowl, use the reservoirs for nesting, forage and migration habitat.

The reservoir sites display zones of vegetation as a result of differing soil saturation levels. The outermost zone is the driest, and harbors vegetation not obligate to saturated soils, yet is more mesic than the surrounding uplands. The draw down zone is an area adjacent to the shoreline that has been inundated seasonally for durations sufficient to support hydrophytic vegetation. There are shallow water areas where aquatic vegetation is rooted in mud, and deeper water areas where tall emergent vegetation occurs e.g., cattail (*Typha latifolia*) and softstem bulrush (*Schoenoplectus tabernaemontani*). Please see Table 61 below for more details.

All wetlands in the SLS do not exhibit all vegetation zones described. For example, Dry Lake is a natural depression with very little standing water. The perennial water supports a large mesic area dominated by solid stands of common spikerush (*Eleocharis palustris*) and pale false mannagrass (*Torreyochloa pallida* var. *pauciflora*). In addition to cattail and softstem bulrush, Corral Lake harbors dense stands of sedges including awned sedge (*Carex atherodes*) and wooly sedge (*Carex lanuginosa*) within the emergent zone. Please see table 61 for details regarding plant species and their location. Survey within the majority of the sites took place in September 2004 and more research is needed at an earlier time in the season to ensure thorough species lists. Corral Lake was surveyed in June, 2004.

The SLS harbors a variety of wetland plant species and a rich habitat for wildlife. Birds observed at the sites throughout the 2004 season include Black-crowned Night Heron (*Nycticorax nycticorax*), Red-winged Blackbird (*Agelaius phoeniceus*), American Coot (*Fulica americana*), Mallard Duck (*Anas platyrhynchos*), Western Bluebird (*Sialia mexicana*), Mourning Dove (*Zenaida macroura*), Lark Sparrow (*Chondestes grammacus*), Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*), Ruddy Duck (*Oxyura jamaicensis*), Mountain Bluebird (*Sialia currucoides*), Cinnamon Teal (*Anas cyanoptera*), Killdeer (*Charadrius vociferus*), and Red Tail Hawk (*Buteo jamaicensis*). Several frogs were audible at Cabin Reservoir.

Uplands surrounding the wetland sites include sagebrush flats (*Artemisia* spp.), open rangeland dominated by pasture grasses e.g., smooth brome (*Bromus inermis*), and ponderosa pine (*Pinus ponderosa*) forests.

Table 61. Plant species occurring in San Juan National Forest Reservoir SLS.
Plant species presence are indicated by “X”.

Plant species technical name	Common name	Beef Trail Reservoir	Cabin Reservoir	Corral Lake	Dry Lake	Dry Lake Reservoir	Ferris Reservoir
Outermost zone (driest)							
<i>Deschampsia caespitosa</i>	Tufted hairgrass			X			
<i>Carex athrostachya</i>	Slender beak sedge	X	X			X	X
<i>Carex praegracilis</i>	Field sedge	X	X				
<i>Festuca thurberi</i>	Thurber's fescue				X	X	
<i>Hordeum brachyantherum</i>	Meadow barley			X			
<i>Iris missouriensis</i>	Wild iris				X	X	
<i>Pascopyrum smithii</i>	Western wheatgrass				X		
<i>Phleum pratense</i>	Timothy	X			X		
<i>Rosa woodsii</i>	Wood's rose	X					
Draw down zone							
<i>Alopecurus aequalis</i>	Shortawn foxtail		X	X	X	X	X
<i>Arnica chamissonis subsp. genuina</i>	Chamisso arnica			X			
<i>Beckmannia syzigachne</i>	American sloughgrass						X
<i>Eleocharis palustris</i>	Common spikerush	X	X	X	X	X	X
<i>Hordeum jubatum</i>	Foxtail barley		X				X
<i>Mentha arvensis</i>	Wild mint		X	X	X		
<i>Persicaria coccinea</i>	Longroot smartweed			X			
<i>Persicaria</i> sp.	Smartweed				X		
<i>Poa compressa</i>	Canada bluegrass	X		X	X		? grazed
<i>Rorippa teres</i>	Southern marsh yellowcress				X		
<i>Rumex triangulivalvis</i>	Mexican dock		X	X		X	X
Aquatics in mud and shallow water							
<i>Alisma triviale</i>	Northern	X	X	X		X	X

Plant species technical name	Common name	Beef Trail Reservoir	Cabin Reservoir	Corral Lake	Dry Lake	Dry Lake Reservoir	Ferris Reservoir
	water plantain						
<i>Callitriche palustris</i>	Vernal water sandwort			X			
<i>Eleocharis acicularis</i>	Needle spikerush	X	X	X			
<i>Hippuris vulgaris</i>	Common mare's tail	X	X	X			X
<i>Myriophyllum sibiricum</i>	Shortspike water-milfoil		X	X			X
<i>Potamogeton pectinatus</i>	Sago pondweed						X
<i>Ranunculus longirostris</i>	Longleaf buttercup			X			X
<i>Rorippa curvipes</i> var. <i>alpina</i>	Bluntleaf yellowcress		X	X			
<i>Sagittaria cuneata</i>	Arum leaf arrowhead	X					
<i>Torreyochloa pallida</i> var. <i>pauciflora</i>	Pale false mannagrass	X	X	X	X		X
<i>Persicaria amphibia</i>	Water smartweed	X	X	X		X	X
Emergent zone deeper water							
<i>Carex atherodes</i>	Awned sedge			X			
<i>Carex pellita</i>	Wooly sedge			X			
<i>Carex utriculata</i>	Beaked sedge			X			X
<i>Schoenoplectus tabernaemontani</i>	Softstem bulrush	X	X	X			X
<i>Typha latifolia</i>	Broadleaf cattail	X	X	X		X	X

Note: survey took place in September 2004 for all sites except Corral Lake (June 2004) and merits more research at an earlier time in the season to ensure thorough species lists.

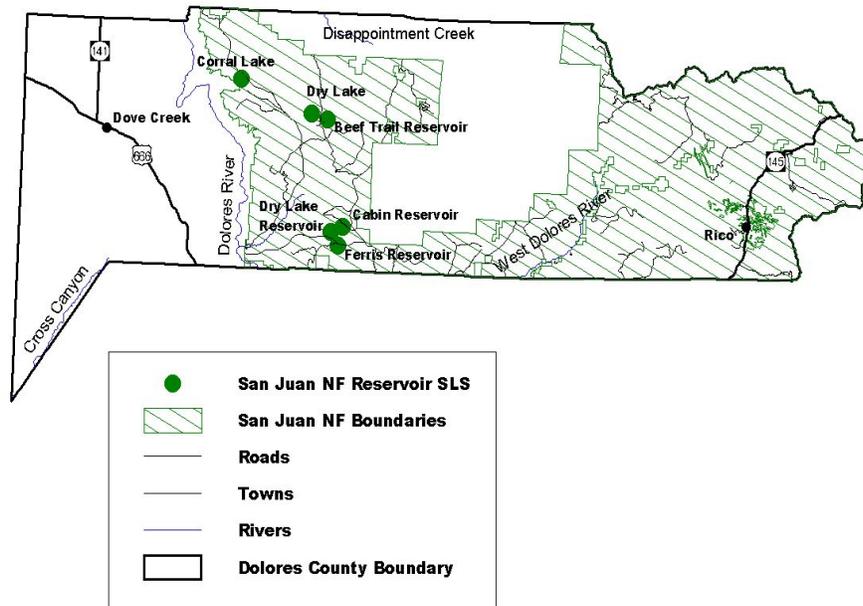
Protection Comments: The SLS is within the San Juan National Forest.

Management Comments: Threats to the SLS include cattle grazing pressure and subsequent effects such as erosion and weed invasion. Some reservoir shorelines are impacted e.g., bare soil, hoof prints. In the Corral Lake area hay grasses and noxious weeds are present in the adjacent uplands e.g., smooth brome (*Bromus inermis*), tansy mustard (*Descurainia sophia*).

Soils Description: Soils sampled at Ferris Reservoir and Cabin Reservoir draw down zones are silty clay with a very thin layer of organic matter at the surface. Ferris Reservoir emergent zone soil displays muck with black channels. Soil sampled at Corral Lake is accumulating mucky organic matter in the upper horizon (8cm) over silty clay, sandy loam and gleyed clay horizons.

Restoration Potential: Utilizing fencing enclosures for grazing rotation may benefit vegetation production, reduce erosion, and increase usable habitat for waterfowl. Glade Lake is a good example of recovering vegetation after fencing was installed -- several waterfowl nests were observed at Glade Lake in 2004.

Map 29. San Juan National Forest Reservoir Site of Local Significance.



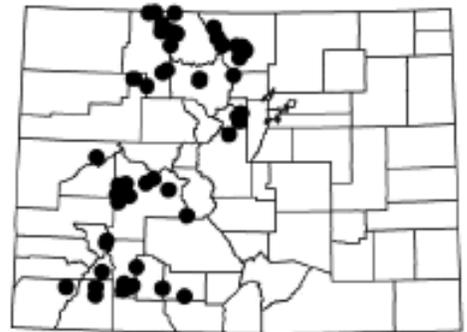
Rare and Imperiled Wetland Plant Communities of Dolores County (adapted from Carsey *et al.* 2003)

Subalpine fir - Engelmann spruce / Thinleaf alder Forest

Abies lasiocarpa - *Picea engelmannii* / *Alnus incana* ssp. *tenuifolia*



Global rank/State rank
G5 / S5
HGM subclass: R2, R3/4
Colorado elevation range:
7,200-10,300 ft (2,200-3,100 m)



General Description

Occurs on heavily forested stream reaches where *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce) forests also occur on adjacent hillslopes. Tall *Alnus incana* ssp. *tenuifolia* (thinleaf alder) and *Salix drummondiana* (Drummond willow) grow in a thick band along the edge of the stream. At lower elevations, *Alnus incana* is more abundant than *Salix drummondiana*. At mid-elevations, the two shrubs can be codominant. At higher elevations, *Salix drummondiana* becomes dominant and *Alnus incana* drops out, forming the *Abies lasiocarpa*-*Picea engelmannii*/*Salix drummondiana* plant association. This is a common community on first- and second-order streams above 8,000 ft in elevation. It is generally found on stream benches and banks in narrow, 150-800 ft (40-250 m) wide, V-shaped valleys. Most commonly occurs within 15-20 ft (5-6 m) of the channel edge and is rarely more than 2 ft (0.5 m) above the stream bank. Stream channels are narrow and steep, moderately wide with a moderate gradient or wide and very sinuous.

Soils are shallow, dark-colored, thin layers of loamy sands, silty loams, and sandy clay loams over cobbly alluvium. There is generally a high organic matter content in the top 20 inches (50 cm) and mottles at 40 inches (100 cm), becoming skeletal at 60 inches (150 cm).

Vegetation Description

Picea engelmannii (Engelmann spruce) and/or *Abies lasiocarpa* (subalpine fir) dominates the upper canopy, with *Picea engelmannii* present more often than *Abies lasiocarpa*. Other tree species such as *Picea pungens* (blue spruce), *Pinus contorta* (lodgepole pine), and *Populus tremuloides* (quaking aspen) are occasionally present. *Alnus incana* ssp. *tenuifolia* (thinleaf alder) is always present in the shrub canopy layer, and other shrubs are often present as well. The herbaceous undergrowth is usually rich in forb species, with an overall herbaceous cover of 20-70%.

Ecological processes

This association appears to be a late-seral, or at least a long-lived, riparian community that may represent a successional change from deciduous-dominated overstory to a conifer-dominated overstory at lower elevations, a shift which may be attributed to a lack of flooding or other frequent disturbance. The successional process of the spruce-fir forest is slow (200 + years); factors such as fire frequency, wind-throw and insect attack can affect the composition and age structure of *Abies lasiocarpa* and *Picea engelmannii* stands.

Potential conservation areas supporting this community type are Navajo Lake Trail. Streams noted within Dolores County supporting this type are Scotch Creek and Silver Creek (near Rico).

Avg. Cover %	(Range)	Species Name	# Plots (N=56)
34	(1-80%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	56
31	(1-82%)	<i>Picea engelmannii</i>	51
22	(1-53%)	<i>Cornus sericea</i> ssp. <i>sericea</i>	8
21	(1-77%)	<i>Abies lasiocarpa</i>	43
17	(3-30%)	<i>Salix geyeriana</i>	8
14	(2-48%)	<i>Pinus contorta</i>	9
12	(1-32%)	<i>Acer glabrum</i>	9
12	(1-43%)	<i>Corydalis caseana</i> ssp. <i>brandegeei</i>	7
9	(0.1-95%)	<i>Calamagrostis canadensis</i>	32
9	(1-43%)	<i>Equisetum arvense</i>	29
7	(1-20%)	<i>Salix drummondiana</i>	25
7	(1-10%)	<i>Picea pungens</i>	9
6	(1-30%)	<i>Lonicera involucrata</i>	40
5	(0.1-15%)	<i>Carex aquatilis</i>	9
5	(1-21%)	<i>Populus tremuloides</i>	15
5	(1-20%)	<i>Salix monticola</i>	6

Other species with < 5% average cover present in at least 10% of plots:

Heracleum maximum (0.1-25%), *Oxyopolis fendleri* (1-34%), *Mertensia ciliata* (0.1-11%), *Mertensia franciscana* (1-7%), *Amelanchier alnifolia* (1-10%), *Maianthemum racemosum* ssp. *amplexicaule* (1-18%), *Rubus parviflorus* (1-10%), *Streptopus amplexifolius* var. *chalazatus* (1-8%), *Pyrola asarifolia* ssp. *asarifolia* (1-10%), *Cardamine cordifolia* (1-11%), *Glyceria striata* (1-14%), *Ribes inerme* (1-10%), *Saxifraga odontoloma* (1-10%), *Symphotrichum foliaceum* (1-10%), *Hydrophyllum fendleri* (1-10%), *Vaccinium scoparium* (1-8%), *Ribes lacustre* (1-7%), *Viola canadensis* var. *scopulorum* (0.1-20%), *Galium trifidum* ssp. *subbiflorum* (1-10%), *Equisetum pratense* (1-6%), *Osmorhiza depauperata* (1-10%), *Aconitum columbianum* (1-10%), *Actaea rubra* ssp. *arguta* (1-8%), *Senecio triangularis* (1-9%), *Arnica cordifolia* (1-7%), *Thalictrum fendleri* (1-10%), *Mitella pentandra* (1-10%), *Geranium richardsonii* (1-8%), *Rosa woodsii* (1-7%), *Chamerion angustifolium* ssp. *circumvagum* (1-6%), *Maianthemum stellatum* (1-8%), *Osmorhiza berteroi* (1-3%), *Dodecatheon pulchellum* (1-5%), *Galium triflorum* (1-8%), *Chaenactis douglasii* (1-4%), *Elymus glaucus* (1-5%), *Carex disperma* (0.1-5%), *Orthilia secunda* (1-3%), *Conioselinum scopulorum* (0.1-5%), *Rubus idaeus* ssp. *strigosus* (1-3%), *Luzula parviflora* (0.1-4%), *Taraxacum officinale* (1-3%), *Achillea millefolium* var. *occidentalis* (1-5%), *Poa pratensis* (1-4%), *Pyrola minor* (1-3%), *Geum macrophyllum* var. *perincisum* (0.1-3%), *Fragaria virginiana* ssp. *glauca* (1-3%), *Pseudocymopterus montanus* (1-2%), *Galium boreale* (1-3%), *Carex microptera* (1-2%), *Bromus ciliatus* var. *ciliatus* (1%).

Thinleaf alder / Mesic forb Shrubland

Alnus incana ssp. *tenuifolia* / Mesic forb

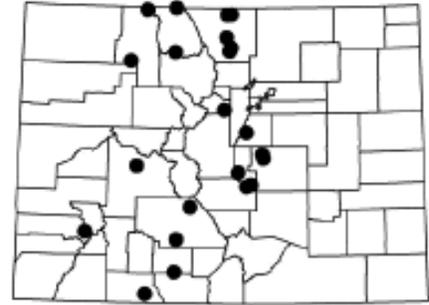


Global rank/State rank:

G3 / S3

HGM subclass: R2, R3/4

Colorado elevation range:
5,800-9,600 ft (1,750-2,930 m)



General Description

This association is characterized by stands of medium-tall, deciduous shrubs and a thick, herbaceous undergrowth of forbs and wetland grasses. A low canopy of shorter shrubs may also be present with *Ribes* (currant) and *Salix* (willow) species and *Cornus sericea* (red-osier dogwood). Undisturbed stands have abundant forbs and native grasses. Stands disturbed by season-long livestock grazing have reduced forb cover and an increase in non-native grasses including *Poa pratensis* (Kentucky bluegrass) and *Agrostis stolonifera* (creeping bentgrass). Large stands (>0.5 acre, 0.2 ha) with the native herbaceous undergrowth intact are uncommon. This plant association occurs along narrow, 130-230 ft (40-70 m) wide, alluvial benches and terraces of canyons and valleys. It also occurs as narrow bands in wider valleys and occasionally forms a wide band on the floodplain. Stream channels are highly variable. They can be steep (3-12%) gradient and narrow or wider, rocky, and moderately sinuous. Occasionally, stream channels are low gradient and highly sinuous, narrow and highly sinuous, or braided. Soils are well-drained silt loams, loams, sandy clay loams, sandy loams, or just sand. Some profiles have a high percentage of organic matter and are either skeletal or stratified with skeletal layers. Some profiles have significant silt fractions in the upper layers.

Vegetation Description

Alnus incana ssp. *tenuifolia* (thinleaf alder) creates a dense, tall shrub canopy. Other shrubs occasionally present include *Lonicera involucrata* (twinberry honeysuckle), *Ribes inerme* (whitestem gooseberry), *R. montigenum* (gooseberry currant) *Rosa woodsii* (Woods rose), *Salix bebbiana* (Bebb willow), *S. drummondiana* (Drummond willow), *S. geyeriana* (Geyer willow), *S. lucida* ssp. *caudata* (shining willow) and *S. monticola* (mountain willow). A few trees, including *Picea engelmannii* (Engelmann spruce), *Populus tremuloides* (quaking aspen), and *Populus angustifolia* (narrowleaf cottonwood) may be present along the edges of the stand. The ground is

generally very wet and covered with tall, 3-7 ft (1-2 m), forbs and graminoids. Forb cover is high in undisturbed stands, with total cover often exceeding 60%. Dominant forb species include *Heracleum maximum* (common cowparsnip), *Angelica ampla* (giant angelica), *Aconitum columbianum* (Columbian monkshood), *Mertensia ciliata* (tall fringed bluebells), *Rudbeckia laciniata* var. *ampla* (cutleaf coneflower), *Viola canadensis* var. *scopulorum* (Canada white violet) and *Streptopus amplexifolius* (claspleaf twistedstalk). Graminoid species include *Glyceria striata* (fowl mannagrass), *Calamagrostis canadensis* (bluejoint reedgrass), *Carex microptera* (smallwing sedge), and *C. utriculata* (beaked sedge). A dense ground cover also includes *Equisetum arvense* (field horsetail), *Equisetum hyemale* (scouringrush horsetail) and *Equisetum pratense* (meadow horsetail).

Ecological Processes

Alnus incana ssp. *tenuifolia* (thinleaf alder) is a long-lived, early-seral species. It is one of the first species to establish on fluvial or glacial deposits as well as the spoils of placer mining. After establishment, young stands of *Alnus incana* are continually flooded. As stands mature, the stems can slow flood waters and trap sediment. Fine-textured sediments accumulate on top of the coarser alluvial material and the land

surface eventually rises above annual flood levels. Flooding is then less frequent and soils begin to develop.

This plant community is found at Silver Creek and Johnny Bull Creek PCA.

Avg. Cover		Species Name	# Plots (N=56)
%	(Range)		
56	(10-98%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	56
14	(0.1-70%)	<i>Heracleum maximum</i>	42
12	(1-70%)	<i>Aconitum columbianum</i>	27
9	(0.1-18%)	<i>Picea engelmannii</i>	14
8	(1-62.5%)	<i>Senecio triangularis</i>	27
7	(1-40%)	<i>Mertensia ciliata</i>	40
7	(1-20%)	<i>Salix drummondiana</i>	15
7	(1-20%)	<i>Rudbeckia laciniata</i> var. <i>ampla</i>	13
7	(1-20%)	<i>Populus tremuloides</i>	14
7	(1-18%)	<i>Salix geyeriana</i>	8
7	(1-70%)	<i>Rosa woodsii</i>	14
6	(1-30%)	<i>Ribes inerme</i>	12
6	(1-32%)	<i>Salix lucida</i> ssp. <i>caudata</i> , <i>lasiandra</i>	11
6	(1-30%)	<i>Lonicera involucrata</i>	25
6	(1-16%)	<i>Salix monticola</i>	13
6	(1-30%)	<i>Equisetum arvense</i>	39
5	(1-25%)	<i>Cardamine cordifolia</i>	21
5	(1-13%)	<i>Urtica dioica</i> ssp. <i>gracilis</i>	13
5	(1-20%)	<i>Calamagrostis canadensis</i>	31
5	(1-11%)	<i>Salix bebbiana</i>	7

Other species with < 5% average cover present in at least 10% of plots:

Maianthemum stellatum (0.1-27%), *Glyceria striata* (0.1-15%), *Geranium richardsonii* (1-15%), *Elymus glaucus* (1-10%), *Mentha arvensis* (1-14%), *Oxypolis fendleri* (1-37.5%), *Rubus idaeus* ssp. *strigosus* (1-15%), *Carex utriculata* (1-6%), *Poa pratensis* (1-12%), *Streptopus amplexifolius* var. *chalazatus* (0.1-10%), *Saxifraga odontoloma* (1-5%), *Taraxacum officinale* (1-13%), *Conioselinum scopulorum* (1-10%), *Abies lasiocarpa* (1-6%), *Arnica cordifolia* (1-11%), *Mitella pentandra* (1-6%), *Galium boreale* (1-10%), *Carex aquatilis* (1-5%), *Galium triflorum* (1-5%), *Osmorhiza depauperata* (1-5%), *Thalictrum fendleri* (1-5%), *Achillea millefolium* var. *occidentalis* (1-8%), *Actaea rubra* ssp. *arguta* (1-5%), *Phleum pratense* (0.1-10%), *Bromus inermis* (1-5%), *Fragaria virginiana* ssp. *glauca* (1-3%), *Geum macrophyllum* var. *perincisum* (0.1-3%), *Carex microptera* (1-3%), *Chamerion angustifolium* ssp. *circumvagum* (1%).

Thinleaf alder-Drummond willow Shrubland

Alnus incana ssp. *tenuifolia* - *Salix drummondiana*



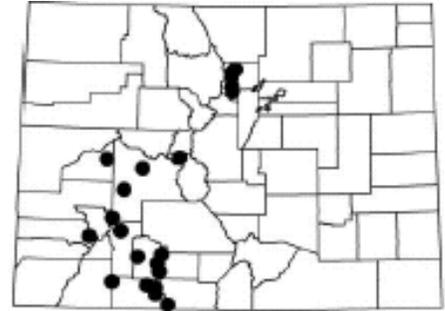
Global rank/State rank:

G3 / S3

HGM subclass: R2, R3/4

Colorado elevation range:

7,300-9,700 ft (2,200-3,000m)



General Description

Alnus incana ssp. *tenuifolia*-*Salix drummondiana* (thinleaf alder-Drummond willow) is a relatively common plant association on the Western Slope. The association is generally found along steep-gradient streams with stable, shaded stream banks. This association occurs in the Gunnison, Arkansas, and St. Vrain River Basins and the San Juan and Rio Grande National Forests.

This association occurs along very steep, fast-moving streams in sheer-walled, confined canyons. It also occurs along or within the active channel of moderately to slightly entrenched channels in wider valleys. Stream channels are steep and rocky, less steep with limited floodplains and gravel and cobble bottoms, or wide and sinuous. Soils of this association are highly variable, but most are stratified alluvium with buried A horizons. Stands with a rich, herbaceous undergrowth have a thick layer, 5-10 inches (10-30 cm), of fine sandy loam and sandy clay loam over a coarse alluvial deposit. Stands with little shrub cover and herbaceous growth have coarse, skeletal soils without an accumulated fine layer at the surface.

Vegetation Description

This plant association is characterized by a dense, closed canopy of *Alnus incana* ssp. *tenuifolia* (thinleaf alder) and *Salix drummondiana* (Drummond willow) bordering the stream. Other willows that may be present include *Salix monticola* (mountain willow), *S. boothii* (Booth willow), *S. exigua* (sandbar willow), *S. lucida* (ssp. *caudata* or ssp. *lasiandra*) (shining willow), and *S. geyeriana* (Geyer willow). Other shrubs occasionally present include *Lonicera involucrata* (twinberry honeysuckle), *Ribes inerme* (whitestem gooseberry), *Cornus sericea* (red-osier dogwood), *Rosa woodsii* (Woods rose), *Amelanchier utahensis* (Utah serviceberry), *Acer glabrum* (Rocky Mountain maple), *Symphoricarpos oreophilus* (mountain snowberry), and *Ribes montigenum* (gooseberry currant). Some stands have a rich herbaceous understory that includes *Oxypolis fendleri* (Fendler cowbane), *Heracleum maximum* (common cow parsnip), *Equisetum pratense* (field horsetail), *Mertensia ciliata* (tall fringed bluebells) *Rudbeckia laciniata* var. *ampla* (cutleaf coneflower), and *Angelica ampla* (giant angelica). In some stands, the herbaceous undergrowth is sparse (less than 10% cover) due to shading and flood scouring.

Ecological Processes

The *Alnus incana* ssp. *tenuifolia*-*Salix drummondiana* (thinleaf alder-Drummond willow) plant association is an early to midseral community restricted to stream margins, rarely forming large, extensive stands. Both species are prolific seed producers and are the first to colonize coarse-textured cobble bars and recently scoured alluvial surfaces. When young, these shrubs are flexible, can tolerate most flood events, and readily resprout. With time, *Salix drummondiana* may become more abundant by taking advantage of the nitrogen-rich soils associated with *Alnus incana* ssp. *tenuifolia*.

This association occurs within the Dolores River at Peterson Slide and Fish Creek at Black Mesa PCAs.

Avg. Cover		Species Name	# Plots (N=22)
%	(Range)		
46	(14-98%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	22
27	(7-60%)	<i>Salix drummondiana</i>	22
13	(2-70%)	<i>Heracleum maximum</i>	13
11	(2-30%)	<i>Carex utriculata</i>	4
10	(1-43%)	<i>Salix monticola</i>	12
9	(1-30%)	<i>Calamagrostis canadensis</i>	13
8	(1-30%)	<i>Equisetum arvense</i>	10
7	(1-23%)	<i>Picea pungens</i>	7
6	(1-25%)	<i>Salix lucida</i> ssp. <i>caudata</i> , <i>lasiandra</i>	6
6	(1-20%)	<i>Lonicera involucrata</i>	11
6	(1-16%)	<i>Equisetum pratense</i>	5
6	(1-10%)	<i>Geranium richardsonii</i>	9
5	(1-15%)	<i>Mertensia ciliata</i>	14
5	(1-11%)	<i>Abies lasiocarpa</i>	4
5	(1-10%)	<i>Poa pratensis</i>	10

Other species with < 5% average cover present in at least 10% of plots:

Cardamine cordifolia (1-11%), *Rudbeckia laciniata* var. *ampla* (1-10%), *Taraxacum officinale* (1-13%), *Salix bebbiana* (3-7%), *Picea engelmannii* (0.1-10%), *Cornus sericea* (1-10%), *Ribes inerme* (1-6%), *Oxypolis fendleri* (0.1-14%), *Carex microptera* (1-9%), *Fragaria vesca* ssp. *bracteata* (1-8%), *Thalictrum fendleri* (1-5%), *Rubus idaeus* ssp. *strigosus* (1-5%), *Mertensia franciscana* (1-6%), *Achillea millefolium* var. *occidentalis* (1-8%), *Fragaria virginiana* ssp. *glauca* (1-10%), *Viola canadensis* var. *scopulorum* (1-4%), *Osmorhiza depauperata* (1-3%), *Galium triflorum* (1-3%), *Senecio triangularis* (1-5%), *Geum macrophyllum* var. *perincisum* (0.1-4%), *Galium boreale* (1-5%), *Conioselinum scopulorum* (0.1-4%), *Chamerion angustifolium* ssp. *circumvagum* (1-2%), *Luzula parviflora* (0.1-4%), *Maianthemum stellatum* (1-2%), *Rosa woodsii* (1%).

Thinleaf alder / Mesic graminoid Shrubland

Alnus incana ssp. *tenuifolia* / Mesic graminoid



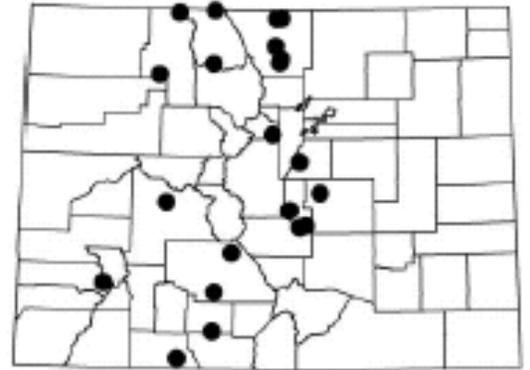
Global rank/State rank:

G3/ S3

HGM subclass: S3/4, R2, R3/4

Colorado elevation range:

6,400-9,800 ft (2,000-3,000 m)



General Description

The *Alnus incana* ssp. *tenuifolia*/mesic graminoid plant association is a stand of medium-tall deciduous shrubs with a thick herbaceous cover of mostly native forb and grass species and little to no overstory tree canopy. Heavily disturbed stands have abundant non-native grasses. While many stands in Colorado fit the latter description, there are also several stands that remain undisturbed where the undergrowth is dominated by native graminoid cover.

This plant association occurs on narrow to moderately wide floodplains, stream benches, frequently flooded point bars, recently deposited islands, and dredged stream banks. It also occurs on isolated hillside seeps. Stream channels can be steep and straight to highly sinuous or moderately steep and sinuous. Where this association occurs on point bars, stream channels are low gradient (<1%) and highly sinuous.

Soils are mostly coarse alluvium, but characteristically have silt loams or sandy clay loams at the surface with a high percentage of organic matter. Soils are shallow to moderately deep, 15-30 inches (35-62 cm), and become increasingly skeletal with depth. Most profiles have 10-50% mottles at 7-10 inches (18-25 cm) depth.

Vegetation Description

Alnus incana ssp. *tenuifolia* (thinleaf alder) dominates the upper canopy. Other shrubs occasionally present include *Rosa woodsii* (Woods rose), *Rubus deliciosus* (Boulder raspberry), *Salix bebbiana* (Bebb willow), *S. drummondiana* (Drummond willow), *S. exigua* (sandbar willow), and *S. monticola* (mountain willow). Trees are infrequent and may be scattered throughout the shrubland or they may occur along one edge.

Tree species include *Pinus ponderosa* (ponderosa pine), *Populus tremuloides* (quaking aspen), and *Picea engelmannii* (Engelmann spruce). The undergrowth is a thick carpet of grasses. Native

graminoids include *Calamagrostis canadensis* (bluejoint reedgrass), *Carex utriculata* (beaked sedge), *Glyceria striata* (fowl mannagrass), *Carex aquatilis* (water sedge), *Carex pellita* (woolly sedge) and *Festuca rubra* (red fescue). Some stands are dominated by introduced, non-native grasses, including *Poa pratensis* (Kentucky bluegrass), *Agrostis stolonifera* (creeping bentgrass), and *Bromus inermis* (smooth brome). Forb cover is usually low relative to the amount of graminoid cover in both disturbed and undisturbed stands, but can include a high variety of species, including *Mertensia ciliata* (tall fringed bluebells), *Mentha arvensis* (wild mint), *Cardamine cordifolia* (heartleaf bittercress) and *Caltha leptosepala* (marsh marigold).

Ecological Processes

Alnus incana ssp. *tenuifolia* (thinleaf alder) is a long-lived, early-seral species. It is one of the first species to establish on fluvial or glacial deposits as well as the spoils of placer mining. After establishment, young stands of *Alnus* are continually flooded. As stands mature, the stems can slow flood waters and trap sediment. Fine-textured sediments accumulate on top of the coarser alluvial material and the land surface eventually rises above annual flood levels. Flooding is then less frequent and soils begin to develop. *Alnus incana* ssp. *tenuifolia* is shade-intolerant, 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.

This plant association was noted in a riverine wetland on Dolores River in the Town of Rico.

Avg. Cover %	(Range)	Species Name	# Plots (N=25)
56	(8-95%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	25
27	(1-65%)	<i>Calamagrostis canadensis</i>	14
15	(1-41%)	<i>Poa pratensis</i>	16
12	(2-26%)	<i>Salix exigua</i>	8
11	(2-26%)	<i>Glyceria striata</i>	6
10	(1-19%)	<i>Carex disperma</i>	4
10	(1-29%)	<i>Salix bebbiana</i>	4
10	(3-19%)	<i>Betula occidentalis</i>	4
9	(1-48%)	<i>Rosa woodsii</i>	8
9	(1-25%)	<i>Agrostis stolonifera</i>	6
9	(1-32%)	<i>Carex utriculata</i>	7
7	(1-23%)	<i>Bromus inermis</i>	5
6	(1-10%)	<i>Pinus ponderosa</i> var. <i>scopulorum</i>	5
6	(1-14%)	<i>Salix ligulifolia</i>	5
6	(1-20%)	<i>Carex aquatilis</i>	8
6	(1-15%)	<i>Mertensia ciliata</i>	12
5	(3-7%)	<i>Carex microptera</i>	5

Other species with < 5% average cover present in at least 10% of plots:

Heracleum maximum (1-11%), *Salix monticola* (1-16%), *Juncus balticus* var. *montanus* (1-10%), *Mentha arvensis* (0.1-14%), *Equisetum arvense* (1-14%), *Cardamine cordifolia* (1-8%), *Ribes inerme* (1-8%), *Taraxacum officinale* (1-14%), *Trifolium repens* (1-7%), *Achillea millefolium* var. *occidentalis* (1-13%), *Geum macrophyllum* var. *perincisum* (1-5%), *Urtica dioica* ssp. *gracilis* (1-5%), *Galium boreale* (1-3%), *Rubus idaeus* ssp. *strigosus* (1-5%), *Geranium richardsonii* (1-4%), *Phleum pratense* (1-2%), *Fragaria virginiana* ssp. *glauca* (1-2%), *Oxypolis fendleri* (1-2%), *Maianthemum stellatum* (0.1-2%).

Mancos columbine - (Eastwood monkeyflower) Hanging Garden

Aquilegia micrantha - (*Mimulus eastwoodiae*)



Global rank/State rank:

G2G3 / S2S3

HGM subclass: S3/4

Colorado elevation range:

5,200-6,500 ft (1,585-1,980 m)



General Description

Hanging gardens flourish in the sandstone canyons of the Colorado River drainage. Three main garden types have been described: alcove, terrace, or windowblind. The type is determined by the nature of the geological formation and the presence or absence of joint systems. In general, the hanging gardens result from ancient swales or valleys in a sand dune-swale system that developed between the Cretaceous and Pennsylvanian periods (65-310 mya). The formations with greatest development are the Navajo and Entrada, both of them cross-bedded, massive formations composed of wind-blown sand and containing ancient pond bottoms that serve as impervious bedding planes. In Colorado, this plant association is often found in seeps at the base of the Wingate sandstone formation just above contact with the underlying Chinle formation.

The *Aquilegia micrantha*-(*Mimulus eastwoodiae*) (Mancos columbine-(Eastwood monkeyflower)) plant association occurs on seeping sandstone walls and in alcoves. Known localities are in overhanging caverns cut into steep, sheer Wingate sandstone walls by springs and seeps. These tend to occur in small draws on the southeastfacing sides of canyons, but probably are not restricted to this exposure.

Vegetation Description

The seeps are often under overhanging cliffs or emerge from a vertical sandstone face. *Aquilegia micrantha* (Mancos columbine) is typically abundant while *Mimulus eastwoodiae* (Eastwood monkeyflower) is less so. A few shrubs, such as *Prunus virginiana* (chokecherry), *Ribes aureum* (golden currant), or *Betula occidentalis* (river birch) may occur nearby. Other species found in these seeps include the fern *Adiantum capillus-veneris* (common maidenhair), *Epipactis gigantea* (giant helleborine or stream orchid), and occassionally the globally imperiled (G2) *Erigeron kachinensis* (Kachina daisy).

Ecological Processes

Aquilegia micrantha-(*Mimulus eastwoodiae*) (Mancos columbine-(Eastwood monkeyflower)) hanging gardens are often lush, stable and long-lived wetlands. Their physical location reduces the risk of disturbance, although disturbance of the water source can eliminate the association. This association is expected to occur within the Dolores River Canyon.

There is no stand data available.

River birch / Mesic forb Shrubland

Betula occidentalis / Mesic forb

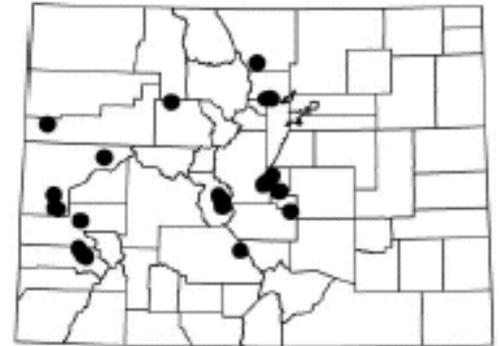


Global rank/State rank:

G3 / S2

HGM subclass: R3/4

Colorado elevation range:
6,300-8,800 ft (1,900-2,700 m)



General Description

This association is characterized by a tall, narrow band of shrubs lining the stream channel. The undergrowth can be sparse or a thick carpet of grasses and forbs. In undisturbed stands, forb species richness can be high.

This association occupies moderately wide stream benches and floodplains in narrow to moderately wide valleys and on hillside seeps. At lower elevations along sunny valley bottoms, well-developed, large occurrences occupy relatively flat stream benches and often extend away from the channel edge. Stream channels are wide, rocky/cobble-bottomed, moderately steep, and sinuous, wide, cobble-bottomed, less steep, and highly sinuous, or braided from beaver activity. This association also occurs along small floodplains of steep-gradient, narrow streams where the valley side slope meets the stream edge. In such settings *Betula occidentalis* (river birch) is squeezed between large boulders and herbaceous growth is limited to small pockets, or is found around seeps adjacent to the stream channel and along isolated springs on hillslopes away from the valley bottom (these may be in different HGM subclasses).

Soils are fairly shallow, ranging from 12 to 25+ inches (30-60+ cm), and have a surface layer of 50-90% organic matter. Subsurface layers are clay loams, sandy clays, and sandy loams. Stands along narrow, steep stream channels occur between large alluvial and colluvial boulders and have almost no soil development.

Vegetation Description

Betula occidentalis (river birch) forms a nearly continuous tall-shrub to small-tree canopy along the stream bank. Other shrubs may include *Alnus incana* ssp. *tenuifolia* (thinleaf alder), *Cornus sericea* (red-osier dogwood), *Salix exigua* (sandbar willow), *Jamesia americana* (cliffbush), *Amelanchier utahensis* (Utah serviceberry), *Prunus virginiana* (chokecherry), and *Salix monticola* (mountain willow). Along narrow valleys at higher elevations, conifers may overhang the stream edge. Conifer species include *Pseudotsuga menziesii* (Douglas-fir), *Abies lasiocarpa* (subalpine fir), *Picea pungens* (blue spruce), and *Pinus ponderosa* (ponderosa pine).

Although some stands have considerable herbaceous cover, herbaceous undergrowth is usually limited due to the dense shrub canopy. Forb cover can include *Maianthemum stellatum* (starry false Solomon seal), *Heracleum maximum* (common cowparsnip), *Thalictrum fendleri* (Fendler meadowrue) and *Rudbeckia laciniata* var. *ampla* (cutleaf coneflower). Graminoid cover is usually low, but can include *Poa pratensis* (Kentucky bluegrass), *Carex utriculata* (beaked sedge), *Juncus balticus* var. *montanus* (mountain rush), *Calamagrostis canadensis* (bluejoint reedgrass), and *Agrostis stolonifera* (creeping bentgrass). *Equisetum arvense* (field horsetail) may also be present.

Ecological Processes

This association is considered a mid-seral type. With prolonged heavy grazing, it may succeed to a *Salix* (willow) dominated association. It may also be an early successional stage for conifer-dominated associations. *Betula occidentalis* can tolerate flooding, but not permanent inundation. *Betula occidentalis* occurs at slightly lower elevations and on lower- gradient stream reaches than *Alnus incana* ssp. *tenuifolia* (thinleaf alder). Because *Betula occidentalis* communities occupy low elevation, foothill habitats in Colorado, they are more threatened by development and stream impoundments than *Alnus incana* ssp. *tenuifolia* or *Cornus sericea* (red-osier dogwood) riparian communities.

This association occurs along the Disappointment Creek in Dolores County.

Avg. Cover %	(Range)	Species Name	# Plots (N=26)
55	(14-98%)	<i>Betula occidentalis</i>	26
18	(1-53%)	<i>Cornus sericea</i> ssp. <i>sericea</i>	11
16	(1-66%)	<i>Pseudotsuga menziesii</i>	7
16	(1-60%)	<i>Angelica ampla</i>	5
12	(8-21%)	<i>Picea pungens</i>	5
11	(1-38%)	<i>Salix monticola</i>	8
10	(1-40%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	16
10	(1-30%)	<i>Lonicera involucrata</i>	5
10	(1-40%)	<i>Maianthemum stellatum</i>	19
9	(1-34%)	<i>Poa pratensis</i>	16
8	(1-34%)	<i>Heracleum maximum</i>	11
7	(1-16%)	<i>Calamagrostis canadensis</i>	5
7	(1-25%)	<i>Salix exigua</i>	8
7	(1-23%)	<i>Carex utriculata</i>	5
7	(4-13%)	<i>Agrostis stolonifera</i>	5
6	(1-17%)	<i>Juniperus scopulorum</i>	9
6	(1-36%)	<i>Equisetum arvense</i>	15
6	(1-17%)	<i>Juncus balticus</i> var. <i>montanus</i>	12
5	(1-18%)	<i>Rosa woodsii</i>	19
5	(1-17%)	<i>Prunus virginiana</i> var. <i>melanocarpa</i>	6

Other species with < 5% average cover present in at least 10% of plots:

Thalictrum fendleri (1-21%), *Equisetum hyemale* var. *affine* (1-10%), *Geranium richardsonii* (1-10%), *Rubus idaeus* ssp. *strigosus* (1-10%), *Rudbeckia laciniata* var. *ampla* (1-10%), *Ribes inerme* (0.1-10%), *Cirsium arvense* (0.1-5%), *Mertensia ciliata* (1-2%), *Achillea millefolium* var. *occidentalis* (1-3%), *Vicia americana* (1-2%), *Galium boreale* (0.1-2%), *Taraxacum officinale* (0.1-2%).

**Heartleaf bittercress - Tall fringed bluebells - Arrowleaf ragwort
Herbaceous Vegetation**

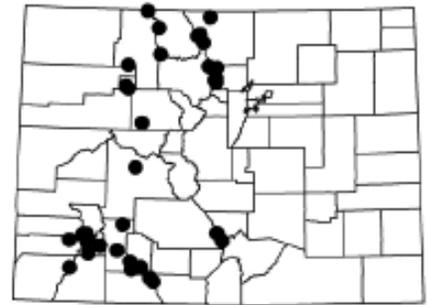
Cardamine cordifolia - *Mertensia ciliata* - *Senecio triangularis*

Global rank/State rank:

G4 / S4

HGM subclass: S1/2, R1, R2

Colorado elevation range:
8,450-12,300 ft (2,570-3,800 m)



General Description

The generally small stands of the *Cardamine cordifolia*-*Mertensia ciliata*-*Senecio triangularis* (heartleaf bittercress-tall fringed bluebells-arrowleaf groundsel) plant association are found in and near running water of small streams, seeps, and springs.

Associated taxa may vary greatly with this plant association, but the dominance of *Cardamine cordifolia*, *Mertensia ciliata* or *Senecio triangularis* is clear. All of these species, or only one of the three, may be present. If trees form a canopy above the forbs, the stand may belong to the *Abies lasiocarpa*-*Picea engelmannii*/*Mertensia ciliata* (subalpine fir-Engelmann spruce/tall fringed bluebells) association.

This association typically occurs on moderately steep to very steep first order streams, but can occur on less steep stream reaches as well. In many cases this habitat probably experiences a long period of snow cover. Soils can be moderately deep (15 in, 40 cm) sandy clay loam and sand, but in general are quite thin and skeletal.

Vegetation Description

This association is easy to recognize. It is a narrow band of forbs and mosses with one or more of the following three forb species being abundantly present: *Cardamine cordifolia* (heartleaf bittercress), *Mertensia ciliata* (tall fringed bluebells) and *Senecio triangularis* (arrowleaf ragwort). All of these species may be present or only one of them. In addition, this type is always rich in other forbs. Stands generally have at least fifteen species, and often have as many as 45 forb species present. This diversity is made up of a wide variety of forb species; some can be quite abundant. Other forb species include *Saxifraga odontoloma* (brook saxifrage), *Mitella pentandra* (fivestamen miterwort), *Oxypolis fendleri* (Fendler cowbane), *Delphinium barbeyi* (tall larkspur), *Epilobium* spp. (willowherb), *Caltha leptosepala* (marsh marigold), *Geranium richardsonii* (Richardson geranium), *Arnica cordifolia* (heartleaf arnica), *Conioselinum scopulorum* (Rocky Mountain hemlockparsley), *Rhodiola integrifolia* ssp. *integrifolia* (ledge stonecrop), *Primula parryi* (Parry primrose), *Corydaliscaseana* ssp. *brandegei* (Brandege fumewort), *Senecio taraxacoides* (dandelion ragwort), *Heracleum maximum* (common cowparsnip), and *Ligusticum porteri* (Porter licoriceroot), among others.

Ecological Processes

This association is found in a habitat which is early-seral and experiences frequent fluvial depositions, keeping any invading conifers from advancing beyond the sapling stage. Although it is an early-seral community, the *Cardamine cordifolia-Mertensia ciliata-Senecio triangularis* plant association is reasonably stable because it is maintained by frequent disturbance. However, with excessive grazing by sheep, it may be converted to communities dominated by various increaser species.

This association occurs within the Fish Creek at Dunn Peak PCA.

Avg. Cover		Species Name	# Plots (N=57)
%	(Range)		
33	(1-87%)	<i>Cardamine cordifolia</i>	51
27	(1-80%)	<i>Mertensia ciliata</i>	36
24	(0.1-90%)	<i>Senecio triangularis</i>	37
11	(1-30%)	<i>Heracleum maximum</i>	10
8	(0.1-30%)	<i>Oxypolis fendleri</i>	19
8	(0.1-30%)	<i>Rhodiola integrifolia</i>	5
8	(0.1-37%)	<i>Saxifraga odontoloma</i>	31
7	(2-20%)	<i>Equisetum arvense</i>	11
7	(1-25%)	<i>Carex aquatilis</i>	7
7	(0.1-20%)	<i>Calamagrostis canadensis</i>	10
6	(0.1-30%)	<i>Caltha leptosepala</i>	24
6	(0.1-15%)	<i>Carex scopulorum</i>	6
6	(1-18%)	<i>Geranium richardsonii</i>	8
5	(0.1-28%)	<i>Picea engelmannii</i>	10
5	(1-24%)	<i>Arnica mollis</i>	8

Other species with < 5% average cover present in at least 10% of plots:
Aconitum columbianum (1-15%), *Juncus mertensianus* (0.1-15%), *Deschampsia caespitosa* (0.1-20%), *Carex utriculata* (1-7%), *Conioselinum scopulorum* (1-5%), *Rhodiola rhodantha* (1-3.1%), *Primula parryi* (0.1-13%), *Mitella pentandra* (0.1-6%), *Taraxacum officinale* (1-9%), *Mimulus guttatus* (1-3%), *Poa leptocoma* (0.1-5%), *Erigeron peregrinus* ssp. *callianthemus* (0.1-7%), *Castilleja rhexiifolia* (0.1-3%), *Phleum alpinum* (0.1-3%), *Trollius laxus* ssp. *albiflorus* (0.1-3%), *Achillea millefolium* var. *occidentalis* (1-3%), *Sibbaldia procumbens* (0.1-3%), *Luzula parviflora* (1-3%), *Juncus drummondii* (0.1-3%), *Polygonum bistortoides* (0.1-3%), *Epilobium anagallidifolium* (0.1-4%), *Stellaria umbellata* (0.1-1%), *Veronica wormskjoldii* (0.1-1%), *Poa reflexa* (0.1-1%).

Water sedge Herbaceous Vegetation

Carex aquatilis



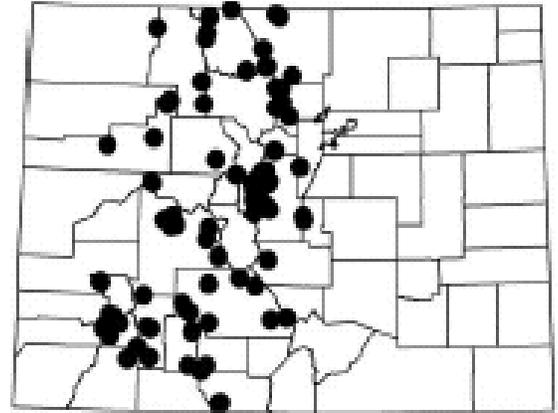
Global rank/State rank:

G5 / S4

HGM subclass: S1/2

Colorado elevation range:

7,600-11,800 ft (2,300-3,600 m)



General Description

Carex aquatilis (water sedge) is a common, widespread plant association that can occur as large meadows in high montane valleys or as narrow strips bordering ponds and streams at lower elevations. It occurs in a variety of environmental settings in the montane and subalpine zones. A clear dominance by *Carex aquatilis* and low cover of *C. utriculata* (beaked sedge) or *Pedicularis groenlandica* (elephanthead lousewort) set this plant association apart from closely related types. This plant association occurs in a variety of valley types, but the largest expanses occur in broad, low-gradient valleys where large snow-melt fed swales and slopes dominate the landscape. It can also grow in fine sediments at the margins of lakes and beaver ponds. The largest occurrences are found adjacent to narrow, deep, sinuous streams. Some stands occur along steep streams, others along wide, shallow streams, as well as where beaver dams and ponds have altered the channel morphology.

Soils are mostly deep, dark colored heavy clays, silts or organic layers over more skeletal layers. Soils are often saturated to the surface, and if not, mottling is commonly present within 10 cm of the surface.

Vegetation Description

This plant association is characterized by a dense rhizomatous meadow of *Carex aquatilis* (water sedge), usually accompanied by a few other graminoids species such as *Calamagrostis canadensis* (bluejoint reedgrass) or *Deschampsia caespitosa* (tufted hairgrass). *Eleocharis quinqueflora* (fewflower spikerush) can be abundant on organic substrates. *Carex utriculata* (beaked sedge) may be present. When present, *Carex utriculata* (beaked sedge) is usually not more than one third the cover of *C. aquatilis* (water sedge) cover. If it is more than that, the stand may be a *Carex aquatilis* – *Carex utriculata* (water sedge- beaked sedge) or *Carex utriculata* (beaked sedge) plant association. Forbs are often present, although sometimes inconspicuously. Species include *Epilobium* spp. (willowweed), *Pedicularis groenlandica* (elephanthead lousewort), *Caltha leptosepala* (marsh marigold), *Cardamine cordifolia* (heartleaf bittercress), and *Mertensia ciliata* (tall fringed bluebells).

Ecological Processes

Presence of *Carex utriculata* (beaked sedge) may indicate the site has progressed from the more wet *Carex utriculata* community to the current less mesic conditions, and may become dominated by *Salix planifolia* (planeleaf willow) or *Salix wolfii* (Wolf willow). *Carex aquatilis* (water sedge) associations trap sediment from overbank flows which forms a clay pan, eventually raising the water table. This process drives retrogressive succession and a plant association dominated by *Carex utriculata* takes over on these sites.

This plant association occurs at Dolores River at Snow Spur and The Coal Creek Meadows PCAs.

Avg. Cover %	(Range)	Species Name	# Plots (N=133)
60	(5-95%)	<i>Carex aquatilis</i>	133
13	(0.1-48%)	<i>Caltha leptosepala</i>	30
10	(1-30%)	<i>Carex utriculata</i>	35
9	(1-40%)	<i>Calamagrostis canadensis</i>	27
6	(0.1-31%)	<i>Deschampsia caespitosa</i>	40
6	(1-30%)	<i>Juncus balticus</i> var. <i>montanus</i>	19
5	(0.1-30%)	<i>Salix planifolia</i>	32

Other species with < 5% average cover present in at least 10% of plots:
Taraxacum officinale (0.1-20%), *Cardamine cordifolia* (1-15%), *Achillea millefolium* var. *occidentalis* (1-36%), *Poa pratensis* (1-7%), *Geum macrophyllum* var. *perincisum* (0.1-5%), *Pedicularis groenlandica* (0.1-10%), *Rhodiola rhodantha* (0.1-5%).

Awned Sedge Herbaceous Vegetation

Carex atherodes

Global rank/State rank:

G3G5 / S2?



There is no stand data compiled for *Carex atherodes* herbaceous vegetation in Colorado. This association is not included within Field Guide to the Wetland and Riparian Plant Associations of Colorado (Carsey *et al.* 2003).

Carex atherodes plant association at Glade Lake, 2004.

This plant association occurs within the Glade Lake PCA and at Corral Lake in Dolores County.

The following information is summarized from NatureServe Explorer (2005):

General Description

Carex atherodes (awned sedge) herbaceous vegetation distribution is within the northern tallgrass prairie region in the United States and Canada. Colorado, Iowa, Minnesota, North Dakota, and South Dakota document occurrences within the United States. This plant association typically occurs within depressional wetlands, but is also found along streams and rivers. Water can be saline or fresh. Soils are mineral or mucky.

Vegetation Description

Vegetation cover is usually high, and *Carex atherodes* (awned sedge) can form monotypic stands. Plant species that associate with awned sedge herbaceous vegetation include *Alisma triviale* (water plantain), *Symphyotrichum lanceolatum* (white panicle aster), *Eleocharis palustris* (common spikerush), *Glyceria grandis* (American mannagrass) (in drier stands), *Mentha arvensis* (wild mint), *Phalaris arundinacea* (reed canary grass), *Polygonum amphibium* (water smartweed), *Scolochloa festucacea* (common rivergrass), *Sium suave* (hemlock water parsnip), and, *Sparganium eurycarpum* (broad fruit bur-reed).

Ecological Processes

Carex atherodes (awned sedge) plant community occurs on lowlands that have standing water for several weeks of the season. Invasion by shrubs such as *Salix* spp., can occur especially in the eastern part of its range, where fire may be important to shrub invasion prevention. Cover or dominance by *Carex atherodes* can vary according with wet or dry years.

References listed by NatureServe Explorer, *Carex atherodes* herbaceous vegetation page:

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Dix, R. L., and F. E. Smeins. 1967. The prairies, meadows, and marsh vegetation of Nelson County, North Dakota. *Canadian Journal of Botany* 45:21-58.

Looman, J. 1982. The vegetation of the Canadian prairie provinces. III. Aquatic and semi-aquatic vegetation, Part 2. Freshwater marshes and bogs. *Phytocoenologia* 10(4):401-423.

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Smith, A. L. 1973. Life cycle of the marsh grass *Scolochloa festucacea*. *Canadian Journal of Botany* 51:1661-1668.

Stewart, R. E., and H. A. Kantrud. 1971. Classification of natural ponds and lakes in the glaciated prairie region. USDI Bureau of Sport Fisheries and Wildlife Resources, Publication 92. Washington, DC. 77 pp.

Stewart, R. E., and H. A. Kantrud. 1972. Vegetation of prairie potholes, North Dakota, in relation to quality of water and other environmental factors. USDI Geologic Survey Professional Paper 585-d. 36 pp.

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Small-head sedge Herbaceous Vegetation

Carex illota

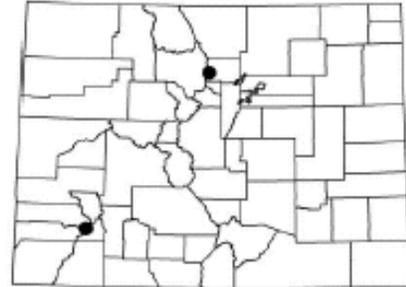


Global rank/State rank:

GUQ / S2

HGM subclass: S1/2

Colorado elevation range:
10,900-12,300 ft (3,320-3,750 m)



General Description

This association is found on lake shores, near springs, and below snow patches in a narrow altitudinal range in the lower alpine. It is characterized by a near monoculture of *Carex illota* (small-head sedge), low cover of other graminoids and forbs, and bare ground over at least one-third of the stand. Surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years.

Sites are flat to gently sloping, stable and snow-covered in winter. Soils from stands in Colorado are loess, with accumulations of organic matter. The average pH of the surface horizon is 5.2. The pH increases with depth; clay and organic matter, moisture retention capacity and available water decrease sharply with depth.

Vegetation Description

The *Carex illota* (small-head sedge) association is a seasonally flooded subpolar grassland. *Carex illota* (small-head sedge) often forms a near monoculture, usually with over 50% cover. Other forb and graminoid species that may be present, usually with less than 1% cover include *Carex scopulorum* (mountain sedge), *Juncus drummondii* (Drummond rush), *Carex nigricans* (black alpine sedge), *Caltha leptosepala* (marsh marigold), *Rhodiola rhodantha* (redpod stonecrop), and *Pedicularis groenlandica* (elephanthead lousewort). The shrub *Salix planifolia* (planeleaf willow) may also be present with less than 1% cover. The non-vascular layer is highly developed and almost equally as abundant as the vascular cover.

Ecological Processes

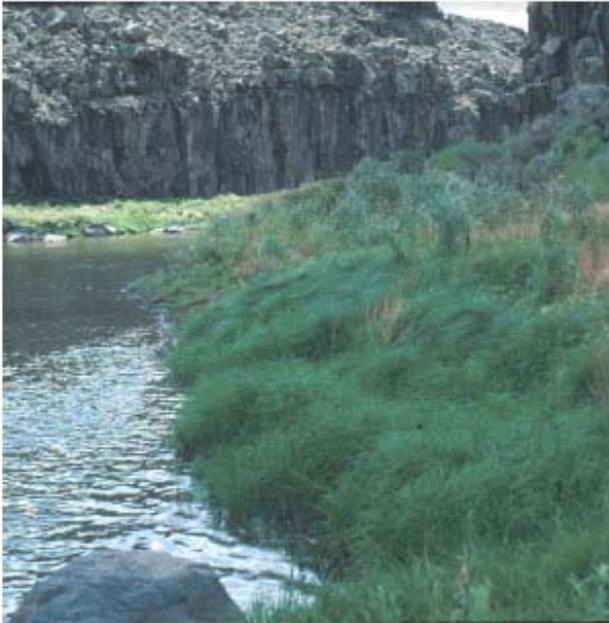
This plant association usually occurs under high quality undisturbed conditions with no introduced species, no advanced soil erosion or signs of trampling or soil compaction. Chronic disturbance from overgrazing or recreational use can result in plant trampling, damage or death, and increasing bare ground. This plant association occurs within the Snow Spur Tributary and Lakes at Bolam Pass PCAs.

Avg. Cover		Species Name	# Plots (N=8)
%	(Range)		
57	(37-70%)	Carex illota	8
10	—	Deschampsia caespitosa	1
5	(0.1-20%)	Caltha leptosepala	4

Other species with < 5% average cover present in at least 10% of plots:
 Juncus drummondii (0.1-10%), Pedicularis groenlandica (0.1-3%), Castilleja rhexiifolia (1%),
 Packera dimorphophylla (1%), Phleum alpinum (1%), Primula parryi (1%), Saxifraga odontoloma
 (1%), Carex nigricans (0.1-1%), Carex vernacula (0.1-1%), Carex scopulorum (0.1%), Rhodiola
 rhodantha (0.1%), Carex praegracilis (0.1%), Juncus biglumis (0.1%), Stellaria umbellata (0.1%),
 Salix planifolia (0.1%), Epilobium anagallidifolium (0.1%).

Woolly sedge Herbaceous Vegetation

Carex pellita (=lanuginosa)



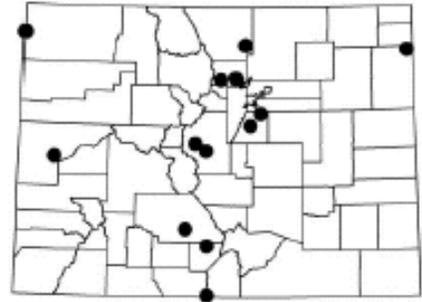
Global rank/State rank:

G3 / S3

HGM subclass: D2/3, S3/4, R5

Colorado elevation range:

4,600-9,300 ft (1,400-2,830 m)



General Description

Carex pellita is the name currently used by the USDA Plants Database (USDA, NRCS 2003b) for both *Carex lanuginosa* and *Carex lasiocarpa*. These species are recognized separately in Colorado, where *C. lasiocarpa* is much less common than *C. lanuginosa*. The *Carex lasiocarpa* association is ranked as S1 in Colorado and is currently known only from the subalpine fens on the east side of the Park Range.

Carex pellita (= *C. lanuginosa*) (woolly sedge) is a distinctive wetland-indicator sedge that forms small- to medium sized meadows. It occurs in depressions and swales at the saturated edge of stream channels or in standing water. On the eastern plains of Colorado, it can occur under the canopy of cottonwood trees, forming the *Populus deltoides*/*Carex pellita* (plains cottonwood/woolly sedge) plant association. This plant association occurs in very wet conditions, generally at the saturated edge of the stream channel or in standing water. Stream channels are sinuous with a moderate gradient.

Soils are deep silt loams to clays. Mottling often occurs throughout the profile.

Vegetation Description

This plant association is characterized by a nearly monotypic stand of *Carex lanuginosa* (woolly sedge). Other graminoid cover is minor, but includes *Phalaris arundinacea* (reed canarygrass), *Carex nebrascensis* (Nebraska sedge), *Schoenoplectus pungens* (threesquare bulrush), and *Poa pratensis* (Kentucky bluegrass). Scattered forbs include *Mentha arvensis* (wild mint), and *Cirsium arvense* (Canada thistle). *Equisetum arvense* (field horsetail) and *Equisetum hyemale* (scouringrush horsetail) may also be present.

Ecological Processes

The *Carex pellita* (woolly sedge) plant association appears to be a fairly stable community because of its strongly rhizomatous roots and well developed soils. In Montana, the *Carex pellita* plant association can be associated with large amounts of *Carex lasiocarpa* (slender sedge). With

season-long grazing, *Carex pellita* decreases in abundance, shifting dominance towards *Poa pratensis* (Kentucky bluegrass). In Colorado, stands of *Carex pellita* that occur on stream banks with a consistent water table depth and heavy, cohesive clay soils, appear stable and long-lived as long as the water table level remains consistent.

This association occurs within the Glade Lake PCA and occurs at Corral Lake.

Avg. Cover		Species Name	# Plots (N=22)
%	(Range)		
73	(20 -98%)	<i>Carex pellita</i>	22
25	(10-40%)	<i>Phalaris arundinacea</i>	2
12	(3-20%)	<i>Polygonum amphibium</i> var. <i>emersum</i>	2
11	(0.1-40%)	<i>Mentha arvensis</i>	6
10	(0.1-20%)	<i>Muhlenbergia asperifolia</i>	2
10	(0.1-30%)	<i>Poa pratensis</i>	7
10	(1-20%)	<i>Argentina anserina</i>	7
9	(1-40%)	<i>Eleocharis palustris</i>	7
8	(5-10%)	<i>Calamagrostis stricta</i>	2
6	(5-7%)	<i>Lycopus asper</i>	2

Other species with < 5% average cover present in at least 10% of plots:
Deschampsia caespitosa (1-10%), *Carex praegracilis* (2-5%), *Hordeum jubatum* ssp. *jubatum* (0.1-10%), *Carex nebrascensis* (0.1-5%), *Agrostis gigantea* (2.5-3%), *Schoenoplectus pungens* (1-5%), *Cirsium arvense* (1-4%), *Juncus balticus* var. *montanus* (0.1-5%), *Polygonum lapathifolium* (0.1-2%), *Rumex crispus* (0.1-1%), *Equisetum arvense* (0.1-1%), *Juncus torreyi* (0.1-1%).

Beaked sedge Herbaceous Vegetation

Carex utriculata



Global rank/State rank:

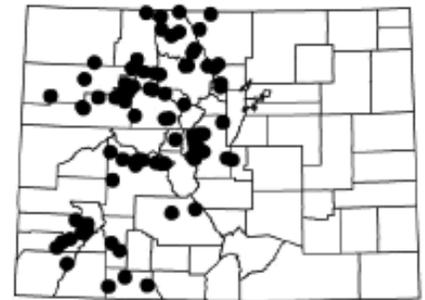
G5 / S5

HGM subclass: D1, D2/3, R2,

S1/2?, S3/4

Colorado elevation range:

5,600-11,000 ft (1,700-3,350 m)



General Description

The *Carex utriculata* (beaked sedge) plant association is a common wet meadow community that occurs around the edges of montane lakes and beaver ponds, along the margins of slow-moving reaches of streams and rivers, and in marshy swales and overflow channels on broad floodplains. The water table is usually near the surface for most of the growing season. This association is well documented throughout the western states. A clear dominance of *Carex utriculata* over other *Carex* species including *C. aquatilis* (water sedge), sets this association apart from closely related types. *Carex utriculata* (beaked sedge) grows in standing water or saturated soils. It also occurs along the margins of lakes and beaver ponds. Stream channels are wide and slightly sinuous, to wide and more sinuous. Soils are saturated organics or fine silty clays to clays over cobbles and alluvium. Mottling often occurs within a few centimeters of the surface.

Vegetation Description

This plant association is characterized by stands dominated by *Carex utriculata* (beaked sedge). Stands often appear to be nearly pure *Carex utriculata* (beaked sedge), but a variety of other graminoid species may be present as well. *Carex aquatilis* can be abundant, but if equal in cover to *C. utriculata*, see the *Carex aquatilis-Carex utriculata* association on page 336. Other *Carex* (sedge) species present include *Carex lenticularis* (shore sedge) and *C. microptera* (small-wing sedge), but usually with low cover relative to the amount of *C. utriculata* (beaked sedge) present. Other graminoid species that may be present include *Glyceria striata* (fowl manna grass), *Calamagrostis canadensis* (bluejoint reedgrass), and *Juncus balticus* var. *montanus* (mountain rush). Forb cover is very inconspicuous and can include *Mentha arvensis* (wild mint), *Mimulus guttatus* (seep monkeyflower), and *Geum macrophyllum* (largeleaf avens). Willow carrs (i.e., shrubland thickets) are often adjacent and a few scattered willows will occur within the *Carex utriculata* (beaked sedge) stand. Individual willows tend to be very short if present, either from limiting growth conditions (extremely cold and/or extremely wet), or because of heavy browsing by wildlife or livestock. The elevation of the site determines which willow species are in and adjacent to *Carex utriculata* (beaked sedge) stands. Willow species that are present may include

Salix monticola (mountain willow), *S. drummondiana* (Drummond willow), *S. geeyeriana* (Geyer willow), *S. planifolia* (planeleaf willow), and *S. exigua* (sandbar willow).

Ecological Processes

The *Carex utriculata* (beaked sedge) plant association occurs on the wettest sites of the riparian or wetland area, such as low-lying swales, and shallow margins of lakes and ponds, often in standing water. It is an early-seral community and is known to invade margins of newly formed beaver ponds, as well as the freshly exposed silt beds of drained beaver ponds. With time, the *Carex utriculata* plant association will grade into *Carex aquatilis* (water sedge) and *Calamagrostis canadensis* (bluejoint reedgrass) associations. 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. As aggradation, or build up, of the floodplain proceeds, the site can become drier and the dominant graminoid cover 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 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. Depending on site characteristics, various willow species may become established in the overstory as well, creating the *Salix monticola*/*Carex utriculata* (mountain willow/beaked sedge) plant association or the *Salix geeyeriana*/*Calamagrostis canadensis* (Geyer willow/bluejoint reedgrass) plant association, for example. Distance from the stream channel can also differentiate the graminoid dominance spatially within the riparian mosaic. *Carex utriculata* commonly occurs at the stream channel or pond 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*. This type occurs along streams with beaver activity in Dolores County, such as Fish Creek, and within Barlow Creek PCA.

Avg. Cover		Species Name	# Plots (N=143)
%	(Range)		
72	(7-100%)	<i>Carex utriculata</i>	143
9	(0.1-50%)	<i>Carex aquatilis</i>	40
7	(1-20%)	<i>Carex microptera</i>	15
7	(0.1-30%)	<i>Calamagrostis canadensis</i>	20
7	(1-20%)	<i>Juncus balticus</i> var. <i>montanus</i>	16
6	(1-10%)	<i>Salix monticola</i>	15
5	(0.1-15%)	<i>Mentha arvensis</i>	15

Other species with < 5% average cover present in at least 10% of plots:
Equisetum arvense (0.1-20%), *Glyceria striata* (0.1-10%), *Deschampsia caespitosa* (1-10%),
Geum macrophyllum var. *perincisum* (0.1-15%), *Poa pratensis* (1-10%).

River hawthorn Shrubland

Crataegus rivularis

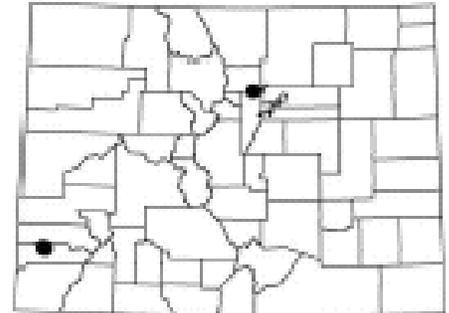


Global rank/State rank:

G2Q / S2

HGM subclass: R2, R3/4

Colorado elevation range:
5,500-8,000 ft (1,670-2,450 m)



General Description

The *Crataegus rivularis* (river hawthorn) plant association is a medium-tall (3-6 ft, 1-2 m) shrubland. It occurs on dry floodplains of ephemeral rivers and creeks, and is most often intermixed with cottonwood forests. This association is known from the San Juan National Forest. A closely related community dominated by *Crataegus succulenta* (fleshy hawthorn) is known from Boulder County and is placed in this association until more information suggests otherwise.

This association occurs on narrow draws and valley floors that are approximately 65- 100 ft (20-30 m) wide. One area had signs of beaver activity. Streams appeared to be mostly ephemeral streams with seeps along the sides of the valley, making for a complex wetland/riparian area. Stream channels are narrow, straight and steep or braided by beaver activity. Soils are sandy clay with 20-50% coarse material over highly stratified alluvial parent material.

Vegetation Description

Crataegus rivularis (river hawthorn) forms a dense shrub canopy. One plot is dominated by *Crataegus succulenta* (fleshy hawthorn). *Salix bebbiana* (Bebb willow), *Salix ligulifolia* (strapleaf willow), and *Salix monticola* (mountain willow) may also be present. Other shrub species present include *Rosa woodsii* (Woods rose), *Dasiphora floribunda* (shrubby cinquefoil), *Symphoricarpos oreophilus* (mountain snowberry), and *Ribes* spp. (currant). *Populus angustifolia* (narrowleaf cottonwood) seedlings and saplings occurred in one stand with less than 10% total cover. Forb and graminoid cover is insignificant.

Ecological Processes

Crataegus occupies the driest part of the riparian habitat, and may indicate the surface is no longer flooded. In Montana, thickets of *Crataegus* are considered a grazing disclimax. Cattle will browse *Crataegus* and heavy pressure can cause thickets to become open and increase species such as *Rosa woodsii* (Wood's rose), *Symphoricarpos* (snowberry) and *Poa pratensis* (Kentucky

bluegrass) become established and abundant. The presence of seedling and sapling *Populus angustifolia* (narrowleaf cottonwood) indicate the stand may mature into a *Populus angustifolia/Crataegus rivularis* (narrowleaf cottonwood/river hawthorn) plant association. This plant association occurs along Disappointment Creek and within the Morrison at Lone Cone PCA.

Avg. Cover %	(Range)	Species Name	# Plots (N=3)
55	—	<i>Crataegus succulenta</i>	1
50	(30-70%)	<i>Crataegus rivularis</i>	2
31	(1-60%)	<i>Salix monticola</i>	2
21	—	<i>Centaurea diffusa</i>	1
20	(20-20%)	<i>Salix bebbiana</i>	2
17	—	<i>Leersia oryzoides</i>	1
15	(10-20%)	<i>Salix ligulifolia</i>	2
13	—	<i>Prunus americana</i>	1
12	—	<i>Agrostis stolonifera</i>	1
11	—	<i>Eleocharis palustris</i>	1
7	—	<i>Populus deltoides</i>	1
7	—	<i>Equisetum laevigatum</i>	1
7	(3-10%)	<i>Rudbeckia laciniata</i> var. <i>ampla</i>	2
6	—	<i>Bromus inermis</i>	1
6	—	<i>Echinocystis lobata</i>	1
6	—	<i>Rorippa nasturtium-aquaticum</i>	1
6	(1-10%)	<i>Poa pratensis</i>	2
5	—	<i>Dactylis glomerata</i>	1
5	—	<i>Lolium pratense</i>	1
4	—	<i>Salix exigua</i>	1

Other species with < 5% average cover present in at least 10% of plots:
Populus angustifolia (4%), *Rosa woodsii* (3%), *Geranium richardsonii* (3%), *Cornus sericea* (3%), *Carex praegracilis* (3%), *Ribes inerme* (3%), *Mertensia ciliata* (1-3%), *Glyceria striata* (1-3%), *Symphoricarpos oreophilus* (1-3%), *Thermopsis montana* (1-3%), *Galium triflorum* (1-3%), *Clematis ligusticifolia* (2%), *Elymus lanceolatus* (2%), *Maianthemum stellatum* (1%), *Zigadenus elegans* ssp. *elegans* (1%), *Achillea millefolium* var. *occidentalis* (1%), *Thalictrum fendleri* (1%), *Allium brandegeei* (1%), *Vicia americana* (1%), *Carex hassei* (1%), *Asclepias speciosa* (1%), *Artemisia ludoviciana* (1%), *Arabis hirsuta* var. *pyncocarpa* (1%), *Angelica pinnata* (1%), *Amelanchier alnifolia* (1%), *Ambrosia artemisiifolia* var. *elatior* (1%), *Carex microptera* (1%), *Veronica americana* (1%), *Valeriana occidentalis* (1%), *Trifolium longipes* (1%), *Taraxacum officinale* (1%), *Senecio integerrimus* (1%), *Pseudocymopterus montanus* (1%), *Juncus balticus* var. *montanus* (1%), *Potentilla pulcherrima* (1%), *Epilobium ciliatum* ssp. *glandulosum* (1%), *Poa annua* (1%), *Pascopyrum smithii* (1%), *Moehringia lateriflora* (1%), *Juncus parryi* (1%), *Iris missouriensis* (1%), *Frasera speciosa* (1%).

Tufted hairgrass Herbaceous Vegetation

Deschampsia caespitosa



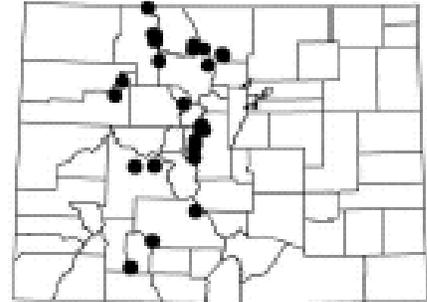
Global rank/State rank:

G4 / S4

HGM subclass: S1/2, S3/4

Colorado elevation range:

7,900-12,300 ft (2,400-3,750 m)



General Description

This dense, bunch-grass meadow occurs in broad, nearly flat, valley bottoms in openings of willow carrs (i.e., shrubland thickets) and coniferous forests in subalpine regions across Colorado. It is characterized by uniform to patchy cover of *Deschampsia caespitosa* (tufted hairgrass) with minor cover of other graminoids and forbs. Drier phases of this association grow on gentle slopes above the valley floor.

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 at a depth of 8 in (20 cm). Stream channels are wide and moderately sinuous or narrow and highly sinuous. Soils are a shallow to deep organic layer over stratified sandy or silty loams and loamy sands.

Vegetation Description

This plant association is a meadow dominated by *Deschampsia caespitosa* (tufted hairgrass). Other graminoids may be abundant depending on local conditions, but no other species are consistently present. These include *Carex aquatilis* (water sedge), *Carex utriculata* (beaked sedge), and *Calamagrostis canadensis* (bluejoint reedgrass). Forb cover is highly variable, *Caltha leptosepala* (marsh marigold) is present in about half of all stands. Other forbs often, but not always, present include *Ranunculus alismifolius* (plantainleaf buttercup), *Rhodiola rhodantha* (redpod stonecrop), *Veronica wormskjoldii* (American alpine speedwell), and *Pedicularis groenlandica* (elephanthead lousewort). Occasionally, a few shrub stems from adjacent stands occur within this association, including *Dasiphora floribunda* (shrubby cinquefoil), *Salix planifolia* (planeleaf willow), and *Salix brachycarpa* (barrenground willow).

Ecological Processes

The *Deschampsia caespitosa* (tufted hairgrass) plant association can continue to occupy sites indefinitely under relatively stable conditions. *Deschampsia caespitosa* occurs along a broad moisture gradient from mesic and dry-mesic environments to those that are very wet. As sites become drier, *Deschampsia caespitosa* cover gradually decreases and *Dasiphora 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.

The presence of native increaser species such as *Juncus balticus* var. *montanus* (mountain rush) and exotic species such as *Poa pratensis* (Kentucky bluegrass) and *Taraxacum officinale* (dandelion) may indicate disturbed conditions. As disturbance levels increase, *Poa pratensis* may replace *Deschampsia caespitosa*. Many subalpine areas now dominated by *Poa pratensis* may have supported *Deschampsia caespitosa* communities in the past.

This is a common association in Colorado, however few pristine stands have been documented. It is highly threatened by heavy livestock grazing, invasion by nonnative species, and reduced fire frequency.

This plant association occurs within the Snow Spur Tributary and Lakes at Bolam Pass PCAs.

Avg. Cover		Species Name	# Plots (N=31)
%	(Range)		
39	(10-80%)	<i>Deschampsia caespitosa</i>	31
16	(1-38%)	<i>Ligusticum tenuifolium</i>	6
16	(2-30%)	<i>Juncus balticus</i> var. <i>montanus</i>	6
13	(1-90%)	<i>Poa pratensis</i>	9
13	(1-50%)	<i>Carex aquatilis</i>	19
12	(6-20%)	<i>Calamagrostis canadensis</i>	3
11	(1-40%)	<i>Carex microptera</i>	7
11	(5-26%)	<i>Argentina anserina</i>	5
10	(1-20%)	<i>Carex utriculata</i>	3
10	(3-20%)	<i>Arnica mollis</i>	4
10	(1-45%)	<i>Caltha leptosepala</i>	16
9	(3-15%)	<i>Hordeum jubatum</i> ssp. <i>jubatum</i>	3
9	(1-15%)	<i>Hordeum brachyantherum</i> ssp. <i>brachyantherum</i>	3
8	(5-12%)	<i>Carex illota</i>	5
7	(2-11%)	<i>Erigeron peregrinus</i> ssp. <i>callianthemus</i>	4
6	(1-11%)	<i>Trollius laxus</i> ssp. <i>albiflorus</i>	4

Other species with < 5% average cover present in at least 10% of plots:
Carex scopulorum (3-4%), *Trisetum wolfii* (1-7%), *Juncus drummondii* (1-11%), *Pheum alpinum* (1-12%), *Senecio triangularis* (1-8%), *Taraxacum officinale* (1-9%), *Salix planifolia* (1-7%), *Packera dimorphophylla* (1-5%), *Carex nigricans* (1-8%), *Symphotrichum foliaceum* (1-5%), *Potentilla diversifolia* (2-3%), *Pedicularis groenlandica* (0.1-5%), *Achillea millefolium* var. *occidentalis* (1-5%), *Cardamine cordifolia* (1-3%), *Viola macloskeyi* ssp. *pallens* (1-3%), *Agrostis humilis* (1-4%), *Veronica wormskjoldii* (1-4%), *Polygonum bistortoides* (0.1-5%), *Plantago tweedyi* (1-2%), *Carex ebenea* (1-2%), *Ranunculus alismifolius* var. *montanus* (1-3%), *Juncus mertensianus* (1-2%), *Rhodiola rhodantha* (0.1-3%), *Fragaria virginiana* ssp. *glauca* (1%), *Castilleja sulphurea* (1%), *Antennaria corymbosa* (1%), *Stellaria umbellata* (1%).

Blue spruce / Thinleaf alder Woodland

Picea pungens / *Alnus incana* ssp. *tenuifolia*



Global rank/State rank:

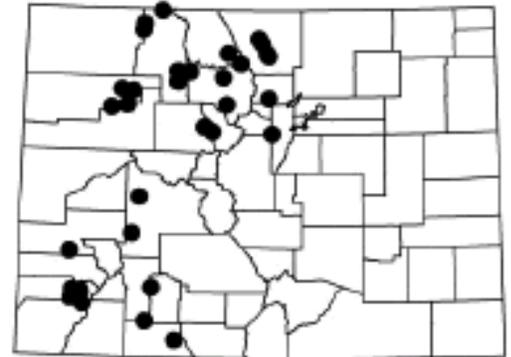
G3 / S3

HGM subclass:

R2, R3/4

Colorado elevation range:

6,100-10,650 ft (1,900-3,200 m)



General Description

The *Picea pungens*/*Alnus incana* ssp. *tenuifolia* (blue spruce/thinleaf alder) plant association occurs in montane riparian areas in Colorado. It occurs in deep, shaded canyons and narrow valleys along relatively straight stream reaches. It generally forms small patches, but can be continuous for several river miles. This plant association occurs along narrow to moderately wide floodplains and stream benches in canyons subject to cold air drainage and limited sunlight. Stream channels are steep and narrow, moderately broad and slightly sinuous, or broad and highly sinuous. Soils are generally shallow and range from loamy sand to silty clay loams with heavy organic matter content over gravel, cobbles, and boulders.

Vegetation Description

Picea pungens (blue spruce) dominates the overstory with 1-70% cover. There are typically many seedling and saplings as well as mature trees. *Abies lasiocarpa* (subalpine fir) is usually present with up to 50% cover. Other tree species that occurred in half or fewer of the stands sampled include *Picea engelmannii* (Engelmann spruce), *Populus tremuloides* (quaking aspen), *Pinus contorta* (lodgepole pine) and *Pinus ponderosa* (ponderosa pine).

The thick shrub understory is confined to a narrow band lining the stream channel. *Alnus incana* ssp. *tenuifolia* (thinleaf alder) was present in all stands sampled, and ranged in cover from 1 to 80%. Other shrub species present were highly variable, with constancy of less than 40%, but often appearing with abundant cover when present. These shrubs include *Salix drummondiana* (Drummond willow), *Cornus sericea* (red-osier dogwood), *Ribes lacustre* (current), *Acer glabrum* (Rocky Mountain maple), *Vaccinium* spp. (whortleberry), *Salix boothii* (Booth willow), and *Salix wolfii* (Wolf willow). The forb canopy layer is thick, up to 50% total cover and species-rich, often with more than 40 species represented in one stand. Species include *Actaea rubra* (red baneberry), *Conioselinum scopulorum* (Rocky Mountain hemlockparsley), *Oxypolis fendleri*

(cowbane), *Geranium richardsonii* (Richardson geranium), *Heracleum maximum* (common cowparsnip), *Maianthemum stellatum* (starry false Solomon seal), *Mertensia ciliata* (tall fringed bluebells), *Rudbeckia laciniata* var. *ampla* (cutleaf cornflower), and *Equisetum arvense* (field horsetail).

Ecological Processes

In deep, narrow canyons with swift-moving streams and narrow floodplains and benches, *Picea pungens* (blue spruce) appears to be a climax riparian species, and will remain until removed or damaged by a catastrophic flood. In Colorado, the closely related *Picea pungens/Equisetum arvense* (blue spruce/field horsetail) plant association is considered an indicator of frequent flooding. With less frequent flooding, this association may gradually change to a *Picea pungens/Alnus incana* ssp. *tenuifolia* (blue spruce/thinleaf alder) plant association.

Potential Conservation Areas supporting *Picea pungens/Alnus incana* are West Dolores Campground PCA and Silver Creek and Johnny Bull Creek PCA.

Avg. Cover %	(Range)	Species Name	# Plots (N=35)
32	(1-70%)	<i>Picea pungens</i>	35
28	(1-80%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	34*
12	(1-85%)	<i>Calamagrostis canadensis</i>	13
12	(1-55%)	<i>Salix exigua</i>	5
12	(1-50%)	<i>Abies lasiocarpa</i>	15
9	(1-28%)	<i>Acer glabrum</i>	6
9	(1-32%)	<i>Salix bebbiana</i>	7
9	(1-28%)	<i>Salix monticola</i>	7
9	(1-18%)	<i>Populus tremuloides</i>	8
8	(1-45%)	<i>Equisetum arvense</i>	27
8	(1-40%)	<i>Salix drummondiana</i>	16
8	(1-20%)	<i>Ribes lacustre</i>	7
7	(1-32%)	<i>Ribes inerme</i>	10
7	(1-18%)	<i>Pinus contorta</i>	6
5	(1-25%)	<i>Poa pratensis</i>	20
5	(1-30%)	<i>Lonicera involucrata</i>	26
5	(0.1-20%)	<i>Rudbeckia laciniata</i> var. <i>ampla</i>	14
5	(1-10%)	<i>Cornus sericea</i>	8
5	(0.1-20%)	<i>Trifolium repens</i>	8

Other species with < 5% average cover present in at least 10% of plots:

Saxifraga odontoloma (1-10%), *Symphoricarpos oreophilus* (1-20%), *Heracleum maximum* (1-15%), *Rubus idaeus* ssp. *strigosus* (0.1-20%), *Mertensia ciliata* (1-10%), *Thalictrum fendleri* (1-10%), *Streptopus amplexifolius* var. *chalmazatus* (1-10%), *Senecio triangularis* (1-10%), *Erigeron speciosus* var. *speciosus* (1-9%), *Maianthemum stellatum* (0.1-13%), *Geranium richardsonii* (0.1-10%), *Bromus ciliatus* var. *ciliatus* (1-11%), *Actaea rubra* ssp. *arguta* (1-10%), *Salix ligulifolia* (1-5%), *Rosa woodsii* (1-10%), *Aconitum columbianum* (1-10%), *Taraxacum officinale* (0.1-15%), *Poa palustris* (1-5%), *Amelanchier alnifolia* (1-10%), *Phleum pratense* (1-10%), *Cardamine cordifolia* (1-10%), *Urtica dioica* ssp. *gracilis* (1-10%), *Elymus glaucus* (1-10%), *Galium triflorum* (1-10%), *Luzula parviflora* (0.1-8%), *Conioselinum scopulorum* (0.1-5%), *Dasiphora floribunda* (1-7%), *Chamerion angustifolium* ssp. *circumvagum* (1-10%), *Osmorhiza depauperata* (0.1-10%), *Fragaria virginiana* ssp. *glauca* (1-5%), *Glyceria striata* (0.1-5%), *Achillea millefolium* var. *occidentalis* (1-5%), *Galium boreale* (1-5%), *Orthilia secunda* (1-3%), *Viola canadensis* var. *scopulorum* (0.1-3%), *Carex microptera* (1-3%), *Vicia americana* (1-5%), *Oxypolis fendleri* (1-3%), *Osmorhiza berteroi* (1-3%), *Geum macrophyllum* var. *perincisum* (0.1-5%), *Prunella vulgaris* (1%), *Ranunculus macounii* (1%).

**Alnus incana* ssp. *tenuifolia* occurred in all stands, but was not captured in every sample plot.

Narrowleaf cottonwood - Blue spruce / Thinleaf alder Woodland

Populus angustifolia - *Picea pungens* / *Alnus incana* ssp. *tenuifolia*

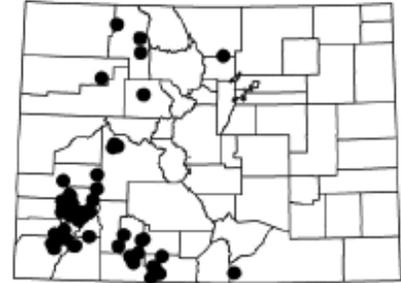
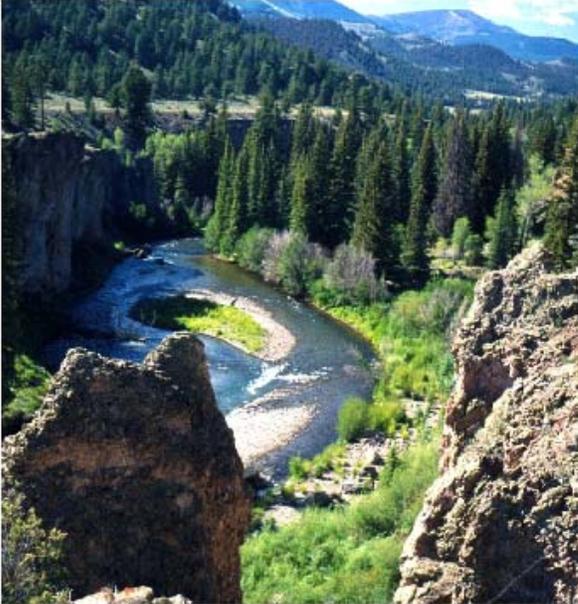
Global rank/State rank:

G4 / S4

HGM subclass: R2?, R3/4

Colorado elevation range:

6,800-9,600 ft (2,070-2,925 m)



General Description

This is a common mixed deciduous-evergreen community of montane valleys, where *Populus angustifolia* (narrowleaf cottonwood) and *Picea pungens* (blue spruce) are co-dominant along a stream reach. Frequently, other conifer trees are present, but not as abundant as *Picea pungens* (blue spruce). The shrub understory is typically dense and diverse. *Alnus incana* ssp. *tenuifolia* (thinleaf alder) is almost always present.

Only a handful of good condition stands are known, and the community is highly threatened by improper livestock grazing, heavy recreational use, and stream flow alterations.

This association occurs in valleys with narrow to moderately wide floodplains, 30-600 ft (10-200 m), and in deep canyons. This association is commonly found on slightly meandering to meandering floodplains of broad reaches. Occasionally, stands occur along steep reaches. 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.

Vegetation Description

The upper canopy is dominated by *Populus angustifolia* (narrowleaf cottonwood) and either *Picea pungens* (blue spruce) or *Picea engelmannii* (Engelmann spruce). Other less frequently encountered tree species may also be present and include *Pseudotsuga menziesii* (Douglas-fir), *Abies concolor* (white fir), *Populus tremuloides* (quaking aspen), and *Abies lasiocarpa* (subalpine fir). *Alnus incana* ssp. *tenuifolia* (thinleaf alder) is almost always present in the shrub canopy layer, although cover amounts vary and other shrub species may be more abundant. *Lonicera involucrata* (twinberry honeysuckle) is the most frequently encountered species after *Alnus*. Many other shrub species can occur within this association, including *Amelanchier alnifolia* (Saskatoon serviceberry), *Acer glabrum* (Rocky Mountain maple), *Salix drummondiana* (Drummond willow), *S. exigua* (sandbar willow), *S. lucida* ssp. *caudata* (shining willow), *S. geigeriana* (Geyer willow), *S. boothii* (Booth willow), *Prunus virginiana* (chokecherry), and *Symphoricarpos oreophilus* (mountain snowberry).

The undergrowth is diverse and can be sparse or dense, depending on local conditions. Total herbaceous cover rarely exceeds 40%. *Maianthemum stellatum* (starry false Solomon seal) and *Geranium richardsonii* (Richardson geranium) are frequently found. Graminoid cover is less diverse than forb cover.

Ecological Processes

This mixed deciduous-evergreen plant association is a mid-seral community. With continued fluvial activity, such as flooding, channel migration, sediment deposition, and scouring, narrowleaf cottonwood and blue spruce will continue to co-occur along the reach. 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 canyon walls that provide conditions for strong cold-air drainage. If the floodplain is no longer active, i.e., is no longer flooded because the stream channel has become lower (surface becomes a terrace) or upstream dams control floods, then cottonwoods will eventually die and the conifers may persist.

This plant community occurs within the West Dolores Campground PCA.

Avg. Cover %	(Range)	Species Name	# Plots (N=51)
34	(2-90%)	<i>Populus angustifolia</i>	51*
28	(1-60%)	<i>Betula occidentalis</i>	8
27	(0.1-90%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	41
25	(1-80%)	<i>Picea pungens</i>	51
17	(1-50%)	<i>Picea engelmannii</i>	9
17	(1-96%)	<i>Cornus sericea</i> ssp. <i>sericea</i>	31
11	(1-50%)	<i>Salix ligulifolia</i>	15
11	(1-25%)	<i>Pseudotsuga menziesii</i>	17
9	(1-50%)	<i>Acer glabrum</i>	12
7	(1-40%)	<i>Lonicera involucrata</i>	33
7	(1-28%)	<i>Populus tremuloides</i>	8
7	(1-23%)	<i>Abies concolor</i>	9
7	(1-15%)	<i>Salix drummondiana</i>	11
6	(2-20%)	<i>Salix exigua</i>	8
6	(1-30%)	<i>Calamagrostis canadensis</i>	8
5	(1-30%)	<i>Salix monticola</i>	15
5	(1-20%)	<i>Prunus virginiana</i> var. <i>melanocarpa</i>	8
5	(1-15%)	<i>Amelanchier alnifolia</i>	17

Other species with < 5% average cover present in at least 10% of plots:
Rudbeckia laciniata var. *ampla* (1-16%), *Symphoricarpos rotundifolius* (1-30%), *Salix bebbiana* (0.1-15%), *Equisetum arvense* (1-10%), *Maianthemum stellatum* (0.1-30%), *Elymus glaucus* (1-20%), *Equisetum hyemale* var. *affine* (1-20%), *Geranium richardsonii* (1-10%), *Heracleum maximum* (1-11%), *Osmorhiza depauperata* (1-30%), *Poa pratensis* (1-16%), *Actaea rubra* ssp. *arguta* (1-10%), *Taraxacum officinale* (0.1-16%), *Mertensia franciscana* (1-9%), *Ligusticum porteri* (1-10%), *Fragaria virginiana* ssp. *glauca* (1-9%), *Rosa woodsii* (0.1-9%), *Thalictrum fendleri* (1-10%), *Pseudocymopterus montanus* (1-10%), *Ribes inerme* (1-5%), *Viola canadensis* var. *scopulorum* (1-10%), *Amelanchier utahensis* (0.1-3%), *Paxistima myrsinites* (1-4%), *Galium triflorum* (1-10%), *Chamerion angustifolium* ssp. *circumvagum* (1-3%), *Equisetum pratense* (1-4%), *Rubus idaeus* ssp. *strigosus* (1-5%), *Geum macrophyllum* var. *perincisum* (0.1-4%), *Cardamine cordifolia* (1-4%), *Achillea millefolium* var. *occidentalis* (1-5%), *Vicia americana* (1-5%), *Galium boreale* (0.1-5%), *Oxypolis fendleri* (1-4%), *Mertensia ciliata* (0.1-5%).

**Populus angustifolia* occurred in all stands, but was not captured in every sample plot.

Narrowleaf cottonwood / Thinleaf alder Woodland

Populus angustifolia / *Alnus incana* ssp. *tenuifolia*



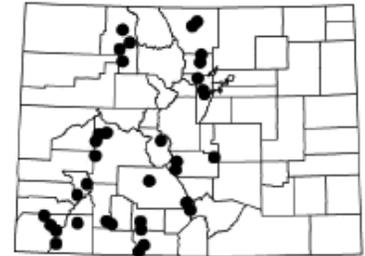
Global rank/State rank:

G3 / S3

HGM subclass: R3/4

Colorado elevation range:

6,000-9,600 ft (1,830-2,930 m)



General Description

The *Populus angustifolia*/*Alnus incana* ssp. *tenuifolia* (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*. Other shrubs may occur but *Alnus incana* ssp. *tenuifolia* (thinleaf alder) usually has at least 10-20% cover and is the most abundant of all other shrubs within the stand. It occurs along narrow, fast-moving stream reaches in montane areas.

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. Other sites occur along low gradient, moderately sinuous, broad channel reaches, low gradient, highly sinuous reaches, or very narrow and highly sinuous stream sections. 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).

Vegetation Description

The dominance of *Populus angustifolia* (narrowleaf cottonwood) and *Alnus incana* ssp. *tenuifolia* (thinleaf alder) are the key diagnostic characteristics of this association. Several other tree and shrub species may be present, but they rarely equal the abundance of the diagnostic species. The overstory is an open to dense canopy of *Populus angustifolia*, which is always present, if sometimes only as sapling-sized individuals. Other tree species that may be present include *Pseudotsuga menziesii* (Douglas-fir), *Juniperus scopulorum* (Rocky Mountain juniper), *Populus tremuloides* (quaking aspen), *Pinus ponderosa* (ponderosa pine), *Populus x acuminata* (lanceleaf cottonwood), *Abies concolor* (white fir), or *Picea pungens* (blue spruce). The shrub understory is dominated by a dense band of *Alnus incana* ssp. *tenuifolia* (thinleaf alder) lining the stream bank. A variety of other shrubs may be present, intermingling with the alder but usually providing less than the total alder cover. Other shrub species include *Salix bebbiana* (Bebb willow), *Salix monticola* (mountain willow), *Salix drummondiana* (Drummond willow), *Salix ligulifolia* (strapleaf willow), *Salix lucida* ssp. *caudata* (shining willow), *Salix exigua* (sandbar willow), *Cornus sericea* (red-osier dogwood), *Rosa woodsii* (Woods rose), *Acer glabrum* (Rocky

Mountain maple), and *Betula occidentalis* (river birch). The herbaceous undergrowth is generally sparse. Herbaceous species include *Poa pratensis* (Kentucky bluegrass), *Taraxacum officinale* (dandelion), *Equisetum arvense* (field horsetail), *Rudbeckia laciniata* var. *ampla* (cutleaf coneflower), *Heracleum maximum* (common cowparsnip), *Maianthemum stellatum* (starry false Solomon seal), *Trifolium repens* (white clover), *Calamagrostis canadensis* (bluejoint reedgrass), *Oxypolis fendleri* (Fendler cowbane), and *Cardamine cordifolia* (heartleaf bittercress).

Ecological Processes

The *Populus angustifolia*/*Alnus incana* ssp. *tenuifolia* (narrowleaf cottonwood/thinleaf alder) plant association is considered a mid-seral community (not the youngest and not the oldest stands of cottonwoods within a reach). With time and without flooding disturbance, stands may become dominated by invading conifers from adjacent upland communities such as *Pseudotsuga menziesii* (Douglas-fir), *Juniperus* spp. (juniper), or *Picea engelmannii* (Engelmann spruce). This association occurs within the West Dolores Campground PCA and along Dolores River south of Rico.

Avg. Cover %	(Range)	Species Name	# Plots (N=37)
37	(3-84%)	<i>Populus angustifolia</i>	37
35	(1-80%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	37
18	(1-40%)	<i>Agrostis gigantea</i>	5
13	(1-30%)	<i>Salix lucida</i> ssp. <i>caudata</i> , <i>lasiandra</i>	14
13	(3-28%)	<i>Betula occidentalis</i>	5
12	(1-48%)	<i>Trifolium repens</i>	7
11	(3-35%)	<i>Salix drummondiana</i>	10
10	(1-30%)	<i>Poa pratensis</i>	26
10	(1-30%)	<i>Cornus sericea</i> ssp. <i>sericea</i>	12
10	(1-34%)	<i>Populus tremuloides</i>	5
8	(1-32%)	<i>Salix exigua</i>	8
7	(1-15%)	<i>Agrostis stolonifera</i>	6
7	(1-14%)	<i>Salix monticola</i>	9
6	(1-22%)	<i>Cardamine cordifolia</i>	5
6	(0.1-40%)	<i>Dactylis glomerata</i>	9
6	(1-20%)	<i>Rubus idaeus</i> ssp. <i>strigosus</i>	6
6	(1-17%)	<i>Calamagrostis canadensis</i>	8
6	(1-14%)	<i>Pseudotsuga menziesii</i>	7
5	(1-14%)	<i>Salix bebbiana</i>	8
5	(1-11%)	<i>Ribes inerme</i>	5
5	(1-20%)	<i>Rudbeckia laciniata</i> var. <i>ampla</i>	12

Other species with < 5% average cover present in at least 10% of plots:

Acer glabrum (1-10%), *Rosa woodsii* (1-30%), *Heracleum maximum* (0.1-15%), *Pyrola asarifolia* ssp. *asarifolia* (1-10%), *Poa palustris* (1-10%), *Taraxacum officinale* (1-20%), *Juniperus scopulorum* (1-11%), *Salix ligulifolia* (1-10%), *Lonicera involucrata* (0.1-10%), *Equisetum arvense* (0.1-18%), *Oxypolis fendleri* (1-11%), *Urtica dioica* ssp. *gracilis* (1-10%), *Prunus virginiana* var. *melanocarpa* (1-7%), *Maianthemum stellatum* (0.1-10%), *Osmorhiza depauperata* (1-4%), *Achillea millefolium* var. *occidentalis* (0.1-12%), *Clematis ligusticifolia* (1-3%), *Juncus balticus* var. *montanus* (1-6%), *Vicia americana* (1-5%), *Mertensia ciliata* (1-5%), *Galium triflorum* (1-4%), *Thalictrum fendleri* (1-5%), *Geum macrophyllum* var. *perincisum* (1-6%), *Geranium richardsonii* (1-5%), *Fragaria virginiana* ssp. *glauca* (1-5%), *Chamerion angustifolium* ssp. *circumvagum* (1-3%), *Galium boreale* (1-3%), *Mentha arvensis* (1-4%), *Symphoricarpos oreophilus* (1-3%), *Galium trifidum* ssp. *subbiflorum* (1-3%), *Actaea rubra* ssp. *arguta* (0.1-3%), *Phleum pratense* (1%), *Equisetum laevigatum* (0.1-1%).

Narrowleaf cottonwood / Red-osier dogwood Woodland

Populus angustifolia / *Cornus sericea*

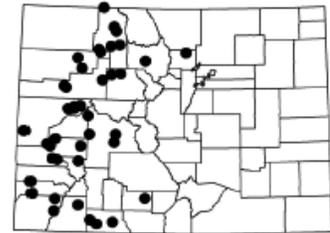
Global rank/State rank:

G4 / S3

HGM subclass: R3/4

Colorado elevation range:

5,400-8,700 ft (1,800-2700 m)



General Description

The *Populus angustifolia*/*Cornus sericea* (narrowleaf cottonwood/red-osier dogwood) plant association is found along moderate-size rivers in the montane zone. It is highly variable in the number of conifer and shrub species present along the reach. However, it is generally recognized by a clear dominance of *Populus angustifolia* (narrowleaf cottonwood), which is often twice the abundance of other tree species, and a thick understory of *Cornus sericea* (red-osier dogwood). This association occurs in two distinct settings - one in narrow valleys (30 ft, 10 m) with swift, steep streams (4% gradient) where it occurs on narrow benches, and the other in wide valleys (500 ft, 150 m) on broad floodplains along, moderately steep, meandering rivers (2% gradient). This association usually occurs 2-6 ft (0.5-2 m) above the stream channel. Stream channels vary widely in slope and width and are either broad, moderately sinuous with moderate gradients or broad, highly sinuous with low gradients. Occasionally, stream channels are steep and narrow. Soils are highly variable and stratified. Soil textures include silty clays, silty clay loams, clay loams, sandy clays, sandy clay loam, and loamy sands.

Vegetation Description

This is one of the most diverse cottonwood-dominated riparian plant associations. The upper canopy can consist of several species, but *Populus angustifolia* (narrowleaf cottonwood) is almost always dominant with 5-85% cover. Other tree species that may be present include *Picea pungens* (blue spruce), *Populus tremuloides* (quaking aspen), *Pseudotsuga menziesii* (Douglas-fir), *Pinus ponderosa* (ponderosa pine), and *Abies lasiocarpa* (subalpine fir). The shrub layer is dense and diverse with 1-98% cover of *Cornus sericea* (red-osier dogwood). Other shrub species may be as abundant, but not exceeding *Cornus*. Shrub species include *Alnus incana* ssp. *tenuifolia* (thinleaf alder), *Amelanchier* spp. (serviceberry), *Rosa woodsii* (Woods rose), *Symphoricarpos oreophilus* (mountain snowberry), *Acer glabrum* (Rocky Mountain maple), *Prunus virginiana* (chokecherry), *Quercus gambelii* (Gambel's oak), *Salix ligulifolia* (strapleaf willow), *Crataegus rivularis* (river hawthorn), *Lonicera involucrata* (twinberry honeysuckle), *Salix exigua* (sandbar willow), *Betula occidentalis* (river birch), *Salix drummondiana* (Drummond willow), *Salix lucida* ssp. *caudata*

(shining willow), and *Salix monticola* (mountain willow). Stands vary in aspect and shade provided, some are relatively moist and shady, others are relatively dry and open. In the moister environments, the herbaceous cover can be high (>50%).

Ecological Processes

In Colorado, some stands of this association appear to be mid- to late-seral mature cottonwood forests that are isolated from frequent flooding and sediment deposition. A seasonally high water table is required to maintain a vigorous *Cornus sericea* layer. Stands of this association growing at lower elevations and on high, drier terraces have greater cover of *Amelanchier utahensis* (Utah serviceberry), *Amelanchier alnifolia* (Saskatoon serviceberry) and *Crataegus rivularis* (river hawthorn) and may have undergone over-grazing in the past.

This plant community occurs within the Glade Canyon Spring PCA, and along Dolores River below McPhee dam in Montezuma County.

Avg. Cover %	(Range)	Species Name	# Plots (N=46)
44	(5-85%)	<i>Populus angustifolia</i>	46
36	(1-98%)	<i>Cornus sericea</i> ssp. <i>sericea</i>	46
18	(3-50%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	25
14	(1-30%)	<i>Crataegus rivularis</i>	7
14	(1-30%)	<i>Salix lucida</i> ssp. <i>caudata</i> , <i>lasiandra</i>	6
12	(1-50%)	<i>Picea pungens</i>	10
12	(1-30%)	<i>Amelanchier utahensis</i>	9
10	(1-22%)	<i>Salix ligulifolia</i>	13
8	(1-40%)	<i>Rosa woodsii</i>	41
8	(0.1-30%)	<i>Populus tremuloides</i>	8
8	(1-30%)	<i>Acer glabrum</i>	13
8	(1-30%)	<i>Solidago gigantea</i>	7
8	(1-30%)	<i>Lonicera involucrata</i>	16
7	(1-30%)	<i>Rudbeckia laciniata</i> var. <i>ampla</i>	19
7	(1-20%)	<i>Salix drummondiana</i>	10
7	(1-30%)	<i>Clematis ligusticifolia</i>	6
7	(1-20%)	<i>Pseudotsuga menziesii</i>	8
7	(1-70%)	<i>Poa pratensis</i>	31
7	(1-44%)	<i>Ribes inerme</i>	17
7	(1-29%)	<i>Quercus gambelii</i>	14
7	(1-30%)	<i>Prunus virginiana</i> var. <i>melanocarpa</i>	19
6	(1-25%)	<i>Actaea rubra</i> ssp. <i>arguta</i>	9
6	(1-31%)	<i>Salix exigua</i>	11
5	(1-20%)	<i>Heracleum maximum</i>	16
5	(1-20%)	<i>Maianthemum stellatum</i>	37
5	(1-10%)	<i>Salix monticola</i>	6
5	(1-12%)	<i>Symphoricarpos oreophilus</i>	23

Other species with < 5% average cover present in at least 10% of plots:

Dactylis glomerata (1-20%), *Amelanchier alnifolia* (1-10%), *Juniperus scopulorum* (1-20%), *Agrostis gigantea* (1-10%), *Rubus idaeus* ssp. *strigosus* (1-20%), *Taraxacum officinale* (1-20%), *Geranium richardsonii* (1-30%), *Fragaria virginiana* ssp. *glauca* (1-20%), *Mentha arvensis* (1-10%), *Osmorhiza depauperata* (1-10%), *Elymus glaucus* (1-5%), *Phleum pratense* (1-10%), *Equisetum arvense* (0.1-10%), *Calamagrostis canadensis* (1-5%), *Ligusticum porteri* (1-10%), *Viola canadensis* var. *scopulorum* (1-5%), *Vicia americana* (1-10%), *Paxistima myrsinites* (1-5%), *Galium boreale* (1-5%), *Geum macrophyllum* var. *perincisum* (1-5%), *Equisetum laevigatum* (1-5%), *Chamerion angustifolium* ssp. *circumvagum* (1-8%), *Mertensia ciliata* (1-5%), *Galium triflorum* (1-3%), *Thalictrum fendleri* (1-5%), *Equisetum hyemale* var. *affine* (1-5%), *Glyceria striata* (1-3%), *Achillea millefolium* var. *occidentalis* (1-3%), *Conioselinum scopulorum* (1-2%), *Solidago canadensis* (1%).

Narrowleaf cottonwood - Rocky Mountain juniper Woodland

Populus angustifolia - *Juniperus scopulorum*



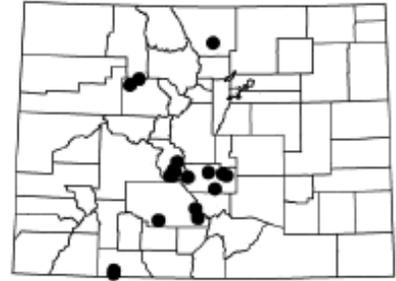
Global rank/State rank:

G2G3 / S3

HGM subclass: R3/4

Colorado elevation range:

6,000-8,600 ft (1,800-2,600 m)



General Description

Populus angustifolia (narrowleaf cottonwood) and *Juniperus scopulorum* (Rocky Mountain juniper) dominated riparian areas are uncommon. The community occurs along lower foothill streams with perennial to intermittent stream flows. Total biomass and canopy cover are often low. The association is characterized by an open canopy of *Populus angustifolia* (narrowleaf cottonwood) and *Juniperus scopulorum* (Rocky Mountain juniper), often with little else growing in the understory. The species composition and percent cover is variable and depends on aspect, elevation, and stream flow, in addition to the degree of disturbance by recreational use and livestock grazing.

Stream channels are steep and narrow with rocky to sandy bottoms. This association can also occur on upper terraces and elevated islands of wide, meandering river reaches such as those found along the Arkansas and Colorado Rivers. Valley widths are typically 700 ft (200 m) or less and stream gradients are generally low to moderate (0.5-2.5%). *Juniperus scopulorum* (Rocky Mountain juniper) is situated at the high water line and above, while the *Populus angustifolia* (narrowleaf cottonwood) grades into the active floodplain area. Soils of this plant association are derived from alluvial deposits. The surface soils consist of loamy sand, clay loams, silty clays or organic matter. Subsurface layers range from sandy loams and loamy sands to clay loams and sandy clay loams with 20-50% gravel and cobbles. Soil depth ranges from 15-25 inches (40 to 65 cm).

Vegetation Description

This plant association is characterized by an open to closed canopy of 20-100% cover of *Populus angustifolia* (narrowleaf cottonwood) and scattered to abundant *Juniperus scopulorum* (Rocky Mountain juniper) with 5-85% cover. Stands with northern aspects may include *Pseudotsuga menziesii* (Douglas-fir) or *Populus tremuloides* (quaking aspen). Two stands in the lower San Juan watershed with *Juniperus osteosperma* (Utah juniper), rather than *J. scopulorum* (Rocky Mountain juniper), are included in this type. There is very little shrub canopy and little to no

herbaceous undergrowth due to dry conditions. If present, the shrub canopy may include a wide variety of species, although none is present in every stand. Shrub species may include *Clematis ligusticifolia* (western white clematis), *Acer glabrum* (Rocky Mountain maple), *Rhus trilobata* (skunkbush sumac), *Symphoricarpos oreophilus* (mountain snowberry), *Quercus gambelii* (Gamble oak), and *Berberis fendleri* (Colorado barberry). Non-native species are some of the more commonly encountered herbaceous components of this association, and generally occur in disturbed stands. Species include *Poa pratensis* (Kentucky bluegrass), *Taraxacum officinale* (dandelion), *Agrostis stolonifera* (creeping bentgrass), and *Melilotus officinalis* (sweet clover).

Ecological Processes

As with all cottonwood woodlands, this association is found within a continually hanging alluvial environment where riparian vegetation is constantly being “re-set” by flooding disturbance.

Mature cottonwood stands do not regenerate in place, but regenerate by “moving” up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities.

The process of cottonwood regeneration is dependent on flooding disturbance. Periodic flooding allows cottonwood seedlings to germinate and become established on newly deposited, moist sandbars. Natural river processes of bank erosion, deposition and channel migration result in a dynamic patchwork of different age classes, plant associations and habitats.

This natural plant community occurs within the Disappointment Creek and Dolores River Canyon SLSs.

Avg. Cover %	(Range)	Species Name	# Plots (N=20)
51	(12-97%)	<i>Populus angustifolia</i>	20
29	(3-86%)	<i>Juniperus scopulorum</i>	18
12	(6-22%)	<i>Quercus gambelii</i>	3
11	(3-24%)	<i>Carex utriculata</i>	3
10	(1-29%)	<i>Poa pratensis</i>	13
9	(0.1-30%)	<i>Maianthemum stellatum</i>	6
9	(6-12%)	<i>Pseudotsuga menziesii</i>	3
9	(1-23%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	3
8	(1-18%)	<i>Acer glabrum</i>	4
7	(1-17%)	<i>Agrostis stolonifera</i>	6
6	(1-27%)	<i>Clematis ligusticifolia</i>	10
6	(1-12%)	<i>Melilotus officinalis</i>	6

Other species with < 5% average cover present in at least 10% of plots:

Leymus cinereus (1-10%), *Medicago lupulina* (1-8%), *Equisetum arvense* (1-8%), *Thermopsis divaricarpa* (2-7%), *Trifolium repens* (1-7%), *Thalictrum fendleri* (1-4%), *Juncus balticus* var. *montanus* (1-6%), *Rhus trilobata* var. *trilobata* (1-6%), *Equisetum hyemale* var. *affine* (1-6%), *Rosa woodsii* (0.1-5%), *Salix exigua* (1-3%), *Achillea millefolium* var. *occidentalis* (1-3%), *Symphoricarpos oreophilus* (1-2%), *Taraxacum officinale* (1-3%), *Artemisia ludoviciana* (1-2%), *Bromus tectorum* (1%), *Pascopyrum smithii* (1%), *Tragopogon dubius* (1%).

Narrowleaf cottonwood / Skunkbush sumac Woodland

Populus angustifolia / *Rhus trilobata*

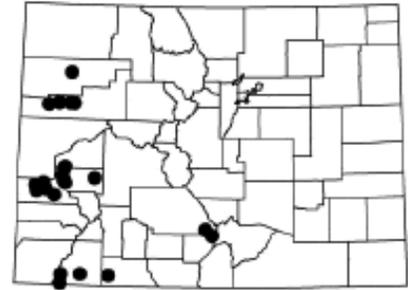


Global rank/State rank:

G3 / S3

HGM subclass: R3/4

Colorado elevation range:
5,000-8,000 ft (1,500-2,440 m)



General Description

The *Populus angustifolia*/*Rhus trilobata* (narrowleaf cottonwood/skunkbush sumac) plant association is characterized by a scattered overstory of *Populus angustifolia* with an occasional *P. x acuminata* (lanceleaf cottonwood) or *P. deltoides* ssp. *wislizenii* (Rio Grande cottonwood). The shrub understory is a dense layer of *Rhus trilobata*. It occurs in sandstone canyons and on streams adjacent to sand dunes.

This plant association occurs on immediate river banks, floodplain meanders, and narrow benches in narrow to wide, 65-500 ft (20-150 m), sandstone canyons. Stands generally occur within 3 ft (1 m) of the high water mark, but can also occur on higher terraces, up to 10 ft (3 m) above the channel. In the western portion of the Colorado River drainage, this association occurs on small streams in shale canyon areas. Stream channels are wide and highly sinuous or wide and moderately sinuous. Occasionally, stream channels are narrow and steep. The soils associated with this plant association are often alkaline and of a calcareous parent material. The soil textures are fine sandy loams, clay loams, silty clay loams, and silty clay.

Vegetation Description

This plant association is characterized by the presence and abundance of *Rhus trilobata* (skunkbush sumac) with *Populus angustifolia* (narrowleaf cottonwood), or *P. x acuminata* (lanceleaf cottonwood). The cottonwoods may be young or mature trees. Other trees that may be present in the overstory include *Acer negundo* (boxelder), *Juniperus osteosperma* (Utah juniper), *Juniperus scopulorum* (Rocky Mountain juniper), *Pinus ponderosa* (ponderosa pine), *Pseudotsuga menziesii* (Douglas-fir), *Pinus edulis* (pinyon pine), and *Ulmus pumila* (Siberian elm), an introduced species found in a single plot. The shrub layer is dominated by *Rhus trilobata* (skunkbush sumac). Other shrubs that may be present include *Clematis ligusticifolia* (western white clematis), *Rosa woodsii* (Woods rose), *Quercus gambelii* (Gambel's oak), *Salix exigua* (sandbar willow), *Amelanchier utahensis* (Utah serviceberry), *Cornus sericea* (red-osier dogwood), *Forestiera pubescens* (wild privet), *Prunus virginiana* (chokecherry), *Berberis*

fendleri (Colorado barberry), *Shepherdia argentea* (silver buffaloberry), and *Acer glabrum* (Rocky Mountain maple). The herbaceous undergrowth is usually sparse.

Ecological Processes

In southwestern Colorado, *Rhus trilobata* is present in both young and old cottonwood stands. As the stand matures, *Rhus trilobata* becomes denser and excludes other shrubs. On higher terraces that are less frequently flooded, *Populus angustifolia* does not reproduce. This indicates succession to an upland community. The presence of *Quercus gambelii* (Gambel's oak) in some stands may indicate a trend toward an upland oak shrub community.

As with all cottonwood woodlands, this association is found within a continually changing alluvial environment where riparian vegetation is constantly being "re-set" by flooding disturbance. The process of cottonwood regeneration is dependent on flooding disturbance. Periodic flooding allows cottonwood seedlings to germinate and become established on newly deposited, moist sandbars. Natural river processes of bank erosion, deposition and channel migration result in a dynamic patchwork of different age classes, plant associations and habitats. This association occurs within the Dolores River Canyon SLS.

Avg. Cover		Species Name	# Plots (N=34)
%	(Range)		
37	(1-99%)	<i>Rhus trilobata</i> var. <i>trilobata</i>	32*
33	(1-80%)	<i>Populus angustifolia</i>	32*
20	(1-50%)	<i>Mahonia repens</i>	5
20	(1-60%)	<i>Populus x acuminata</i>	6
19	(3-40%)	<i>Forestiera pubescens</i>	6
18	(1-40%)	<i>Acer negundo</i> var. <i>interius</i>	8
17	(3-31%)	<i>Prunus virginiana</i> var. <i>melanocarpa</i>	5
16	(1-26%)	<i>Berberis fendleri</i>	5
11	(1-30%)	<i>Shepherdia argentea</i>	4
10	(1-21%)	<i>Maianthemum stellatum</i>	9
9	(1-30%)	<i>Salix exigua</i>	11
9	(1-20%)	<i>Crataegus rivularis</i>	4
8	(1-56%)	<i>Clematis ligusticifolia</i>	22
8	(1-20%)	<i>Quercus gambelii</i>	13
7	(1-30%)	<i>Poa pratensis</i>	19
7	(1-21%)	<i>Pascopyrum smithii</i>	5
6	(1-10%)	<i>Cornus sericea</i>	7
6	(0.1-30%)	<i>Rosa woodsii</i>	18
6	(1-10%)	<i>Artemisia tridentata</i>	8
5	(1-10%)	<i>Juniperus scopulorum</i>	6
5	(1-20%)	<i>Symphoricarpos oreophilus</i>	9
5	(1-10%)	<i>Toxicodendron rydbergii</i>	6

Other species with < 5% average cover present in at least 10% of plots:

Ericameria nauseosa ssp. *nauseosa* var. *glabrata* (0.1-10%), *Amelanchier utahensis* (1-10%), *Melilotus officinalis* (0.1-10%), *Equisetum arvense* (1-5%), *Glycyrrhiza lepidota* (1-5%), *Taraxacum officinale* (1-5%), *Vicia americana* (1-5%), *Artemisia ludoviciana* (1-3%), *Bromus tectorum* (1-3%), *Heterotheca villosa* (1%), *Eleocharis palustris* (1%), *Achillea millefolium* var. *occidentalis* (0.1-1%), *Equisetum laevigatum* (0.1-1%).

* *Populus angustifolia* and *Rhus trilobata* occurred in all stands, but were not captured in every sample plot.

**Narrowleaf cottonwood / Strapleaf willow - Silver buffaloberry
Woodland**

Populus angustifolia / *Salix ligulifolia* - *Shepherdia argentea*

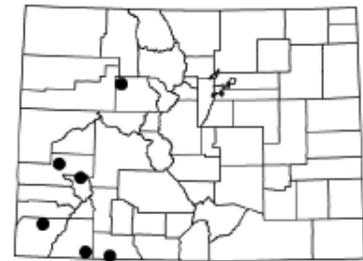
Global rank/State rank:

G2 / S2

HGM subclass: R3/4

Colorado elevation range:

6,000-7,100 ft (1,800-2,200 m)



General Description

Populus angustifolia/*Salix ligulifolia*-*Shepherdia argentea* (narrowleaf cottonwood/ strapleaf willow-silver buffaloberry) is an extremely limited plant association in western Colorado. Historically, it was more widespread and common in broad river valleys. Intense, long-term use by livestock and alterations in the river flow regime have caused a decline in its distribution. This plant association occurs in narrow to broad, 1,000 ft (300 m) wide, alluvial valleys. Mature stands occur on terraces up to 10 ft (2.5 m) above the active channel. Mature stands spread out across wide floodplains, but also occur on narrow floodplains of constricted reaches. Stream channels are wide and sinuous with low to moderate gradients (1-5%). The soils are deep, sandy loams.

Vegetation Description

This plant association is characterized by an overstory canopy of *Populus angustifolia* (narrowleaf cottonwood) and the presence of *Shepherdia argentea* (silver buffaloberry). The tree canopy consists of mature *Populus angustifolia* (narrowleaf cottonwood), with seeding and sapling sized *P. angustifolia* that can occur in bands close to the river's edge. Other trees that may be present include *Pinus edulis* (pinyon pine) and *Populus x acuminata* (lanceleaf cottonwood). The shrub layer is diverse and widely spaced. *Shepherdia argentea* (silver buffaloberry) is the key characteristic shrub for this association. Low abundance may indicate a degraded occurrence. *Salix ligulifolia* (strapleaf willow) is so widely spaced that it may not be sampled. Other shrub species which may be present include *Rhus trilobata* (skunkbush sumac), *Alnus incana* ssp. *tenuifolia* (thinleaf alder), *Cornus sericea* (red-osier dogwood), *Rosa woodsii* (Woods rose), *Crataegus rivularis* (river hawthorne), *Quercus gambelii* (Gambel's oak), *Salix exigua* (sandbar willow), *Salix irrorata* (bluestem willow), and *Betula occidentalis* (river birch). The herbaceous undergrowth is typically dominated by introduced hay grasses including *Agrostis stolonifera* (creeping bentgrass), *Poa pratensis* (Kentucky bluegrass), and *Dactylis glomerata* (orchardgrass).

A few native species also occur, including *Maianthemum stellatum* (starry false Solomon seal), *Equisetum arvense* (field horsetail), *Glycyrrhiza lepidota* (American licorice), *Thlaspi montanum* (alpine pennycress), and *Pascopyrum smithii* (western wheatgrass).

Ecological Processes

No undisturbed stands of the *Populus angustifolia*/*Salix ligulifolia*-*Shepherdia argentea* (narrowleaf cottonwood/strapleaf willow-silver buffaloberry) plant association are known in Colorado. The predominance of non-native grasses in the undergrowth and widely spaced shrubs indicate heavy utilization by cattle.

This association is expected to occur within the Dolores River Canyon SLS, and was viewed from the roadside along the Dolores River in Montezuma County, below the McPhee dam.

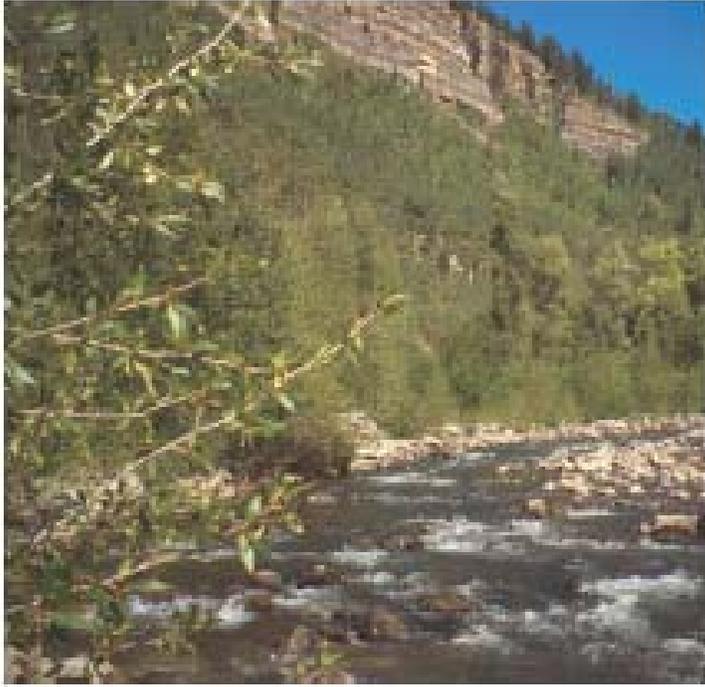
Avg. Cover %	(Range)	Species Name	# Plots (N=7)
34	(1-85%)	<i>Populus angustifolia</i>	7
33	(3-59%)	<i>Shepherdia argentea</i>	7
28	—	<i>Salix irrorata</i>	1
26	—	<i>Salix lucida</i> ssp. <i>caudata</i> , <i>lasiandra</i>	1
20	—	<i>Agrostis stolonifera</i>	1
18	(1-69%)	<i>Poa pratensis</i>	6
18	—	<i>Populus x acuminata</i>	1
16	(1-30%)	<i>Clematis ligusticifolia</i>	5
11	(1-28%)	<i>Rosa woodsii</i>	4
10	—	<i>Crataegus rivularis</i>	1
10	—	<i>Thlaspi montanum</i>	1
10	—	<i>Quercus gambelii</i>	1
10	—	<i>Salix ligulifolia</i>	1
10	—	<i>Symphoricarpos oreophilus</i>	1
9	(1-40%)	<i>Rhus trilobata</i> var. <i>trilobata</i>	5
9	(1-22%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	4
9	—	<i>Deschampsia caespitosa</i>	1
9	(3-14%)	<i>Betula occidentalis</i>	2
8	(1-27%)	<i>Salix exigua</i>	4
4	(1-11%)	<i>Trifolium repens</i>	3

Other species with < 5% average cover present in at least 10% of plots:

Melilotus officinalis (3-5%), *Poa compressa* (4-4%), *Dactylis glomerata* (3-3%), *Symphotrichum laeve* var. *geyeri* (3-3%), *Thalictrum fendleri* (3-3%), *Chamerion angustifolium* ssp. *circumvagum* (3-3%), *Amelanchier alnifolia* (3-3%), *Salix monticola* (3-3%), *Pinus edulis* (3-3%), *Heterotheca villosa* (3-3%), *Prunella vulgaris* (3-3%), *Cornus sericea* ssp. *sericea* (1-3%), *Taraxacum officinale* (1-3%), *Pascopyrum smithii* (1-3%), *Glycyrrhiza lepidota* (1-3%), *Elymus lanceolatus* (2%), *Hedysarum boreale* (2%), *Equisetum arvense* (1-3%), *Maianthemum stellatum* (1-3%), *Cirsium arvense* (1-2%), *Phleum pratense* (1%), *Juncus balticus* var. *montanus* (1%), *Carduus nutans* ssp. *macrolepis* (1%), *Elymus trachycaulus* ssp. *trachycaulus* (1%), *Dasiphora floribunda* (1%), *Symphotrichum spathulatum* (1%), *Mahonia repens* (1%), *Equisetum laevigatum* (1%), *Calamagrostis canadensis* (1%), *Toxicodendron rydbergii* (1%), *Asparagus officinalis* (1%), *Arctium minus* (1%), *Apocynum cannabinum* (1%), *Trifolium pratense* (1%), *Poa reflexa* (1%), *Ribes cereum* (1%), *Equisetum hyemale* var. *affine* (1%), *Achillea millefolium* var. *occidentalis* (1%), *Solidago canadensis* (1%), *Ipomopsis aggregata* (1%), *Streptopus amplexifolius* var. *chazatus* (1%), *Galium triflorum* (1%), *Galium boreale* (1%), *Oxypolis fendleri* (1%).

Narrowleaf cottonwood/Mixed willow Woodland

Populus angustifolia / *Salix* (*monticola*, *drummondiana*, *lucida*)



Global rank/State rank:

G3 / S3

HGM subclass: R3/4

Colorado elevation range:

7,900-8,900 ft (2,400-2,700 m)



General Description

The *Populus angustifolia*/*Salix* (*monticola*, *drummondiana*, *lucida*) (narrowleaf cottonwood/mixed willow) plant association is an early to mid-seral stage of more mature *Populus angustifolia* dominated plant associations. The cottonwoods are fairly young trees (5-15 in, 12-38 cm dbh), with a diverse mix of willows and other shrubs in the understory canopy. This community occurs on active floodplains, stream benches and low terraces, generally within 1-4.5 ft (0.3-1.4 m) of the active channel elevation. Stream channels range from steep and narrow to broad, moderate gradient and more sinuous. Sites show signs of active flooding. One stand occurs on an overflow or back channel.

Soils are somewhat deep (about 3 ft, 1 m), loamy to clay sands over very coarse alluvial layers with at least 25% gravel and other coarse fragments present in all layers.

Vegetation Description

The upper canopy is dominated by young (sapling, pole and medium-sized 5-15 in, 12-35 cm in diameter) *Populus angustifolia* (narrowleaf cottonwood) trees with 25- 90% cover. The understory has a consistent mixture of two or more willow species, which can include *Salix exigua* (sandbar willow), *S. ligulifolia* (strapleaf willow), *S. monticola* (mountain willow), *S. lucida* ssp. *caudata* (shining willow), *S. drummondiana* (Drummond willow), and *S. geyeriana* (Geyer willow). Total cover of the shrub layer is between 15-70%. Other, non-willow shrubs are usually present as well, and include *Rosa woodsii* (Woods rose), *Ribes* spp. (gooseberry), *Alnus incana* ssp. *tenuifolia* (thinleaf alder), *Crataegus rivularis* (river hawthorn), *Dasiphora floribunda* (shrubby cinquefoil), and *Symphoricarpos* spp. (snowberry). The herbaceous undergrowth is generally low in total cover, with 10-40% forbs and 5- 15% graminoids. Common species include *Maianthemum stellatum* (starry false Solomon seal), *Trifolium* spp. (clover), *Erigeron* spp. (fleabane), *Poa pratensis* (Kentucky bluegrass), and *Bromus inermis* (smooth brome).

Ecological Processes

As with all cottonwood woodlands, this association is found within a continually changing alluvial environment where riparian vegetation is constantly being “re-set” by flooding disturbance. Mature cottonwood stands do not regenerate in place, but regenerate by “moving” up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities. The process of cottonwood regeneration is dependent on flooding disturbance. Periodic flooding allows cottonwood seedlings to germinate and become established on newly deposited, moist sandbars. Natural river processes of bank erosion, deposition and channel migration result in a dynamic patchwork of different age classes, plant associations and habitats. This plant association occurs in the floodplain of the Dolores River, West Dolores River, and is within the West Dolores River Campground PCA.

Avg. Cover %	(Range)	Species Name	# Plots (N=4)
57	(23-89%)	<i>Populus angustifolia</i>	4
17	(6-36%)	<i>Salix monticola</i>	3
13	(10-16%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	2
12	—	<i>Salix drummondiana</i>	1
11	—	<i>Juniperus monosperma</i>	1
7	—	<i>Ribes cereum</i>	1
6	(1-13%)	<i>Poa pratensis</i>	4
5	(1-9%)	<i>Ribes inermis</i>	2
5	(4-6%)	<i>Salix exigua</i>	2
5	(3-7%)	<i>Salix lucida</i> ssp. <i>caudata</i> , <i>lasiantha</i>	2
5	—	<i>Maianthemum stellatum</i>	1

Other species with < 5% average cover present in at least 10% of plots:

Symphytotrichum foliaceum (4%), *Symphoricarpos albus* (4%), *Rosa woodsii* (1-8%), *Lonicera involucrata* (3%), *Equisetum arvense* (3%), *Heracleum maximum* (3%), *Bromus ciliatus* var. *ciliatus* (3%), *Galium triflorum* (3%), *Equisetum pratense* (3%), *Crataegus rivularis* (3%), *Cornus sericea* ssp. *sericea* (3%), *Trifolium pratense* (3%), *Thermopsis montana* (3%), *Symphoricarpos oreophilus* (3%), *Salix geyeriana* (3%), *Rudbeckia laciniata* var. *ampla* (3%), *Pseudocymopterus montanus* (3%), *Phleum pratense* (3%), *Pedicularis procera* (3%), *Medicago lupulina* (3%), *Salix ligulifolia* (2-3%), *Taraxacum officinale* (2-3%), *Achillea millefolium* var. *occidentalis* (1-2%), *Juncus balticus* var. *montanus* (1%), *Glyceria striata* (1%), *Fragaria virginiana* ssp. *glauca* (1%), *Dasiphora floribunda* (1%), *Iris missouriensis* (1%), *Thalictrum fendleri* (1%), *Dactylis glomerata* (1%), *Amelanchier alnifolia* (1%), *Angelica pinnata* (1%), *Geranium richardsonii* (1%), *Bromus inermis* (1%), *Chamerion angustifolium* ssp. *circumvagum* (1%), *Calamagrostis canadensis* (1%), *Carex pellita* (1%), *Cardamine cordifolia* (1%), *Carex microptera* (1%), *Mertensia ciliata* (1%), *Castilleja sulphurea* (1%), *Castilleja miniata* (1%), *Carex utriculata* (1%), *Elymus glaucus* (1%), *Vicia americana* (1%), *Trifolium repens* (1%), *Solidago canadensis* (1%), *Ribes lacustre* (1%), *Heterotheca villosa* (1%), *Platanthera sparsiflora* var. *ensifolia* (1%), *Pinus ponderosa* var. *scopulorum* (1%), *Oxypolis fendleri* (1%), *Mimulus guttatus* (1%), *Zigadenus elegans* ssp. *elegans* (1%), *Maianthemum racemosum* ssp. *amplexicaule* (1%), *Rubus idaeus* ssp. *strigosus* (1%).

Skunkbush sumac - (Sandbar willow) Shrubland

Rhus trilobata - (*Salix exigua*)

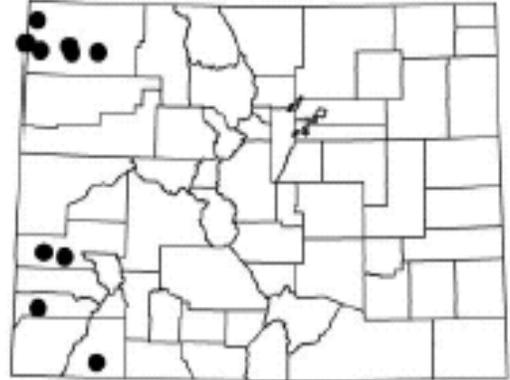
Global rank/State rank:

G2 / S2

HGM subclass: R3/4

Colorado elevation range:

5,100-6,500 ft (1,600-2,000 m)



General Description

The *Rhus trilobata*-(*Salix exigua*) (skunkbush sumac-(sandbar willow)) plant association is a small shrubland that forms linear bands on rocky, well-drained benches and toeslopes. It is often confined between the high water mark of a river and adjacent cliff faces. On the West Slope *Rhus trilobata* is limited to riparian areas, but it occurs as an upland species in the Colorado Front Range foothills.

This plant association occurs at the bottom of cliffs and on toeslopes in very narrow, rocky river reaches having little floodplain development due to bedrock confinement. It often occurs as a narrow band on rocky, well-drained benches located between the high water line and the upland slopes in moderately wide valleys and along narrow reaches of larger rivers. Stream channels are wide and sinuous. Soil textures are shallow sandy loams or loamy sands over coarse alluvium or bedrock.

Vegetation Description

This plant association is characterized by a dense shrub layer dominated by 1-98% cover of *Rhus trilobata* (skunkbush). *Salix exigua* (sandbar willow) is present with moderate cover in about 30% of stands. In cooler, mesic sites *Cornus sericea* (redosier dogwood) may be abundant. Other shrubs that may be present include *Salix. ligulifolia* (strapleaf willow), *Clematis ligusticifolia* (western white clematis), *Ribes aureum* (golden currant), *Chrysothamnus viscidiflorus* (green rabbitbrush), *Rosa woodsii* (Woods rose), and *Berberis fendleri* (Colorado barberry). The herbaceous undergrowth is sparse.

Ecological Processes

The *Rhus trilobata*-(*Salix exigua*) (skunkbush sumac-(sandbar willow)) plant association appears to be late-seral because it occurs at or above the high-water mark of the channel. *Rhus trilobata* can tolerate well-drained, rocky soils by remaining close to the river. This shrub species has roots that penetrate the water table through cracks in the bedrock or into areas where the roots can take

advantage of summer rainfall events. This type appears to be a non-obligate riparian plant association because it occurs on the driest sites within a riparian zone and also occurs on Eastern Slope uplands in Colorado.

This plant association occurs within the Dolores River Canyon.

Avg. Cover %	(Range)	Species Name	# Plots (N=16)
31	(0.1-97.5%)	<i>Rhus trilobata</i> var. <i>trilobata</i>	16
21	(5-37.5%)	<i>Toxicodendron rydbergii</i>	2
21	(1-40%)	<i>Ribes aureum</i>	2
18	(15-20%)	<i>Lepidium latifolium</i>	2
15	(1-50%)	<i>Clematis ligusticifolia</i>	5
11	(10-11.9%)	<i>Juniperus osteosperma</i>	2
10	(1-20%)	<i>Salix ligulifolia</i>	3
10	(10-10%)	<i>Cornus sericea</i> ssp. <i>sericea</i>	3
9	(2.5-15%)	<i>Tamarix ramosissima</i>	2
9	(1-15%)	<i>Bromus tectorum</i>	4
7	(1-20%)	<i>Salix exigua</i>	5
7	(1-15%)	<i>Melilotus officinalis</i>	3
6	(0.1-15%)	<i>Glycyrrhiza lepidota</i>	5
6	(1-10%)	<i>Elymus trachycaulus</i> ssp. <i>trachycaulus</i>	2
4	(1-10%)	<i>Maianthemum stellatum</i>	4

Other species with < 5% average cover present in at least 10% of plots:
Chrysothamnus viscidiflorus (1-10%), *Taraxacum officinale* (1-10%), *Rosa woodsii* (0.1-10%), *Elymus repens* (2.5-5%), *Bromus inermis* (0.1-10%), *Juncus balticus* var. *montanus* (1-5%), *Medicago lupulina* (1-5%), *Plantago major* (1-5%), *Berberis fendleri* (1-5%), *Artemisia tridentata* (1-5%), *Amelanchier alnifolia* (0.1-5%), *Sporobolus cryptandrus* (2.5%), *Poa pratensis* (1-5%), *Iva axillaris* (1-2.5%), *Artemisia tripartita* ssp. *tripartita* (0.1-5%), *Apocynum cannabinum* (0.1-5%), *Pinus edulis* (0.1-2.5%), *Pascopyrum smithii* (0.1-2%), *Trifolium repens* (1%), *Asclepias speciosa* (1%), *Plantago lanceolata* (1%), *Mentha arvensis* (1%), *Equisetum arvense* (1-1%), *Equisetum laevigatum* (0.1-1%), *Equisetum hyemale* var. *affine* (0.1-2%), *Achillea millefolium* var. *occidentalis* (0.1-1%), *Ambrosia tomentosa* (0.05-0.1%).

Bebb willow Shrubland

Salix bebbiana



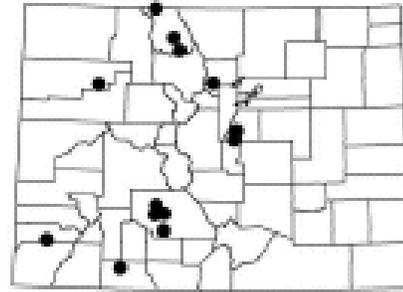
Global rank/State rank:

G3? / S2

HGM subclass: R2, R3/4

Colorado elevation range:

7,300-9,400 ft (2,225-2,870 m)



General Description

This association occurs in canyon country at lower elevations in the San Juan National Forest, the Rio Grande River Basin and in foothill canyons of the South Platte River Basin. The *Salix bebbiana* (Bebb willow) plant association is a minor type in Colorado. It is a tall (5-15 ft, 1.5-3 m), deciduous, shrubland with an open to closed canopy, generally forming small thickets within larger riparian mosaics or long and thin continuous thickets in narrow tributary canyons.

This plant association occurs on briefly flooded, low-gradient streams or along narrow alluvial terraces of canyons. It can also occur on broad, seep-fed meadows. Stream channels are steep and narrow, wider, less steep, and moderately sinuous, or moderately wide and sinuous.

Soils are highly stratified layers of sandy loams, clay loams, and silty clay with mottling near the surface. Soils can also be deep, dark-colored silty clay loams with high organic content and mottling or they can be shallow, becoming skeletal at about 10 inches (25 cm) depth. In the spring and early summer, soils are saturated for several days to weeks and then slowly dry out over the rest of the growing season.

Vegetation Description

Salix bebbiana (Bebb willow) rarely forms large willow shrublands in Colorado and commonly appears in small patches within other plant associations. On occasion, however, it will form a small and dense shrubland with an overstory. Other shrubs that may be present include *Alnus incana* ssp. *tenuifolia* (thinleaf alder), *Cornus sericea* (red-osier dogwood), *Dasiphora floribunda* (shrubby cinquefoil), *Ribes montigenum* (gooseberry currant), and *Salix ligulifolia* (strapleaf willow). The herbaceous undergrowth is characterized by a sparse to moderately dense forb layer on raised, better-drained hummocks and ridges beneath the willow canopy. Herbaceous species include *Achillea millefolium* var. *occidentalis* (western yarrow), *Poa pratensis* (Kentucky bluegrass), *Calamagrostis canadensis* (bluejoint reedgrass), *Geranium richardsonii* (Richardson geranium), *Juncus balticus* var. *montanus* (mountain rush), and *Heracleum maximum* (common cowparsnip).

Ecological Processes

In Colorado, stands of *Salix bebbiana* (Bebb willow) do not frequently occur. *Salix bebbiana* appears to be very sensitive to grazing, and forms the classic “mushroom” shape with overgrazing. *Salix bebbiana* rarely forms large willow carrs and is limited to small patches within larger riparian mosaics or in protected, narrow canyon bottoms that preclude livestock grazing.

This plant association occurs within the Upper Plateau Creek and Morrison Creek at Lone Cone PCAs.

Avg. Cover %	(Range)	Species Name	# Plots (N=14)
35	(10-68%)	<i>Salix bebbiana</i>	14
27	(1-80%)	<i>Poa compressa</i>	3
22	(6-36%)	<i>Ribes montigenum</i>	3
16	(1-70%)	<i>Calamagrostis canadensis</i>	8
13	(10-18%)	<i>Salix monticola</i>	3
11	(2-36%)	<i>Dasiphora floribunda</i>	6
11	(1-30%)	<i>Juncus balticus</i> var. <i>montanus</i>	5
10	(1-22%)	<i>Populus tremuloides</i>	3
10	(2-21%)	<i>Carex utriculata</i>	6
8	(3-17%)	<i>Ribes inermis</i>	4
8	(1-20%)	<i>Poa pratensis</i>	9
6	(2-13%)	<i>Carex aquatilis</i>	3
6	(2-10%)	<i>Agrostis gigantea</i>	3
5	(1-10%)	<i>Geum macrophyllum</i> var. <i>perincisum</i>	3

Other species with < 5% average cover present in at least 10% of plots:
Rudbeckia laciniata var. *ampla* (2-8%), *Geranium richardsonii* (1-7%), *Conioselinum scopulorum* (1-10%), *Thermopsis divaricarpa* (1-8%), *Lonicera involucrata* (2-5%), *Fragaria virginiana* ssp. *glauca* (1-8%), *Mertensia ciliata* (1-5%), *Chamerion angustifolium* ssp. *circumvagum* (1-5%), *Equisetum arvense* (1-5%), *Galium boreale* (1-7%), *Glyceria striata* (1-5%), *Taraxacum officinale* (1-5%), *Pedicularis groenlandica* (1-5%), *Potentilla pulcherrima* X *hippiana* (1-3%), *Thalictrum fendleri* (1-5%), *Trifolium repens* (1-5%), *Maianthemum stellatum* (1-4%), *Equisetum pratense* (1-3%), *Achillea millefolium* var. *occidentalis* (0.1-3%), *Rubus idaeus* ssp. *strigosus* (1-2%), *Mentha arvensis* (1-2%), *Dodecatheon pulchellum* (1-2%), *Phleum pratense* (1%).

Barrenground willow / Mesic forb Shrubland

Salix brachycarpa / Mesic forb

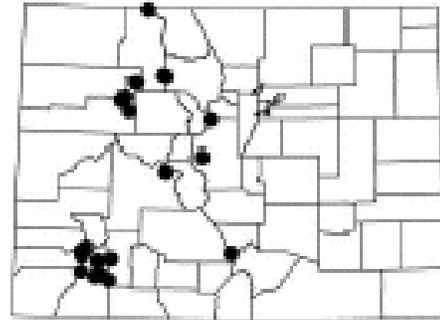
Global rank/State rank:

G4 / S4

HGM subclass: S1/2, R1, R2

Colorado elevation range:

8,500-11,500 ft (2,600-3,500 m)



General Description

Typically, the *Salix brachycarpa*/mesic forb (barrenground willow/mesic forb) plant association occurs on well-drained slopes in subalpine valleys. This association may be considered 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.

This plant association occurs in subalpine areas of the San Juan Mountains, the San Miguel/Dolores, Gunnison, Colorado and White River Basins, the Routt National Forest, and Rio Grande/Closed Basin.

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, or narrow, deep and sinuous. Soil textures range from silty clay loams to fine sandy loams with some mottling.

Vegetation Description

Salix brachycarpa (barrenground willow) occurs in almost pure stands on hummocks and well-drained slopes adjacent to the valley floor. *Salix planifolia* (planeleaf willow) dominated associations occur within the same riparian/wetland mosaic in lower, poorly-drained areas and intermix with the *Salix brachycarpa* (barrenground willow) association at their ecotone. Within the *Salix brachycarpa* (barrenground willow) association, *Salix planifolia* (planeleaf willow) may occur with 2-30% cover. Other shrubs may include *Salix wolfii* (Wolf willow) and *Betula nana* (= *glandulosa*) (bog birch) in high, subalpine stands; and *Salix monticola* (mountain willow), and *S. drummondiana* (Drummond willow). The herbaceous undergrowth is dominated by forb cover, which exceeds total graminoid cover, although no one forb species is dominant nor present in every stand. Forb species include *Senecio triangularis* (arrowleaf ragwort), *Mertensia ciliata* (tall fringed bluebells), *Cardamine cordifolia* (heartleaf bittercress), *Caltha leptosepala* (marsh marigold), *Thalictrum* spp. (meadowrue), *Pseudocymopterus montanus* (alpine false springparsley), *Fragaria virginiana* (strawberry), *Oxypolis fendleri* (Fendler cowbane) and *Ligusticum* spp. (licoriceroot). Graminoid species may include *Deschampsia caespitosa* (tufted hairgrass), *Carex aquatilis* (water sedge) and *Calamagrostis canadensis* (bluejoint reedgrass). Lichen and moss-covered boulders are often present.

Ecological Processes

Salix planifolia (planeleaf willow), *Salix brachycarpa* (barrenground willow) and *Salix wolfii* (Wolf willow) are abundant low-stature (1-3 ft, 0.3-1 m) willows of firststand second-order streams

of subalpine elevations of Colorado. *Salix planifolia* and *Salix brachycarpa* can form extensive stands, often creating intricate mosaics in broad, subalpine valleys. In general, *Salix planifolia* occupies the wettest micro-habitats on peat soils, although it can grow well on mineral soils. *Salix brachycarpa* is more often found on slightly drier and more well-drained micro-habitats than *Salix planifolia*. *Salix wolfii* grows on deep, undecomposed peat, while *Salix planifolia* tends to grow on more decomposed (humified) organic soils. *Salix brachycarpa* grows on lateral moraines, coarse-textured stream banks, ridge tops and on small hummocks. This plant association appears to be stable, but little is known about its successional trends. It is sometimes intensely grazed by sheep, which may alter the species composition. This plant association occurs within the Dolores River at Snow Spur PCA.

Avg. Cover %	(Range)	Species Name	# Plots (N=20)
48	(10-98%)	<i>Salix brachycarpa</i>	20
20	(3-70%)	<i>Salix wolfii</i>	5
16	(10-22%)	<i>Carex aquatilis</i>	6
15	(3-50%)	<i>Salix monticola</i>	8
14	(2-30%)	<i>Salix planifolia</i>	10
12	(2-30%)	<i>Caltha leptosepala</i>	6
10	(1-25%)	<i>Picea engelmannii</i>	7
8	(1-20%)	<i>Fragaria virginiana</i> ssp. <i>glauca</i>	9
7	(1-20%)	<i>Thalictrum alpinum</i>	5
6	(1-10%)	<i>Dasiphora floribunda</i>	9
6	(1-20%)	<i>Senecio triangularis</i>	11
6	(1-20%)	<i>Carex utriculata</i>	5
6	(1-20%)	<i>Ligusticum porteri</i>	7
6	(1-26%)	<i>Deschampsia caespitosa</i>	11
5	(1-16%)	<i>Taraxacum officinale</i>	12
5	(1-13%)	<i>Hymenoxys hoopesii</i>	7
5	(1-13%)	<i>Calamagrostis canadensis</i>	8

Other species with < 5% average cover present in at least 10% of plots:
Geranium richardsonii (1-11%), *Mertensia ciliata* (1-16%), *Oxypolis fendleri* (1-13%), *Bromus ciliatus* var. *ciliatus* (1-10%), *Aconitum columbianum* (3-5%), *Carex microptera* (1-10%), *Cardamine cordifolia* (1-14%), *Valeriana edulis* (1-6%), *Equisetum arvense* (1-6%), *Poa pratensis* (1-10%), *Achillea millefolium* var. *occidentalis* (1-8%), *Geum macrophyllum* var. *perincisum* (1-5%), *Erigeron coulteri* (1-7%), *Phleum alpinum* (1-5%), *Rhodiola rhodantha* (1-9%), *Pedicularis groenlandica* (1-3%), *Stellaria longifolia* (1%), *Luzula parviflora* (1%), *Veronica wormskjoldii* (1%).

Drummond willow / Bluejoint reedgrass Shrubland

Salix drummondiana / *Calamagrostis canadensis*

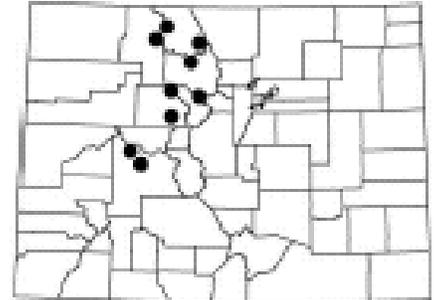


Global rank/State rank:

G3 / S3

HGM subclass: S1/2, R2

Colorado elevation range:
8,000-9,800 ft (2,400-3,000 m)



General Description

The *Salix drummondiana*/*Calamagrostis canadensis* (Drummond willow/bluejoint reedgrass) plant association is characterized by a dense canopy of *Salix drummondiana* and a thick undergrowth of *Calamagrostis canadensis*. This association is often associated with beaver activity along streams and can also occur within the riparian mosaic with *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir- Engelmann spruce) forests. This plant association occurs in scattered locations on the West Slope in the Yampa, Colorado and Gunnison River Basins and in the Routt National Forest.

This plant association occurs as small, isolated patches in forest and shrubland openings along channels in narrow valley bottoms. *Salix drummondiana* (Drummond willow) usually occurs along steep, narrow stream margins. It is often associated with beaver activity and can occasionally occur along low-gradient streams.

Vegetation Description

Salix drummondiana (Drummond willow) dominates the shrub overstory. Other shrubs can be present and abundant, such as *Salix planifolia* (planeleaf willow) and *Alnus incana* ssp. *tenuifolia* (thinleaf alder). The graminoid layer is dominated by *Calamagrostis canadensis* (bluejoint reedgrass). Other abundant graminoids include *Carex aquatilis* (water sedge), *Carex utriculata* (beaked sedge), and *Glyceria striata* (fowl mannagrass). Forb cover is typically low and includes *Galium boreale* (northern bedstraw), *Geranium richardsonii* (Richardson geranium), and *Mertensia ciliata* (tall fringed bluebells).

Ecological Processes

The *Salix drummondiana*/*Calamagrostis canadensis* (Drummond willow/bluejoint reedgrass) plant association is often an early colonizer of first-order, boulder-strewn, steep streams. Only a few stands representing the *Salix drummondiana*/*Calamagrostis canadensis* (Drummond willow/bluejoint reedgrass) plant association have been found in Colorado, and livestock grazing

has probably altered the species composition of these stands. This association appears to be limited to saturated wetland environments and therefore may be dependent on beaver populations that maintain a high water table. In addition, near beaver activity, this association may be a mid-successional community that will eventually become a *Salix planifolia* (planeleaf willow) or *Salix monticola* (mountain willow) type as the area dries slightly and accumulates sediment.

This plant association occurs within the Dolores River at Peterson Slide PCA.

Avg. Cover %	(Range)	Species Name	# Plots (N=12)
54	(20-95%)	<i>Salix drummondiana</i>	12
34	(3-80%)	<i>Calamagrostis canadensis</i>	11
15	(5-30%)	<i>Carex utriculata</i>	3
14	(5-30%)	<i>Carex aquatilis</i>	4
13	(5-20%)	<i>Salix geyeriana</i>	2
11	(1-20%)	<i>Salix planifolia</i>	2
10	(1-20%)	<i>Salix monticola</i>	3
9	(5-11%)	<i>Glyceria striata</i>	3
8	(0.1-30%)	<i>Heracleum maximum</i>	8
4	(1-7%)	<i>Equisetum arvense</i>	6

Other species with < 5% average cover present in at least 10% of plots:
Chamerion angustifolium ssp. *circumvagum* (1-5%), *Galium triflorum* (1-5%), *Veronica americana* (1-4%), *Deschampsia caespitosa* (2-3%), *Geranium richardsonii* (1-5%), *Alnus incana* ssp. *tenuifolia* (2-3%), *Mertensia ciliata* (1-5%), *Taraxacum officinale* (1-3%), *Poa pratensis* (1-3%), *Fragaria virginiana* ssp. *glauca* (1-3%), *Cardamine cordifolia* (1-3%), *Veratrum tenuipetalum* (1-2%), *Thalictrum sparsiflorum* (1-2%), *Geum macrophyllum* var. *perincisum* (1-3%), *Senecio triangularis* (1-3%), *Conioselinum scopulorum* (0.1-2%), *Achillea millefolium* var. *occidentalis* (1%), *Galium boreale* (1%), *Rubus idaeus* ssp. *strigosus* (1%), *Lonicera involucrata* (1%), *Bromus ciliatus* var. *ciliatus* (1%), *Epilobium lactiflorum* (0.1-1%).

Drummond willow / Mesic forb Shrubland

Salix drummondiana / Mesic forb



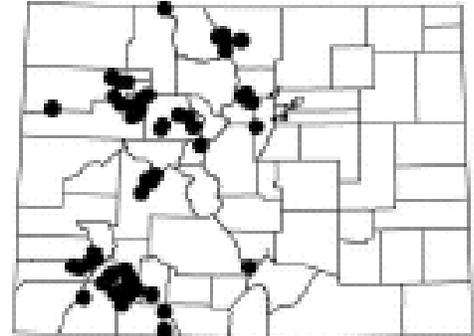
Global rank/State rank:

G4 / S4

HGM subclass: S3/4, R2, R3/4

Colorado elevation range:

7,500-11,300 ft (2,400-3,500 m)



General Description

The *Salix drummondiana*/mesic forb (Drummond willow/mesic forb) plant association most commonly occurs on relatively steep streams and rarely forms more than a narrow, 5-25 ft (1.5-7.5 m) wide, band along streambanks. The closed to partially open canopy of *Salix drummondiana* and a thick carpet of many forb species characterize this plant association. This plant association occurs throughout the Western Slope and in montane regions along the Colorado Front Range.

The association occurs as a narrow band along high gradient streams in narrow, Vshaped valleys and as large willow carrs in the broad valleys of low gradient (1-3%), moderately sinuous streams. It is also located along broad, highly sinuous streams and broad, actively downcutting channels. This association also occurs near seeps. 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.

Vegetation Description

Salix drummondiana (Drummond willow) forms an open to closed, narrow canopy of tall shrubs lining the stream bank. Other shrub species may be present with cover equal to but not exceeding that of *Salix drummondiana*. Mature trees may be present as a few individuals scattered through the shrubland or as canopy from an adjacent forested association. Stands with an overstory canopy of aspen are currently included in this association, although a *Populus tremuloides*/*Salix drummondiana* type may be separated at a later date. The herbaceous undergrowth may be sparse or richly diverse. In general, total forb cover exceeds that of graminoid cover, and no single species is dominant.

Ecological processes

The *Salix drummondiana*/mesic forb (Drummond willow/mesic forb) 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) plant association which also occurs along steep streams and alternates with the willow carrs. In wider valleys, this 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.

This plant association occurs within the Navajo Lake Trail PCA.

Avg. Cover		Species Name	# Plots (N=60)
%	(Range)		
55	(20-98%)	<i>Salix drummondiana</i>	60
15	(2-37%)	<i>Salix planifolia</i>	7
13	(1-75%)	<i>Populus tremuloides</i>	10
12	(1-21%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	17
11	(0.1-40%)	<i>Salix monticola</i>	33
10	(0.1-44%)	<i>Mertensia ciliata</i>	41
9	(1-29%)	<i>Carex utriculata</i>	12
8	(1-40%)	<i>Heracleum maximum</i>	39
8	(1-26%)	<i>Mertensia franciscana</i>	9
8	(1-34%)	<i>Picea engelmannii</i>	21
8	(1-30%)	<i>Delphinium barbeyi</i>	8
8	(1-60%)	<i>Equisetum arvense</i>	30
7	(1-20%)	<i>Carex aquatilis</i>	7
6	(0.1-30%)	<i>Lonicera involucrata</i>	36
6	(1-40%)	<i>Cardamine cordifolia</i>	44
6	(1-24%)	<i>Ligusticum porteri</i>	12
6	(0.1-30%)	<i>Calamagrostis canadensis</i>	31
6	(1-30%)	<i>Oxypolis fendleri</i>	24
5	(1-20%)	<i>Ribes inerme</i>	14
5	(1-20%)	<i>Agrostis gigantea</i>	7
5	(1-21%)	<i>Arnica cordifolia</i>	8
5	(1-13%)	<i>Picea pungens</i>	10
5	(1-34%)	<i>Saxifraga odontoloma</i>	19

Other species with < 5% average cover present in at least 10% of plots:
Hydrophyllum fendleri (1-17%), *Rudbeckia laciniata* var. *ampla* (1-14%), *Dasiphora floribunda* (1-10%), *Senecio triangularis* (1-24%), *Abies lasiocarpa* (1-12%), *Geranium richardsonii* (1-20%), *Aconitum columbianum* (1-20%), *Elymus glaucus* (1-10%), *Osmorhiza depauperata* (1-10%), *Sambucus racemosa* var. *racemosa* (1-10%), *Chamerion angustifolium* ssp. *circumvagum* (1-12%), *Maianthemum stellatum* (1-10%), *Poa pratensis* (1-20%), *Conioselinum scopulorum* (1-8%), *Bromus ciliatus* var. *ciliatus* (1-5%), *Carex microptera* (1-10%), *Deschampsia caespitosa* (1-7%), *Thalictrum fendleri* (1-5%), *Veratrum tenuipetalum* (1-5%), *Viola canadensis* var. *scopulorum* (1-10%), *Geum macrophyllum* var. *perincisum* (1-10%), *Taraxacum officinale* (0.1-8%), *Galium triflorum* (1-5%), *Fragaria virginiana* ssp. *glauca* (1-6%), *Phleum pratense* (1-5%), *Urtica dioica* ssp. *gracilis* (1-5%), *Achillea millefolium* var. *occidentalis* (0.1-5%), *Streptopus amplexifolius* var. *chazatus* (1-5%), *Rubus idaeus* ssp. *strigosus* (1-5%), *Mitella pentandra* (1-4%), *Symphoricarpos oreophilus* (1-5%), *Mimulus guttatus* (1-3%), *Glyceria striata* (1-4%), *Thlaspi montanum* (1%), *Pedicularis groenlandica* (1%), *Descurainia incana* (1%).

Sandbar willow / Barren Ground Shrubland

Salix exigua / Barren Ground

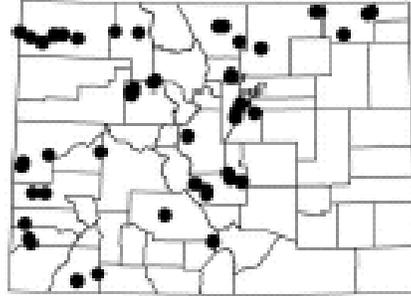
Global rank/State rank:

G5 / S5

HGM subclass: D4/5, R3/4, R5

Colorado elevation range:

3,600-9,900 ft (1,100-3,000 m)



General Description

This association occurs throughout Colorado, in every major watershed without exception. *Salix exigua* (sandbar willow) is one of the most common willow species in Colorado and occurs as a dominant in two associations, the *Salix exigua*/mesic graminoid and the *Salix exigua*/barren ground. These are easy to recognize as they are nearly pure stands of the willow, with few other species present. An undergrowth of a few, widely scattered forbs and grasses, where exposed cobbles or sand characterizes the ground cover, constitutes the *Salix exigua*/barren ground association, while an undergrowth of dense grasses and forbs covering at least 30% of the ground falls into the mesic graminoid type. *Salix exigua*/barren ground association occurs within the annual flood zone of a river on point bars, islands, sand or cobble bars and stream banks, while the *Salix exigua*/mesic graminoid association generally occurs along backwater channels and other perennially wet, but less scoured sites, such as floodplain swales and irrigation ditches. This early seral plant association occurs primarily on sand and cobble bars of larger (second order and up) rivers. It is associated with annual flooding and inundation and will grow well into the channel, where it is flooded, even in drier years. It can form large, wide stands on mid-channel islands on larger rivers such as the Gunnison, Colorado and South Platte, or narrow stringer bands on small, rocky tributaries. This plant association occurs along a wide variety of stream reaches from moderately sinuous and moderate gradient reaches, to broad, meandering rivers with wide floodplains or broad, braided channels. Many stands also occur within highly entrenched or eroding gullies. Soils of this association are typically coarse alluvial deposits of sand, silt and cobbles that are highly stratified with depth from flooding scour and deposition. Highly stratified profiles consist of alternating layers of clay loam and organic material with coarser sand or thin layers of sandy loam over very coarse alluvium. Occasionally, this association occurs on deep pockets of sand.

Vegetation Description

This association is characterized by an almost exclusive canopy of *Salix exigua* (sandbar willow) (1-98% cover) with very little herbaceous cover. Other shrubs and tree species may be present, but these rarely have greater cover than *Salix exigua*. Because this is such a widespread and common association, many other species can be present. A variety of other woody species may include *Populus angustifolia* (narrowleaf cottonwood), *P. deltoides* (plains cottonwood), *Abies lasiocarpa* (subalpine fir), *Salix ligulifolia* (strapleaf willow), *S. lucida* ssp. *caudata* (shining willow), *S. monticola* (mountain willow), *Acer negundo* (boxelder), and *Alnus incana* ssp. *tenuifolia* (thinleaf alder). The herbaceous cover is typically very low, but can be as high as 30%. No single key herbaceous species is an indicator for this association, rather is it the combined amount of bare soil (dirt), gravel, cobble, or boulders that make up the ground cover that is the diagnostic indicator for this association. Common herbaceous species include *Poa pratensis* (Kentucky bluegrass), *Carex* spp. (sedge), *Melilotus officinalis* (yellow sweetclover), and *Cirsium* spp. (thistle). Although some species may appear high in cover, it is usually not representative of

the whole stand, or it occurs between cobbles and boulders. Another key indicator for this association is the lack of soil development, and high ground cover of coarse alluvial material.

Ecological Processes

The *Salix exigua*/barren ground (sandbar willow/barren ground) plant association is considered an early seral community, capable of colonizing freshly deposited sand and gravel bars. *Salix exigua* is an excellent soil stabilizer with a deep root system and flexible stems that can withstand flooding. *Salix exigua* reduces erosion potential by increasing the friction of stream flow, trapping sediments and building a protected seed bed for a number of tree and shrub species. Succession without disturbance may lead to a greater understory cover, which, in turn, facilitates the establishment of shrub and tree seedlings. The presence of cottonwood seedlings within this association indicates succession to a cottonwood stand, if seedlings survive subsequent flooding events.

This plant association occurs in the Dolores River Canyon and within the Narraguinne Canyon.

Avg. Cover		Species Name	# Plots (N=73)
%	(Range)		
61	(0.1-98%)	<i>Salix exigua</i>	73
10	(0.1-60%)	<i>Clematis ligusticifolia</i>	9
8	(1-40%)	<i>Melilotus officinalis</i>	10
6	(1-15%)	<i>Cirsium arvense</i>	10
6	(1-22%)	<i>Trifolium repens</i>	7
5	(1-20%)	<i>Rosa woodsii</i>	13
5	(0.1-30%)	<i>Cornus sericea</i>	13

Other species with < 5% average cover present in at least 10% of plots:
Agrostis gigantea (0.1-10%), *Poa pratensis* (1-15%), *Populus deltoides* (0.1-10%), *Glycyrrhiza lepidota* (0.1-10%), *Equisetum hyemale* var. *affine* (0.1-7%), *Xanthium strumarium* (0.1-5%), *Apocynum cannabinum* (0.1-10%), *Bromus inermis* (1-5%), *Eleocharis palustris* (0.1-10%), *Medicago lupulina* (1-5%), *Echinochloa crus-galli* (0.1-5%), *Equisetum arvense* (1-3%), *Mentha arvensis* (0.1-3%), *Taraxacum officinale* (0.1-1%).

Geyer willow / Mesic forb Shrubland

Salix geeyeriana / Mesic forb



Global rank/State rank:

G3 / S3

HGM subclass: R2, R3/4

Colorado elevation range:

8,100-9,900 ft (2,460-3,000 m)

General Description



General Description

The *Salix geeyeriana*/mesic forb (Geyer willow/mesic forb) plant association is a tall (5-15 ft, 1.5-2.5 m), deciduous shrubland confined to a narrow band along stream banks. The herbaceous undergrowth is dominated by mosses and forbs. This association is well documented in several western states. However, large, pristine stands without introduced species in the undergrowth are extremely rare.

This plant association generally occurs along moderately wide, low-gradient valley bottoms with sinuous stream channels. It can also occur in narrow valley bottoms (65- 165 ft, 20-50 m), and on flood benches of moderately sinuous stream channels. Soils are coarse skeletal sandy loams and sandy clay loams overlying gravel and cobble horizons. Soils of this plant association tend to have more coarse fragments than other more moist *Salix geeyeriana* associations.

Vegetation Description

Salix geeyeriana (Geyer willow) dominates the tall shrub canopy. Other willow species that may be present include *Salix monticola* (mountain willow), *Salix drummondiana* (Drummond willow), *Salix planifolia* (planeleaf willow), *Salix wolfii* (Wolf willow), and *Salix brachycarpa* (barrenground willow). *Alnus incana* ssp. *tenuifolia* (thinleaf alder) can also be present. Forb cover is low to fairly dense and includes *Mertensia ciliata* (tall fringed bluebells), *Heracleum maximum* (common cowparsnip), *Senecio triangularis* (arrowleaf ragwort), *Oxypolis fendleri* (Fendler cowbane), and *Fragaria virginiana* (strawberry). Graminoid cover is sparse.

Ecological Processes

The *Salix geeyeriana*/mesic forb (Geyer willow/mesic forb) plant association appears to be a long-lived, late-seral community that will remain dominant where a high water table saturates soils for much of the growing season. However, if the stand has predominantly non-native species in the undergrowth, such as *Trifolium repens* (white clover) and *Taraxacum officinale* (dandelion), it is likely a grazing-induced community. With appropriate grazing management, the stand can revert back to the *Salix geeyeriana*/mesic forb (Geyer willow/mesic forb) or the *Salix geeyeriana* /mesic

graminoid (Geyer willow/mesic graminoid) plant association.

This plant association occurs within Lower Coal Creek PCA.

Avg. Cover %	(Range)	Species Name	# Plots (N=10)
54	(30-75%)	<i>Salix geyeriana</i>	10
28	(15-50%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	4
20	(6-32%)	<i>Salix monticola</i>	4
14	(7-20%)	<i>Salix boothii</i>	2
12	(3-20%)	<i>Salix wolfii</i>	2
11	(1-28%)	<i>Heracleum maximum</i>	6
9	(1-17%)	<i>Juncus balticus</i> var. <i>montanus</i>	2
9	(1-34%)	<i>Mertensia ciliata</i>	6
8	(6-10%)	<i>Trifolium repens</i>	2
8	(1-16%)	<i>Picea engelmannii</i>	3
7	(1-18%)	<i>Cardamine cordifolia</i>	4
7	(3-11%)	<i>Carex utriculata</i>	2
6	(1-20%)	<i>Poa pratensis</i>	4
6	(1-11%)	<i>Trifolium longipes</i>	2
6	(2-9%)	<i>Senecio triangularis</i>	5
6	(1-10%)	<i>Castilleja sulphurea</i>	2
5	(1-13%)	<i>Taraxacum officinale</i>	7
5	(2-8%)	<i>Erigeron speciosus</i> var. <i>speciosus</i>	2
5	(1-9%)	<i>Pinus contorta</i>	2
5	(1-18%)	<i>Carex aquatilis</i>	5

Other species with < 5% average cover present in at least 10% of plots:
Prunella vulgaris (4-5%), *Veratrum tenuipetalum* (3-7%), *Geranium richardsonii* (2-10%),
Aconitum columbianum (1-9%), *Thalictrum fendleri* (1-6%), *Carex microptera* (1-10%), *Achillea*
millefolium var. *occidentalis* (1-23%), *Dasiphora floribunda* (1-9%), *Calamagrostis canadensis* (2-
6%), *Salix planifolia* (1-10%), *Ligusticum tenuifolium* (2-5%), *Viola macloskeyi* ssp. *pallens* (1-6%),
Oxypolis fendleri (1-10%), *Conioselinum scopulorum* (1-5%), *Erigeron peregrinus* ssp.
callianthemus (3-3%), *Galium boreale* (1-5%), *Fragaria virginiana* ssp. *glauca* (1-5%), *Lonicera*
involuta (2-3%), *Equisetum arvense* (1-5%), *Aster alpinus* var. *vierhapperi* (1-3%), *Osmorhiza*
depauperata (1-3%), *Carex foenea* (1-3%), *Carex norvegica* (1-3%), *Trisetum spicatum* (1-3%),
Vicia americana (1-4%), *Pedicularis groenlandica* (1-3%), *Luzula parviflora* (1-3%), *Phleum*
alpinum (1-3%), *Maianthemum stellatum* (1-2%), *Galium triflorum* (1-2%), *Castilleja miniata* (1-
2%), *Ribes montigenum* (1-2%), *Mitella pentandra* (1-2%), *Saxifraga odontoloma* (1-2%), *Geum*
macrophyllum var. *perincisum* (1%), *Deschampsia caespitosa* (1%), *Caltha leptosepala* (1%),
Bromus ciliatus var. *ciliatus* (1%), *Bromus lanatipes* (1%), *Chamerion angustifolium* ssp.
circumvagum (1%), *Elymus glaucus* (1%), *Stellaria longifolia* (1%), *Streptopus amplexifolius* var.
chalmazatus (1%).

Strapleaf willow Shrubland

Salix ligulifolia (= *S. eriocephala* var. *ligulifolia*)

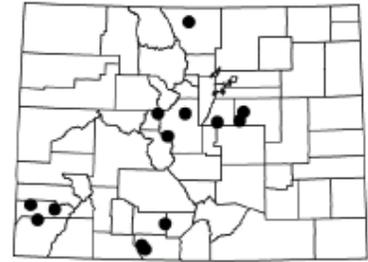
Global rank/State rank:

G2G3 / S2S3

HGM subclass: S1/2, R2, R3/4

Colorado elevation range:

6,350-10,200 ft (1,900-3,100 m)



General Description

The *Salix ligulifolia* (strapleaf willow) plant association is a medium- to tall-willow shrubland occurring on saturated floodplains and stream banks of montane and lower subalpine elevations. *Salix ligulifolia* often mixes with *Salix exigua* (sandbar willow) and *Salix lucida* (shining willow) in the foothills, forming the *Salix exigua*-*Salix ligulifolia* (sandbar willow-strapleaf willow) plant association. In the mountains, *Salix ligulifolia* mixes with *Salix monticola* (mountain willow) and *Salix drummondiana* (Drummond willow) where it grows in relatively broad valley bottoms. This association occurs in moderately wide valleys along low terraces and floodplains, and stream banks of narrower reaches. The plant association occurs along reaches with vegetated islands between multiple channels below an active beaver pond, along slightly sinuous broad channels, along more sinuous channels with well developed floodplains, and along steep narrow gullies. Soils are saturated sandy loams and clay loams with a high organic matter content in the upper layers.

Vegetation Description

This association has a canopy dominated by *Salix ligulifolia* (strapleaf willow), usually mixed with several other willow species. *Salix ligulifolia* (strapleaf willow) is the key diagnostic species, other willows may have equal cover, but in general do not exceed that of *Salix ligulifolia*. Other willows that may be present include *Salix monticola* (mountain willow), *Salix geyeriana* (Geyer willow), *Salix bebbiana* (Bebb willow), *Salix lucida* (ssp. *caudata* or ssp. *lasiandra*) (shining willow), *Salix wolfii* (Wolf willow), and *Salix planifolia* (planeleaf willow). Additional shrubs that may be present include *Alnus incana* ssp. *tenuifolia* (thinleaf alder), *Cornus sericea* (red-osier dogwood), and *Dasiphora floribunda* (shrubby cinquefoil).

The herbaceous undergrowth can be dense in undisturbed stands with *Carex utriculata* (beaked sedge), *Carex nebrascensis* (Nebraska sedge), *Carex pellita* (woolly sedge), *Juncus balticus* var. *montanus* (mountain rush), and *Calamagrostis canadensis* (bluejoint reedgrass). Forb cover is generally low, but some species are abundant, including *Taraxacum officinale* (dandelion), *Achillea millefolium* var. *occidentalis* (western yarrow), *Thalictrum fendleri* (Fendler

meadowrue), and *Fragaria virginiana* (strawberry). No herbaceous species was consistently present with high abundance, so none was chosen as diagnostic.

Ecological Processes

This association appears to be a long-lived mid to late-seral type since it is associated with beaver activity and saturated soils throughout the growing season.

This plant association occurs within the Beaver Creek at Willow Spring PCA.

Avg. Cover %	(Range)	Species Name	# Plots (N=13)
34	(18-66%)	<i>Salix ligulifolia</i>	13
26	(15-36%)	<i>Carex nebrascensis</i>	2
20	(3-41%)	<i>Carex utriculata</i>	5
17	(1-35%)	<i>Salix lucida</i> ssp. <i>caudata</i> , <i>lasiandra</i>	7
15	(3-43%)	<i>Salix monticola</i>	9
13	(1-25%)	<i>Salix exigua</i>	6
12	(2-27%)	<i>Calamagrostis canadensis</i>	6
12	(6-21%)	<i>Salix planifolia</i>	3
11	(2-26%)	<i>Carex aquatilis</i>	3
10	(1-19%)	<i>Thalictrum fendleri</i>	2
10	(1-28%)	<i>Poa pratensis</i>	10
9	(1-25%)	<i>Juncus balticus</i> var. <i>montanus</i>	6
8	(3-13%)	<i>Typha latifolia</i>	2
8	(1-34%)	<i>Trifolium repens</i>	6
7	(5-8%)	<i>Scirpus microcarpus</i>	2
6	(3-10%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	3
6	(5-7%)	<i>Betula nana</i>	2
5	(1-10%)	<i>Taraxacum officinale</i>	8
5	(2-8%)	<i>Chamerion angustifolium</i> ssp. <i>circumvagum</i>	2
5	(3-6%)	<i>Poa palustris</i>	2

Other species with < 5% average cover present in at least 10% of plots:

Dasiphora floribunda (1-10%), *Salix geyeriana* (1-12%), *Carex pellita* (1-8%), *Mentha arvensis* (1-9%), *Fragaria virginiana* ssp. *glauca* (1-12%), *Eleocharis palustris* (1-7%), *Cirsium arvense* (2-4%), *Salix bebbiana* (3%), *Equisetum arvense* (1-6%), *Mertensia ciliata* (1-4%), *Achillea millefolium* var. *occidentalis* (1-7%), *Conioselinum scopulorum* (2-3%), *Geranium viscosissimum* var. *incisum* (1-4%), *Agrostis stolonifera* (2-3%), *Geum macrophyllum* var. *perincisum* (1-4%), *Deschampsia caespitosa* (1-4%), *Trifolium pratense* (1-3%), *Carex microptera* (1-3%), *Phleum pratense* (1-3%), *Heracleum maximum* (1-2%), *Iris missouriensis* (1-2%), *Juncus articulatus* (1-2%), *Picea pungens* (1-2%), *Bromus inermis* (1-2%), *Potentilla pulcherrima* (1-2%), *Cicuta douglasii* (1-2%), *Oxypolis fendleri* (1%), *Platanthera dilatata* var. *albiflora* (1%), *Plantago major* (1%), *Populus angustifolia* (1%), *Galium triflorum* (1%), *Medicago lupulina* (1%), *Ambrosia artemisiifolia* var. *elatior* (1%), *Maianthemum stellatum* (1%), *Rumex crispus* (1%), *Carex hassei* (1%).

Geyer willow - Mountain willow / Mesic forb Shrubland

Salix geeyeriana - *Salix monticola* / Mesic forb

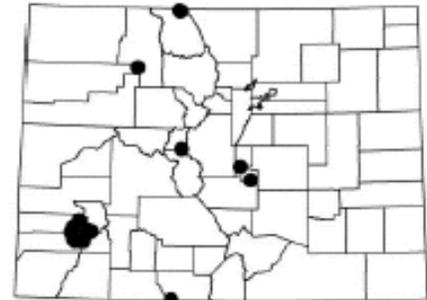
Global rank/State rank:

G3 / S3

HGM subclass: R2

Colorado elevation range:

7,700-9,800 ft (2,300-3,000 m)



General Description

The *Salix geeyeriana*-*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 in most occurrences.

This plant association occurs on broad alluvial floodplains with steep side slopes. Stream channels are broad and moderately sinuous to highly sinuous or narrow, entrenched, ephemeral gullies. 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.

Vegetation Description

This plant association is characterized by a tall, nearly closed canopy of *Salix monticola* (mountain willow) and *Salix geeyeriana* (Geyer willow), with a combined cover between 10-90% and usually so near in abundance, one cannot determine which is the dominant willow in the stand. Other shrubs that may be present include *Ribes inerme* (whitestem gooseberry), *Alnus incana* ssp. *tenuifolia* (thinleaf alder), *Salix drummondiana* (Drummond willow), and *Dasiphora floribunda* (shrubby cinquefoil). The undergrowth in undisturbed stands is a thick carpet of forbs including *Mertensia ciliata* (tall fringed bluebells), *Achillea millefolium* var. *occidentalis* (western yarrow), *Heracleum maximum* (common cowparsnip), *Conioselinum scopulorum* (Rocky Mountain hemlockparsley), *Senecio triangularis* (arrowleaf ragwort), and *Cardamine cordifolia* (heartleaf bittercress). The graminoid layer is usually sparse, but includes *Carex utriculata* (beaked sedge) and *Carex aquatilis* (water sedge). Disturbed stands have a high cover of non-native grasses including *Agrostis stolonifera* (creeping bentgrass) and *Poa pratensis* (Kentucky bluegrass).

Ecological Processes

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 may be a grazing-induced type due to the abundance of non-native grasses in some stands. 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.

This plant association occurs within Dolores River at Dunton PCA.

Avg. Cover		Species Name	# Plots (N=19)
%	(Range)		
45	(8-86%)	<i>Salix monticola</i>	18*
38	(10-80%)	<i>Salix geyeriana</i>	18*
20	(1-52%)	<i>Agrostis stolonifera</i>	6
13	(10-20%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	3
10	(1-35%)	<i>Ribes inerme</i>	11
10	(1-20%)	<i>Poa pratensis</i>	12
8	(1-15%)	<i>Poa palustris</i>	3
7	(1-30%)	<i>Carex aquatilis</i>	5
7	(1-30%)	<i>Trifolium repens</i>	5
7	(1-20%)	<i>Lonicera involucrata</i>	8
7	(5-10%)	<i>Rudbeckia laciniata</i> var. <i>ampla</i>	3
6	(1-30%)	<i>Fragaria virginiana</i> ssp. <i>glauca</i>	7
6	(1-20%)	<i>Juncus balticus</i> var. <i>montanus</i>	7
5	(1-20%)	<i>Taraxacum officinale</i>	14
5	(1-10%)	<i>Carex utriculata</i>	3
5	(1-9%)	<i>Senecio triangularis</i>	3
5	(1-14%)	<i>Heracleum maximum</i>	10

Other species with < 5% average cover present in at least 10% of plots:

Dasiphora floribunda (1-22%), *Cirsium tioganum* var. *coloradense* (1-10%), *Mertensia ciliata* (1-14%), *Geranium richardsonii* (1-20%), *Maianthemum stellatum* (1-10%), *Equisetum arvense* (1-20%), *Phleum pratense* (1-10%), *Rubus idaeus* ssp. *strigosus* (3-5%), *Urtica dioica* ssp. *gracilis* (1-10%), *Thalictrum fendleri* (1-5%), *Aconitum columbianum* (1-5%), *Achillea millefolium* var. *occidentalis* (1-14%), *Bromus ciliatus* var. *ciliatus* (1-5%), *Vicia americana* (1-5%), *Conioselinum scopulorum* (1-4%), *Ligusticum porteri* (1-5%), *Potentilla pulcherrima* (1-5%), *Geum macrophyllum* var. *perincisum* (1-10%), *Chamerion angustifolium* ssp. *circumvagum* (1-5%), *Hymenoxys hoopesii* (1-3%), *Rosa woodsii* (1-3%), *Carex microptera* (1-2%), *Cardamine cordifolia* (1-3%), *Deschampsia caespitosa* (1-2%), *Oxypolis fendleri* (1%), *Moehringia lateriflora* (1%), *Mentha arvensis* (1%), *Erigeron coulteri* (1%), *Galium boreale* (1%), *Cirsium parryi* (1%), *Senecio bigelovii* var. *hallii* (1%).

**Salix geyeriana* and *Salix monticola* occurred in all stands, but were not captured in every sample plot.

Mountain willow / Beaked sedge Shrubland

Salix monticola / *Carex utriculata*

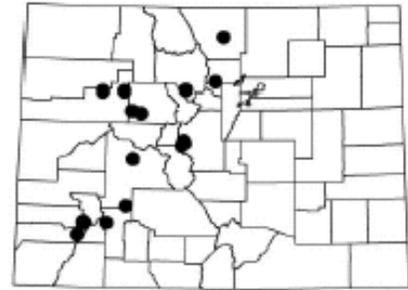


Global rank/State rank:

G3 / S3

HGM subclass: S1/2, R2

Colorado elevation range:
6,600-10,300 ft (2,000-3,100 m)



General Description

The *Salix monticola*/*Carex utriculata* (mountain willow/beaked sedge) plant association is a tall (5-8 ft, or 1.5-2.5 m), deciduous shrubland with an open canopy of willows and a thick understory of grasses and sedges. It occurs on open floodplains and often occupies the entire valley floor.

The undergrowth is dominated by patches of *Carex utriculata* (beaked sedge). This association often includes *Carex aquatilis* (water sedge) and *Calamagrostis canadensis* (bluejoint reedgrass), but is distinguished from the *Salix monticola*/*Carex aquatilis* (mountain willow/water sedge) and *Salix monticola*/*Calamagrostis canadensis* (mountain willow/bluejoint reedgrass) associations because *Carex utriculata* is either the clear dominant or most consistently present of the three throughout the stand.

This plant association commonly occurs near beaver ponds. Willows establish on hummocks of higher ground and *Carex utriculata* (beaked sedge) establishes at the pond margins. This association also occurs along wet stream banks and terraces of low gradient (<3%), broad valley bottoms. Stream reaches can be moderately wide with a gentle gradient, wide and meandering, or altered by beaver activity, creating multiple channels. Soils are clay loam, sandy clay loam and heavy silty clay textures with occasional mottling. Some profiles have a buried organic layer. Others have up to 40% organic matter in the top 20 inches (50 cm).

Vegetation Description

This association is characterized by a thick canopy dominated by *Salix monticola* (mountain willow) as the matrix species. The matrix species is the willow with the highest abundance, even though other willow species combined may have greater canopy cover. Other shrub species that may be present include *Salix geyeriana* (Geyer willow), *Salix brachycarpa* (barrenground willow), *Salix drummondiana* (Drummond willow), *Salix ligulifolia* (strapleaf willow), and *Salix*

boothii (Booth willow). *Carex utriculata* (beaked sedge) is the most abundant graminoid. Other graminoid cover is minor and includes *Carex aquatilis* (water sedge), *Poa pratensis* (Kentucky bluegrass), and *Deschampsia caespitosa* (tufted hairgrass). Total forb cover is generally less than 10%. Forb species include *Cardamine cordifolia* (heartleaf bittercress), *Mertensia ciliata* (tall fringed bluebells), and *Heracleum maximum* (common cowparsnip).

Ecological Processes

This plant association requires a high water table and saturated soils for much of the growing season and may be an early successional stage of the *Salix monticola*/*Carex aquatilis* and the *Salix monticola*/*Calamagrostis canadensis* associations. *Carex utriculata* (beaked sedge), *Carex aquatilis* (water sedge), and *Calamagrostis canadensis* (bluejoint reedgrass) are common dominant undergrowth of several *Salix* plant associations. These three graminoids indicate different micro-environments, generally separating out along a moisture gradient related to the depth of the water table, and can represent different stages of succession of the floodplain. *Carex utriculata* (beaked sedge) occurs on the wettest sites, such as shallow pond margins, low-lying swales, and overflow channel with the shallowest water tables. *Carex aquatilis* (water sedge) occurs on intermediate sites that have saturated but not inundated soils. *Calamagrostis canadensis* (bluejoint reedgrass) dominates the drier sites with lower water tables.

This plant association occurs within the Upper Fish Creek Below Dunn Peak and Willow Creek at Groundhog Mountain PCAs.

Avg. Cover %	(Range)	Species Name	# Plots (N=30)
52	(10-95%)	<i>Salix monticola</i>	30
39	(1-80%)	<i>Carex utriculata</i>	30
18	(1-60%)	<i>Carex aquatilis</i>	9
16	(7-30%)	<i>Cirsium arvense</i>	3
15	(4-40%)	<i>Salix geyeriana</i>	9
11	(1-25%)	<i>Salix wolfii</i>	7
9	(1-28%)	<i>Salix brachycarpa</i>	8
7	(2-10%)	<i>Ribes lacustre</i>	4
7	(1-20%)	<i>Salix drummondiana</i>	9
6	(1-20%)	<i>Salix planifolia</i>	4
6	(1-11%)	<i>Salix ligulifolia</i>	5
6	(1-20%)	<i>Cardamine cordifolia</i>	12
6	(3-9%)	<i>Equisetum pratense</i>	3
5	(1-15%)	<i>Betula nana</i>	5
5	(1-15%)	<i>Equisetum arvense</i>	17
5	(1-25%)	<i>Calamagrostis canadensis</i>	9

Other species with < 5% average cover present in at least 10% of plots:

Poa pratensis (1-24%), *Phleum pratense* (1-10%), *Juncus balticus* var. *montanus* (2-8%), *Conioselinum scopulorum* (1-10%), *Glyceria striata* (0.1-15%), *Swertia perennis* (0.1-10%), *Juncus tracyi* (1-9%), *Fragaria virginiana* ssp. *glauca* (1-9%), *Heracleum maximum* (1-10%), *Mertensia ciliata* (1-20%), *Oxypolis fendleri* (1-7%), *Trifolium repens* (0.1-8%), *Geum macrophyllum* var. *perincisum* (0.1-15%), *Alnus incana* ssp. *tenuifolia* (1-5%), *Lonicera involucrata* (1-7%), *Dasiphora floribunda* (1-5%), *Picea pungens* (1-6%), *Pedicularis groenlandica* (1-6%), *Taraxacum officinale* (1-5%), *Achillea millefolium* var. *occidentalis* (0.1-5%), *Deschampsia caespitosa* (1-4%), *Senecio triangularis* (1-3%), *Angelica ampla* (1-3%), *Chamerion angustifolium* ssp. *circumvagum* (1-3%), *Aconitum columbianum* (1-3%), *Geranium richardsonii* (0.1-3%), *Ribes inerme* (1%), *Rosa woodsii* (1%), *Castilleja miniata* (1%).

Mountain willow / Mesic forb Shrubland

Salix monticola / Mesic forb

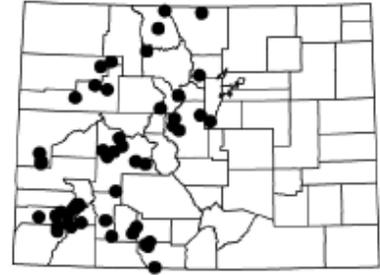


Global rank/State rank:

G4 / S3

HGM subclass: S1/2, R2, R3/4

Colorado elevation range:
6,800-10,700 ft (2,070-3,260 m)



General Description

The *Salix monticola*/mesic forb (mountain willow/mesic forb) plant association is a tall (5-8 ft, 1.5-2.5 m), deciduous shrubland with a dense or open canopy and an herbaceous layer dominated by a variety of forbs and grasses. While no single herbaceous species is a clear dominant, total forb cover is generally greater than 30% and exceeds total graminoid cover.

This association occurs along broad, swift-moving streams and active floodplains in narrow to moderately wide valleys. The ground surface is usually undulating, from past flooding or beaver activity. Stands form narrow bands at the stream edge, ranging from 1-6 ft (0.1-2 m) above the channel elevation. In wider valley bottoms, stands occur further from the bank, but never more than 2.5 ft (0.75 m) above the annual high water mark. Most stands occur adjacent to straight, wide, and shallow channels ranging from bedrock to silty-bottomed reaches. A few stands occur on meandering, cobble-bottomed reaches or streams braided by beaver activity. Soils are fine textured sandy clays to silty and sandy clay loams.

Vegetation Description

Salix monticola (mountain willow) forms a dense to open canopy, and if not the clear dominant, then it is the matrix willow. The matrix species is the willow with the highest abundance, even though other willow species combined may have greater canopy cover. Other shrub species that may be present include *Ribes inerme* (whitestem gooseberry), *Salix drummondiana* (Drummond willow), *S. planifolia* (planeleaf willow), *S. bebbiana* (Bebb willow), *S. geyeriana* (Geyer willow), *S. brachycarpa* (barrenground willow), *S. wolfii* (Wolf willow), *S. lucida* ssp. *caudata* or *lasiandra* (shining willow), *Alnus incana* ssp. *tenuifolia* (thinleaf alder) and *Lonicera involucrata* (twinberry honeysuckle). Total forb cover ranges from 10-70%. No one forb species is noticeably more abundant than any other, nor is any species consistently present in all stands. Forb species that may be present include *Heracleum maximum* (common cowparsnip), *Rudbeckia laciniata* var. *ampla* (cutleaf coneflower), *Mertensia ciliata* (tall fringed bluebells), and *Fragaria virginiana* (strawberry). Graminoid cover may be absent or up to 50% cover; in general it does not exceed the total forb cover. Graminoid species that may be present include *Calamagrostis canadensis* (bluejoint reedgrass) and *Carex utriculata* (beaked sedge). Generally, forbs are dominant under shrubs on hummocks and ridges while graminoids dominate the undergrowth in

low-lying, wetter swales. Exotic graminoid and forb species include *Poa pratensis* (Kentucky bluegrass), *Trifolium repens* (white clover), and *Taraxacum officinale* (dandelion).

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 ft (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. This plant association occurs on mesic sites and supports a rich diversity of forbs. On broad, hummocky floodplains stands can form extensive willow carrs. Sites with a higher abundance of exotic forbs and graminoids may be grazing-induced. At higher elevations, this association grades into the *Salix planifolia*/mesic forb (planeleaf willow/mesic forb) association.

This plant association occurs within the Lower Coal Creek and Fish Creek Below Dunn Peak PCA.

Avg. Cover %	(Range)	Species Name	# Plots (N=93)
58	(1-100%)	<i>Salix monticola</i>	93
17	(1-40%)	<i>Ribes lacustre</i>	26
16	(0.1-60%)	<i>Salix drummondiana</i>	31
16	(1-75%)	<i>Heracleum maximum</i>	49
12	(1-70%)	<i>Ribes inerme</i>	23
11	(1-40%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	16
10	(1-30%)	<i>Salix geyeriana</i>	15
9	(1-50%)	<i>Poa pratensis</i>	42
9	(0.1-30%)	<i>Salix bebbiana</i>	15
9	(1-20%)	<i>Salix brachycarpa</i>	11
9	(0.1-60%)	<i>Mertensia ciliata</i>	55
9	(1-30%)	<i>Salix planifolia</i>	18
8	(1-28%)	<i>Rudbeckia laciniata</i> var. <i>ampla</i>	13
8	(0.1-30%)	<i>Calamagrostis canadensis</i>	31
7	(1-60%)	<i>Juncus balticus</i> var. <i>montanus</i>	10
7	(1-22%)	<i>Trifolium repens</i>	10
6	(1-14%)	<i>Picea pungens</i>	14
6	(0.1-30%)	<i>Cardamine cordifolia</i>	22
6	(1-20%)	<i>Lonicera involucrata</i>	43
6	(1-25%)	<i>Urtica dioica</i> ssp. <i>gracilis</i>	21
5	(0.1-20%)	<i>Equisetum arvense</i>	44
5	(1-16%)	<i>Aconitum columbianum</i>	18
5	(1-20%)	<i>Carex utriculata</i>	13

Other species with < 5% average cover present in at least 10% of plots:

Picea engelmannii (1-13%), *Bromus ciliatus* var. *ciliatus* (0.1-20%), *Conioselinum scopulorum* (0.1-15%), *Hydrophyllum fendleri* (1-10%), *Carex aquatilis* (1-10%), *Dasiphora floribunda* (0.1-13%), *Fragaria virginiana* ssp. *glauca* (0.1-10%), *Geranium richardsonii* (0.1-10%), *Senecio triangularis* (1-10%), *Taraxacum officinale* (0.1-12%), *Maianthemum stellatum* (0.1-12%), *Achillea millefolium* var. *occidentalis* (1-10%), *Chamerion angustifolium* ssp. *circumvagum* (0.1-11%), *Thalictrum fendleri* (0.1-9%), *Ligusticum porteri* (0.1-10%), *Geum macrophyllum* var. *perincisum* (1-5%), *Rosa woodsii* (0.1-5%), *Oxypolis fendleri* (1-5%), *Vicia americana* (0.1-5%).

Mountain willow / Mesic graminoid Shrubland

Salix monticola / Mesic graminoid

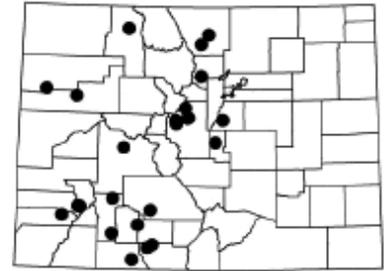


Global rank/State rank:

G3 / S3

HGM subclass: S1/2, S3/4, R2

Colorado elevation range:
6,600-11,000 ft (2,000-3,350 m)



General Description

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 and forb species. This association is distinguished from the *Salix monticola*/mesic forb association by having a higher cover of graminoid species. Stands with predominantly non-native graminoid species in the undergrowth are considered grazing-induced. Stands are considered high quality when their undergrowth is predominantly native graminoid species.

The *Salix monticola*/mesic graminoid (mountain willow/mesic graminoid) plant association dominates stream reaches in narrow to wide valleys, 65-400 ft (20-120 m) wide, with active floodplains and broad, swift-moving streams. Stands usually occur > 2 ft (0.5 m) above the bankfull channel along the stream edge or away from the channel up to 50 ft (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, moderately wide and sinuous with cobble beds or broad, meandering rivers with a developed floodplain. Some stands also occur along channels that are braided due to beaver activity. 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.

Vegetation Description

Salix monticola (mountain willow) forms a dense to open canopy. If it is not the clear dominant, then it is the matrix willow. The matrix species is the willow with the highest abundance, even though other willow species combined may have greater canopy cover. Other shrubs that may be present at higher elevations include *Salix planifolia* (planeleaf willow), *S. geyeriana* (Geyer willow), and *S. brachycarpa* (barrenground willow). At lower elevations, other shrubs that may be present include *Salix irrorata* (bluestem willow), *S. lucida* ssp. *caudata* (shining willow), *Alnus incana* ssp. *tenuifolia* (thinleaf alder) and *Dasiphora floribunda* (shrubby cinquefoil).

Total graminoid cover ranges from 10-55% and exceeds that of total forb cover. No single species is particularly dominant over the others, and no one species is present in every stand. Graminoid species that may be present include *Poa pratensis* (Kentucky bluegrass), *Juncus balticus* var. *montanus* (mountain rush), *Carex aquatilis* (water sedge), and *Equisetum arvense* (field horsetail). Forb cover ranges from 5-20% and forbs generally are not as abundant as graminoids. Forb species that may be present include *Heracleum maximum* (common cowparsnip), *Fragaria virginiana* (strawberry) and *Achillea millefolium* var. *occidentalis* (western yarrow). In stands with pronounced hummock micro-topography underneath the willow canopy, graminoids will typically dominate the low-lying swales, while forbs will dominate the better drained hummocks and ridge tops.

Ecological Processes

The *Salix monticola*/mesic graminoid (mountain willow/mesic graminoid) plant association appears to be a stable, long-lived community. Stands with an abundance of *Poa pratensis* (Kentucky bluegrass) or *Agrostis stolonifera* (creeping bentgrass) may be a grazing-induced disclimax. 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.

This association occurs along Fish Creek within Fish Creek at Black Mesa and Upper Fish Creek Below Dunn Peak PCAs. It also occurs within Willow Creek at Groundhog Mountain PCA. The plant community occurs on streams with beaver activity in Dolores County.

Avg. Cover		Species Name	# Plots (N=31)
%	(Range)		
52	(7-90%)	<i>Salix monticola</i>	31
25	(5-48%)	<i>Salix drummondiana</i>	5
22	(2-40%)	<i>Salix planifolia</i>	6
18	(0.1-60%)	<i>Juncus balticus</i> var. <i>montanus</i>	13
17	(1-50%)	<i>Carex aquatilis</i>	11
15	(4-20%)	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	4
14	(1-40%)	<i>Poa pratensis</i>	18
12	(0.1-40%)	<i>Carex utriculata</i>	13
11	(1-30%)	<i>Salix geyeriana</i>	8
8	(1-20%)	<i>Calamagrostis canadensis</i>	10
7	(0.1-21%)	<i>Dasiphora floribunda</i>	11
7	(1-30%)	<i>Deschampsia caespitosa</i>	6
6	(0.1-25%)	<i>Salix lucida</i> ssp. <i>caudata</i> , <i>lasiandra</i>	7
6	(1-15%)	<i>Phleum pratense</i>	4
5	(0.1-22%)	<i>Taraxacum officinale</i>	19
5	(1-15%)	<i>Picea pungens</i>	5
5	(0.1-16%)	<i>Salix bebbiana</i>	7

Other species with < 5% average cover present in at least 10% of plots:

Equisetum arvense (0.1-20%), *Lonicera involucrata* (1-10%), *Carex microptera* (1-10%), *Trifolium repens* (0.1-6%), *Dodecatheon pulchellum* (0.1-10%), *Achillea millefolium* var. *occidentalis* (0.1-8%), *Mertensia ciliata* (0.1-10%), *Ribes inerme* (1-5%), *Salix brachycarpa* (1-5%), *Geranium richardsonii* (1-4%), *Conioselinum scopulorum* (1-5%), *Fragaria virginiana* ssp. *glauca* (1-3%), *Heracleum maximum* (1-3%), *Geum macrophyllum* var. *perincisum* (0.1-3%), *Equisetum pratense* (1-3%), *Cardamine cordifolia* (0.1-3%).

Planeleaf willow / Marsh-marigold Shrubland

Salix planifolia / *Caltha leptosepala*

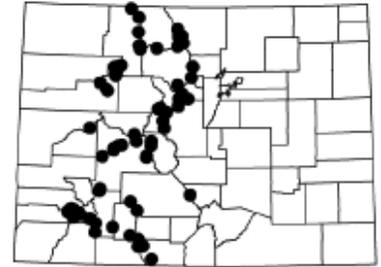
Global rank/State rank:

G4 / S4

HGM subclass: S1/2, R1

Colorado elevation range:

8,900-11,800 ft (2,700-3,600 m)



General Description

The *Salix planifolia*/*Caltha leptosepala* (planeleaf willow/marsh marigold) plant association is a common and abundant upper montane and subalpine community occurring on very wet to saturated soils. This association is characterized by low-stature shrubs, less than 2 ft (0.5 m) tall, and a thick carpet of forbs in the undergrowth. There may be scattered patches of other willows present. This is a major subalpine wetland plant association that occurs throughout the Rocky Mountains of Colorado.

This plant association typically occurs in wide, glaciated valleys adjacent to streams. It occurs in swales, depressions, and on slopes where snowmelt 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, relatively wide and straight, narrow, relatively deep, and meandering in broad, glaciated valleys or braided, multiple channels below beaver dams. 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 gravelly alluvium. Some stands occur on well-drained, mineral soils with well-oxygenated water and no mottled or gleyed layers. Other sites have a shallow 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. Still other stands occur on deep, dark clay loams with high organic content or a fibrous layer on top.

Vegetation Description

Salix planifolia (planeleaf willow) may form nearly pure stands with 10-100% cover. Other willows that may be present at lower elevations include *Salix geyeriana* (Geyer willow) and *S. monticola* (mountain willow). At higher elevations, other shrubs that may be present include *Salix brachycarpa* (barrenground willow) on drier sites, or *Betula nana* (= *glandulosa*) (bog birch) and *Salix wolfii* (Wolf willow) on wetter sites. *Picea engelmannii* (Engelmann spruce) is occasionally scattered throughout the stand. Typically, the willow canopy is nearly closed and an herbaceous undergrowth occurs only in openings between willow patches. The undergrowth is characterized

by an abundance of forbs with few graminoids. *Caltha leptosepala* (marsh marigold) is usually present. Other wet species such as *Trollius laxus* (American globeflower), *Cardamine cordifolia* (heartleaf bittercress), *Senecio triangularis* (arrowleaf ragwort), *Mertensia ciliata* (tall fringed bluebells), *Pedicularis groenlandica* (elephant head lousewort) and *Rhodiola rhodantha* (redpod stonecrop) are also indicators of this type. Graminoid species that may be present include *Calamagrostis canadensis* (bluejoint reedgrass) and *Carex aquatilis* (water sedge).

Ecological Processes

Salix planifolia (planeleaf willow), *S. brachycarpa* (barrenground willow) and *S. wolfii* (Wolf willow) are abundant low-stature willows of first- and second-order streams of subalpine elevations of Colorado. *Salix planifolia* and *Salix brachycarpa* can form extensive stands, often creating intricate mosaics in broad, subalpine valleys. In general, *Salix planifolia* occupies the wettest micro-habitats on peat soils, although it can grow well on mineral soils. *Salix brachycarpa* is more often found on slightly drier and more well-drained micro-habitats than *Salix planifolia*. *Salix wolfii* grows on deep, undecomposed peat, while *Salix planifolia* tends to grow on more decomposed (humified) organic soils. *Salix planifolia* also grows at elevations below the subalpine, and becomes a much taller willow due to a longer growing season. In montane elevations, *Salix planifolia* is often a co-dominant in *Salix monticola* plant associations. This association occurs in wet swales that are saturated throughout most or all of the growing season. It is a long-lived, stable association that changes with fluctuations in the water table and degree of soil saturation.

This plant association occurs within Fish Creek at Dunn Peak PCA and along high elevation streams throughout Dolores County.

Avg. Cover %	(Range)	Species Name	# Plots (N=73)
65	(12.4-100%)	<i>Salix planifolia</i>	73
19	(1-64%)	<i>Caltha leptosepala</i>	69
11	(0.1-30%)	<i>Salix brachycarpa</i>	15
9	(1-48%)	<i>Salix wolfii</i>	14
9	(1-40%)	<i>Salix monticola</i>	13
9	(0.1-40%)	<i>Carex aquatilis</i>	46
7	(1-30%)	<i>Senecio triangularis</i>	51
7	(1-58%)	<i>Cardamine cordifolia</i>	43
7	(0.1-36%)	<i>Calamagrostis canadensis</i>	34
6	(1-18%)	<i>Picea engelmannii</i>	21
5	(1-20%)	<i>Erigeron peregrinus</i> ssp. <i>callianthemus</i>	13
5	(1-20%)	<i>Geranium richardsonii</i>	15
5	(0.1-20%)	<i>Mertensia ciliata</i>	46
5	(1-11%)	<i>Carex utriculata</i>	13

Other species with < 5% average cover present in at least 10% of plots:
Aconitum columbianum (1-20%), *Saxifraga odontoloma* (1-16%), *Oxypolis fendleri* (1-14%), *Conioselinum scopulorum* (0.1-10%), *Pedicularis groenlandica* (0.1-19%), *Fragaria virginiana* ssp. *glauca* (1-10%), *Deschampsia caespitosa* (1-11%), *Rhodiola rhodantha* (0.1-11%), *Swertia perennis* (0.1-10%), *Chamerion angustifolium* ssp. *circumvagum* (1-6%), *Achillea millefolium* var. *occidentalis* (1-5%), *Polygonum bistortoides* (1-10%), *Phleum alpinum* (1-10%), *Veronica wormskjoldii* (0.1-8%), *Polygonum viviparum* (1-6%), *Taraxacum officinale* (1-5%), *Luzula parviflora* (1-4%).

Wolf willow / Water sedge Shrubland

Salix wolfii / *Carex aquatilis*

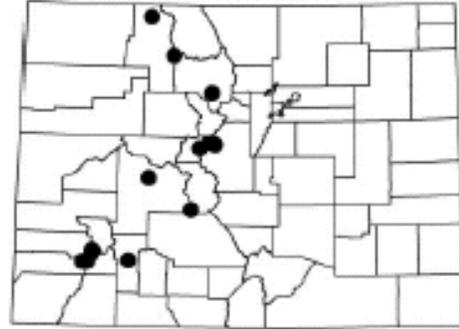
Global rank/State rank:

G4 / S3

HGM subclass: S1/2, R1

Colorado elevation range:

8,400-11,400 ft (2,600-3,500 m)



General Description

The *Salix wolfii*/*Carex aquatilis* (Wolf willow/water sedge) plant association is an uncommon community of very wet subalpine sites in western Colorado. In Colorado, *Salix wolfii* grows in small patches and does not form as large, expansive willow carrs as *Salix planifolia* (planeleaf willow). *Salix wolfii* often forms a mosaic with stands of *Salix planifolia*, *Salix brachycarpa* (barrenground willow) and open *Carex* spp. (sedge) meadows.

The *Salix wolfii*/*Carex aquatilis* (Wolf willow/water sedge) plant association occurs in moderately narrow to wide valleys and glacial basins. It occurs on saturated peat wetlands and floodplains with lateral seepage of groundwater. Stream reaches can be moderately steep (gradient of 3-7%). Stream channels are deep, narrow, and sinuous, shallow, broad, and gently meandering, and highly divided by beaver activity. Soils vary from highly organic or peat to mineral-based. Soil 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.

Vegetation Description

The shrub layer is dominated by 20-70% cover of *Salix wolfii* (Wolf willow). Other willow species that may be present include *Salix planifolia* (planeleaf willow), *Salix boothii* (Booth willow), *Salix monticola* (mountain willow) and *Salix brachycarpa* (barrenground willow). *Betula nana* (= *glandulosa*) (bog birch) may also be present. The herbaceous graminoid cover is generally dense and rich, dominated by *Carex aquatilis* (water sedge). Other graminoid species that may be present include *Carex utriculata* (beaked sedge) and *Deschampsia caespitosa* (tufted hairgrass). Forb cover varies from sparse (< 10% cover) to very dense (70%) and species are generally diverse. Forb species that may be present include *Caltha leptosepala* (marsh marigold), *Ligusticum tenuifolium* (Idaho licoriceroot) and *Thalictrum alpinum* (alpine meadowrue).

Ecological Processes

The dense shrub canopy and thick undergrowth of the *Salix wolfii*/*Carex aquatilis* (Wolf willow/water sedge) plant association indicate stable conditions. *Carex utriculata* (beaked sedge), *Carex aquatilis* (water sedge), and *Calamagrostis canadensis* (bluejoint reedgrass) 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*. *Carex aquatilis* is well-suited to wet, organic soils and succession will occur slowly under these conditions. If the water table is lowered, other herbaceous species may become dominant in the undergrowth and eventually give way to nonnative graminoid species.

Avg. Cover %	(Range)	Species Name	# Plots (N=19)
42	(10-80%)	Carex aquatilis	18*
40	(20-70%)	Salix wolfii	19
13	(1-30%)	Salix planifolia	9
12	(1-30%)	Betula nana	7
9	(2-20%)	Salix brachycarpa	4
8	(1-20%)	Caltha leptosepala	10
8	(5-13%)	Salix monticola	4
8	(1-20%)	Polygonum bistortoides	3
8	(1-20%)	Aconitum columbianum	3
6	(1-19%)	Carex utriculata	5
6	(2-20%)	Dasiphora floribunda	13
6	(1-25%)	Mertensia ciliata	6
5	(1-20%)	Fragaria virginiana ssp. glauca	5
5	(1-20%)	Geum macrophyllum var. perincisum	7
5	(1-7%)	Swertia perennis	3
5	(1-13%)	Thalictrum alpinum	6

Other species with < 5% average cover present in at least 10% of plots:

Juncus balticus var. montanus (1-10%), Conioselinum scopulorum (0.1-8%), Deschampsia caespitosa (1-7%), Achillea millefolium var. occidentalis (1-5%), Cardamine cordifolia (1-6%), Taraxacum officinale (1-5%), Carex microptera (1-5%), Antennaria corymbosa (1-3%), Pedicularis groenlandica (1-7%), Poa pratensis (1-3%), Calamagrostis canadensis (1-2%), Veronica wormskjoldii (1-2%), Polygonum viviparum (1-2%), Castilleja sulphurea (1-2%), Equisetum arvense (1%), Carex aurea (1%), Luzula parviflora (1%).

* Carex aquatilis occurred in all stands, but was not captured in every sample plot.



Salix wolfii / *Carex aquatilis* at Snow Spur Creek near Lizardhead Pass in Dolores County. Photograph © CNHP 2004.

Rare and Imperiled Plants associated with wetlands Potential Conservation Areas in Dolores County

Draba borealis (Boreal whitlow-grass)

Taxonomy

Class: *Dicotyledoneae*
Order: *Capparales*
Family: *Brassicaceae*
Genus: *Draba*

Taxonomic Comments: *Draba borealis* De Candolle

CNHP Ranking: G4 S2

State/Federal Status: None



Photograph © CNHP, by M. J. Lyon

Description and Phenology: *Draba borealis* has one to several leafy stems, erect to drooping, pubescent with simple or branched hairs. Leaves are oval, sometimes coarsely toothed, and pubescent. Flowers are white or pale yellow with four petals. Fruits are pubescent and sometimes twisted. Flowering/Fruiting Period: June-August/July-September

Habitat Comments: Habitat in Wyoming is described as moist, north-facing limestone slopes and cliffs and shady streamsides at elevations from 6200 to 8600 ft. In Dolores County, it was found growing in soil pockets in cliffs and in shallow soils of tundra ridges at 12,000 to 12,500 ft.

Global Range: *Draba borealis* is known from five Canadian provinces, Alaska, Washington, Montana, Wyoming and Colorado. It is ranked S2 in Colorado and Wyoming and unranked in the other states. Colorado represents the southernmost location for the species.

State Range: *D. borealis* is known in Colorado from the central Rockies in Summit and Park counties, and the San Juan Mountains in Ouray, San Juan and Dolores counties. The four Dolores County occurrences were first located in 2004.



Distribution in Colorado

Distribution/Abundance: There are 10 occurrences in the CNHP database. There are four specimens at the University of Colorado Herbarium, from Summit and Park counties. The four occurrences found in Dolores County in 2004 ranged from two to over 100

individuals.

Known Threats and Management Issues: Hiking, horse packing and sheep grazing may pose threats at sites along alpine ridges.

Potential Conservation Areas on San Juan Public Lands in Dolores and Montezuma counties that support *Draba borealis*: Navajo Basin, Elliott Mountain, Hermosa Peak.

***Draba graminea* (San Juan whitlow-grass)**

Taxonomy

Class: *Dicotyledoneae*

Order: *Capparales*

Family: *Brassicaceae*

Genus: *Draba*

Taxonomic Comments: *D. graminea*

Greene was first described by Baker in 1901. The type locality is in Hinsdale County, Colorado.

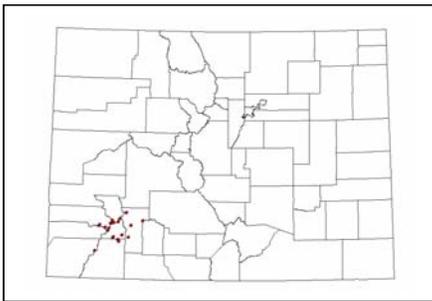
CNHP Ranking: G2 S2

State/Federal Status: None. Currently on list of species considered for inclusion on Forest Service sensitive species list for Region 2, but for which more information is needed.

Description and Phenology: San Juan whitlow-grass is a yellow flowered perennial with small green leaflike bracts beneath each flower. Its basal leaves are narrow with ciliate margins and glabrous surfaces. It may have up to two reduced leaves on its flower stem.

Plants are usually flowering and easiest to see in late July and early August. Look for bright yellow, four-petaled flowers nestled in dark green, narrow-leaved rosettes.

Habitat Comments: The plant occurs in gravelly tundra, shaded areas in crevices or base of cliffs, late snowmelt areas, 12,400 to 13,500 ft. San Juan whitlow-grass is nearly always found above 12,000 feet in elevation.



Distribution in Colorado



Draba graminea. Photograph copyright CNHP by P. Lyon

It often grows near the melting edge of a snow bank, or at the shaded base of cliffs in cold wet tundra. The plants depend on the depth and longevity of the snowpack, stability of the soil, and presence or absence of appropriate pollinators.

Global Range: This species is endemic to Colorado.

State Range: *D. graminea* is endemic to the San Juan Mountains, known from five counties: Ouray, San Miguel, San Juan, Hinsdale, La Plata, and Montezuma.

Distribution/Abundance: There are 23 occurrences of the species, including two found in 2004.

Known Threats and Management Issues: Concern for the viability of the species is based on its limited abundance and restricted global distribution. Most occurrences are on National Forest

land, at high elevations and in habitats that are not subject to much disturbance. Climate change could cause the extinction of this species, along with other endemic high elevation species, as there is little room for it to move upward if the global climate becomes warmer.

Potential Conservation Areas: In Dolores County Navajo Basin PCA supports *Draba graminea*.

***Draba streptobrachia* (Colorado Divide whitlow-grass)**

Taxonomy

Class: *Dicotyledoneae*

Order: *Capparales*

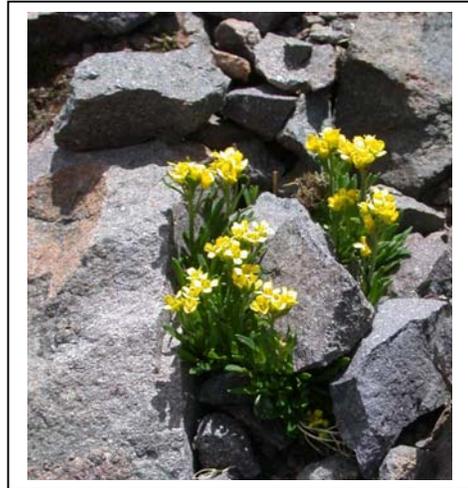
Family: *Brassicaceae*

Genus: *Draba*

Taxonomic Comments: The species was first described in 1980.

CNHP Ranking: G3 S3

State/Federal Status: None. Currently on list of species considered for inclusion on Forest Service sensitive species list for Region 2, but for which more information is needed.



Draba streptobrachia. Photo CNHP by P. Lyon

Description: Colorado Divide whitlow-grass is one of several *Draba* species found in the high mountains of Colorado. All are diminutive yellow or white flowered plants with four petals.

The Colorado Divide whitlow-grass is a tap-rooted perennial plant with a rosette of stellate-pubescent basal leaves and yellow flowers.



Distribution in Colorado

It resembles the San Juan whitlow-grass (*Draba graminea*), but can be distinguished from it by the absence of bracts below the flowers, and the presence of stellate hairs on the leaves.

Habitat Comments: Alpine zone, usually in rock outcrops, at elevations from 10,800 to 13,500 ft. The plants grow on weathered rock and loose soil in the alpine tundra, on scree margins and in fell-fields. Associated species often include alpine avens (*Geum rossii*), snow willow (*Salix reticulata*), false strawberry (*Sibbaldia procumbens*), and alpine bistort (*Bistorta bistortoides*).

Global Range: Endemic to Colorado.

State Range: Found in 15 counties, in the San Juan Mountains and also in the Sawatch, Mosquito, and Front Ranges.

Distribution/Abundance: There are 42 known occurrences in Colorado. Several have over 1000 individuals, although a typical location usually has fewer than 200.

Known Threats and Management Issues: Most occurrences are in National Forests, with several in designated wilderness areas. This species is found at high elevations, often in fairly inaccessible locations, and therefore enjoys some natural protection. However, some plants are still vulnerable to direct disturbances such as trampling.

Potential Conservation Areas: In Dolores County Navajo Basin PCA supports *Draba streptobrachia*.

Epipactis gigantea (Giant helleborine)

Taxonomy

Class: *Monocotyledoneae*

Order: *Orchidales*

Family: *Orchidaceae*

Genus: *Epipactis*

Taxonomic Comments: Stream orchid, *Epipactis gigantea* Dougl. ex Hook. (David Douglas 1798-1834, Royal Horticultural Society; Sir William Jackson Hooker, 1785-1865, Flora Boreali-Americana, 2: 202. 1839) (Kaul 1986). There are 20 species of *Epipactis* across the temperate regions of Europe and North America (Luer 1975).



Epipactis gigantea Photograph © CNHP, by R. Rondeau

CNHP Ranking: G3 S2

State/Federal Status: Forest Service Sensitive.



Distribution in Colorado

Description and Phenology: The greenish-purple flowers of the giant helleborine orchid have the familiar orchid shape, about an inch across and grow several to a stalk. Flowers appear in June and July, and fruit is produced in August and September.

Habitat Comments: The giant helleborine orchid is often associated with hanging gardens in sandstone canyons. It

may also be found in seeps, around springs and occasionally along stream banks.

Global Range: *Epipactis gigantea* is known from fifteen western U. S. states and British Columbia. It is ranked S1 in South Dakota, Wyoming and Oklahoma; S2 in Colorado, New Mexico, Utah, Montana and British Columbia; S3 in Washington, Idaho and Texas; and unranked in Oregon, Nevada, California, Arizona and Nebraska.

State Range: The species occurs in nine western Colorado counties: Moffatt, Mesa, Delta, Montrose, Montezuma, Archuleta, Saguache and Chaffee.

Distribution/Abundance: There are 37 occurrences in the CNHP database. Abundance data are scarce for this species, and the data that do exist are based upon casual field estimates. Based on the available EOR and herbarium label data, it is estimated that approximately 4,000 or more individuals make up the known abundance of this species. This number is based on general field observations and not on actual counts. The precision of the estimate may over or underestimate the actual population number by thousands. No population trend data or inferences of population trend are known (Moore and Friedley 2004).

Known Threats and Management Issues: Threats to the plants include diversion of the water feeding the seeps, and trampling. Its limited habitat and dependence on moist conditions make it susceptible to random events such as drought and disease.

Potential Conservation Areas: There is a PCA in Montezuma County that supports *Epipactis gigantean* in the Dolores River Canyon below McPhee dam (Lyon and Hanson 2005). The species is expected to occur within Dolores County as well, however, more research is needed to locate it.

Eriophorum altaicum ssp. *neogaeum* (Altai cottongrass)

Taxonomy

Class: *Monocotyledoneae*

Order: *Cyperales*

Family: *Cyperaceae*

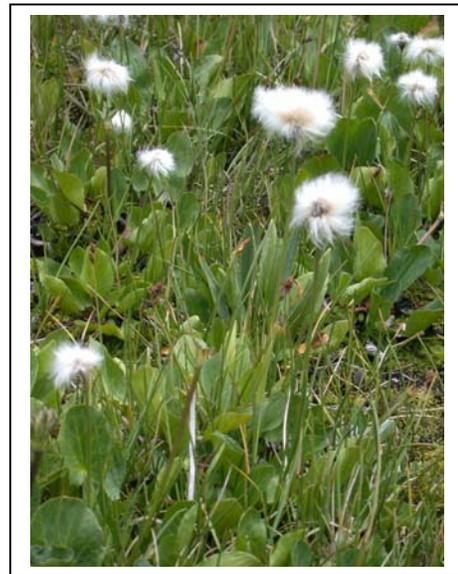
Genus: *Eriophorum*

Taxonomic Comments: A more common, closely related plant, the narrowleaf cottongrass (*E. angustifolia*), has multiple heads and leaf blades nearly as long as the stems. It is closely related to plants found in Siberia (Weber and Wittman 1986).

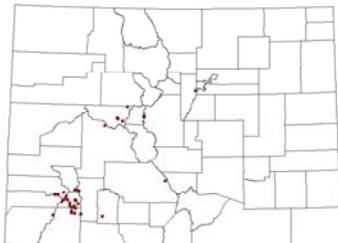
CNHP Ranking: G4?T3? S3

State/Federal Status: Forest Service Sensitive

Description: The plants are rhizomatous, with solitary white fleecy heads on the tops of the stems, and lacking well-developed leaf blades (Weber 1996).



Eriophorum altaicum ssp. *neogaeum*
Photograph © CNHP, by M.J. Lyon



Distribution in Colorado

Habitat Comments: Altai cottongrass grows in wet meadows, fens, and around ponds, usually above or at treeline. It is often associated with elephant-head Pedicularis (*Pedicularis groenlandica*), tufted hairgrass (*Deschampsia cespitosa*), marsh marigold (*Caltha leptosepala*), mosses and sedges. It grows in patches in wetlands at high elevations, often associated with water sedge (*Carex aquatilis*), marsh marigold (*Caltha leptosepala*), elephant head (*Pedicularis groenlandica*)

and tufted hairgrass (*Deschampsia cespitosa*). In San Juan County, it is sometimes associated with iron fens.

Global Range: *Eriophorum altaicum* var. *neogaeum* is the New World variety of a circumpolar species.

In North America, it occurs in Colorado, Montana, Utah, Wyoming and British Columbia. It is unranked in all but Colorado.

State Range: Altai cottongrass occurs in 10 counties: Eagle, Gunnison, La Plata, Mineral, Park, Pitkin, Saguache, San Juan and San Miguel.

Distribution/Abundance: There are 38 known occurrences in Colorado, in ten counties. Several locations have over a thousand individuals.

Known Threats and Management Issues: Threats appear to be limited for this species; however, local trampling may affect easily accessed occurrences. The primary management issue is maintaining the natural hydrologic regime of the wetlands in which it occurs.

Potential Conservation Areas on San Juan Public Lands in Dolores and Montezuma counties that support *Eriophorum altaicum*: Grindstone Lake and Navajo Basin.

***Trifolium kingii* (King's clover)**

Taxonomy

Class: *Dicotyledoneae*

Order: *Fabales*

Family: *Fabaceae*

Genus: *Trifolium*

Taxonomic Comments: *Trifolium kingii* ssp. *macilentum* - (Greene) J. Gillett. Other Related Names: *Trifolium kingii* var. *macilentum* (Greene) Isely ; *Trifolium macilentum* Greene

CNHP Ranking: G5 S1

State/Federal Status: None



Photograph © CNHP, by M. J. Lyon

Description and Phenology: This attractive tall pink clover has bright green three-parted toothed leaves and down-turned flowers that soon turn brown.

Habitat Comments: *Trifolium kingii* is found in wet meadows and streambanks in aspen and mixed conifer communities.

Global Range: *Trifolium kingii* is known from Colorado, Arizona, Idaho, Nevada and Utah. It is ranked S1 in Arizona, and unranked in Idaho, Nevada and Utah..

State Range: In Colorado, there are records from Montrose, San Miguel and Dolores counties.



Distribution in Colorado

Distribution/Abundance: There are now 14 known occurrences in Colorado, including six found in 2004 in Dolores County. There are five A-ranked occurrences, 5 B-ranked, 1 C and 3 D.

Known Threats and Management Issues: Survival of *Trifolium kingii* populations is dependent on continuing the existing moisture regime. Any upstream diversions would negatively impact the plants. Direct disturbance from grazing or roads are additional threats.

Potential Conservation Areas within Dolores County that support *Trifolium kingii*: Mavreeso Creek-Cottonwood Canyon; Upper Fish Creek below Dunn Peak; Willow Creek at Groundhog Mountain; Navajo Lake Trail.

Botrychium echo (Reflected moonwort)

Taxonomy

Class: Ophioglossopsida
 Order: *Ophioglossales*
 Family: *Ophioglossaceae*
 Genus: *Botrychium*

Taxonomic Comments: *Botrychium echo* was described in 1983 by Drs. Herb and Florence Wagner along with *B. hesperium* (Wagner and Wagner 1983b). Before this, specimens of this species were usually identified as *B. matricariifolium* ssp. *hesperium* or *B. lanceolatum*

CNHP Ranking: G3 S3

State/Federal Status: None (formerly Region FS sensitive)

Description and Phenology: A perennial fern that produces a shiny green leaf (the trophophore) and a taller, erect spore-bearing spike (the sporophore). Both arise from a common stalk and can be thought of as a single, highly modified fern frond. This species tends to have a reddish brown stripe along the common stalk from the base of the trophophore stalk. Mature plants are 3-15 cm tall. *B. echo* produces clusters of minute, spheric gemmae at the root bases. Leaves appear in June and die in September.



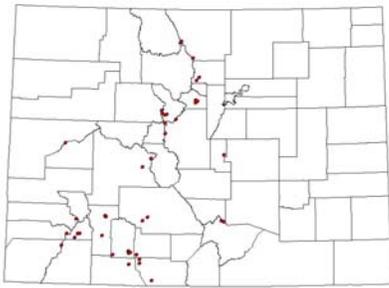
Botrychium echo Photograph © CNHP by Dave Anderson

Habitat Comments: Wagner and Wagner (1993) describe the habitat of *B. echo* as grassy slopes, roadsides, and edges of lakes in rocky soil, often derived from granitic parent material. Similarly, Spackman *et al.* (1997) describe the habitats of *B. echo* as gravelly soils near roads and trails, rocky hillsides, grassy slopes, and meadows. Colorado Natural Heritage Program element occurrence records commonly cite the presence of coarse, gravelly soil and little or no tree cover. Element occurrence records from Colorado document occurrences in numerous settings including gravelly hillsides, disturbed trailsides through meadows, small openings in lodgepole or spruce forest, roadcuts, adjacent to roads, and near an old fire ring (Colorado Natural Heritage Program

2004). Throughout most of Colorado *Botrychium echo* is found on soils derived from granitic parent material. In the San Juan Mountains this species occurs in soils derived from extrusive volcanics, such as tuff and andesite. It has also been found on sedimentary rocks in San Juan and Summit counties. Natural habitats identified by Kolb and Spribille (2000), Thompson (2000 and 2001), and Buell (2001) include areas where catastrophic fire has occurred, and persistent sites such as grassy or stony exposures near treeline in the krummholz zone and avalanche chutes. *Botrychium echo* occurs at high elevations. Wagner and Wagner (1993) report an elevation range of 8,200 to 12,140 feet, which concurs closely with Colorado Natural Heritage Program (2005) element occurrence records (8,500 to 12,080 feet) (Anderson and Cariveau 2004).

Global Range: In the United States, *Botrychium echo* is known from Colorado, Utah and Arizona. It is ranked S1 in Utah, and not ranked in Arizona.

State Range: Colorado records are scattered through the central mountains and the San Juan Mountains.



Distribution in Colorado

Distribution/Abundance: *Botrychium echo* is known from approximately 58 occurrences which are scattered across northern Utah and central Colorado. Forty-three of these occurrences are in Colorado. A report for northern Arizona needs verification. Many occurrences consist of fewer than ten individuals and the total number of individuals documented at all extant sites is less than 50. This species hybridizes

with western moonwort (*B. hesperium*).

Known Threats and Management Issues: The primary threats are habitat loss, recreation, succession, overgrazing, effects of small population size, sedimentation, timber harvest, exotic species invasion, global climate change, and pollution. However, these threats and their hierarchy are highly speculative because there is very little known about this species in Colorado. Because most of the known occurrences are small, they are also threatened by stochastic processes (Anderson and Cariveau 2003).

Potential Conservation Areas on San Juan Public Lands in Dolores and Montezuma counties that support *Botrychium echo*: Orphan Butte and Flattop Mountain South. No wetlands PCAs contain *Botrychium echo* in Dolores County.



Searching for *Botrychiums* in potential habitat.

Rare and Imperiled Birds and Fish associated with wetlands Potential Conservation Areas in Dolores County

Boreal Owl (*Aegolius funereus*)

Taxonomy

Class: Aves
Order: Strigiformes
Family Tytonidae
Genus: Aegolius

Taxonomic comments: Known as Tengmalm's Owl in European literature (AOU 1998).

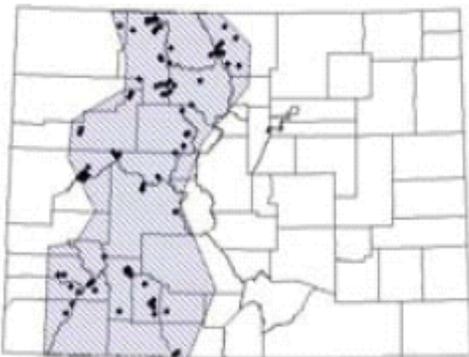
CNHP Ranking: G5 S2

State/Federal Status: FS Sensitive

Phenology: In Colorado, nest initiation for Boreal Owls range from late-May to late-June. The summer home ranges of three radio marked adules near Cameron Pass averaged 731 acres, while the winter ranges averaged 2796 acres (Kingery 1998).

Habitat Comments: in Colorado, boreal wols occur mainly in mature to old age Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) above 9,500 feet in elevation, but also frequent higher elevation lodge pole pine and aspen stands (Hayward and Hayward 1993). They prefer wet areas near streams or bogs because these often have good populations of small rodents (CBBA 1998).

Global Range: The Boreal Owl inhabits spruce – fir /lodge pole pine forests from the Rocky Mountains of Colorado northwest in to Canada and Alaska (National Geographic Society 1987). Scattered populations also occur in northern Minnesota, the Cascade ranges and south in the Rocky Mountains into north-central New Mexico.



Distribution in Colorado

unavailable. Their nomadic habit, caused by fluctuating prey density complicates estimates of population size (Hayward and Hayward 1993). The population is considered “stable” in Canada (COSEWIC 1995 unpublished report). Although Boreal Owls were recently discovered breeding far to the south of previously known locations, this is probably due to the season and location of greeding (high elevation in February-April) rather than range expansion (Stahlecker and Duncan 1996).



State Range: Field workers have found Boreal Owls in most Colorado mountain ranges, including the Elk, San Juan, Sangre de Cristo , and Wet Mountain ranges, as well as the Grand Mesa, Park range and Flat Tops areas (CBBA 1998).

Distribution / Abundance: The widespread range of the Boreal Owl, its apparently large numbers and occurrences seem tto make this species secure. Reliable information on p9opulation numbers are

Known Threats and Management Issues: No population trends are available for the Colorado Boreal Owls since large areas remain unsurveyed for this species. There are few obvious threats to this species except where development or other land use alters nesting and foraging habitat.

Potential Conservation Areas: No PCAs were created for the Boreal Owl in Dolores County, however there is an element occurrence near The Coal Creek Meadows PCA.

Black Swift (*Cypseloides niger*)



Taxonomy:

Class: Aves
Order: Apodiformes
Family: Apodidae
Genus: *Cypseloides*

Photo © Michael G. Shepard from <http://birdinfo.com>

State/Federal Status: FS sensitive.

Phenology: The Black Swift's nest is a cup-like structure of mud, mosses and algae, and in Colorado all nests are located on sheer cliff faces with waterfalls pouring down close to the nesting colony (Boyle 1998). Colony size tends to average approximately 5 nests/pairs. Only one offspring is produced in a given year and hatchlings are fed all summer long, fledging in September.

Habitat Comments: Black Swifts are colonial birds that nest behind or next to waterfalls and wet cliffs (Michael 1927, Knorr 1961, Foerster and Collins 1990). Nests are built in dark sites getting usually no more than 1 hour of sunlight each day. A flight path unobstructed by trees is necessary (Knorr and Knorr 1990). Nest site fidelity is virtually absolute, with birds returning year after year and old nest occupancy being very high (Knorr and Knorr 1990).

Global/State Range: Globally, this bird is widespread, occupying more than 1,000,000 sq. miles of the Americas. Winter range is poorly known; however, northern populations like those in Colorado may winter in South America (Stiles and Negret 1994). Although calculation of population size is difficult because of colony inaccessibility, it is estimated that over 200 nesting pairs occur in Colorado representing between 10% and 20% of the total nesting population of this species (Boyle 1998). This merits Colorado's population an important component of this bird's total population.

Distribution/Abundance: Black Swifts are difficult to accurately census and study because of their eccentric habit of nesting on rock faces in the coldest, dampest spots they can find adjacent to waterfalls. The initial discovery of the Black Swift was made in 1881 from a specimen collected east of the town of Silverton (Knorr 1961). For the next several years, it was believed that this species was limited entirely to San Juan County, Colorado, but breeding status was

unknown. In 1949, breeding birds were located in Cataract Gulch on the South Mineral drainage. Subsequent investigations have found colonies in other locations in Colorado and along the Pacific coast as well. Much remains unknown about their distribution, habits and winter range (Stiles and Negret 1994).

Known Threats and Management Issues: Black Swifts are tolerant of human disturbance, as demonstrated by the group at Bridal Veil Falls power plant near Telluride. However, flowing falls, (including low flows) are a necessity for nesting swifts. Therefore, potential threats to this species include diversion or blockage of stream flows, which could result in abandonment of breeding sites.

Potential Conservation Areas: The Black Swift occurs within the West Dolores River at Dunton PCA.

Roundtail chub (*Gila robusta*)

Taxonomy

Class: Actinopterygii
Order: Cypriniformes
Family: Cyprinidae
Genus: *Gila*

Taxonomic Comments: Subclass Neopterygii

CNHP Ranking: G3 S2

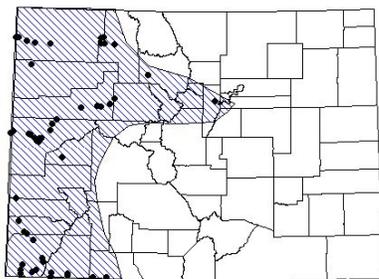
State/Federal Status: Colorado Species of Special Concern, BLM Sensitive Species

Habitat Comments: The Roundtail chub occurs in large streams and intermediate sized rivers (Page and Burr 1991).



By Kara Inci

Photograph ©Kara Inci.



Distribution in Colorado

Distribution: The Roundtail Chub is endemic to the Colorado River basin (Page and Burr 1991). In Colorado, this species occurs in the Colorado River mainstem and its larger tributaries, including the White, Yampa, Dolores, San Juan, and Gunnison rivers.

Important Life History Characteristics: Roundtail chub occupies slow moving water adjacent to areas of faster water. Gravel substrates are required for spawning (Woodling 1985).

Known Threats and Management Issues: Threats include low water temperatures, attributed to cold water releases from dams, that may affect reproductive patterns (Woodling 1985; Vanicek and Kramer 1969), and interactions of watershed changes such as reductions in suitable habitat due to impoundment, channel downcutting, substrate sedimentation, water diversion, and groundwater pumping, and displacement through invasion of non-native predatory and competitive species (Hubbs 1954, Miller 1961, Minckley and Deacon 1968, Meffe 1985). The importance of retaining a natural flow regime in southwestern streams has been emphasized repeatedly (e.g., see Meffe and Minckley 1987).

Management needs include careful monitoring of existing populations and eliminating detrimental water and land use and exposure to non-native fishes. Large stream areas that incorporate diverse habitats (pools, riffles, runs, backwaters, adequate substrate, and current diversity) are especially important. Fish barriers (or enhancing natural barriers) can help protect populations not impacted by non-native species. Barrier design should not significantly alter stream flow and the potential impact on natural upstream and downstream movements of native fishes should be assessed.

Potential Conservation Areas: No PCAs are drawn for the Roundtail chub, however there are three historic occurrences within the Dolores River Canyon within Dolores County (CNHP 2005).

Empidonax trailii

Willow Flycatcher

Taxonomy

Class: Aves

Order: Passeriformes

Family: Tyrannidae

Genus: *Empidonax*



Taxonomic comments: The Willow Flycatcher is sometimes treated as *E. brewsteri*, a junior synonym, which was formerly regarded as conspecific with *E. alnorum* and *E. trailii*, Traill's Flycatcher (AOU 1998). See Phillips (1948) for a review of geographic variation in morphology, with the original descriptions of subspecies *alascensis* and *extimus*. Unitt (1987) reviewed infraspecific variation and concluded that four subspecies (*brewsteri*, *extimus*, *adatus*, and *trailii*) are recognizable. Sedwick (2001) demonstrated that *E.t. adatus* and *E.t. extimus* each have distinctive songs and used vocal signatures to determine distributional limits of the two subspecies. The two song types seem to be largely allopatric, separated by latitude and/or elevation. The two groups appear to be evolving independently of one another and warrant at least subspecific status.

State/Federal Status: LE: The subspecies *extimus* (Southwestern Willow Flycatcher).

Phenology: Willow flycatchers begin nesting in early- to mid-June. Incubation of eggs ends in late-June. Young leave the nest from mid-July to mid-August (Finch and Stoleson 2000).

Global Range: Southern Canada, south throughout the United States.

State Range: In Colorado, Willow Flycatchers breed largely west of the Continental Divide except for North Park. Distribution is patchy in Colorado.

Habitat Comments: Breeding Willow Flycatchers are strongly tied to shrublands (e.g., *Salix* spp., *Alnus* spp., *Populus* spp.) associated with streams, rivers and wetland areas (AOU 1983). They are associated with dense riparian deciduous shrub cover separated by open areas. Large contiguous willow thickets without openings are typically avoided. They will not occur in dense tree cover but will use scattered trees for song and foraging perches and gleaning substrate (USDA Forest Service 1994).

Distribution/Abundance: The North American Breeding Bird Survey (BBS) data indicate a significant survey-wide population decline between 1966 and 1996 (Sauer *et al.* 1997). Once common along the Colorado River, Willow Flycatchers are very rare except for a few miles of Glen Canyon that is not inundated, and in the Grand Canyon. They no longer breed in the Lower Colorado River Valley (Sogge 1995). The Grand Canyon population is dynamic, localized, and small, where one or two sites are occupied in a given year (Sogge *et al.* 1997).

Known Threats and Management Issues: Threats include factors that destroy or degrade shrubby riparian vegetation. See *Observations on Major Threats to Wetland Biodiversity* in this report. Habitat loss and alteration is thought to be the principle cause of decline of Willow Flycatchers in the western United States. Among habitat loss and fragmentation, noxious shrub invasion is a major threat. Although Willow Flycatchers will nest in saltcedar (*Tamarix ramosissima*) where it provides the right vegetation structure, saltcedar may provide poor quality habitat and some studies have documented low breeding densities and low reproductive success in saltcedar (USFWS 1995, 1996; Sogge *et al.* 1997). Willow Flycatchers are a common host to brood parasitism by the Brown-headed Cowbird, especially within fragmented or degraded riparian ecosystems (Sanders and Flett 1989). Improper grazing by cattle and sheep may destroy, damage and fragment shrubland habitat used by the Willow Flycatcher. Cattle prefer willow and cottonwood shoots to saltcedar, further depleting viable Willow Flycatcher habitat in grazed riparian areas (Flett and Sanders 1987).

Restoring riparian and wetland areas will benefit Willow Flycatcher habitat. Improving cattle grazing practices especially during the nesting period reduces direct damage by livestock (USDA Forest Service 1994). Flycatchers will nest near cattle trails (Sanders and Flett 1989) and in some circumstances cattle might be used to create trails and openings in exceptionally dense willow stands (outside the breeding season) to benefit Flycatcher's habitat. Reducing impacts of Cowbirds through cattle management will also benefit the species. (USDA Forest Service 1994).

Potential Conservation Areas: No PCAs were drawn for Southwest Willow Flycatcher but the species is known to occur within Dolores County (CNHP 2005).

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