Survey of Critical Wetlands of Gilpin County Colorado 2011

Natural Heritage Program COLORADO

Colorado State University

Survey of Critical Wetlands of Gilpin County, CO

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Cover Photo: Joe Stevens

EXECUTIVE SUMMARY

In 2009, the US Environmental Protection Agency (USEPA) Region 8 Wetland Program contracted with Colorado State University and the Colorado Natural Heritage Program (CNHP) to survey for critical wetland resources in Gilpin County. The purpose of this project was to provide a scientific data resource for managers, planners, and the citizens of Gilpin County for conducting proactive land planning and management. This document should be considered a tool for managing wetlands in the county that support rare, imperiled and/or sensitive plants, animals, and significant plant communities.

The goal of the project was to systematically identify the locations of wetland dependent rare species and significant wetland resources. Additionally, the original paper-based National Wetland Inventory topographic maps were digitized in accordance with the U.S. Fish and Wildlife Wetland Inventory protocol. This project provides an additional data resource for the Gilpin County Master Plan (2008). The Master Plan indicates the importance of providing for planned and orderly development within the County while balancing basic human needs and maintaining a healthy environment for future generations. One of the main goals of this planning effort was to provide the data that can be used to direct future growth to appropriate places while avoiding sensitive wetlands and other important ecological areas. CNHP approached this survey of critical wetland resources with these ecological objectives as a priority.

Prior to conducting the survey, CNHP and its stakeholders identified potential survey areas for significant plants, animals, and wetland resources. Areas that were expected to contain significant elements were delineated as “Targeted Inventory Areas” (TIAs). These areas were prioritized for field survey based on the relative rarity of the elements expected to be found there and the area’s ability to maintain viable populations of those elements. Summer field surveys were conducted within the TIAs and those areas found to contain significant elements were delineated as sites or “Potential Conservation Areas” (PCAs). A PCA is designed to represent CNHP's best estimate of the primary area supporting the long-term survival of targeted species, subspecies and natural plant communities.

Results of the survey confirm that there are many wetland areas with outstanding to high biological significance in Gilpin County. There are several rare plants and animals that depend on these areas for survival. Altogether, 39 Element Occurrences (EO’s) were documented in Gilpin County as a result of the study; six are rare or imperiled plant species and 33 are wetland plant communities. Despite a very successful and productive field season, it is likely that some elements that are present in the County were not documented, due to either lack of access, phenology (reproductive timing) of species, or time constraints.

CNHP has identified 13 Potential Conservation Areas (PCAs) for wetlands in Gilpin County. Of the 13 PCAs presented in this report, one is of very high biodiversity significance (B2), four are of high biodiversity significance (B3), eight are of moderate biodiversity significance (B4), and one is a site of Local Significance (SLS). These PCAs represent the best examples of targeted

species and plant communities and their ecological processes observed on the private and public lands that were visited.

The Mammoth Gulch PCA is a site with Very High Biodiversity Significance (B2) due to the occurrence of an Iron Fen community. Iron fens are a unique type of fen that is only found in areas with highly mineralized geology, such as Gilpin County. The site is drawn for a good (B-ranked) occurrence of the globally imperiled (G2/S2) iron fen, Engelmann spruce / bog birch / water sedge / sphagnum spp. (*Picea engelmannii* / *Betula nana* / *Carex aquatilis* / *Sphagnum* spp.) woodland.

The Ralston Creek PCA is a site with High Biodiversity Significance (B3) due to the occurrence of a Globally Imperiled plant species. The site is drawn for a fair (C-ranked) occurrence of the globally imperiled (G2G3/S2) pale blue-eyed grass (*Sisyrinchium pallidum*).

The Lower South Boulder Creek PCA is a site with High Biodiversity Significance (B3) due to the occurrence of two Globally Vulnerable woodland and shrubland communities. This site is drawn for good (B-ranked) occurrences of two globally vulnerable (G3/S3) plant communities, Douglas-fir / river birch woodland (*Pseudotsuga menziesii* / *Betula occidentalis*) and thinleaf alder (*Alnus incana*) / mesic forbs riparian shrubland.

The Middle and South Boulder Creek PCA is a site with High Biodiversity Significance (B3) due to the occurrence of a Globally Vulnerable forested fen and a shrubland community. This site was drawn for a good (B-ranked) occurrence of the globally vulnerable (G3?/S1) Engelmann spruce - subalpine fir / marsh marigold (*Picea engelmannii* - *Abies lasiocarpa* / *Caltha leptosepala*) forested fen and a good (B-ranked) occurrence of the state imperiled (GNR/S2) planeleaf willow / beaked sedge (*Salix planifolia* / *Carex utriculata*) shrub community.

The Jenny Lake PCA is a site with High Biodiversity Significance (B3) due to the occurrence of a Globally Vulnerable shrubland and Globally Vulnerable plant species. This site is drawn for a good (B-ranked) occurrence of the globally vulnerable (G3/S3) wolf willow (*Salix wolfii*) / mesic forbs shrubland and a fair (C-ranked) occurrence of the globally vulnerable (G3/S3) plant, Rocky Mountain columbine (*Aquilegia saximontana*).

The wetland resources of Gilpin County are truly unique with an amazing richness of rare fauna and flora well worth preserving for future generations. The diversity of species and plant communities that range from montane riparian woodlands to alpine lakes substantiate the important contribution of wetlands in the County to the biodiversity of both Colorado and the World. Overall, the concentration and quality of imperiled species and habitats attest to the fact that conservation efforts in Gilpin County will have both statewide and global significance. The final report and PCAs of the survey will be provided to the stakeholders and will be available to the public on the CNHP website (www.cnhp.colostate.edu).

ACKNOWLEDGEMENTS

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Our thanks go to all of the helpful and concerned landowners of Gilpin County who participated in the survey.

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INTRODUCTION

This survey project was conducted to document the location, quantity, type, and condition of the wetlands and wetland dependent species located within Gilpin County. The U.S. Environmental Protection Agency (US EPA) contracted with the Colorado Natural Heritage Program (CNHP) to identify and assess biologically significant areas within Gilpin County. Other organizations, including the Gilpin County Department of Community Development, The Denver Museum of Nature and Science, The Denver Botanical Gardens, The US Forest Service, and The Colorado State Parks contributed labor as in-kind support to the project. Identification of sites containing significant wetland resources and natural heritage elements will provide the county government, citizens, and others with valuable information that will facilitate planning and conservation of the wetland resources in the county.

While historically the economy of the county was dependent upon mining and other resource extraction industries, various forms of recreation and wildlife enjoyment now serve as major economic assets that attract tourists and revenue to the County. Pro-active and informed planning decisions are critical for the preservation of the unique natural resources upon which those activities depend. This report can provide the information the County and its citizen need to protect the natural values that provide both economic assets and environmental benefits for residents and visitors alike.

The Survey of Critical Wetland in Gilpin County is part of the ongoing biological surveys of Colorado counties and/or watersheds conducted by CNHP since 1992 (Figure 1). Through funding by the US EPA, Great Outdoors Colorado Trust Fund (GOCO), Bureau of Land Management (BLM), and other entities, wetland and/or upland resource surveys have been conducted in 38 counties across Colorado. Wetland-specific surveys have been completed in nine Colorado counties. CNHP has also conducted upland-specific biological surveys in eight Colorado Counties. In the 21 Colorado counties where biological surveys of upland and wetland resources have both been completed, citizens and planners now possess the information necessary to conserve the full range of their biological resources.

The primary goal of this project was to survey wetlands on private property throughout the county. The results provide County Planners and citizens with data on the location and condition of significant wetland resources and the wetland dependent plants and animals that occur there. These data can inform land use planning and management and be used to balance the often competing needs of conservation and development. Additionally, individual landowners can use the results of surveys on their properties as a baseline when considering future conservation options. Through all this, it is important to note that the results from the project do not imply any additional legal restrictions on landowners or wetlands within the County.

CNHP is a research unit within the Warner College of Natural Resources at Colorado State University comprised of a multi-disciplinary team of scientists, information managers, and conservation planners that gathers and analyzes comprehensive information on rare, threatened, and endangered species and significant plant communities of Colorado. CNHP is

the state's primary, comprehensive, biological diversity data center, gathering information and field observations to help develop statewide conservation priorities. CNHP is a member of NatureServe, an international network of conservation data centers that use the Biological and Conservation Data System developed by The Nature Conservancy. There are 85 conservation data centers, including one in each of the 50 United States. Information collected by the Heritage Programs throughout the globe provides a means to protect species before the need for legal endangerment status arises. Methods used to conduct this *Survey of Critical Wetlands of Gilpin County* were those employed worldwide throughout Natural Heritage Programs and Conservation Data Centers. CNHP's primary focus was to identify the locations of the plant and animal populations and plant communities on CNHP's list of rare and imperiled elements of biodiversity, assess their conservation value, and systematically prioritize these for conservation action.

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 of delineating PCAs 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. Best available knowledge of each species' life history is used in conjunction with information about topographic, geomorphic, and hydrologic features, vegetative cover, and current and potential land uses to delineate PCA boundaries.

PCA boundaries delineated in this report do not confer any regulatory protection of the site, nor do they automatically recommend 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. These PCA boundaries represent the best professional estimate of the primary area supporting the long-term survival of the targeted species or plant communities and are presented for planning purposes. They delineate ecologically sensitive areas where land-use practices should be carefully planned and managed to ensure that planned activities are compatible with protection of natural heritage resources and sensitive species. Please note that these boundaries are based primarily on CNHP's understanding of the ecological systems. A thorough analysis of the human context and potential stresses was not conducted. All land within the conservation planning boundary should be considered an integral part of a complex economic, social, and ecological landscape that requires wise land-use planning at all levels to achieve sustainability.

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. Sites are prioritized according to their biodiversity significance rank, or "B-rank", which ranges from B1 (outstanding significance) to B5 (general or statewide significance). Biodiversity ranks are based on the conservation (imperilment or rarity) ranks for each element and the element occurrence ranks (viability 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). The B1-B3 sites are the highest priorities for conservation actions (due to limited resources, only the B1-B3

PCAs are presented in the report). Based on current knowledge, the sites in this report represent areas that CNHP recommends for protection in order to preserve the natural heritage of Gilpin County. In addition to presenting prioritized PCAs, this report also includes a section with summaries of selected plants, animals, and plant communities that are known to occur within the PCAs.

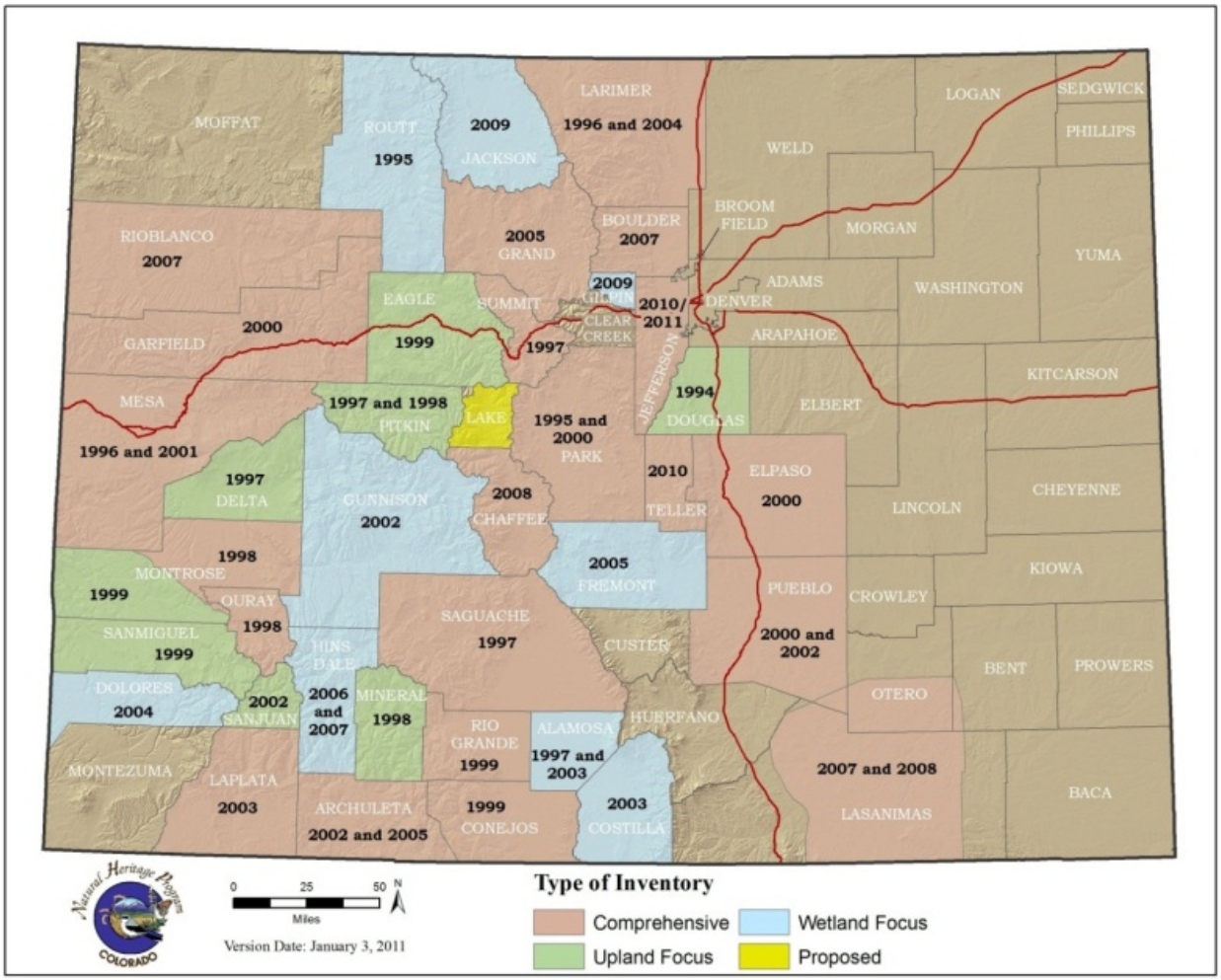


Figure 1. CNHP county inventories as of January 2011

WETLAND DEFINITIONS, MAPPING, REGULATIONS, AND ASSESSMENT

Wetland Definitions

The objective of CNHP's wetland work, and in the case of this report specifically, is to identify ecologically significant wetlands in Gilpin County. To do this requires a definition for what constitutes a wetland. Two widely accepted definitions for a wetland exist; a regulatory definition and an ecological definition. The federal regulatory definition of a wetland is supported by the U.S. Army Corps of Engineers (Corps) for determining jurisdiction in implementing a permit system required by Section 404 of the Clean Water Act 1977 (33 U.S.C. 1344(b) and 1361(a)) and amendments (Mitsch and Gosselink 2007). According to the Corps' regulatory definition, 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 regulation), it must have all three of the following criteria: (1) wetland vegetation; (2) wetland hydrology; and (3) hydric soils.

The U.S. Fish and Wildlife Service use an ecological definition of what constitutes a wetland. *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 vegetation); (2) the substrate is predominantly un-drained 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.

CNHP utilizes the ecological definition of a wetland 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' regulatory criteria. For example, riparian areas, which often do not meet all three of the Corps' criteria, 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). Thus, the U.S. Fish and Wildlife Service wetland definition is more suitable to CNHP's objective of identifying ecologically significant wetlands.

Wetland Regulation

In Colorado, operations and activities that place fill material in wetlands are regulated by the State under the authority of the Federal Clean Water Act. A permit issued under section 404 of the Clean Water Act is required by the Corps before dredging and placing fill in a wetland. Normal agricultural activities, and certain other wetland filling activities, are exempt from Section 404 of the Clean Water Act.

The Section 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. At the State level, Colorado has not developed any guidelines or regulations for the management, conservation, and protection of wetlands. A few county and municipal governments have, including the City and County of Boulder, Summit County and San Miguel County.

Although not specifically regulated by Gilpin County, wetland regulation is suggested in the Gilpin County Master Plan (Gilpin County 2008):

> *Wetlands are an important factor in water conservation, water supply, water quality and water habitat. Wetland areas are scarce and merit close attention, particularly in high mountain environments. The County should look at ways to encourage developments that preserve, restore or create wetlands as opposed to ones that do not. Wetland encroachment should be evaluated in the context of a hierarchy, stressing avoidance first and minimum impact second. Regardless of impact, wetland replacement should be required that results in no net loss of wetland area or function. A County wetland study should be conducted identifying areas of sensitive animal and plant life.*

Wetland Classification and Mapping

In 1975, the U.S. Fish and Wildlife Service began the National Wetlands Inventory (NWI) to document the extent and types of the nation's wetlands (USFWS 1975). The Cowardin et al. (1979) classification system provides the basic mapping units for the NWI. Photo-interpretation and field reconnaissance were used to refine wetland boundaries throughout the U. S. according to the wetland classification system.

In Colorado, maps east of the 106th parallel were created using 1970's black and white aerial photography. Maps west of the 106th parallel were created in the early 1980's using color aerial photography. Though the entire State was mapped on paper during the early years of the NWI program, digital versions of NWI polygons are very limited for Colorado.

Gilpin County includes portions of six 1:24,000 topographic quadrangle maps (Empire, Central City, Black Hawk, Tungsten, Nederland, and East Portal). These had originally been produced on paper maps and were eventually scanned to a digital raster graphic file. In conjunction with EPA funding for this project, CNHP was able to digitize the features on those six quads and submit them to USFWS for inclusion in the NWI digital database.

The Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979) describes ecological taxa, arranges them in a system useful to resource managers, furnishes units for mapping and provides uniformity of concepts and terms. Systems form the highest level of the classification hierarchy; five are defined—Marine, Estuarine, Riverine,

Lacustrine, and Palustrine. In Gilpin County, and the majority of the Intermountain West, the Palustrine System is the only system applicable to our wetlands. The next level of the classification indicates the life form of the dominant vegetation; four life forms are defined:

(1) Palustrine Aquatic Bed (PAB)--dominated by plants that grow principally on or below the surface of the water;
(2) Palustrine Emergent Wetland (PEM)--dominated by emergent herbaceous flowering plants;
(3) Palustrine Scrub-Shrub Wetland, (PSS)--dominated by shrubs or small trees; and
(4) Palustrine Forested Wetland (PFO)--dominated by large trees.

Wetland Functions and Ecological Services

Wetland functions are natural processes of wetlands that continue regardless of their perceived value to humans (Novitzki et al. 1996). These include;

- Water storage;
- Sediment retention;
- Nutrient transformation and storage;
- Groundwater recharge and discharge;
- wildlife habitat; and,
- diversity of wetland plants.

Ecological services are the wetland functions that are valued by society (Millennium Ecosystem Assessment 2005). For example, biogeochemical cycling (which includes retention and supply) is an ecological function whereas nutrient removal/retention is an ecological service to society. Also, overbank flooding/subsurface water storage is an ecological function whereas flood abatement/flood-flow alteration is an important ecological service.

Ecological services are typically the value people place on wetlands that is the primary factor determining whether a wetland remains intact or is converted for some other use (National Audubon Society 1993). The actual value attached to any given function or value listed above depends on the needs and perceptions of society (National Research Council 1995).

Wetland Condition Assessment

For the Gilpin County wetland survey and assessment 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. The assessment was used to provide a rapid determination of each wetland's functional integrity. This functional assessment method used various qualitative indicators of structure, composition, and land use to represent and estimate the degree to which a function was being performed. This, as well as most functional assessments, requires the following assumptions: (1) the combination of variables adequately represents the function and (2) their combination results in an estimated "amount" of the function being performed. The result is that most functional assessments are not rapid and do not directly measure functions (Cole 2006).

Condition assessments are 'holistic' in that they consider *ecological integrity* to be an "integrating super-function" (Fennessy et al. 2004). Condition assessments or ecological integrity assessments provide insight into the integrity of a wetland's natural ecological functions that are directly related to the underlying integrity of biotic and abiotic processes. In other words, a wetland with excellent ecological integrity will perform all of its functions at full levels expected for its wetland class or type. Ecological integrity assessments are simply concerned with measuring the condition of the wetland and assume that ecological functions follow a similar trend. This assumption may not be true for all functions, especially ecological services or those functions which provide specific societal value. For example, ecological services such as flood abatement or water quality improvement may still be performed even if ecological integrity has been compromised. However, given that CNHP is attempting to identify and prioritize ecologically significant wetlands, it seemed more pertinent to focus the assessment on ecological integrity or condition of each wetland rather than specific ecological functions, services or values.

The element occurrence rank (see CNHP methodology section, Table 6) used by CNHP is a rapid assessment of the condition of on-site and adjacent biotic and abiotic processes that support and maintain the element. This method was used to assess wetland condition for this report. Recently, NatureServe and CNHP revised this method making it more transparent and repeatable. The Ecological Integrity Assessment (EIA) framework is a conditional assessment of wetlands that identifies biotic and abiotic metrics to measure integrity (Faber-Langendoen et al. 2008). Principles of the EIA framework have been incorporated into CNHP's element occurrence ranks.

PROJECT AREA BACKGROUND

Location of Study Area

Gilpin County is located along the east side of the Continental Divide in the Front Range of north central Colorado (Figure 2). The Continental Divide forms the western border of the County, and adjacent counties include Boulder County to the north, Jefferson County to the east, Clear Creek County to the south, and Grand County to the west. Gilpin County encompasses 150 square miles (38,849 ha) and ranges in elevation from 13,294 feet (4,052 m) to 6960 feet (2,121 m) with most of the land forested and below treeline. Central City is the county seat and is located in the southeastern part of the County.

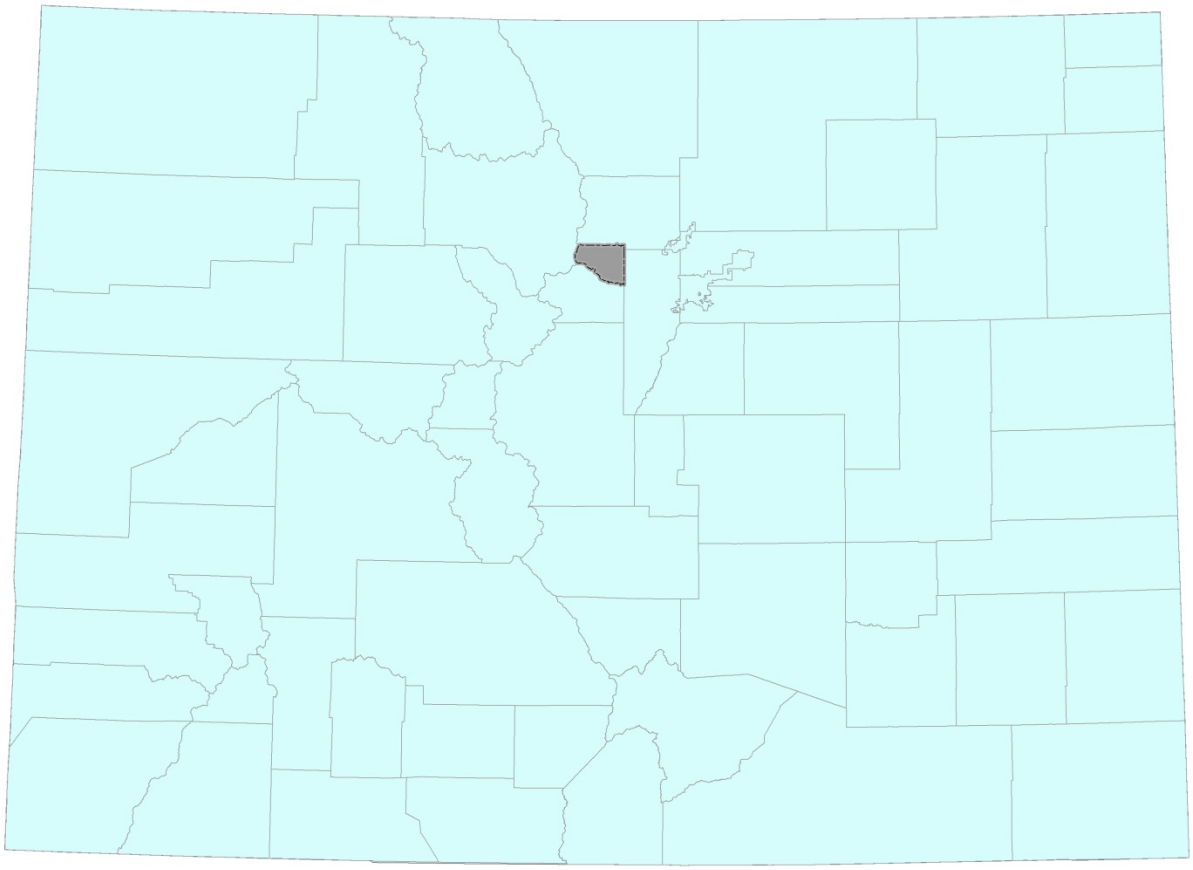


Figure 2. Location of Gilpin County in Colorado

It is entirely within the headwaters of the South Platte River basin and straddles the divide between the Clear Creek sub-basin to the south, and the St. Vrain River sub-basin to the north (Figure 3). The headwaters of South Boulder Creek, a major tributary of the St Vrain River, originate in Gilpin County from snowmelt in glacial tarns that lie just below the Continental Divide.

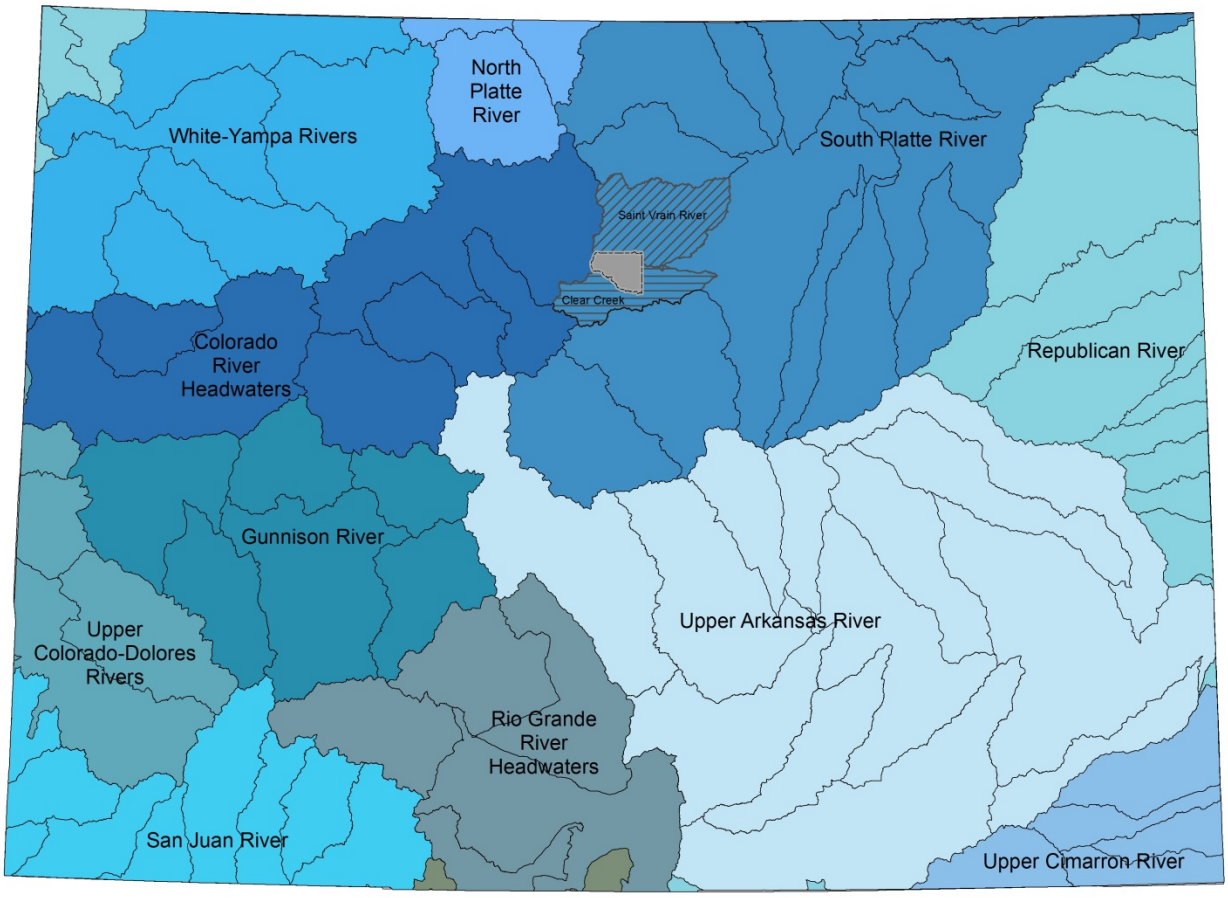


Figure 3. Location of Gilpin County within the South Platte River watershed, and the Clear Creek sub-basin to the south, and the St. Vrain River to the north

Glacial activity sculpted the high peaks along the Divide into steep headwalls, arêtes, pyramidal peaks, cirques, and tarns. The numerous 13,000-foot summits and high plateaus that form the western border of Gilpin County are a major topographic feature and determinant of the County's climate and ecosystem distribution. Most of this high elevation landscape is protected as the James Peak Wilderness area (Figure 4). The James Peak Wilderness encompasses 14,000 acres (5,665 ha) on the east side of the Continental Divide in Boulder, Gilpin, and Clear Creek Counties. The Wilderness is named after its most prominent peak, the 13,294 foot (4,052 m) James Peak, which is located in Gilpin County and honors Dr. Edwin James, an early explorer, historian, and botanist who was a member of the famous Stephen H. Long expedition to Colorado in 1820.

To the east and at the toe of the steep slopes of the Divide, lie lower elevation montane foothills and broad valleys. As indicated by the rounded granitic outcrops and hills that characterize the landscape here, these lower elevation foothills were not glaciated. Weather, water, and wind created the steep canyons and rounded hills of this lower country. Golden Gate Canyon State Park is located at the eastern-most border of the County and just beyond, the foothills give way to hogbacks that descend to the Great Plains. The topographic position of

Gilpin County, extending from the top of the Continental Divide eastward to the foothills, brings great ecological diversity to the landscape.

Figure 4. James Peak Wilderness in Gilpin County (USFS 2010)

Hydrology

Several mountain ranges within the Southern Rocky Mountain Province, including the Front Range, form the Continental Divide which is a major hydrologic feature of the continent that separates river basins flowing west into the Gulf of California and east into the Gulf of Mexico. The South Platte River is a major drainage that originates in the SRM Province and flows eastward across the Great Plains. Gilpin County is entirely within the South Platte drainage and contributes water to the South Platte River via the St. Vrain River and Clear Creek. Numerous small tributary streams feed water from higher elevation areas of the county to these two rivers.

Stream discharge as well as groundwater recharge is tied to the snowpack and the timing of snowmelt. Snow accumulations affect spring runoff and the seasonal rise in temperature causes snowmelt runoff (Siemer 1977). Spring runoff from snowmelt typically begins in mid- to late May. During this time of the year, water from snowmelt can be responsible for almost all of the streamflow in a river (USGS 2010). For example, Figure 5 shows average mean monthly stream discharge for seven years, from 2002 through 2009, for North Clear Creek in Gilpin

County. The large peaks in the chart are mainly the result of melting snow; mean monthly stream discharge in May, during peak snowmelt, was 55 cfs while in September monthly mean discharge was 3.7 cfs. Additionally, the chart shows that runoff from snowmelt not only varies monthly but from year to year and ultimately that water stored as snowpack in the winter can affect the availability of water for the rest of the year.

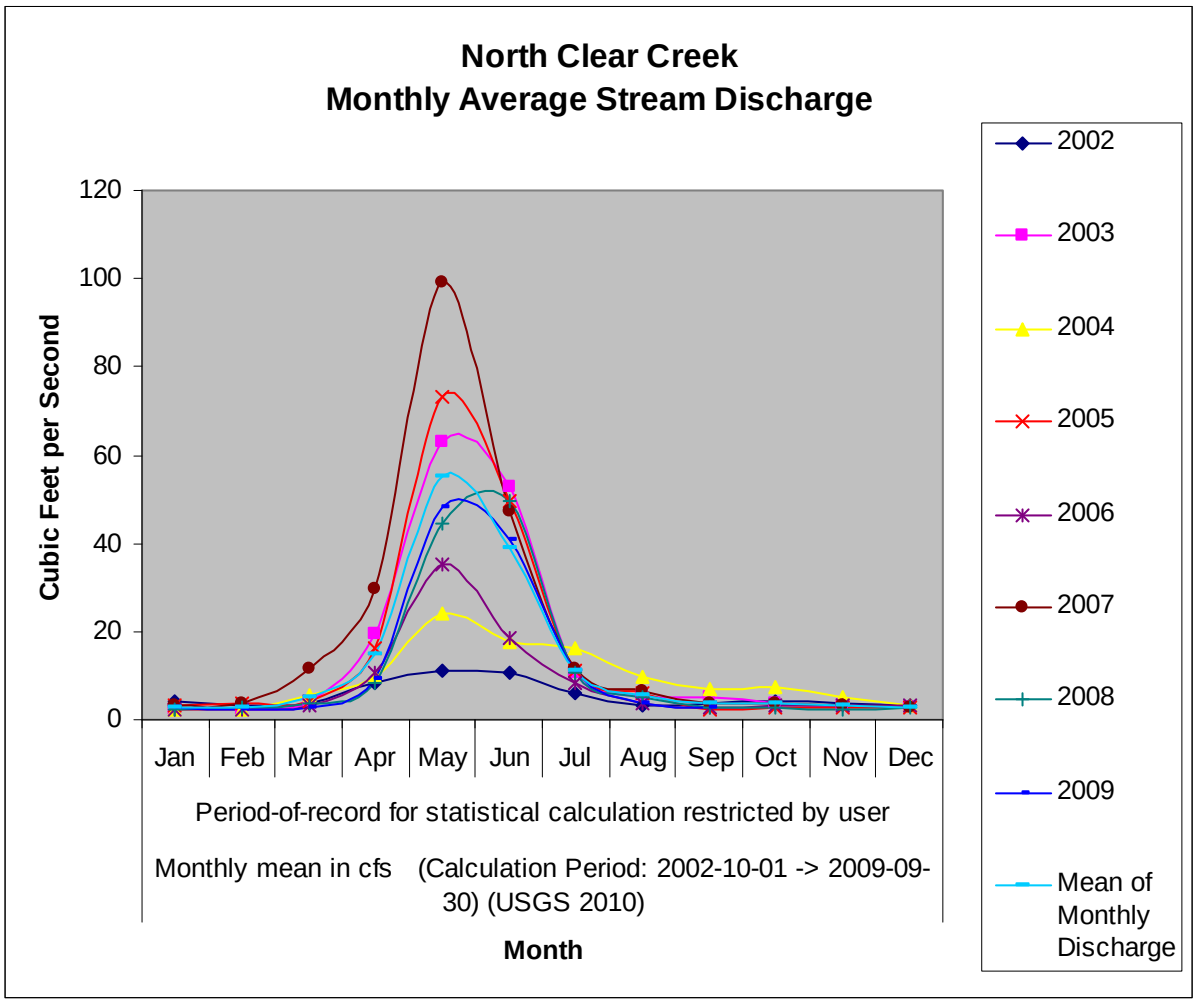


Figure 5. Mean monthly stream discharge from 2002 through 2009 in North Clear Creek (USGS 2010)

Mountain snowfields are a natural water storage system for Colorado. Snowfall is stored in the snowpack during winter and released during spring melt to recharge groundwater and sustain streamflow through the dry season.

Dams and reservoirs include the Braecher Ranch Dam and lake, the Mammoth Creek Dam which was decommissioned in 1986, Snowline Lake and dam, Kriley dam and pond, Slough dam and pond, Chase gulch dam and reservoir, Central City dams and ponds and the Jenny Lake dam, which is in Boulder County but whose effluent stream, Jenny Creek, is in Gilpin County. Numerous stream diversions occur throughout Gilpin County. Most divert water out of streams or impound water in ponds or lakes. The Moffat water tunnel is a trans-basin diversion that

diverts water from the western slope into South Boulder Creek and represents a major inflow: 52,155 acre-feet is imported via the Moffat tunnel from the west slope into South Boulder Creek and eventually into the South Platte River (CWCB 2011). Flows from the Moffat water tunnel into South Boulder Creek may be increased if plans by Denver Water to increase diversions from the Fraser River are approved.

Groundwater

Aquifers are permeable rocks in the saturated groundwater zone that transmit water freely and act as reservoirs for groundwater storage and flow (Matthews et al. 2003). These rock layers consist of either unconsolidated sediments or consolidated rock – each having differing ability to store and transmit water. Unconsolidated sediments are some of the most productive aquifers in Colorado while volcanic and crystalline rock aquifers have less ability to store water (Topper et al. 2003). Colorado's mountainous regions contain both unconsolidated to poorly consolidated aquifers as well as fractured crystalline (igneous and metamorphic) and volcanic rock aquifers. The Front Range is formed of these fractured rock aquifers which consist of Precambrian age granites and gneisses and recent volcanic and igneous intrusive rocks .

Bedrock in the crystalline rock aquifers is highly resistant, variably fractured and complexly deformed (Topper et al. 2003). Fracture characteristics and connections determine water storage characteristics. Crystalline rock aquifers, unlike sedimentary rock aquifers, have no primary porosity (porosity of the rock itself) and water is stored only in fractures within the rocks. These fracture spaces are typically small, thus water storage capacity is low. Recharge of crystalline rock aquifers occurs mostly from snowmelt and timing of recharge typically occurs from May to early July. Amount of recharge depends on rock characteristics as well as on the amount of snow, its moisture content, and rate of melt.

Because evapotranspiration is high in Colorado, only a small percentage of precipitation is available to recharge aquifers, streams, and wetlands (Figure 6). In combination, limited recharge and limited storage capacity suggests a delicate balance between recharge and consumption (Topper et al. 2003).

Crystalline rock aquifers supply most of the domestic water needs in the mountainous parts of the state and in Gilpin County. In Gilpin County most potable water is produced by a well located on each property. Because groundwater is a finite resource, which becomes depleted if use exceeds aquifer recharge rates, several communities located in the crystalline (granite) rocks of the Colorado mountains have had wells dry up (Matthews et al. 2003). Currently residents in Gilpin County use about 177 gallons of water per person per day (CWCB 2010). Although this represents a decrease in per capita water consumption compared to the year 2000, total water consumption is projected to increase with increasing population.

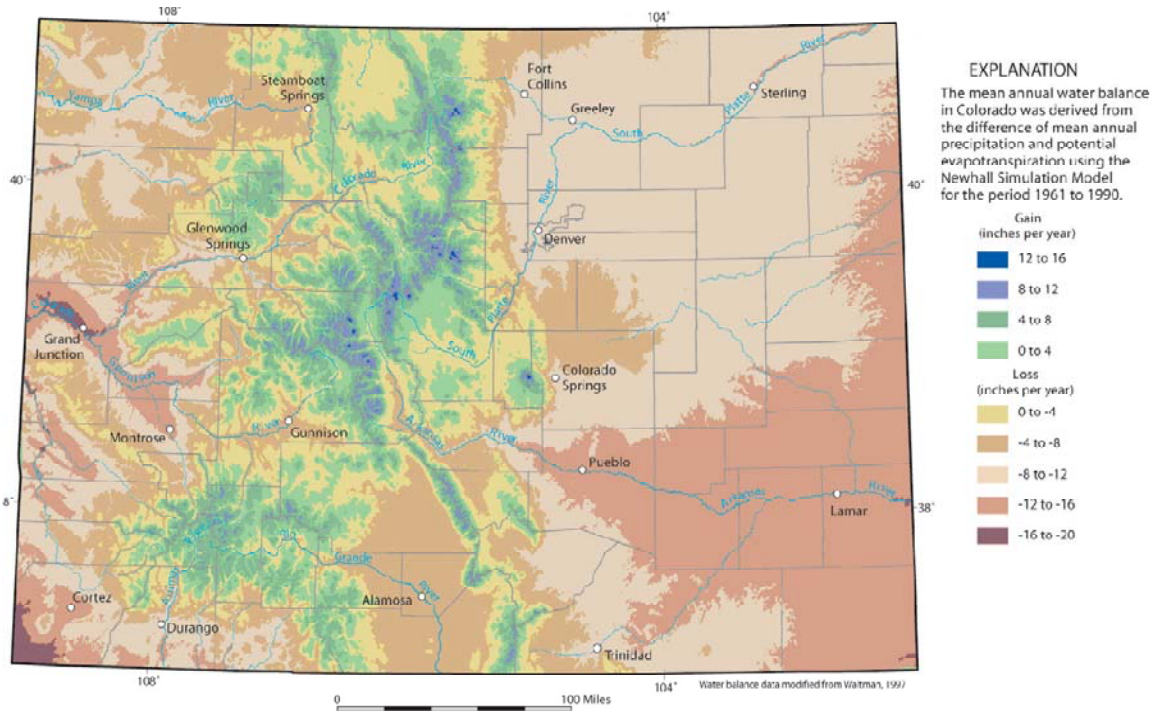


Figure 6. Mean water balance over most of the state is a deficit due to high evapotranspiration rates (Topper et al. 2003). Statewide averages show that approximately 81% of Colorado's precipitation returns to the atmosphere through evapotranspiration

Geology

Geologic Characterization

Gilpin County is located within the Southern Rocky Mountain physiographic province. Colorado is comprised of five physiographic provinces, which are regions where geologic structure, climate and landforms are significantly different from adjacent regions (Figure 7) (Topper et al 2003). The Southern Rocky Mountain (SRM) province bisects Colorado and runs the entire length of the state from north to south, dominating its topography (Mutel and Emerick 1992). The SRM province is comprised of all three of the basic rock types, igneous, metamorphic and sedimentary, and contains the oldest rocks in the region. The Front Range where Gilpin County is located has a core of 1.8 to 1.1 billion year old Precambrian granite, gneiss and schist.

Petersen and Borchert (2010) provide the following description of the geology of the Gilpin County region:

> *Specific Precambrian rock types are biotite gneiss, microcline gneiss, quartz diorite, schist and granitic rocks. Surficial deposits are of Quaternary age. The Precambrian complex of metamorphic and igneous crystalline rocks is known as "basement rocks". Near the end of the Mesozoic and in the early Tertiary, the Larimide Orogeny occurred and major folding and faulting of rocks took place. Subsequent erosion and detritus associated with the uplift scarified older rocks out of the major drainage ways to the east. The Precambrian formations include microcline gneiss of the Boulder Creek granite and quartz*

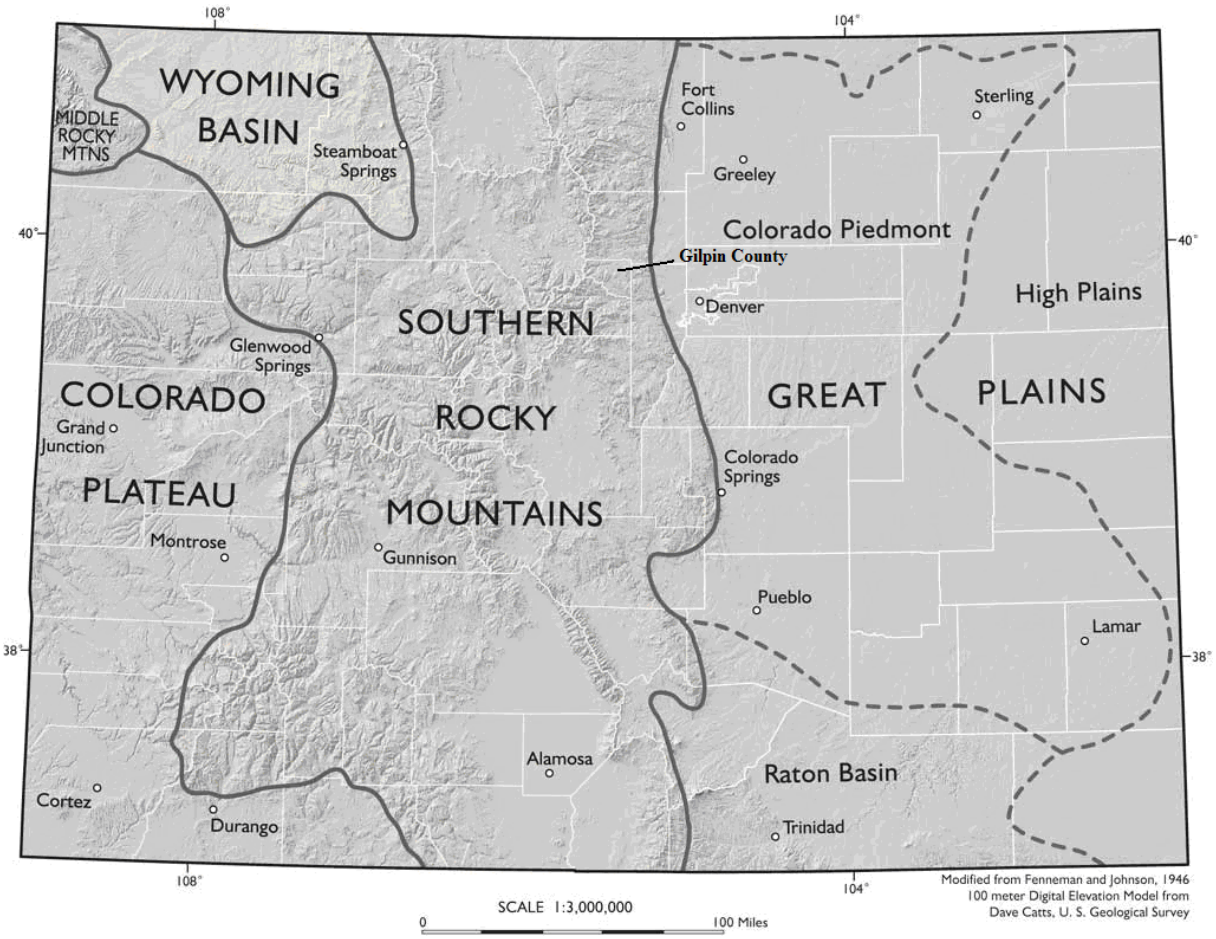


Figure 7. Location of Gilpin County within the Southern Rocky Mountain Physiographic Province of Colorado

> *diorite, biotite-muscovite granite of the Silver Plume granite. The Silver Plume granite intruded after the Boulder Creek granite, and cataclastic deformation of rocks occurred along the major shear zones of the faults. North- to northeasterly-trending folds developed in much of Clear Creek and Gilpin Counties. The present physiography of the area was shaped primarily in Quaternary time by the actions of mass wasting, limited periglacial activity, and streams carrying water and detritus from high mountain glacial melt. Glacial ice was confined to high elevation cirques except for the ice lobes that extended down and are evident in South Boulder Creek, Mammoth Gulch and Jenny and Arapaho Creeks.*

The Front Range is a north-south trending massif that constitutes the easternmost mountains in the Southern Rockies. The range is about forty miles wide and is part of a continuous chain of mountains that extends from the North Platte River in Wyoming to the Arkansas River and down to the Wet Mountains in south-central Colorado (Weimer and Haun 1960). The Front Range is typical of most of the Colorado Rockies, which consist of a cluster of long, narrow faulted anticlines (Chronic and Williams 2002). Numerous faults edge both the eastern and western sides of the Front Range and many of them are thrust faults along which the block of

Precambrian rocks moved upward and outward over surrounding sedimentary rocks (Chronic and Williams 2002). The Front Range rises sharply from the mile-high Colorado Piedmont to the Tertiary pediment at 8,000 to 10,000 feet and then to summits up to 14,000 feet (Chronic and Williams 2002). Most of the significant mineral deposits in the Front Range lie along the Colorado Mineral Belt, a Precambrian fault zone that trends northeast to southwest from north of Boulder to the La Plata mountains northwest of Durango and intersects the Front Range between Boulder and Dillon. The formation of this mineral-rich belt was created by igneous intrusion and volcanic eruptions between 75 and 20 million years ago. Magma rose in many places along this zone during and after Laramide mountain building. Mineral rich solutions containing dissolved metals, silica, carbon dioxide and sulfur compounds escaped from the magma and flowed into cracks and fissures and were deposited there as the solutions became over-saturated (Matthews et al. 2003). These vein deposits range from less than an inch to nearly 100 feet in width and extend from tens of feet to several miles in length. The mining districts of Central City and Black Hawk lie in this belt and numerous other mines occur throughout Gilpin County.

Geologic History

The geologic history of the Rockies over the past several hundred million years is characterized by alternating periods of mountain uplift followed by erosion. As each mountain range was formed, it was worn down and each time another mountain building episode followed (Chronic and Chronic 1972). Structural deformation episodes, associated with the uplift of the Rockies, brought Precambrian age rock to the surface and produced Colorado's complex geology (Topper et al 2003). Precambrian age rock is the oldest (>4,600 mya) and the majority of Precambrian rock in Colorado lies within the SRM province. These Precambrian age rocks are composed primarily of metamorphic gneiss and igneous granite. The Front Range is comprised primarily of Precambrian aged igneous, metamorphic and sedimentary rocks, but also with numerous areas of volcanic and intrusive igneous rocks of the Cenozoic era and unconsolidated deposits of the Quaternary period (Figure 8).

The end of the Mesozoic era, 65mya, marks the beginning of the rise of the modern day Rocky Mountains – the Laramide orogeny. The present shape of the region was acquired starting at the end of the Mesozoic and during the Cenozoic era, beginning 70 million years ago with episodes of mountain uplift, volcanism, erosion and sedimentation (Mutel and Emerick 1992). Mountain range uplift and associated downwarp created ranges and basins throughout Colorado. Erosion followed mountain building and is evidenced by the thick accumulation of sediments in the valleys and basins between the mountain ranges (Topper et al 2003). Igneous activity accompanied Laramide mountain building and intrusive rocks lie throughout the Colorado Mineral Belt (Matthews et al. 2003). Laramide mountain building was followed by erosion and deposition that reduced the entire area to a broad undulating surface of low relief (Matthews et al. 2003).

The most recent uplift of the Rockies occurred at the end of the Tertiary period, 1.8 mya. This uplift was characterized by the southern Rockies spreading apart, which resulted in the crust

breaking into many blocks and basaltic magma rising up through the faults and onto the ground surface. The uplift also caused the blocks of crust to rise and fall creating the block-faulted mountains and basins, plateaus and high plains that characterizes much of present day topography (Matthews et al 2003). Plains that had been near sea level rose to 4,000 feet, mountains 5,000 feet high became 10,000 feet high and those over 9,000 feet became fourteeners (Chronic and Williams 2002).

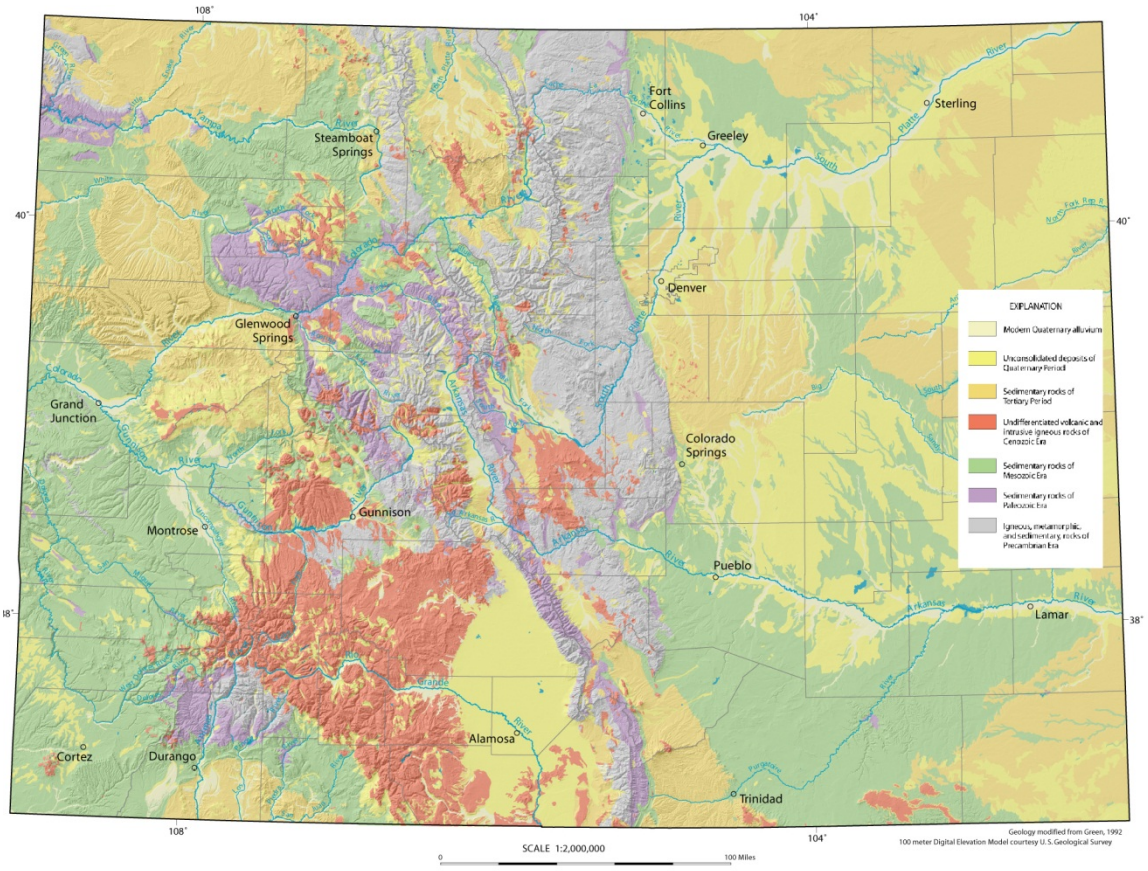


Figure 8. Generalized geology of Colorado showing the types and ages of rocks (Topper et al 2003)

Glaciers provided the final touch to the uplifted mountains. Much of the high mountain terrain that we see today, down to about 8,500 feet, resulted from Ice Age activity of the past two million years. Up until 12,000 years ago large glaciers, thousands of feet thick, filled valleys and left their marks on the mountainous landscapes of Colorado (Matthews et al. 2003). Glaciers formed huge cirques at the heads of valleys, widened valley bottoms, carved pockets that now form lakes and deposited rocks in ridges, called moraines, and over much of the ground in valley bottoms (Mutel and Emerick 1992).

Today small glaciers remain in the Front Range but are not remnants of Ice Age glaciers. These glaciers formed in the mountains during the Little Ice Age between 1,200 and 1,800 A.D. (Matthews et al. 2003), but are barely able to survive today's climate (Mutel and Emerick 1992).

Soils

Generally a thin veneer of soil, with moderate to high permeability, typically less than 5 feet thick, overlies the bedrock throughout Gilpin County. The surficial deposits are generally not extensive enough to yield suitable quantities of water but are an important unit for recharge and shallow, seasonal groundwater discharge (Topper et al. 2003).

Where geology, topography, and moisture allow, and remain consistently so over long periods, fens develop. In the Southern Rocky Mountains, a wetland is considered a fen if organic matter accumulation is at least 40 cm deep and soil composition is 12% (if 0% clay) to >18% (if >60% clay) organic carbon (Cooper 2009). Fens occur across the landscape of Gilpin County from the montane through the alpine zones and their soils are classified as histosols.

The following soils are typical of the various ecological zones in Gilpin County:

- Soils in coniferous forests in the lower montane zone include: Legault-Rock outcrop complex (30 to 80% slope), Ohman-Legault very gravelly sand loams and Grimstone-Bullwark family complex (30 to 60% slopes), Bullwark-Catamount families-Rock outcrop complex (40 to 150% slopes), Grimstone-Peeler-Rock outcrop complex (15 to 30% slopes) and Cypher-Wetmore-Ratake families complex (5 to 40% slopes).

- Soils in mid- and upper montane zone coniferous forests include: Goosepeak-Catamount families and Leighcan-Catamount families moist complexes (5-40% slopes), and Leighcan-Catamount families, moist-Rock outcrop complex (40 – 150% slope)

- Soils in subalpine forested areas include: Leighcan family, till substratum-Cryaquolls complex (5 to 40% slope), Leighcan family, warm-Rock outcrop complex (40 to150% slope), and Leighcan-Catamount families moist complexes (5-40% slopes).

- Alpine soils in meadow ecosystems are characterized by Bross-Matcher families-Lithic Cryorthents complex (5 to 40% slopes), Bross family-Cryaquepts complex (5 to 25% slopes), and Leighcan family-Cryaquolls-Moran family complex (5 to 40% slopes).

- Riparian areas tend to have fine-textured, alluvial soils with coarse material in the matrix and are characterized by soils including: Cryaquolls-Gateview complex (0 to 15% slopes) and Pachic Argiustolls-Aquic Argiustolls complex (0 to 15% slopes).

Climate

Climate data for the following discussion was accessed from the PRISM Climate Group at Oregon State University (2010) and from the Western Regional Climate Center (2010). Three data locations in the county are highlighted: Gilpin East (GE), Gilpin West (GW), and Blackhawk (BH).

Climate in Gilpin County varies with elevation and aspect. In Black Hawk at an elevation of 2,621 m (8,599 ft), climate data reflects a relatively mild but dry climate; April through August

typically are the wettest months and July and August are the warmest while December, January and February are the coldest and driest months (Table 1 and Figure 9). Higher elevations are colder and wetter; the Gilpin West (GW) site is at an elevation of 3,400 m; the Gilpin East site is at an elevation of 2,625 m (8,612 ft) and has an elevation and climate similar to Black Hawk. Additionally, the pattern of precipitation distribution varies from east to west with time of year (Figure 9).

Climate determines precipitation patterns and the presence or absence of a significant spring thaw, streamflow, local flooding regimes, and ground water resources (Mitsch and Gosselink 2007). Colorado's high elevation location at mid-latitude on the interior of the continent produces a semi-arid climate where most of the precipitation is lost through evapotranspiration – which may be the single most important influence on all wetland types in the arid west (Mitsch and Gosselink 2007). Statewide averages show that approximately 81 percent of the precipitation that falls in Colorado returns to the atmosphere through evapotranspiration (CGS 2002).

Table 1. Monthly average temperature and precipitation 1971-2000, at selected sites in Gilpin County; Gilpin West (GW), Gilpin East (GE), and Black Hawk (BH) (Oregon State University 2010)

Climate Character	Location	J	F	M	A	M	J	J	A	S	O	N	D	Annual Total
T max ^{o}F	GW	24.6	27.5	32.3	39.9	49.1	58.8	65.0	62.7	55.6	45.0	31.8	25.7	
	GE	35.2	37.8	42.3	49.6	58.8	68.9	75.4	73.1	65.9	55.4	42.0	35.8	
	BH	35.9	38.4	42.5	50.7	60.0	70.2	76.2	74.2	66.9	56.7	43.4	37.0	
Ppt (in)	GW	2.92	2.49	3.58	4.24	3.34	2.36	2.50	2.31	1.82	1.87	2.78	2.69	33.1
	GE	0.82	0.87	2.41	3.13	3.14	2.22	2.58	2.48	1.68	1.24	1.29	1.15	22.5
	BH	0.60	0.68	1.52	2.35	2.63	2.01	2.44	2.11	1.43	1.04	1.10	0.80	18.7

Colorado's climate is complex and characterized by extreme variations in precipitation and temperature. Complexity is due to a wide range of elevations and varied topography. Precipitation patterns, temperatures and wind are profoundly influenced by the mountains and vary tremendously in Colorado with altitude, topography and whether a location is on the west or east slope of the Continental Divide. During winter in the mountainous regions of Colorado, local climate on the east slope of the Continental Divide is much different compared to nearby areas on the west slope. Prevailing air currents reach Colorado from westerly directions: moisture laden, eastward moving Pacific air masses lose much of their moisture in passage over mountain ranges far to the west of Colorado (Siemer 1977). More moisture is lost as the air masses rise over the Southern Rockies, so that by the time the air masses reach the Front Range, most of the Pacific moisture has been lost. Thus the reason why the Front Range has

less snow than the western ranges is that the eastern slopes of the Continental Divide are in the rain shadow of the wetter mountains to the west (Mutel and Emerick 1992, Siemer 1977).

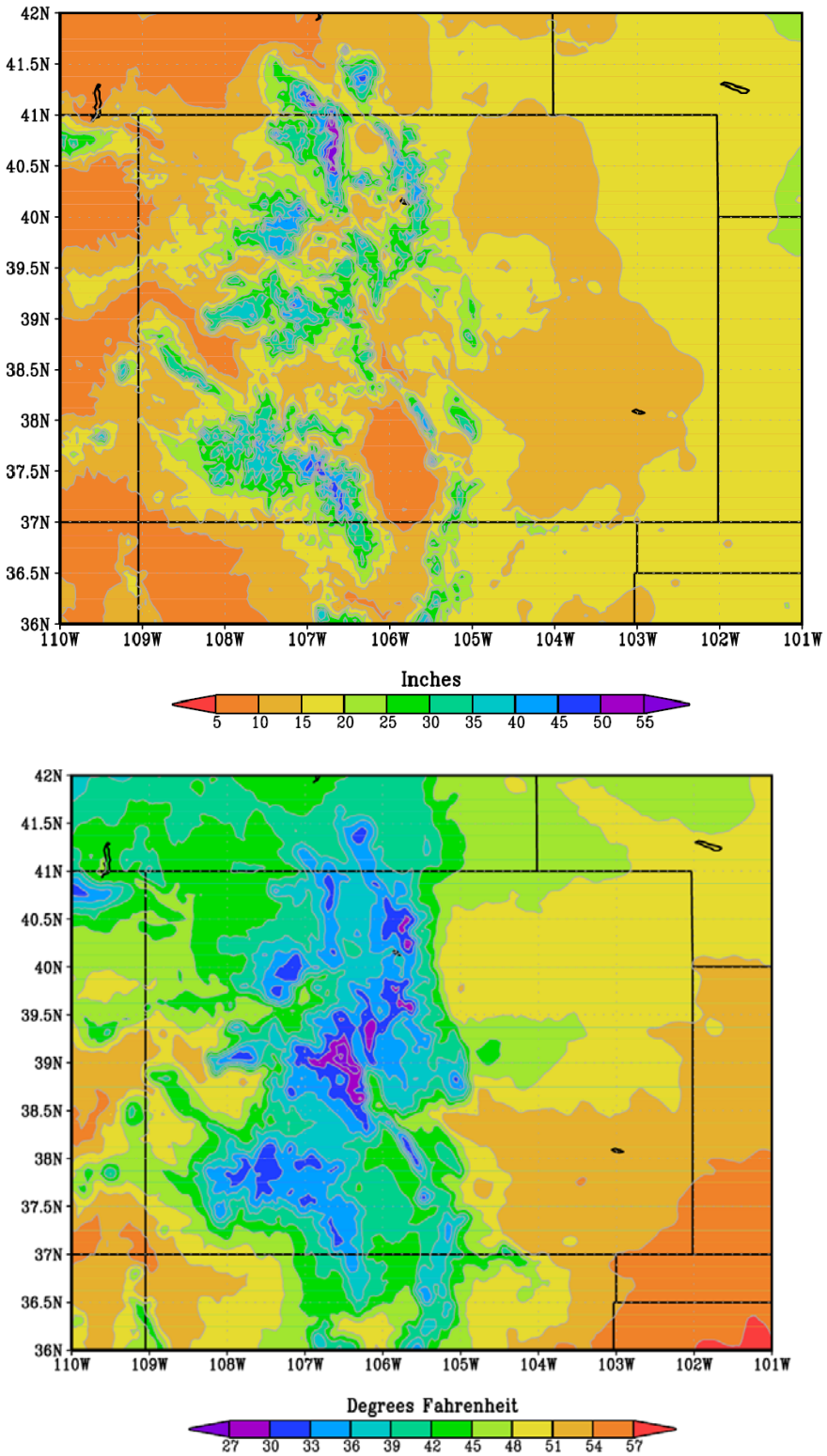


Figure 9. Annual Average Precipitation (top) and Temperature (bottom) in Colorado (1950–99) (CWCB 2010)

In general, lower elevations to the east and south are drier and warmer while higher elevations to the north and west are wetter and colder (Figure 10 and Table 1). In the southern part of the county at Black Hawk (BH) (2,621 m), the average annual precipitation was 47.52 cm (18.71 in) with the majority occurring from April through July. On the east side of the county near Golden Gate Canyon State Park (GE) (2625 m), average annual precipitation was 57.15 cm (22.5 in) with the majority occurring from March through August (Figure 10 and Table 1). Further west, in the James Peak Wilderness (GW) (3,400 m), average annual precipitation was 84.20 cm (33.15 in) with the majority of precipitation occurring from January through May.

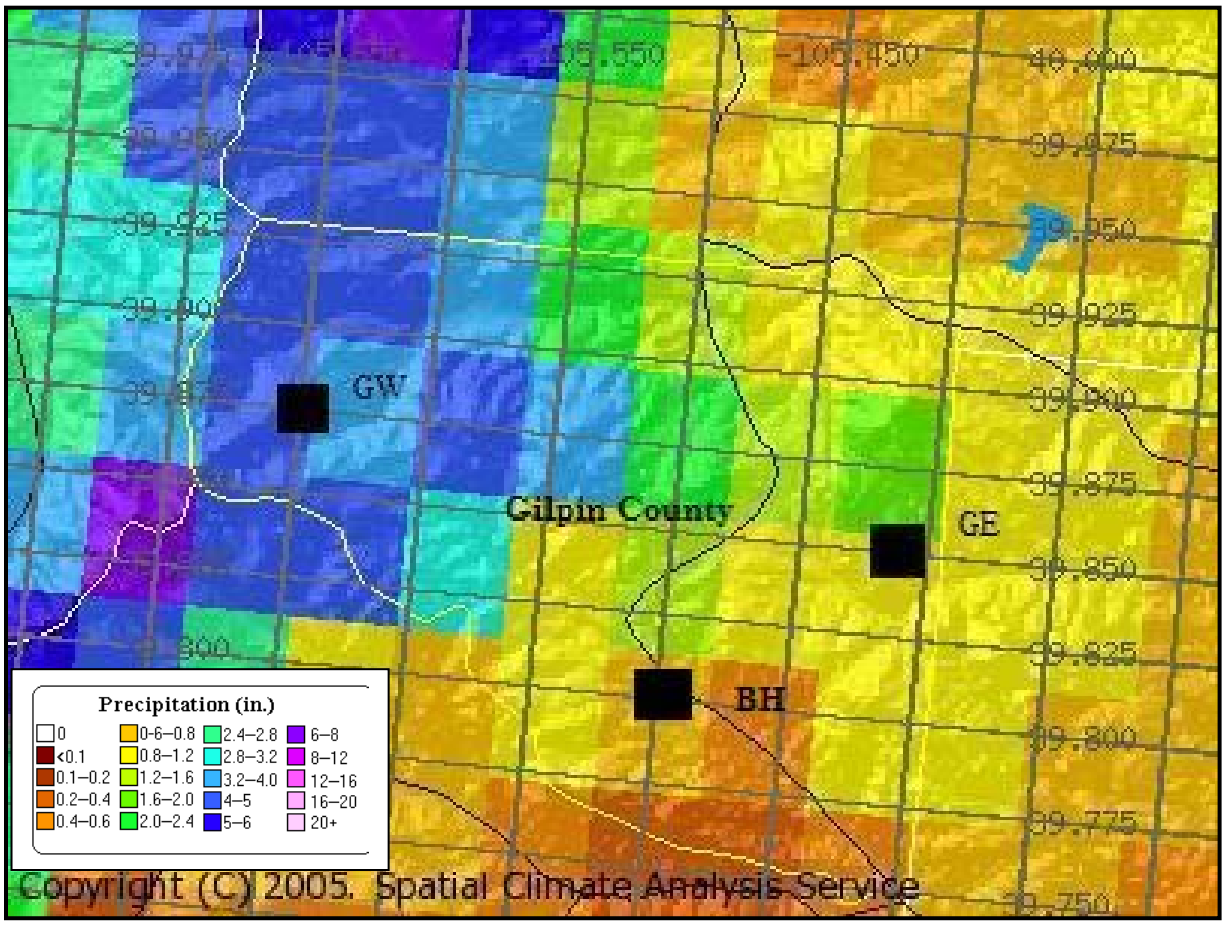


Figure 10. Average annual precipitation (1895 to 2008) (Oregon State University 2010)

Temperature also varies in the County from east to the west, corresponding to changes in elevation. At Black Hawk, average temperatures were warmest in July and August with an average maximum high of 76 °F; coldest temperatures were in January with an average maximum of 36 °F. Average temperatures at the Golden Gate location were warmest in July and August with an average maximum high of 75 °F while the coldest temperatures were in January and February with an average maximum high of 35 °F. At the James Peak location, the average maximum high temperature during the summer months was 65 °F; coldest temperatures occurred in January and February with an average maximum high of 25 °F (Oregon State University 2010).

In Gilpin County distribution of precipitation throughout the year varies from the east to the west with elevation (Figure 10, Figure 11, and Table 1). Western locations at higher elevations receive the majority of their precipitation during late winter and early spring. Winter storms, tracking east, bring precipitation in the form of snowfall to the mountains of the Front Range; snowfall generally correlates with elevation, the higher the elevation the higher the mean snowfall (Hansen et al 1978). Front Range foothills in Gilpin County receive the majority of their moisture during spring and early summer via upslope winds from low-pressure areas situated over southeastern Colorado (Siemer 1977). Additionally, both mountains and foothills receive precipitation from mid-summer thunderstorms which result from mountains heating intensely, causing air to heat and rise, and then cooling, which produces thunderstorms (Siemer 1977).

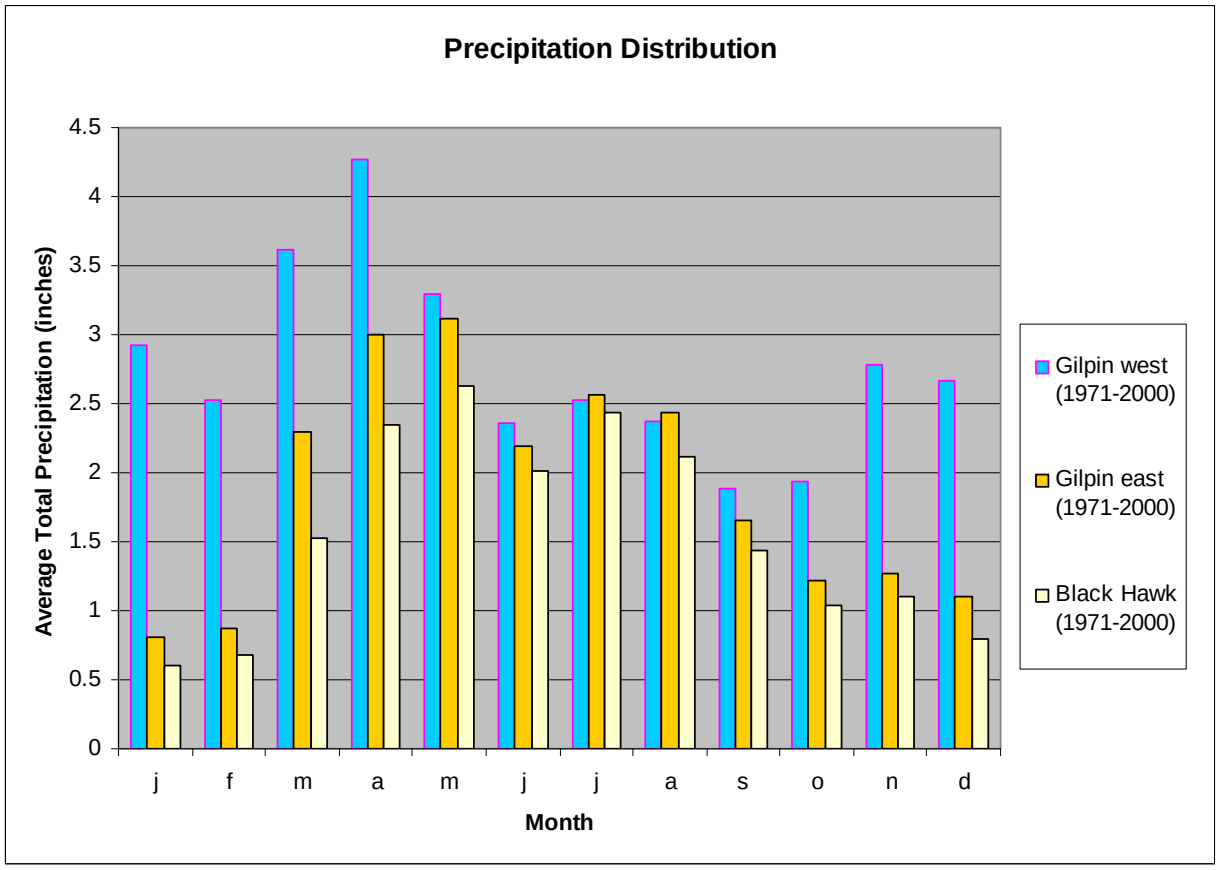


Figure 11. Precipitation distribution compared from low to high elevations in Gilpin County

Ecoregions

Ecoregions are delineated based on common patterns of geology, physiography, vegetation, climate, soils, land use, wildlife, water quality, and hydrology (U.S. EPA 2009). An individual ecoregion is a continuous geographical area across which climate, soil, and topography are sufficiently uniform to permit the development of similar types of vegetation (Smith 1996). Gilpin County is located in the Southern Rocky Mountain (SRM) ecoregion (Figure 12). The SRM ecoregion spans a large elevation range and includes major mountain systems and the intervening valleys and parks (Neely et al. 2001). Ecoregions denote areas of general similarity

in the ecosystems and serve as a spatial framework for research, assessment, management, and monitoring of ecosystems and ecosystem components (Omernik et al. 2000, and others).

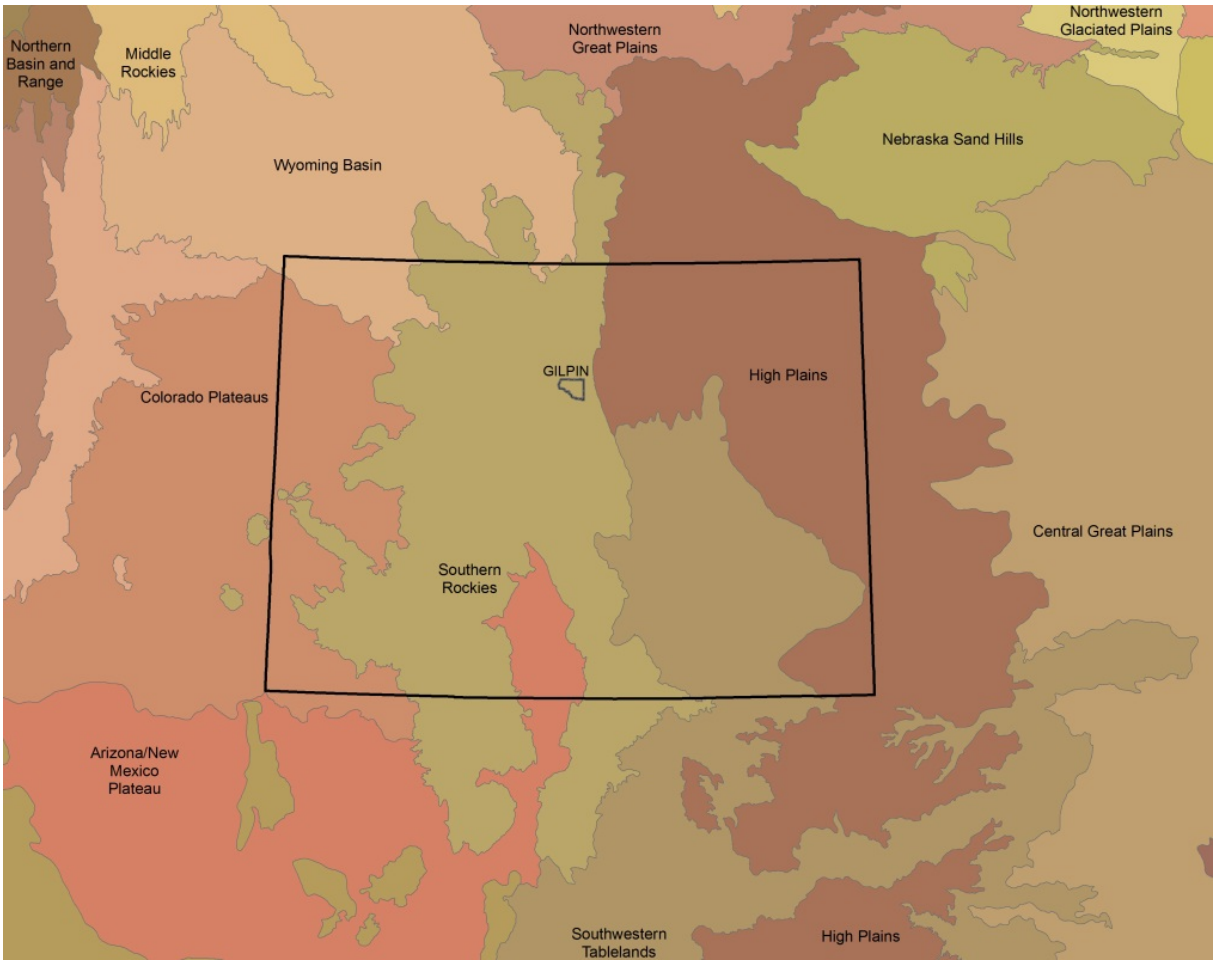


Figure 12. Location of Gilpin County in the Southern Rocky Mountain Ecoregion (Omernik's Level III Ecoregions of the Continental United States)

In the Southern Rocky Mountain Ecoregion, vegetation communities, ecosystems, soils, and climate follow a pattern of elevational banding. In Gilpin County the highest and lowest elevations are dominated by herbaceous cover; below 11,000 feet coniferous subalpine forests characterize vegetation cover; and at mid- elevations, in the montane zone of the foothills, vegetation communities are a mosaic of open coniferous forest, shrublands, and grasslands.

Chapman et al. (2006) defined Level IV ecoregional subsections on the basis of vegetation and geologic substrate. Gilpin County is comprised of three ecoregional subsections, the alpine zone, crystalline subalpine forest zone, and crystalline mid-elevation forest zone. Level IV subsections of the Southern Rocky Mountain ecoregion in Gilpin County are shown in Figure 13.

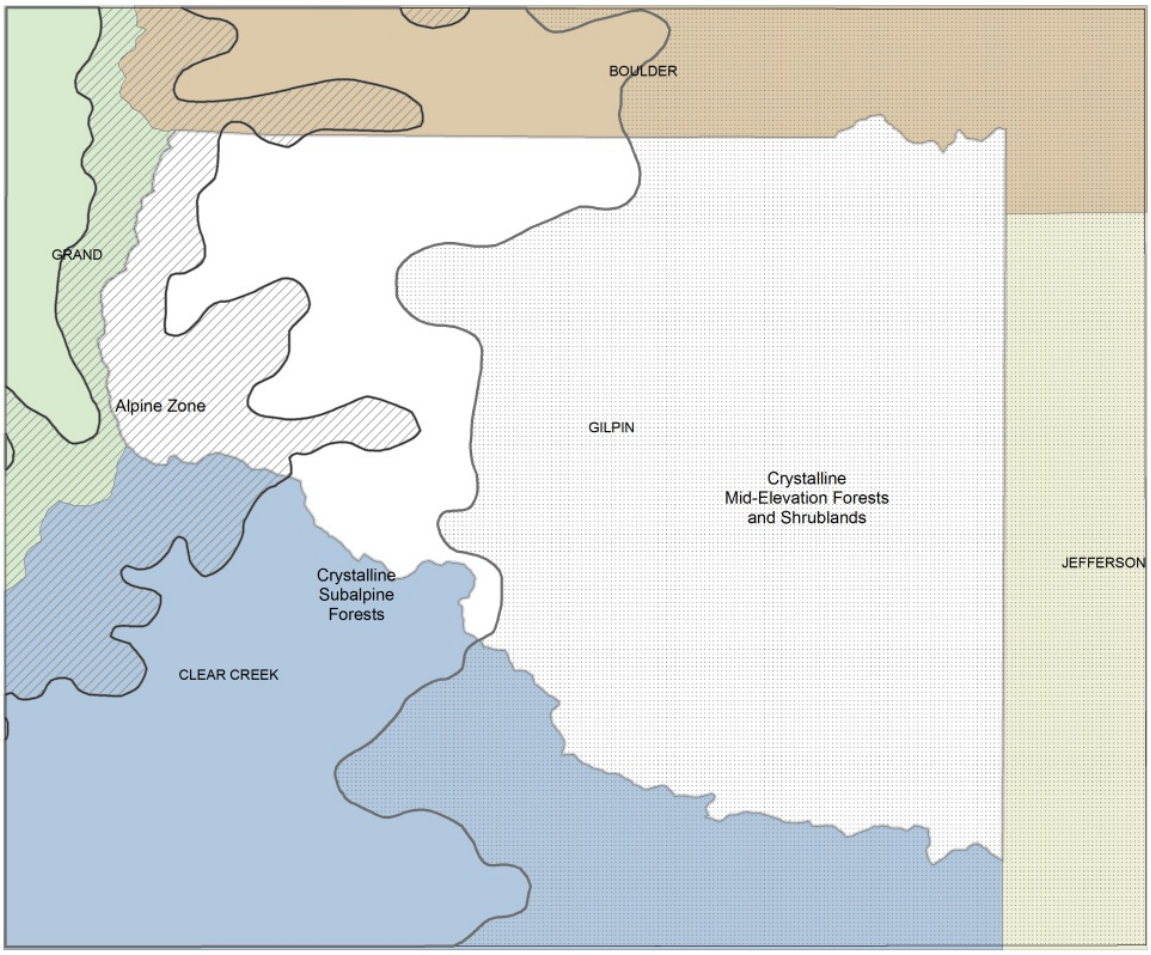


Figure 13. Level IV Ecoregion subsections (Chapman et al. 2006)

Ecological Systems

Ecological systems are assemblages of plant communities that tend to occur together and repeat on the landscape in areas with similar ecological processes, substrates, and/or environmental gradients (NatureServe 2011). Depending on the particular system, they tend to occur at scales of 10's to 1,000's of hectares and are persistent (50 years or longer).

Ecological processes that drive the composition and distribution of ecological systems include natural disturbances (e.g. fire, flooding, erosion, sedimentation, land movement, etc). Substrates include soil surface and bedrock features, such as soils types, parent materials, and soil moisture regimes. Finally, environmental gradients include climate, hydrology, topographic or physiographic patterns (e.g. coastal zones, montane, alpine, or subalpine zones) (NatureServe 2011).

Gilpin County's glacial history, range of elevations, and varied topography has resulted in a moderately wide range of ecological systems. The list of ecological systems that occur in Gilpin County is listed in Table 2. Figure 14 depicts the distribution of ecological systems in Gilpin County.

Table 2. Ecological Systems that occur in Gilpin County and area occupied

Ecological System Name	Area (ha)	Area (ac)
Agriculture	112	276
Barren Lands, Non-specific	11	27
Developed, Medium - High Intensity	70	174
Developed, Open Space - Low Intensity	3	6
Inter-Mountain Basins Active and Stabilized Dune	13	31
Inter-Mountain Basins Big Sagebrush Shrubland	8	19
Inter-Mountain Basins Montane Sagebrush Steppe	223	551
Inter-Mountain West Aspen-Mixed Conifer Forest and Woodland Complex	26	64
Invasive Perennial Grassland	161	399
North American Alpine Ice Field	4	9
Open Water	99	244
Recently Burned	1	3
Recently Logged Areas	74	183
Recently Mined or Quarried	4	10
Rocky Mountain Alpine Bedrock and Scree	700	1,730
Rocky Mountain Alpine Fell-Field	215	532
Rocky Mountain Alpine-Montane Wet Meadow	83	206
Rocky Mountain Aspen Forest and Woodland	1,415	3,495
Rocky Mountain Cliff and Canyon	89	221
Rocky Mountain Dry Tundra	674	1,666
Rocky Mountain Gambel Oak-Mixed Montane Shrubland	164	404
Rocky Mountain Lodgepole Pine Forest	15,068	37,233
Rocky Mountain Lower Montane-Foothill Shrubland	464	1,146
Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland	1,396	3,450
Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland	2,532	6,256
Rocky Mountain Ponderosa Pine Woodland	5,053	12,485
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	2,542	6,282
Rocky Mountain Subalpine Mesic Meadow	123	304
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	4,172	10,309
Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland	33	81
Rocky Mountain Subalpine-Montane Riparian Shrubland	1,378	3,404
Rocky Mountain Subalpine-Montane Riparian Woodland	449	1,108
Southern Rocky Mountain Montane-Subalpine Grassland	1,512	3,737
Southern Rocky Mountain Pinyon-Juniper Woodland	4	9
	38,872 ha	96,054 ac.
	389 sq.km.	150 sq.mi.

Ecological systems in Gilpin County are ordered along an elevational gradient and change in a predictable way with elevation but are also influenced by slope, aspect, available moisture, type of soil and soil moisture, fire, and other natural disturbance regimes, and disturbance related to human use. Boundaries between ecological systems are usually indistinct and species intermix in transitional areas called ecotones. Ecological systems in the county range from alpine tundra types at the highest elevations (typically above 11,000 to 11,500 feet), to subalpine forests from treeline down to about 9,000 feet, and montane forests at lower elevations from 9,000 down to the county's eastern border.

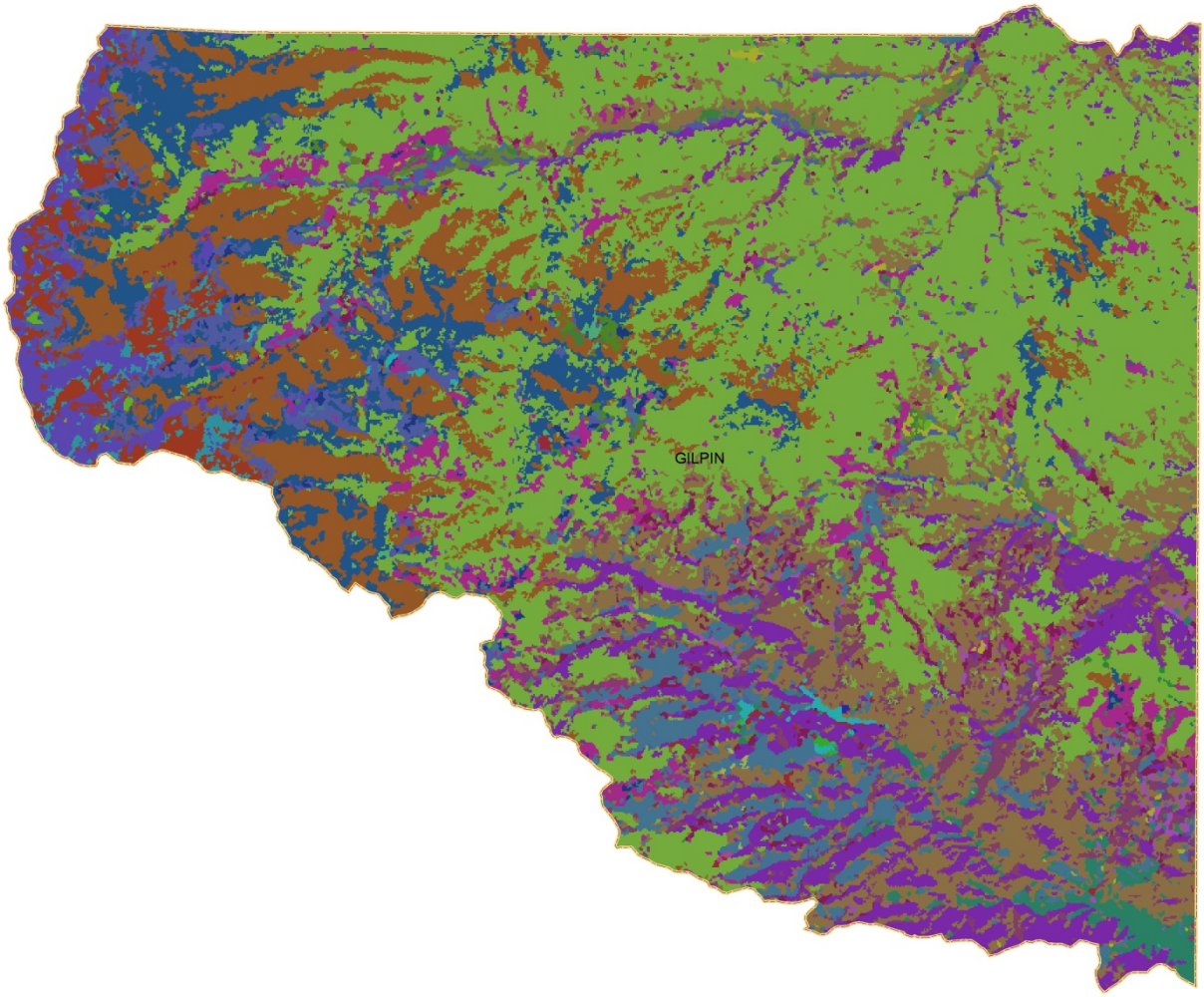


Figure 14. Distribution of ecological systems in Gilpin County

Upland Ecological Systems

At the highest elevations above tree limit, a mosaic of alpine tundra ecosystems characterizes the landscape. Plant communities here are diminutive, resilient and adapted to the short growing season, cold temperatures and desiccating winds. A complex mosaic of ecosystems occurs within a short distance of each other. Boulder and talus fields are dominated by a rich diversity of lichens and transition to fellfields where cushion plants dominate. On flatter sites

where soils have accumulated, sedges, grasses and forbs invade fellfields and replace cushion plants with a dense turf. Where late lying snow persists into the summer a variety of snowbed communities, including moist meadows, wet meadows, and shrublands develop according to soil moisture and length of the growing season. Wetlands occur where soils are saturated and are characterized by sedges, grasses, and willows.

Wind-flagged krummholz trees mark the transition from alpine to subalpine ecosystems. Treeline rises higher on sunny, south-facing slopes and the spruce and fir trees that characterize our subalpine forests rise to the edge of tree limit with small islands of dwarfed, wind-shaped spruce, fir, and quaking aspen trees. These so-called krummholz stands mark the upper limits of tree growth and grade downward into subalpine forests that are dominated by Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa).*

Spruce-fir ecosystems form the highest, most continuous and pristine forests in the region. They are characterized by dense, matrix forming forests that often extend for miles across valleys and slopes of all exposures (Mutel and Emerick 1992). Where topography is variable, especially at higher elevations or along stream corridors, the forest is interrupted by meadows, fens, ponds and willow carrs. Steep, moist gullies are often dominated by quaking aspen (*Populus tremuloides*) with an understory of willow (*Salix* spp.) or alder (*Alnus incana*).

Where logging, fire or other disruption has previously occurred at higher subalpine elevations, pioneering stands of limber pine (*Pinus flexilis*) are common; at lower elevations lodgepole (*Pinus contorta*) and quaking aspen are the most common pioneering species. Lodgepole is also common in the lower subalpine forest, and can extend up to treeline on south-facing slopes. Bristlecone pine (*Pinus edulis*) also occurs at the upper limit of the subalpine forest and up into the krummholz, thriving on rocky, windy outcrops in the full light of the alpine sun.

Below 9,500 feet, spruce-fir forests grade into a diverse mosaic of montane ecological systems. Montane systems include a mix of various types of conifer forests, shrublands, and grasslands. Lodgepole pine forests are common throughout the upper montane, but below 9,000 feet, lodgepole typically occupy moister, north-facing slopes (Mutel and Emerick 1992). Lodgepole pine forests are considered a “fire type” and often their occurrence marks sites of past disturbance. Although lodgepole pine forests may be climax ecosystems, they are typically successional to Douglas fir (*Pseudotsuga menziesii*) in the montane zone or, to Engelmann spruce and subalpine fir in the subalpine zone (Mutel and Emerick 1992). Moist, north-facing slopes in the montane zone support stands of Douglas fir, Engelmann spruce, and occasionally quaking aspen. South-facing slopes in the mid to low elevation montane zone consist primarily of ponderosa pine (*Pinus ponderosa*) forests and woodlands interspersed with mountain meadows, shrublands and grasslands.

Wetland Ecological Systems

Wetland ecological systems in Gilpin County include riverine, palustrine, and lacustrine systems. Dominant vegetation of each type varies and ranges from non-vascular, herbaceous, shrubby, and forested. Each wetland type is associated with plant and animal communities that are

adapted to the environmental conditions presented by that wetland. Although complex, the arrangement of wetland communities is not haphazard and they occur in predictable patterns determined by climate, topography, soils, and hydrologic regime (Melton et al 1987, Windell 1992).

Riverine

Riparian ecosystems occur as linear bands of moisture-loving vegetation along the margins of streams and rivers. Riparian vegetation relies on flooding beyond the confines of the channel to supply moisture and nutrients for vegetation establishment and growth. The distinction between upland and riparian ecosystems is typically sharp; riparian systems are cool, moist and verdant, upland systems are warmer, drier and sparser. Riparian systems are especially valuable to wildlife for refuge, diversity of habitat, water, or as a corridor for migration (Mitsch and Gosselink 2007). Mountain riparian ecological systems are found throughout Gilpin County from the alpine down into the montane. Due to the range of elevations in Gilpin County there is moderate diversity of riparian ecological systems in the county. Riparian ecological systems are categorized based on elevation and vegetation structure. Riparian systems in Gilpin County primarily include: Alpine/Subalpine Wet Meadow, Upper Montane/Subalpine Riparian Forest and Woodland, Upper Montane/Subalpine Riparian Shrubland, Montane Wet Meadow, and Lower Montane Riparian Woodland ecological systems (Rondeau 2001).

Included in the category of riparian wetlands are near-headwater wetlands. These are low gradient, non-alluvial riverine wetlands and are transitional between riparian and depressional landforms with surface flow strong enough to be recognized, but not strong enough to create distinct stream channels (Brinson 1993). In Gilpin County, these wetlands are present near headwaters in the alpine, subalpine, and montane zones.

In the alpine zone, vegetation along the margins of steeper streams tends to be characterized by forb-dominated wet meadow communities. Broad, glaciated valleys often have lower-gradient, sinuous streams winding through the landscape. These valleys tend to be dominated by a mosaic of shrublands and graminoid-dominated riparian wet meadows interspersed with patches of forbs. Commonly occurring shrub species include planeleaf willow (*Salix planifolia*), wolf willow (*Salix wolfii*), and barrenground willow (*Salix brachycarpa*). Herbaceous species include sedges (*Carex, Eleocharis,* and *Eriophorum* spp.), rushes (*Juncus spp.*), and grasses, but forbs can also be abundant. Wet meadow herbaceous ecological systems include both forb and graminoid dominated communities often occurring in a complex mosaic responding to soil moisture conditions. Commonly occurring forb species include marsh marigold (*Caltha leptosepala*), elephantella (*Pedicularis groenlandica*), and alpine lousewort (*Pedicularis scopulorum*). Graminoids include water sedge (*Carex aquatilis*), mountain sedge (*Carex scopulorum*), and bluejoint reedgrass (*Calamagrostis canadensis*).

Subalpine and Upper Montane zones are occupied by four riparian ecological systems: Alpine/Subalpine Wet Meadow, Montane Wet Meadow, Montane/Subalpine Riparian Shrubland, and Upper Montane/Subalpine Riparian Forest and Woodland. In this elevation zone steeper gradient stream channels and slopes are often occupied by a linear mosaic of riparian

forests and woodlands and herbaceous forb communities while broad shallow valleys and lower gradient streams are occupied by a mosaic of shrublands and wet graminoid and forb meadows. Riparian forests are dominated by Engelmann spruce and subalpine fir. Understories in these forests can be shrubby or herbaceous depending on soil characteristics and stream gradient. Shrubland communities are characterized by several willow and non-willow species. Commonly occurring willow species include planeleaf willow (*Salix planifolia*), Drummond's willow (*Salix drummondiana*), and mountain willow (*Salix monticola)*; non-willow shrub species include thinleaf alder (*Alnus incana*), bog birch (*Betula nana*), red-osier dogwood (*Cornus sericea*), twinberry honeysuckle (*Lonicera involucrata*) and shrubby cinquefoil (*Dasiphora floribunda*). Understories in these shrublands tend to be dominated by graminoid species but forbs can also be abundant. Wet herbaceous meadows in this riparian zone include both graminoid and forb dominated communities.

The montane zone is occupied by four riparian systems including primarily Lower Montane Riparian Woodland, Montane/Subalpine Riparian Shrubland, Montane Wet Meadow, and a limited occurrence in protected moist canyons of Upper Montane/Subalpine Riparian Forest and Woodland. Steeper stream channels are characterized by a mosaic of forested, shrubland and herbaceous systems. Narrow moist canyons are often characterized by a mix of quaking aspen with a variety of conifer species including Douglas fir and blue spruce (*Picea pungens*). Understories are comprised of both willow and non-willow shrub species, especially Drummond's willow, mountain willow and thinleaf alder. Dry, steep canyons are characterized by stands of conifers including Douglas fir, blue spruce, and ponderosa pine. The shrub understory is comprised of a diverse mix of willow and non-willow species including coyote willow (*Salix exigua*), strapleaf willow (*Salix ligulifolia*), mountain willow, river birch (*Betula occidentalis*), mountain maple (*Acer glabrum*), thinleaf alder, and red-osier dogwood. Here the herbaceous layer is typically a somewhat sparse mix of forbs and graminoids. Broader, low-gradient valleys and swales tend to be occupied by a mosaic of shrublands and herbaceous meadows often with a margin of forested cover at the riparian-upland ecotone. Commonly occurring willow species include Bebb willow (*Salix bebbiana*), mountain willow, and Drummond's willow. Meadows are often dominated by graminoids, but an abundant and diverse mix of forb species frequently occur with the graminoids, either intermixed within the graminoid layer or in a patchy mosaic.

<u>Palustrine and lacustrine wetlands</u>

These are wetlands that occur on the margin of open bodies of water, in depressions, on slopes, and other areas away from flowing waters. They include marshes, wet meadows, forested and shrub wetlands, and fens (Mitsch and Gosselink 2007). They rely on water from sources other than streams or rivers, primarily groundwater, shallow overland flow, and precipitation, or if on the fringe of a lake or pond, high water tables which saturate the soil. They occupy sites where topography, geology, soils, and hydrology interact to create the conditions that enable the development of moisture-loving (hydrophytic) wetland vegetation. Occasionally these conditions are created by human or animal activity as in the case of a man-made or beaver-made dam that backs up water to result in saturated soils.

Marshes are inundated wetlands characterized by emergent herbaceous vegetation and saturated, mineral soils; wet meadows are shallow marshes with waterlogged mineral soil or rarely, shallow standing water (Mitsch and Gosselink 2007). Marsh and wet meadow ecological systems include: Alpine/Subalpine Wet Meadow and Montane Wet Meadow systems. Marshes and wet meadows occur in shallow depressions and swales, on level terrain, and on the margins of shallow lakes and ponds. Vegetation tends to be dominated by graminoids including sedges, rushes, and grasses. Forbs can also be abundant and typically occur as a patchy mosaic intermixed with graminoids.

Forested wetlands are dominated by woody vegetation greater than six meters tall; shrub wetlands are dominated by woody vegetation less than six meters tall. These wetlands occur on low to moderate gradient slopes where there are breaks in slopes, as well as on flat terrain, on the margins of natural and man-made reservoirs, lakes, ponds, and beaver ponds. Forested wetland ecological systems include the Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland ecological system and occur in the subalpine and montane zones. Tree species in this system include Engelmann spruce, subalpine fir and blue spruce. Understories in this system can be dominated by shrubs, herbs, or mosses. Commonly occurring shrubs include planeleaf willow and bog birch. Shrub-scrub wetland ecological systems include the Montane/Subalpine Riparian Shrubland ecological system and occur in the alpine, subalpine, and montane zones. Typical shrub species include planeleaf willow, wolf willow, barrenground willow, mountain willow, and bog birch; the herbaceous layer can be dominated by graminoids or forbs.

Fens are peat-accumulating wetlands that receive their water from surrounding mineral soil (Mitsch and Gosselink 2007) and may be characterized by a variety of vegetation communities including mosses, herbaceous, shrub and forested types (Chimner and Cooper 2003, Cooper 1990, Cooper 2009, USFWS 2009). Fen ecological systems in Gilpin County include Rocky Mountain Subalpine-Montane Fen Ecological System.

Climate, hydrology, and geomorphology interact to influence fen distribution, characteristics, and hydrology. Fens usually form where groundwater intercepts the soil surface, often at low points within the landscape or on slopes at higher elevation (Rondeau 2001). In Colorado, fens form in basins, on slopes, or on spring mounds, wherever constant high water levels and low temperatures create anaerobic conditions that sufficiently slow decomposition of dead plant material, leading to the accumulation of organic soil. In Colorado, these environmental conditions restrict fen development to alpine, subalpine, and upper montane regions, between 8,000 and 12,000 feet in elevation (Cooper 1990).

In the Southern Rocky Mountains, a wetland is considered a fen if organic matter accumulation is at least 40 cm and soil composition is 12% (if 0% clay) to >18% (if >60% clay) organic carbon (Cooper 2009). Vegetation is often dominated by graminoids especially clonal sedges (*Carex* spp.), spikerushes (*Eleocharis* spp.), and bulrushes (*Scirpus* spp.) (Rocchio 2005, Cooper 2009). However, mosses are also common and are both a floristic and a functional component to fens and forbs can also occupy fens with abundant cover that includes species such as elephant head lousewort and marsh marigold. Shrub and forest cover can also dominate fen vegetation.

Dominant tree species in forested fen communities include Engelmann spruce and subalpine fir. Typical shrub species including planeleaf willow, wolf willow and bog birch.

Fen ecosystems are naturally rare in Colorado. In mountain regions, steep slopes rocky substrates and rapid drainage limit the formation of peatlands (Austin 2008). Additionally, peat accumulation in the arid west occurs very slowly – estimates range from 4.3 to 16.2 inches per thousand years – making many Colorado fens are over 10,000 years old (USFWS 2009). Because fens take thousands of years to form their loss is essentially irreplaceable and they cannot be considered a renewable resource (USFWS 2009).

In Colorado, fens only occupy an estimated 0.1 to 0.3% of the total land area (Austin 2008). Although fens occupy only a small percentage of the landscape, these ecosystems provide important wetland functions including headwater quality functions, carbon and water storage, wildlife habitat, and biodiversity (Austin 2008) and upstream wetlands release water throughout the growing season making an important contribution to streamflow during later-summer and or drought periods (Rocchio 2005). Additional values that are independent of wetland function include recreation such as wildlife watching, and uniqueness/heritage values. In Colorado, fens, and wetlands in general, support state rare wetland plants such as round-leaf sundew (*Drosera rotundifolia*), unique plant communities including bog birch/water sedge shrublands (*Betula nana/Carex aquatilis*) and unusual animals such dragonfly species (*Leucorrhinea hudsonica* and *Somatochlora semicircularis*) (Rocchio 2005, Carsey et al. 2003, Colorado Natural Heritage Program 2008).

Fauna

Animals do not occur randomly in nature– each species has specific requirements for food, shelter, nesting and breeding sites and will occupy those ecosystems that best supply these essential resources (Mutel and Emerick 1992). While some animals can use a wide variety of resources others are specialists and occupy only specific ecosystems. Thus landscapes with a wide variety of ecosystems will support a greater diversity of animal populations. Although animal species respond to differences in elevation they rarely fit into elevation zones and often occupy a broad range of elevations. Rather, animal populations are distributed corresponding to preferred food, cover, denning, and nest sites and, in many cases, specific ecosystem types (Mutel and Emerick 1992). Bird species in the Southern Rockies, have adapted to the complex forest mosaic and thus few species are confined to a single habitat type and many species use several habitat types (Partners in Flight 2010). In Gilpin County, a diversity of habitat types supports a wide range of animal species. The following species are present or likely occur in Gilpin County.

Habitat specialists such as mink (*Mustela vison*), beaver and the American Dipper are found in a wide range of elevations but only in aquatic ecosystems. Conversely, some animal species may occupy a broad range of elevations and ecosystems. Carnivore mammal species in this category include coyote (*Canis latrans*), red fox (*Vulpes vulpes*), bobcat (*Lynx rufus*) and mountain lion. Several species in the weasel family including long-tailed (*Mustela frenata*) and short-tailed weasel (*Mustela erminea*) thrive at a variety of elevations; however short-tailed weasels tend to

be found in most areas while long-tailed weasel distribution corresponds with prey availability (Fitzgerald et al. 1994) and among small mammals, the deer mouse (*Peromyscus maniculatus*) occupies most habitats and most elevations. Both ungulates and carnivores can be elevational migrants, traveling to low elevations in winter and up into the alpine zone during summer, using a variety of ecosystems in several elevational zones along the way. Ungulate elevational migrants include mule deer, elk and big horn sheep. Some predator species, including coyote and mountain lion, are also elevational migrants, following their ungulate prey on their seasonal migration. Other animal species are more restricted to specific elevations and ecosystems by their natural history. These specialist species can be routinely found in those ecosystems.

Forest Species

Ponderosa pine forests occupy sunny, dry slopes in the montane zone of Gilpin County. Douglas fir forests are often intermixed with ponderosa pine forests and fauna is often similar and correlated with montane forests in general (Mutel and Emerick 1992). Here, animal diversity varies annually with food supply and with vegetation condition. Animal diversity is increased by the patchy nature of ponderosa forests, which are characterized by a mosaic of shrubs, herbaceous meadows, tree stands and rocky outcrops. Mule deer use shrubby areas in the winter. Rocky outcrops support a diversity of small mammal species including bushy-tailed woodrat (*Neotoma cinerea*). Abert's squirrel (*Sciurus aberti*) is strictly associated with the ponderosa pine ecosystem and uses ponderosa almost exclusively for food, nesting and cover (Mutel and Emerick 1992). Pine squirrel (*Tamiasciurus hudsonicus*) occurs in ponderosa forests but more commonly occupies Douglas fir forests. Porcupines (*Erethizon dorsatum*) are abundant here throughout the year but are also found in riparian cottonwood willow forests, aspen groves and shrublands (Fitzgerald et al. 1994). The breeding bird community is diverse and includes Virginia's Warbler (*Vermivora virginiae*),Western Tanager (*Piranga ludoviciana*), Plumbeous Vireo (*Vireo plumbeus*), Yellow-rumped warbler (*Dendroica coronata*), Black-headed Grosbeak (*Pheucticus melanocephalus*), Townsend's Solitaire (*Myadestes townsendi*), Mountain Bluebird (*Sialia currucoides*), Western Bluebird (*Sialia mexicana*), Pygmy Nuthatch (*Sitta pygmaea*), Red-breasted Nuthatch (*Sitta canadensis*), Vesper Sparrow (*Pooecetes gramineus*), and Dark-eyed Junco (*Junco hyemalis*).

Lodgepole pine forests provide habitat for pine marten (*Martes americana*) and their prey pine squirrels who cache the pine cones in large middens. Other small mammals also common here include least chipmunk (*Tamias minimus*), Nuttall's cottontail (*Sylvilagus nuttallii*), and southern red-backed vole (*Clethrionomys gapperi*). Mule deer forage in forest openings and coyote, lynx and bobcat visit here occasionally in search of prey. Bird species that commonly occupy lodgepole forests include Sharp-shinned Hawk (*Accipiter striatus*), Steller's Jay (*Cyanocitta stelleri*), Gray Jay (*Perisoreus canadensis*), Ruby-crowned Kinglet (*Regulus calendula*), Dark-eyed Junco, Red-breasted nuthatch, Mountain Chickadee (*Poecile gambeli*), and Yellow-rumped Warbler.

Aspen forests have a varied and abundant animal life, sharing many species with mountain riparian ecosystems (Mutel and Emerick 1992). Aspen forests provide abundant and diverse

cover, forage and breeding resources resulting in a diversity of wildlife – this ecosystem provides resources for over 50 species of mammals and habitat for deciduous obligate bird species such as Warbling Vireos and cavity nesting species such as Williamson's and Red-naped Sapsuckers, small owls, chickadees, and nuthatches (Windell 1992, Fitzgerald et al. 1994). Common small mammals include montane shrew (*Sorex monticolus*) and long-tailed vole (*Microtus longicaudus*). Meso-predators such as long-tailed weasel are common and coyote and red fox occasionally search here for small mammal prey. Black bear commonly visit aspen forests where they feed on aspen buds and grasses and forbs. Elk often browse aspen heavily during the winter often negatively affecting vigor and regeneration. Mule deer occupy aspen forests during spring, summer and fall (Fitzgerald et al. 1994). Aspen forests support the most bird species and the most individual birds of any of the forest types in the Southern Rocky Mountains et al . Aspen bird communities include species such as Hairy Woodpecker (*Picoides villosus*),Downy Woodpecker (*Picoides pubescens*), Williamson's Sapsucker (*Sphyrapicus thyroideus*),Red-naped Sapsucker (*Sphyrapicus nuchalis*), Broad-tailed Hummingbird (*Selasphorus platycercus*), Western Wood-pewee (*Contopus sordidulus*), Cordilleran Flycatcher (*Empidonax occidentalis*), Yellow-rumped Warbler, Cooper's Hawk (*Accipiter cooperii*), House Wren (*Troglodytes aedon*), Tree Swallow (*Tachycineta bicolor*), Dark-eyed Junco, White-breasted Nuthatch (*Sitta carolinensis*), and American Robin (*Turdus migratorius*).

Limber pine forests have pioneered hilltop areas in Gilpin County that were historically clear-cut. Although fauna in limber forests is somewhat depauperate, for those small mammals and birds that can make use of the large limber pine seeds, there is a rich food resource. Clark's Nutcrackers are especially abundant here and have an intimately evolved relationship with limber as well as the other five-needle pines. Nutcrackers have evolved specialized anatomy and behaviors for extracting, transporting, and caching the seeds and limber pine germination depends on their seed caching. In turn, Nutcrackers have an almost exclusive food resource. A few small mammals forage on limber pine seeds and are also common including deer mice (*Peromyscus maniculatus*), chipmunks, and pine squirrels. Other bird species that occasionally occur here include Yellow-rumped Warbler, Dark-eyed Junco, and Mountain Chickadee (*Poecile gambeli*).

Engelmann spruce-subalpine fir forests support fewer animal species than lower elevation forests due to long winters and a short growing season which limits the variety of available forage (Mutel and Emerick 1992). Mammals that are adapted to the environmental conditions here include pine marten and pine squirrel. Other important marten prey species common in these forests include snowshoe hare, southern red-backed montane voles (*Microtus montanus*), masked (*Sorex cinereus*) and montane shrews (*Sorex monticolus*), and insects. Canada lynx also inhabit these forests, denning under large trees and deadfall and hunting their preferred prey, snowshoe hare, in forest openings and in riparian zones. Typical bird inhabitants include Brown Creeper (*Certhia americana*), Gray Jay (*Perisoreus canadensis*), Pine Siskin (*Spinus pinus*), Townsend's Solitaire, Ruby-crowned Kinglet, Golden-crowned Kinglet (*Regulus satrapa*), Red-breasted Nuthatch, Mountain Chickadee, Pine Grosbeak (*Pinicola enucleator*), and in areas that have been attacked by spruce beetles, Downy, Hairy and Three-toed Woodpeckers (*Picoides tridactylus*). Northern Goshawks (*Accipiter gentilis*) hunt here by

day for small birds and mammals and Boreal Owls (*Aegolius funereus*) hunt by night near streams and wetlands for small mammals (Kingery 1998).

Alpine tundra and the krummholz transition zone just below provide summer grazing for large ungulates such as elk, mule deer and big horn sheep. Predators, including mountain lion, coyote, red fox and weasels frequently follow their prey to the tundra. Although many mammals visit the tundra during the summer, few remain year round. American pika (*Ochotona princeps*), a relative of rabbits and hares, live primarily in the alpine; inhabiting talus slopes and foraging in adjacent turf meadows. Pika are active year-round but when winter comes, activity decreases and pika spend a good deal of time in their dens (Fitzgerald et al. 1994). Yellow-bellied marmots survive here by hibernating through the winter. Only a few bird species breed here but some breed here exclusively including White-tailed Ptarmigan (*Aegolius funereus*), Brown-capped Rosy Finch (*Leucosticte australis*), and American Pipit (*Anthus spinoletta*). White-crowned sparrow (*Zonotrichia leucophrys oriantha*) and Horned Larks (*Eremophila alpestris*) nest here but they also nest in similar habitats at lower elevations. Only one bird species remains year-round, the White-tailed Ptarmigan.

Wetland Species

Wetland ecosystems, especially riparian wetlands, provide a diversity of resources and essential habitat to a wide diversity of animal species. For instance although riparian habitat occupies only about 5% of the land area in Colorado these habitats support between 75 and 80 percent of wildlife species (Windell 1992). Beaver and western riparian and stream ecosystems have evolved together and are essential to the sustainability of each other. Beaver build dams that create ponds that perform important ecosystems functions such as sediment trapping, water storage, and providing habitat for other mammal species, songbirds, wading birds and waterfowl, fish rearing, reptiles and amphibians, and insects such as dragonflies, caddisflies, stoneflies, and mayflies. Beaver cache willow branches that eventually grow into dense willow shrublands. Moose (*Alces alces*), an introduced species that occurs in Gilpin county, commonly forage on willow in riparian habitat and wetland habitat and benefit greatly from beaver activity. Other mammals that rely on wetland habitats include water shrew (*Sorex palustris*), snowshoe hare (*Lepus americanus*) – especially willow thickets, western jumping mouse (*Zapus princeps*), montane vole, and meadow vole (*Microtus pennsylvanicus*), muskrat (*Ondatra zibethicus*) and mink (Fitzgerald et al. 1994). Bird species in the county that rely on riparian and wetland habitats include Osprey (*Pandion haliaetus*), Northern Harrier (*Circus cyaneus*), Great Blue Heron (*Ardea herodias*), Spotted Sandpiper (*Actitis macularius*), Common Snipe (*Gallinago gallinago*), Belted Kingfisher (*Megaceryle alcyon*), Red-naped Sapsucker, Olive-sided Flycatcher (*Contopus cooperi*), Cordilleran Flycatcher, Willow Flycatcher (*Empidonax traillii*), Tree Swallow, Violet-green Swallow (*Tachycineta thalassina*), Cedar Waxwing (*Bombycilla cedrorum*), Warbling Vireo (*Vireo gilvus*), American Dipper (*Cinclus mexicanus*), Swainson's Thrush (*Catharus ustulatus*), MacGillivray's Warbler (*Oporornis tolmiei*), Wilson's Warbler (*Wilsonia pusilla*), Yellow Warbler (*Dendroica petechia*), Common Yellowthroat (*Geothlypis trichas*), Lincoln's sparrow (*Melospiza lincolnii*), Song Sparrow (*Melospiza melodia*), and Fox Sparrow (*Passerella iliaca*). Amphibians and reptiles affiliated with wetland habitats include boreal toad

(*Bufo boreas boreas*), western chorus frog (*Pseudacris triseriata),* northern leopard frog (*Rana pipiens*), tiger salamander (*Ambystoma tigrinum*), smooth green snake (*Opheodrys vernalis*) and western terrestrial garter snake (*Thamnophis elegans vagrans*) (COGAP 2010).

Several species of bat occur in Gilpin County, occupying a variety of ecosystems. Each of these species, except for the big brown bat (*Eptesicus fuscus*), commonly forage over water and are thus affiliated with wetland or aquatic systems. Big brown bats occur in almost every habitat in Colorado; little brown myotis (*Myotis lucifugus*) is widely distributed in many habitats; long-eared myotis (*Myotis evotis evotis*) occurs in conifer forests at moderately elevations; long-legged myotis (*Myotis volans*) is common in ponderosa forests; and Townsend's big eared bat (*Plecotus townsendii*) occupy drier habitats but tend to forage over water for one of their diet staples, caddisflies (COGAP 2010, Fitzgerald et al. 1994)).

Rare Species

Several state rare and special status plant and animal species occur in Gilpin County. Upland species in this special status category include several plant, mammal, and bird species. Mammals include the American pika, pine marten, and wolverine (*Gulo gulo*). In the spring of 2009 a wolverine was documented to occur in north central Colorado which is the first confirmed occurrence in the state in 90 years (CDOW 2010).

Birds include Northern Goshawk, Northern Harrier (*Circus cyaneus*), Boreal Owl, Williamson's Sapsucker, Three-toed Woodpecker, Virginia's Warbler, and Brewer's Sparrow. Plants include reflected moonwort (*Botrychium echo*), western moonwort (*B. hesperium*), Mingan's moonwort (*B. minganense*), alpine aster (*Aster alpinus var. vierhapperi*), Clustered lady's-slipper (*Cypripedium fasciculatum*), Clawless draba (*Draba exunguiculata*), and Gray's peak whitlow-grass (*Draba grayana*),

Rare or special status species affiliated with wetlands and riparian areas include several species of mammals, birds, amphibians, fish, mollusks, and plants. Mammals include Townsend's big-eared bat and Canada lynx (*Lynx canadensis*). Townsend's big-eared bats are restricted to deciduous woodlands near suitable caves and rocky outcrops. Distribution is associated with availability of roosts such as caves, abandoned mines and crevice on rock cliffs. Much of the foraging occurs over water where a stable of their diet are the aquatic insect, caddisflies (Fitzgerald et al. 1994). Canada lynx preferred habitat is dense spruce-fir stands in association with rock outcrops and large boulders. Their principal food is snowshoe hare which composes about 80 percent of their diet. Lynx require about four hares per week to stay in good condition. Snowshoe hare are most abundant in willow thickets where they forage on the foliage and twigs of willows as well as on forbs and grasses (Fitzgerald et al. 1994). Canada lynx were reintroduced to Colorado in 1999.

Special status bird species include White-Tailed Ptarmigan, Olive-sided Flycatcher, and Willow Flycatcher. "Species of Concern" include MacGillivray's Warbler, Wilson's Warbler, Cordilleran Flycatcher, and American Dipper. White-tailed Ptarmigan are an alpine species that rely on

willow habitat for winter forage. Willow flycatcher breed primarily in willow carrs. Which is a riparian habitat type. Olive-sided Flycatchers typically breed in old-growth coniferous forest with nearby water.

Rare fish species include greenback cutthroat trout (*Oncorhynchus clarkii stomias*). Greenback cutthroat trout are present in adjacent Boulder and Clear Creek Counties (USFWS 2010). Greenback cutthroat trout are present in only 5% of their historic range. Declines of the cutthroat trout are due to stocking of non-native species fish species, habitat loss and degradation due to logging, livestock over-grazing, water diversions and municipal and industrial pollution (CDOW 2010).

Rare or special status amphibians include boreal toad and northern leopard frog. Boreal toads are restricted to subalpine and alpine areas with suitable breeding habitat which includes lakes, marshes, ponds and bogs with sunny exposures and quiet, shallow water. Habitat alterations from timber harvest, grazing, recreation and water development do not benefit boreal toad populations. Resource management activities that negatively affect the quality or quantity of alpine wetlands potentially have detrimental effects on boreal toads. Marshes, wet meadows, and intermittent wetlands form much of the primary habitat for this species and may be affected by increased evaporation, altered seepage flow from reduced snowpack on exposed cut areas or road bed alteration, physical destruction of wetland vegetation, and deterioration of water quality due to runoff from roads and highways. However, the primary causative agent resulting in the die-offs of amphibians including the boreal toad is the pathogen, chytrid fungus (*Batrachochytrium dendrobatidis*) (CDOW 2010). Northern leopard frog habitat is found in springs, slow streams, marshes, bogs, ponds, canals, flood plains, reservoirs, and lakes with rooted vegetation. In summer they commonly inhabit wet meadows and fields.

Mollusks include umbilicate sprite (*Promenetus umbilicatellus*) which is a freshwater snail that is classified as vulnerable in Colorado (NatureServe 2009).

Plants include mountain bladderfern (*Cystopteris montana*), broadleaf twayblade (*Listera convallarioides*), and pale blue-eye-grass (*Sisyrinchium pallidum*). Mountain bladder-fern is critically imperiled in Colorado. This fern grows in moist or wet woods and along mossy streambanks in the mountains (Williams 1990). Broadleaf twayblade is imperiled in Colorado. This orchid occupies moist sites along streams and lakeshores. Pale blue-eye-grass is a regional endemic of southeastern Wyoming and Central Colorado that is classified as vulnerable based on its limited global distribution and the fragility of the wetland habitats in which it occurs (Moore and Friedley 2004).

Land Ownership

Approximately 56% of the land within Gilpin County's 96,000 acres is publicly owned (Figure 15). The State of Colorado owns approximately 12,000 acres, some of which is in Gilpin County and is managed as Golden Gate Canyon State Park. The Bureau of Land Management (BLM) manages approximately 1,600 acres and the U.S. Forest Service manages 40,580 acres of the public lands, which are in the Arapahoe-Roosevelt National Forest. Included in USFS lands is the

James Peak Wilderness Area which totals approximately 14,000 acres and is located in both Gilpin and Boulder Counties.

Privately-owned lands together with the municipalities of Central City and Black Hawk comprise 48% of the total land area in the county. Mining claims comprise a great deal of the private acreage throughout the county and much of the riparian habitat is in private ownership.

Land Use History

Native Americans were likely the first humans to use the land in what is now Gilpin County. Ancient hunting trails, camps, and game-drive walls are still in evidence above timberline in the Front Range and many of these ancient trails are still used by recreationists. In the alpine zone of the Front Range, prehistoric hunters built stone fences and blinds to gather and ambush elk and bighorn sheep. More than 50 stone game-drive systems, ranging in age from Paleo-Indian to late Prehistoric, have been found above timberline in the Front Range in locations including the Rollins Pass area (Benedict 2005). Hunting camps, butchering sites, vision-quest localities, and sandstone grinding slabs have also been found near timberline. Archaeological artifacts such as Clovis projectile points, sandstone grinding slabs and knives and scrapers made of chert have been found both in the mountains and on the plains and suggest the seasonal migration of hunters (Gellhorn 2002). Evidence points to a circular migration of 150 to 250 miles with summers spent in mountain parks, late summer and autumn hunting in the tundra, and late autumn and winter spent in lower elevation foothills (Benedict 1992). The introduction of horses brought more efficient hunting methods which replaced game drive hunting strategies about 250 years bp (Gellhorn 2002).

The discovery of native gold in 1858, in placer deposits in gravels and river terraces, along both forks of Clear Creek brought the gold rush to Gilpin County. Exploration upstream led to discovery of the lode from which the placer gold had come – the Gregory Lode above Black Hawk was one of the first of these rich, oxidized quartz veins to be found in the Central City,

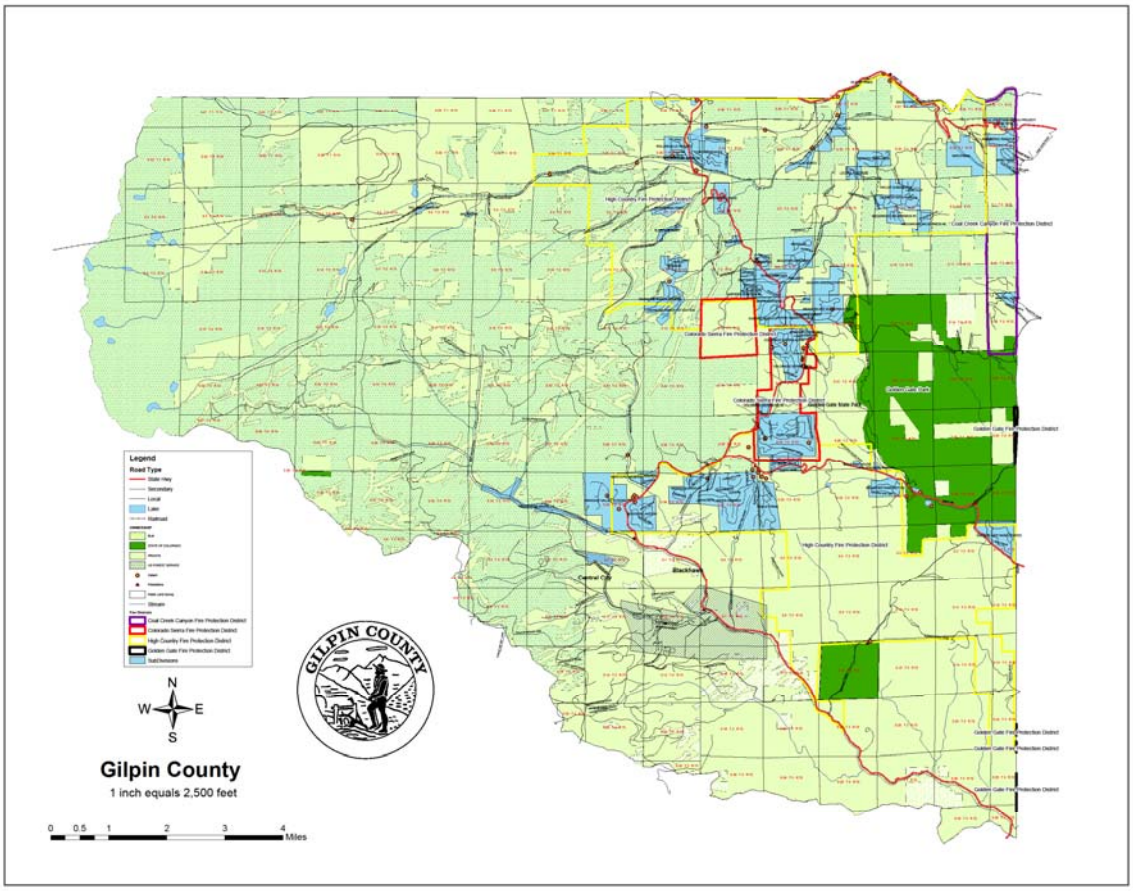


Figure 15. Land ownership in Gilpin County (Gilpin County 2011)

Black Hawk, and Idaho Springs region. These veins trend northeast to southwest and extend through the mountains in a zone about six miles long and three miles wide. Principal ore minerals found in these veins are native gold, pyrite, sphalerite, galena, chalcopyrite, and tennanite (Chronic and Chronic 1972).

Gilpin County was established in 1861 as one of Colorado's original seventeen counties. The county was named in honor of William Gilpin, the first governor of the Territory of Colorado and was the principal metal mining region in Colorado until the late 1880's (Chronic and Chronic 1972). By the mid-1860's the "easy gold" was mined out and the area was in decline. But, in 1868, new technology came with Colorado's first successful ore smelter, which was built in Black Hawk. The new technology enabled the recovery of gold from deeper sulfide ores. Other smelters were built along North Clear Creek and the Colorado Central Railroad extended its line into the area by 1872. By 1900, Central City's population had grown to over 3,000. However, the gold veins eventually became exhausted and by 1920, significant mining activity in the area was over. By 1950, the population of the Black Hawk – Central City area was less than a few hundred.

During the heyday of mining the Central City and Black Hawk area billed itself as the “richest square mile on earth”. In total, the area produced approximately $200 million worth of gold silver, lead, zinc, and copper (Chronic and Chronic 1972). Although mining brought economic benefit to Colorado it also changed the landscape and left a legacy of altered ecosystems.

Railroads brought more reliable transportation and were essential to the growth of the mining industry. However, in mountainous country railroads were often built along stream courses, such as along South Boulder Creek, where the railroad grade severely channelized stream habitat and altered riparian habitat. Numerous railroads served the mining industry in Gilpin County. The Gilpin Tramway Company was a two-foot gauge railroad around Black Hawk and Central City, built to transport ore from the mines above Black Hawk to the mills, but also carried tourists on excursions throughout Gilpin County during the summer months (Figure 16).

The Northwestern and Pacific railroad, otherwise known as the Moffat Road, is the highest standard gauge railroad in America. From 1905 to 1928 the train climbed over the Continental Divide at 11,600’ at the Needles Eye on Rollins Pass. The railroad was closed in 1928 when the Moffat railroad and water tunnel was bored under the pass, between East Portal and Winter Park, eliminating the need for trains to go over Rollins Pass (Figure 17) (Gellhorn 2002). Logging, livestock grazing, and agricultural development accompanied the gold rush. Hilltops and slopes were clear-cut and the downed trees used to support the infrastructure and development that accompanied mining. Valley bottoms, especially riparian habitat and wetlands, were cleared, drained, and developed for agriculture. Grazing was ubiquitous and occurred everywhere vegetation supported domestic livestock. Today very little mining or milling occurs in Gilpin County. The new gold rush is for casino gaming, which is limited to the cities of Black Hawk and Central City. The predominant land use has shifted to a tourism, gaming, recreation, and rural and residential based economy.

Outdoor recreation contributes to the quality of life in Colorado and public outdoor recreational lands are a major feature of Gilpin County. Golden Gate Canyon State Park is located on the eastern side of the county and is located in both Gilpin and Boulder Counties. The Park was established in 1960 and currently is comprised of almost 12,000 acres ranging in elevation from 7,600 feet to 10,400 feet. The remainder of public land in the county is managed by the Arapahoe-Roosevelt National Forest which encompasses 40,580 acres.

The 14,000-acre James Peak Wilderness is located within the Arapaho and Roosevelt National Forests and occurs in spans Gilpin, Boulder, and Clear Creek Counties. The wilderness is adjacent to the Continental Divide on the eastern slope and includes several peaks over 13,000' and dozens of glacially sculpted, alpine lakes (USDA 2009). Elevations range from 9,200 to 13,294 feet with ecosystems that transition from upper montane to subalpine and alpine at the highest elevations adjacent to the Continental Divide. Twenty miles of recreational hiking trail enable access to dozens of lakes and the high peaks along the Divide.

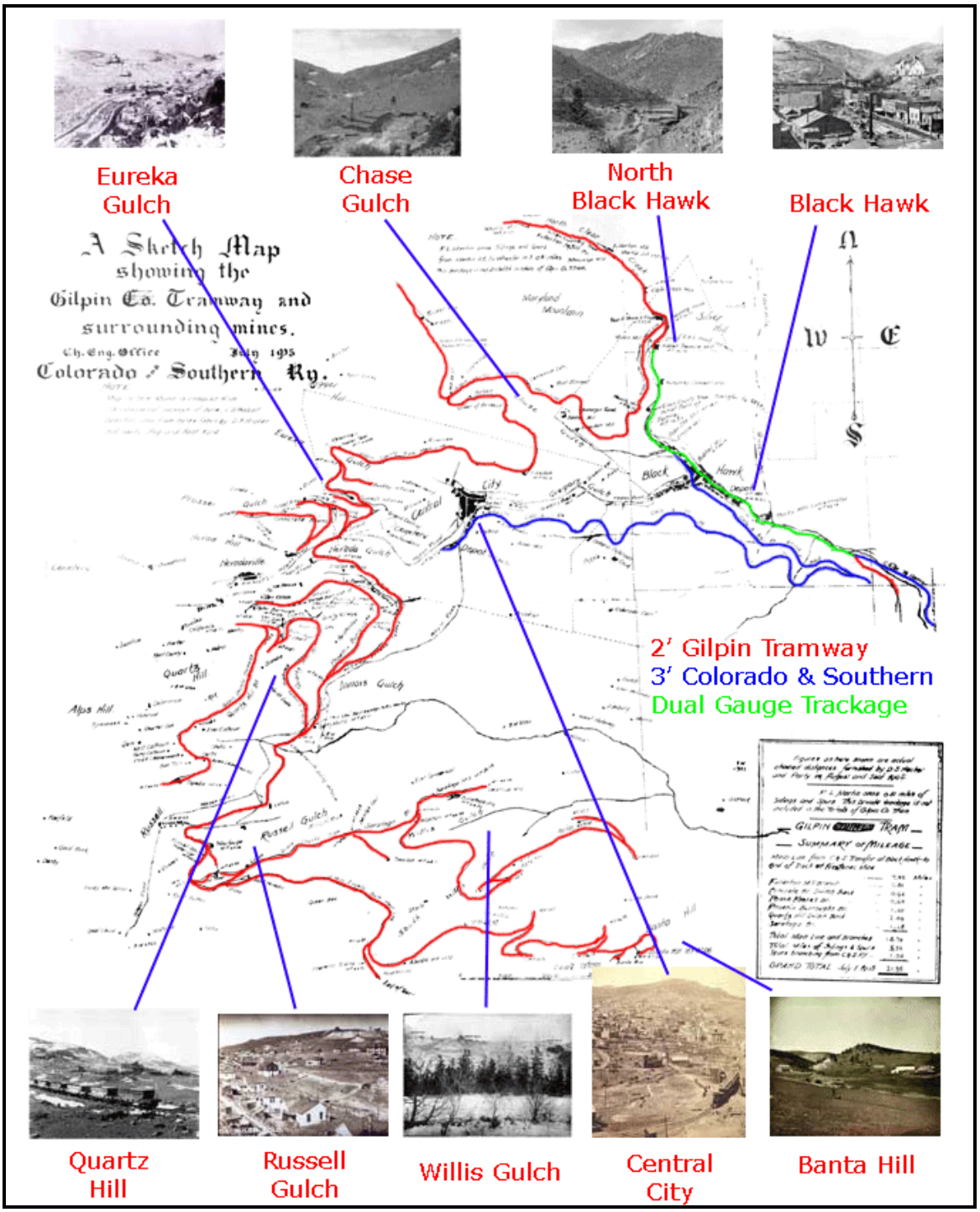


Figure 16. Historical map of Central Gilpin County including Black Hawk and Central City showing the Gilpin Tram and Colorado and Southern trackage (Baldwin 2010)

Figure 17. Moffat railroad tunnel, 2009

Population

Population of Gilpin County in 2007 was 5,091 residents with a population density of 34.25 persons per square mile. Compared to nearby Front Range cities density is fairly low; Boulder County had 398.18 persons per square mile and Denver County had 3,824.24 persons per square mile and overall population density in Colorado is 47.26 persons per square mile (Colorado DOLA 2010).

However, Gilpin County is on the crest of a growth wave. Gilpin County is 37 miles from Denver. Proximity to high density, Front Range cities contributes to its appeal as a mountain getaway. The county's mountain environment is attractive for second home owners, for a weekend get-away for urban Front Range dwellers, and as a popular destination resort for rafting, fishing, wildlife viewing, and gaming. However, Gilpin County's location also results in population impacts from densely populated Front Range cities affecting the rural landscape of Gilpin County. Population in Gilpin County is expected to grow at an average annual growth rate of 1.50% to reach 7,458 people by 2030 (Table 3). Gilpin County is located in the South Platte River basin which is the most populous in the State (CWCB 2010).

Population impacts from adjacent high population density municipalities can be expected to spill over into Gilpin County. For instance, Gilpin County has numerous recreational sites such as Golden Gate Canyon and the James Peak Wilderness area which attract nearby Front Range residents. Recreation use is influenced by population and demographic trends, which vary greatly from county to county. High density Front Range populations result in high levels of recreational use and in less public land available per person.

Table 3. Summary of Population Projections (Colorado DOLA 2010)

	2000	2010	2020	2030	Percent Change 2000-2030	Annual Growth Rate
Summary of Population Projections by County						
Gilpin	4,775	5,369	6,406	7,458	56.2%	1.50%
Denver	555,782	606,161	674,105	753,720	35.6%	1.02%
Summary of Population Projections by River Basin						
South Platte	2,985,586	3,537,764	4,215,553	4,911,601	64.5%	1.67%
Summary of Population Projections in the State						
Colorado	4,335,540	5,137,928	6,133,491	7,156,422	65.1%	1.68

In the Front Range tourism region, there are 1.9 million acres of public land available for recreation but, because of the dense population, this translates to 0.60 acres of public land per person: however, in the Southwest region of Colorado there are 5.7 million acres available for public recreation which translates to 30.3 acres per person of public land available for recreation (Figure 18) (Colorado State Parks 2010).

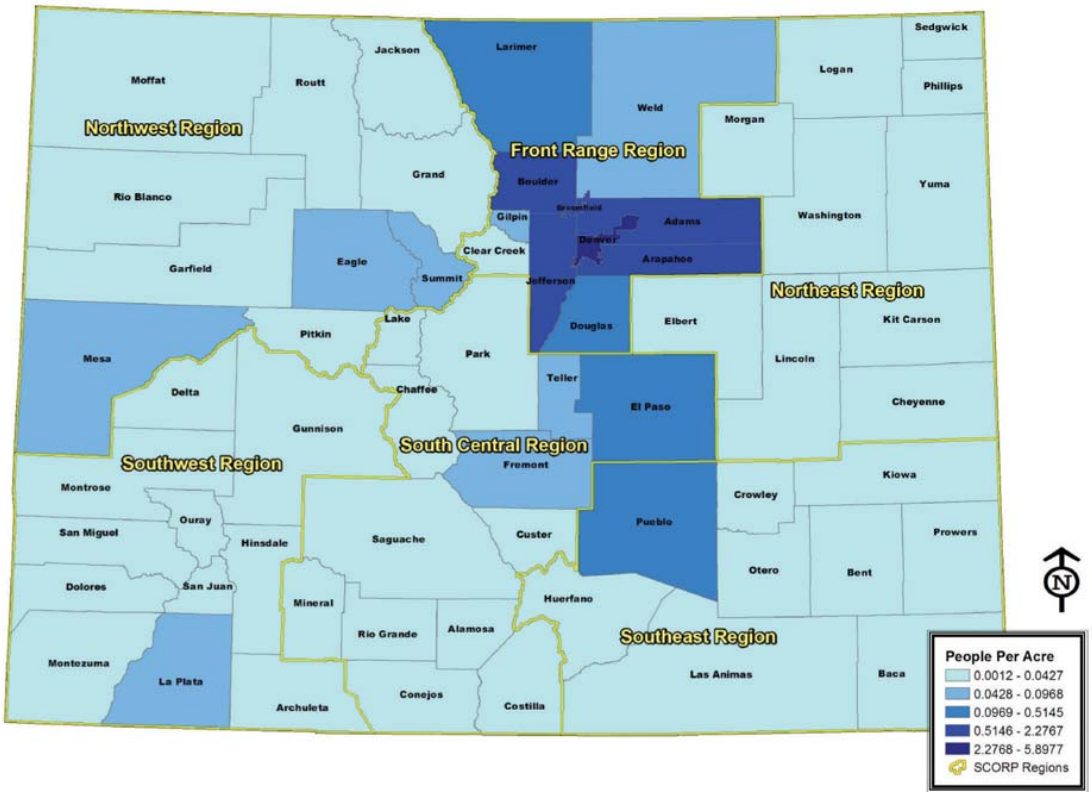


Figure 18. Colorado State Parks tourism regions and Colorado population density 2007 (Colorado State Parks 2010)

METHODS

The methods for assessing and prioritizing conservation needs over a large area, such as a county, are necessarily diverse. CNHP follows a general method that is continuously being developed and updated specifically for this purpose. The survey of Gilpin County was conducted in several steps summarized below.

Survey Methods

Collect Available Information

CNHP databases were updated with information regarding the known locations of wetland-dependent species and significant plant associations within Gilpin County. A variety of information sources were searched for this information. The Colorado State University museums and herbaria were searched, as were plant and animal collections at the University of Colorado, Rocky Mountain Herbarium and local private collections. Both general and specific literature sources were incorporated into CNHP databases, either in the form of locational information or as biological data pertaining to a species in general. Other information was gathered to help locate additional occurrences of natural heritage elements. Such information covers basic species and community biology including range, habitat, phenology (reproductive timing), food sources, and substrates. This information was entered into CNHP's Biodiversity Tracking and Conservation System (BIOTICS).

The information collected in the previous step was used to refine a list of potential species and natural plant communities and to identify *Target Inventory Areas*. TIA's are used to focus the search areas and make the field work as efficient as possible.

In general, species and plant communities that have been recorded from Gilpin County or from adjacent counties are included in this list. Given considerations of time and funding, a specific subset of species and communities were the priority of our inventory efforts. These elements were considered to be a priority because of their high level of biological significance (G1S1-G3S3) (see Table 4) and/or because they are known to occur in areas that are subject to various threats.

Identify Targeted Inventory Areas

Survey sites were chosen based on their likelihood of harboring rare or imperiled species or significant plant communities. Previously documented locations were targeted, and additional potential areas were chosen using available information sources. Areas with potentially high natural values were selected using soil surveys, geology maps, vegetation surveys, aerial photos (color-infrared and natural color) personal recommendations from knowledgeable local residents, and numerous roadside surveys by our field scientists. Using the biological information stored in the CNHP databases, areas having the highest potential for supporting specific elements were identified. Those chosen for survey sites appeared to be in the most natural condition. In general, this means those sites that are the largest, least fragmented, and relatively free of visible disturbances such as roads, trails, fences, and quarries were identified.

The above information was used to delineate Targeted Inventory Areas (TIAs) that were believed to have relatively high probability of harboring significant natural resources. Additional TIAs were identified by Teller County and its stakeholders.

Roadside surveys were useful in further resolving the natural condition of these areas. The condition of shrublands is especially difficult to discern from aerial photographs, and a quick survey from the road can reveal such aspects as weed infestation or vegetation composition. Because there were limited resources to address an overwhelming number of potential sites, surveys for all elements were prioritized by the degree of imperilment. For example, the species with Natural Heritage Program ranks of G1-G3 were the primary target of our inventory efforts. Although species with lower Natural Heritage Program 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 if encountered.

Contact Landowners

Obtaining 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 GIS land ownership coverage obtained from the Gilpin county assessor's office or stakeholders. Landowners were then contacted either by phone or in person. 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 private properties surveyed without landowner permission.

Conduct Field Surveys and Gather Data

Survey sites where access could be obtained were visited at the appropriate time as dictated by the seasonal occurrence (or phenology) of the individual elements. It was essential that surveys took place during a time when the targeted elements were detectable. For instance, plants are often not identifiable without flowers or fruit that are only present during certain times of the year or breeding birds cannot be surveyed outside of the breeding season, because they are most visible in breeding plumage and are easier to spot when singing to attract mates. Amphibians are best surveyed in spring when adults are calling and mating, in mid-summer when tadpoles are out and adults are still active and in late summer when metamorphs are present. Where necessary and permitted, voucher specimens were collected and deposited in local university museums and herbaria.

When a rare species or significant plant community was discovered, its precise location and known extent was recorded with a global positioning system (GPS) unit. Other data recorded at each occurrence include 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 size of the population or community, the condition or naturalness of the habitat and the landscape context (its connectivity and the ease or difficulty of protecting) of the occurrence. These factors are combined into an element occurrence rank, useful in refining

conservation priorities. See the following section on Natural Heritage Program Methodology for more about element occurrence ranking (see Table 4).

Site assessments were conducted as follows:

1). On-site assessments

On-site assessment is the preferred method. 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 and travel to the site. 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.

2). Wetland plant and plant community data collection

- Lists of all plant associations in the survey area, including the percent cover by that community. In almost all cases, plant associations were immediately placed within both the International National Vegetation Classification (Anderson et al. 1998; Comer et al. 2003) and the Comprehensive Statewide Wetlands Classification (Carsey et al. 2003). Plant nomenclature follows Kartesz (1999).
- Vegetation data using Weber and Wittman (2001) 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, including non-native species.
- Soil description
- Water chemistry
- Site information including;
- UTM coordinates and elevation from Garmin GPSmap 76CSx.
- 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.

3). Wetland animal data collection

The methods used in the surveys vary according to the animal that was being targeted. In most cases, the appropriate habitats were visually searched in a systematic fashion, attempting to cover the area as thoroughly as possible in the given time. Some types of organisms require special techniques to document their presence. The specific mmethods used in the Gilpin County survey are summarized below followed by specific reference sources:

- Amphibians: visual observation, vocal surveys and capture using aquatic dip nets (Hammerson 1999)
- Birds: visual observation or identification by song or call (Kingery 1998, Andrews and Righter 1992, National Geographic Society 2006)
- Invertebrates: sweep netting (Opler et al. 2009, Opler and Wright 1999, Scott 1986)

Surveys of Wetland Sites

Potential wetland sites in Gilpin County were located by field reconnaissance in combination with review of map resources including U.S. National Wetland Inventory maps, geology maps, soil surveys, and recommendations from knowledgeable local residents. Those sites identified as wetlands were classified and delineated by on-site evaluation of plant species composition, soil class, hydrologic characteristics, and topographic position. Wetland hydrology was evaluated with regard to water source and potential hydro-period. Topographic position was determined by field measures of aspect, slope, and UTM coordinates from a Garmin GPS 76CSX GPS unit. Additionally, disturbances within wetlands and in adjacent uplands were documented with regard to type and extent.

Vegetation data collected included plant species composition, percent cover, vegetation structure, and identification of plant community associations. Those sites characterized by plant species considered wetland obligate species, wetland facultative species, or facultative species were further evaluated for hydric soils. Soil class was determined by digging a soil pit to a depth of at least 40 cm. Soil texture, drainage class, and color were evaluated to determine soil type. If soils were determined to be histosols, further soil evaluation was conducted using the Von Post peat decomposition scale. At those sites considered fens (as determined by the presence of a minimum of 40 cm of un-mineralized peat) water quality data, including pH, conductivity and temperature, were also collected from groundwater that had flowed into the soil pit.

Riparian wetland evaluation included vegetation characterization as described above and also stream habitat assessment. Stream and riparian habitat are functionally connected and alteration to one impacts the other. Stream habitat assessment included evaluations of embeddedness and sediment deposition, channel flow status, alteration and sinuosity, and bank stability and vegetative protection.

Natural Heritage Methodology

To determine the status of species and plant communities within Colorado, CNHP gathers information on plants, animals, and plant communities. 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. 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 (geographic restriction to a given region or location), 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 4.

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 4, 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.

Table 4. 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 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 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 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 both 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 5 defines the special status assigned by these agencies and provides a key to abbreviations used by CNHP.

Table 5. 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.
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.
PDL	Proposed for delisting.
XN	Nonessential experimental population.
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 native species or subspecies 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 "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 communities, are referred to as *element occurrences*. The element occurrence is considered the most fundamental unit of conservation interest and is at the heart of the Natural Heritage Methodology. 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. 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). This factor for an occurrence is evaluated relative to other known and/or presumed viable, examples.

Condition/Quality – an integrated measure of the composition, structure, and biotic interactions that characterize the occurrence. This includes measures such as reproduction, age structure, biological composition (such as the presence of exotic 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 communities 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 rank or D representing a poor rank. These ranks for each factor 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 6.

Potential Conservation Areas

In order to successfully protect populations or occurrences CNHP designs 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. PCAs may include a single occurrence of a rare element, or a suite of rare element occurrences or significant features. The PCA is designed 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, and hydrologic features; vegetative cover; and current and potential land uses. In developing the boundaries of a PCA, 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;
- 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 adjacent lands;
- Exclusion or control of invasive exotic species; and
- Land necessary for management or monitoring activities.

Table 6. 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.

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 any 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 communities. 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.

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 7 for a summary of these B-ranks.

Table 7. Natural Heritage Program Biological Diversity Ranks and their Definitions

B1	Outstanding Significance (indispensable): only known occurrence of an element A-ranked occurrence of a G1 element (or at least C-ranked if best available occurrence) concentration of A- or B-ranked occurrences of G1 or G2 elements (four or more)
B2	Very High Significance: B- or C-ranked occurrence of a G1 element A- or B-ranked occurrence of a G2 element One of the most outstanding (for example, among the five best) occurrences range wide (at least A- or B-ranked) of a G3 element. Concentration of A- or B-ranked G3 elements (four or more) Concentration of C-ranked G2 elements (four or more)
B3	High Significance: C-ranked occurrence of a G2 element A- or B-ranked occurrence of a G3 element D-ranked occurrence of a G1 element (if best available occurrence) 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)
B4	Moderate Significance: Other A- or B-ranked occurrences of a G4 or G5 community C-ranked occurrence of a G3 element 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) Concentration of A- or B-ranked occurrences of G4 or G5 N1-N2, S1-S2 elements (four or more) D-ranked occurrence of a G2 element At least C-ranked occurrence of a disjunct G4 or G5 element Concentration of excellent or good occurrences (A- or B-ranked) of G4 S1 or G5 S1 elements (four or more)
B5	General or State-wide Biological Diversity Significance: good or marginal occurrence of common community types and globally secure S1 or S2 species.

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 8 summarizes the P-ranks and their definitions.

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 may include the following:

- Forces that threaten the existence of one or more element occurrences at a PCA. 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.

Table 8. 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.

Management Urgency Ranks

Management urgency ranks (M-ranks) indicate the timeframe in which it is recommended that a change occur in management of the PCA. 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 management or stewardship action required to maintain element occurrences at the potential conservation area.

A management action may include biological management (prescribed burning, removal of exotics, mowing, etc.) or people and site management (building barriers, re-routing 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 9 summarizes M-ranks and their definitions.

Table 9. 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.

National Wetland Inventory Map Digitizing

As part of the project, original National Wetland Inventory (NWI) paper topographic maps were scanned, brought into AcrGIS 9.2 (ESRI, Inc., Redlands, CA, USA) and geo-referenced. Wetland polygon features were extracted using Definiens eCognition image recognition software (Definiens, Inc., New Jersey, USA). Once polygons were extracted, extraneous lines and jagged edges were cleaned by hand in ArcGIS. Each polygon was attributed using the original NWI code, following the US FWS's Cowardin classification (Cowardin et al. 1979). All polygons and attributes were reviewed for quality assurance using the QA/QC tools available from the NWI program. Invalid codes no longer used by the NWI program were updated to the currently accepted codes. No effort was made to modify polygons based on land use changes since the original photo interpretation. The goal of the effort was to digitize the original NWI maps as they were and not to update or photo interpret wetlands.

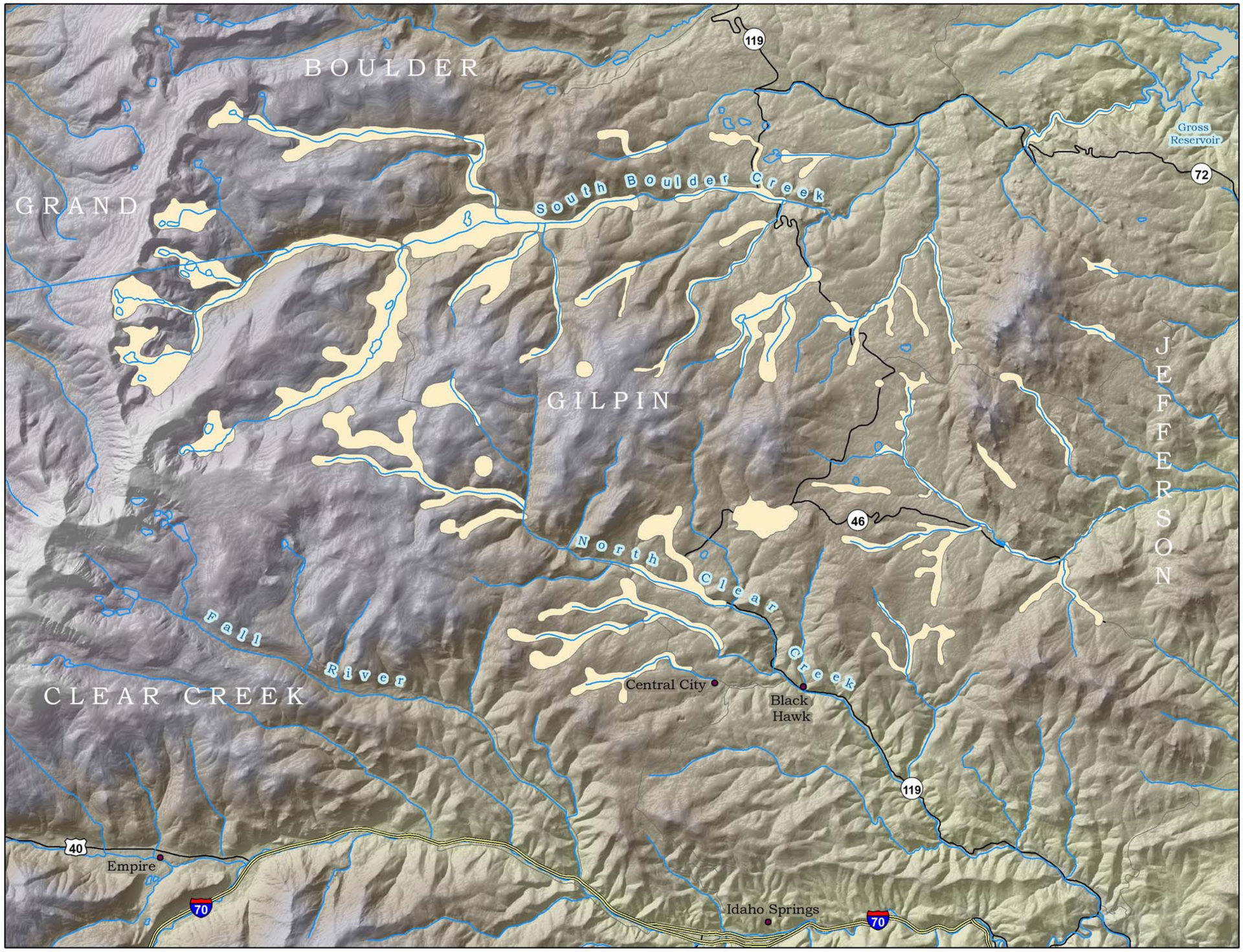
RESULTS

A total of 44 Target Inventory Areas (TIA's) were identified prior to conducting field work in Gilpin County (Map 1). Of these, 35 were visited and searched for the element(s) that identified them as a priority for inventory. Due to access issues, timing, or site conditions, 9 of the original TIA's were not able to be searched. Additional areas were selected opportunistically while conducting the field survey and searched provided landowner permission was acquired.

Results of the wetland survey of Gilpin County confirmed that many wetlands with high biological significance occur in the county. The CNHP team newly documented a total of 39 element occurrences, including 6 plant occurrences and 33 plant community occurrences. Those element occurrences are contained within 13 Potential Conservation Areas (PCAs). These include one site with Very High Biodiversity Significance (B2), four sites with High Biodiversity Significance (B3), and seven sites with Moderate Biodiversity Significance (B4). Detailed descriptions for all the sites are included in the following section titled *Sites of Biodiversity Significance*. Brief summaries for the sites with Very High or High Biodiversity Significance are provided below. An additional site, the Library Park site, is a Site of Local Significance and is included here for general informational purposes only. A listing of all Potential Conservation Areas developed for Gilpin County is provided in Table 10 and shown on Map 2. The list of element occurrences these PCA's are based on is provided in Table 11.

Table 10. Potential Conservation Areas in Gilpin County

Biodiversity Rank	Potential Conservation Area
B2: Very High Biodiversity Significance	Mammoth Gulch
B3: High Biodiversity Significance	Ralston Creek Lower South Boulder Creek Middle and Upper South Boulder Creek Jenny Lake
B4: Moderate Biodiversity Significance	Arapahoe Lakes Forest Lakes Iceberg Lake James Peak Macy Gulch Ellsworth Creek Miner's Gulch Elk Park
SLS: Site of Local Significance	Library Park



Colorado Natural Heritage Program
Colorado State University
254 General Services Building
1474 Campus Delivery
Fort Collins, CO 80523-1474

Ph (970) 491-1309
http://www.cnhp.colostate.edu

Map Date: 03/17/2011

Legend

CNHP Targeted Inventory Areas (TIAs)

- Target Inventory Areas
- Rivers and Streams
- Major Roads
- Highways
- Interstates

10m Digital Elevation Model Produced by the U.S. Geological Survey

Location in Colorado

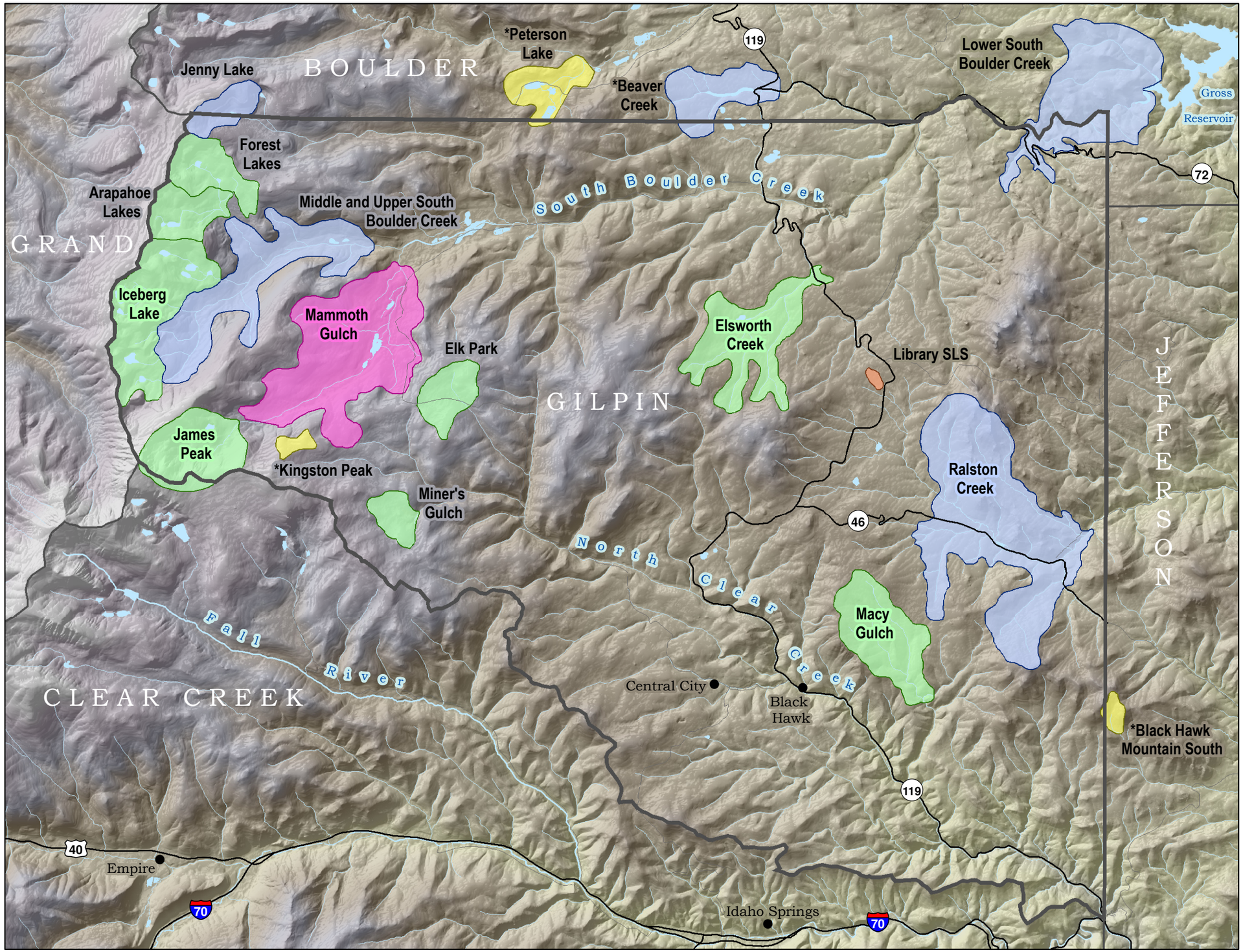
Targeted Inventory Areas are believed to have a relatively high probability of harboring significant biological resources.

0 0.5 1 2 Miles

N

Coordinate System: UTM, Zone 13, NAD83

Map 1. Targeted Inventory Areas in Gilpin County.



Colorado Natural Heritage Program
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http://www.cnhp.colostate.edu

Map Date: 04/26/2011

Legend

CNHP Potential Conservation Areas (PCAs) by Biodiversity Significance Rank*

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

*PCAs with an asterisk preceding the site name are not described in the report

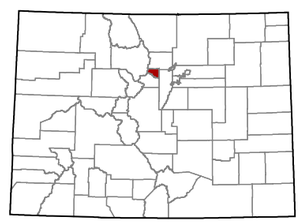
Site of Local Significance

Base Data

Counties, Highways, Major Roads, Lakes, Reservoirs, Rivers, Streams, Creeks

10m Digital Elevation Model Produced by the U.S. Geological Survey

Location in Colorado



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

0 0.5 1 2 Miles

N

Coordinate System: UTM, Zone 13, NAD83

Map 2. Potential Conservation Areas and Sites of Local Significance in Gilpin County.

Table 11. Significant Wetland Dependent Elements Known From Gilpin County and the NWI Classification for Plant Communities

Scientific Name	Common Name	Global Rank	State Rank	NWI Class	USESA	FEDSENS
Amphibians						
Bufo boreas pop. 1	Boreal Toad (Southern Rocky Mountain Population)	G4T1Q	S1			
Fish						
Oncorhynchus clarkii stomias	Greenback Cutthroat Trout	G4T2T3	S2		LT	
Insects						
Callophrys mossii schryveri	Moss's Elfin	G4T3	S2S3			
Erebia pawlowskii	Theano Alpine	G5	S3			
Polites origenes	Cross-line Skipper	G5	S3			
Mammals						
Gulo gulo	Wolverine	G4	S1			USFS
Plecotus townsendii pallescens	Townsend's Big-eared Bat Subsp	G4T4	S2			BLM/USFS
Mollusks						
Promenetus exacuous	Sharp Sprite	G5	S2			
Promenetus umbilicatellus	Umbilicate Sprite	G4	S3			
Natural Communities						
(*Picea engelmannii) / Betula nana / Carex aquatilis - Sphagnum angustifolium* Woodland	Iron Fen	G2	S2	PSS		
Abies lasiocarpa - Picea engelmannii / Carex aquatilis Forest	Subalpine Riparian/wetland Forest	G4	S3	PSS		
Betula nana / Sphagnum spp. Shrubland	Dwarf Birch/sphagnum Shrubland	GU	S2	PSS		
Betula occidentalis / Mesic Graminoids Shrubland	Lower Montane Riparian Shrublands	G3	S2	PSS		
Eleocharis quinqueflora Herbaceous Vegetation	Alpine Wetlands	G4	S3S4	PEM		
Populus tremuloides / Alnus incana Forest	Montane Riparian Forests	G3	S3	PSS		
Populus tremuloides / Salix drummondiana Forest		G3G4	SU	PSS		
Pseudotsuga menziesii / Betula occidentalis Woodland	Montane Riparian Forest	G3?	S3	PSS		

Salix bebbiana Shrubland	Montane Willow Carrs	G3?	S2	PSS		
Salix brachycarpa / Carex aquatilis Shrubland	Subalpine Riparian/Wetland Carr	G2G3	S2S3	PSS		
Salix drummondiana / Mesic Forbs Shrubland	Drummonds Willow/Mesic Forb	G4	S4	PSS		
Salix monticola / Calamagrostis canadensis Shrubland	Montane Willow Carr	G3	S3	PSS		
Salix monticola / Carex aquatilis Shrubland	Montane Riparian Willow Carr	G3	S3	PSS		
Salix monticola / Mesic Forbs Shrubland	Montane Riparian Willow Carr	G4	S3	PSS		
Salix monticola / Mesic Graminoids Shrubland	Montane Riparian Willow Carr	G3	S3	PSS		
Salix planifolia / Calamagrostis canadensis Shrubland	Subalpine Riparian Willow Carr	G4	S2S3	PSS		
Salix planifolia / Caltha leptosepala Shrubland	Subalpine Riparian Willow Carr	G4	S4	PSS		
Salix planifolia / Carex aquatilis Shrubland	Subalpine Riparian Willow Carr	G5	S4	PSS		
Salix planifolia / Carex utriculata Shrubland	Diamondleaf Willow / Beaked Sedge	GNR	S2	PSS		
Salix wolfii / Mesic Forbs Shrubland	Subalpine Riparian Willow Carr	G3	S3	PSS		
Vascular Plants						
Aquilegia saximontana	Rocky Mountain columbine	G3	S3			
Aster alpinus var. *vierhapperi*	alpine aster	G5T5	S1			
Botrychium echo	reflected moonwort	G3	S3			
Botrychium hesperium	western moonwort	G4	S2			
Botrychium minganense	Mingan's moonwort	G4	S2			
Carex oreocharis	a sedge	G3	S1			
Cystopteris montana	mountain bladder fern	G5	S1			
Draba exunguiculata	clawless draba	G2	S2			USFS
Draba grayana	Gray's Peak whitlow-grass	G2	S2			USFS
Draba porsildii	Porsild's whitlow-grass	G3G4	S1			
Dryopteris expansa	spreading wood fern	G5	S1			
Hippochaete variegata	variegated scouringrush	G5	S1			
Juncus vaseyi	Vasey bulrush	G5?	S1			
Listera convallarioides	broad-leaved twayblade	G5	S2			
Sisyrinchium pallidum	pale blue-eyed grass	G2G3	S2			BLM

The Mammoth Gulch PCA is a site with Very High Biodiversity Significance (B2) due to the occurrence of an Iron Fen community. Iron fens are a unique type of fen that is only found in areas with highly mineralized geology, such as Gilpin County.

This site is drawn for a good (B-ranked) occurrence of the globally imperiled (G2/S2) iron fen, Engelmann spruce / bog birch / water sedge / sphagnum spp. (*Picea engelmannii* / *Betula nana* / *Carex aquatilis* / *Sphagnum* spp.) woodland. Other community occurrences within the site include excellent and good occurrences (A and B-ranked) of the state imperiled (GNR/S2) diamondleaf willow / beaked sedge (*Salix planifolia* / *Carex utriculata*) shrubland, and good (B-ranked) and fair (C-ranked) occurrences of the state rare (G4/S2S3) diamondleaf willow / bluejoint reedgrass (*Salix planifolia* / *Calamagrostis canadensis*). This site is the first Iron fen site documented in Gilpin County. Other nearby Iron fens are located in Clear Creek County.

The Ralston Creek PCA is a site with High Biodiversity Significance (B3) due to the occurrence of a Globally Imperiled plant species. The site is drawn for a fair (C-ranked) occurrence of the globally imperiled (G2G3/S2) pale blue-eyed grass (*Sisyrinchium pallidum*). Additionally present are many fair (C-ranked) occurrences; the globally vulnerable (G3G4) deciduous riparian woodland, quaking aspen / Drummond's willow (*Populus tremuloides* / *Salix drummondiana*), two occurrences of globally vulnerable (G3S3) mountain willow (*Salix monticola*) / mesic graminoids shrubland, an occurrence of the globally vulnerable (G3S3) mountain willow / water sedge (*Salix monticola* / *Carex aquatilis*) shrubland, two occurrences of the globally vulnerable (G3?/S2) Bebb willow (Salix bebbiana) shrubland, an occurrence of the globally vulnerable (G3/S2) planeleaf willow / beaked sedge (*Salix planifolia* / *Carex utriculata*) shrubland, an occurrence of the globally apparently secure (G4/S4) Drummond's willow (*Salix drummondiana*) / mesic forbs shrubland and an occurrence of the state rare (G5/S2) plant species, broad-leaved twayblade (*Listera convallarioides*).

The Lower South Boulder Creek PCA is a site with High Biodiversity Significance (B3) due to the occurrence of two Globally Vulnerable woodland and shrubland communities. This site is drawn for good (B-ranked) occurrences of two globally vulnerable (G3/S3) plant communities, Douglas-fir / river birch woodland (*Pseudotsuga menziesii* / *Betula occidentalis*) and thinleaf alder (*Alnus incana*) / mesic forbs riparian shrubland. Additionally, a fair occurrence (C-ranked) of the globally vulnerable (G3/S2) river birch (*Betula occidentalis*) / mesic graminoids shrubland, an excellent (A-ranked) occurrence of the state rare (G5?/S2S3) Sprengel's sedge (*Carex sprengelii*) and a good (B-ranked) occurrence of the state imperiled (G5/S1) variegated scouringrush (*Hippochaete variegata*) occur here.

The Middle and South Boulder Creek PCA is a site with High Biodiversity Significance (B3) due to the occurrence of a Globally Vulnerable forested fen and a shrubland community. This site was drawn for a good (B-ranked) occurrence of the globally vulnerable (G3?/S1) Engelmann spruce - subalpine fir / marsh marigold (*Picea engelmannii - Abies lasiocarpa* / *Caltha leptosepala*) forested fen and a good (B-ranked) occurrence of the state imperiled (GNR/S2) planeleaf willow / beaked sedge (*Salix planifolia* / *Carex utriculata*) shrub community. The state critically imperiled (G5/S1) mountain bladder fern (*Cystopteris montana*) is also found here in good to fair (BC-ranked) condition.

The Jenny Lake PCA is a site with High Biodiversity Significance (B3) due to the occurrence of a Globally Vulnerable shrubland and Globally Vulnerable plant species. This site is drawn for a good (B-ranked) occurrence of the globally vulnerable (G3/S3) wolf willow (*Salix wolfii*) / mesic forbs shrubland and a fair (C-ranked) occurrence of the globally vulnerable (G3/S3) plant, Rocky Mountain columbine (*Aquilegia saximontana*).

Library Park Fen is a Site of Local Significance (SLS) consisting of series of terraced, slope wetland fens, characterized by a mosaic of wetland plant communities surrounded by developed residential uplands. The PCA is drawn for a fair (C-ranked) occurrence of a globally and Colorado imperiled (G2S2) shrubland *Salix brachycarpa*/*Carex aquatilis*. Additionally present are two imperiled plant species, the globally secure (G5) but imperiled in Colorado (S2) lesser bladderwort (*Utricularia minor*) and the globally apparently secure (G4) but critically impaired in Colorado (S1?) northern bladderwort (*Utricularia ochroleuca*).The uniqueness of the site qualifies it to be protected as an educational asset for the county; protection and management actions are necessary to preserve the site.

National Wetland Inventory Wetland Mapping

The National Wetland Inventory program had completed mapping of wetlands in Gilpin County by the late 1980's, but those maps were not digital. As part of this wetland inventory, CNHP digitized the wetland maps for Gilpin County and submitted them to the USFWF for inclusion into the NWI program database. The digitized quadrangles have been checked for quality and compliance with program standards and have been accepted into the digital NWI DB.

Digitizing of the six wetland quadrangle maps for Gilpin County revealed that the total number of mapped wetland acres in the county is 1,673 acres (2%). By sub-watershed, the Clear Creek basin contains 772 wetland acres (46%), and the St. Vrain River basin contains 901 wetland acres (54%). Table 12 shows the distribution of wetland acres of each wetland type within each of the two sub basins in Gilpin County.

Table 12. Wetland acres by sub basin and within the entire county

Wetland Type	Clear Creek Basin	St. Vrain River Basin	Gilpin County
Freshwater Emergent Wetland	238	98	336
Freshwater Forested/Shrub Wetland	485	572	1057
Freshwater Pond	49	104	153
Lake	0	127	127
Total	**772**	**901**	**1,673**

The digital wetland maps indicate that the montane ecoregion contains 899 wetland acres (54%), the sub alpine region contains 506 wetland acres (25%), and the alpine region contains 268 wetland acres (14%). Table 13 shows the distribution of wetland acres by wetland type and ecoregion.

Table 13. Wetland acres within each Level 4 ecoregion

Wetland Type	Montane Ecoregion	Sub Alpine Ecoregion	Alpine Ecoregion
Freshwater Emergent Wetland	336	0	0
Freshwater Forested/Shrub Wetland	445	449	163
Freshwater Pond	118	32	3
Lake	0	25	102
Total	**899**	**506**	**268**

POTENTIAL IMPACTS TO WETLANDS IN GILPIN COUNTY

Hydrologic Modifications

Impacts to water quality and quantity result from both recent and historical hydrologic alteration. Historical impacts to streams and wetlands in Gilpin County result from mining activities including placer mining, mine tailings, and mine drainage, as well as from agricultural development, diversions, grazing and logging, and peat mining. Current impacts to water quantity and quality in Gilpin County include surface water diversions, municipal and residential development, riparian and stream habitat alteration, roads and recreation, agricultural development, and livestock grazing.

Data from the USGS National Water Quality Assessment Program in the South Platte River Basin (USGS 2010) point to some of the current sources of impacts to water quality and quantity. They found that alteration of the natural flow regime has degraded native aquatic habitat along streams; that development in mountain drainages correlated with elevated concentrations of dissolved solids, suspended sediment, and nutrients in surface water; that streambed sediments in forested mountain streams affected by mining or development had the highest concentrations of trace elements in mountainous areas; and that biological communities were less diverse and had fewer fish species in tributaries affected by mining or development compared to undeveloped mountain streams.

Numerous local stream diversions, one major trans-basin diversion, and several private and public dams and reservoirs occur in Gilpin County. Dams and reservoirs alter thermal regimes and interrupt the movements of water, sediment and organisms along the entire longitudinal continuum of the streams they affect (Pepin et al. 2002). Diversions dewater some streams and over-water others; both alter stream hydrology and impact stream biota. Aquatic biodiversity and ecosystem functions have been lost or degraded as a result of fragmentation caused by dams and diversions (Pepin et al. 2002).

Climate Change Impacts to Wetlands

Climate models project Colorado's climate will warm an average of 2.5 °F by 2025, and 4 °F by 2050. The 2050 projections show summers warming by +5 °F and winters by +3 °F. Summer

temperatures on the Eastern Plains of Colorado are projected to shift westward and upslope, bringing into the Front Range temperature regimes that today occur near the Kansas border. Winter projections show fewer extreme cold months, more extreme warm months, and more strings of consecutive warm winters. In all seasons, the climate of the mountains is projected to migrate upward in elevation. Warmer temperatures will also increase evaporation rates of rivers, streams, and reservoirs, making less water available for beneficial use.

Figure 19 depicts the projected change in the average daily temperature across the state for January and July. By 2050 the January climate of the Eastern Plains has moved northward by a distance greater than half the state. The climate zones of the mountains have migrated upward in elevation, and the climate of the Desert Southwest has progressed into the valleys of the Western Slope (CWCB 2010). For July, the temperatures on the Eastern Plains have moved westward and upslope, such that the temperature regime near the western Kansas border has reached the Front Range by 2050 (CWCB 2010).

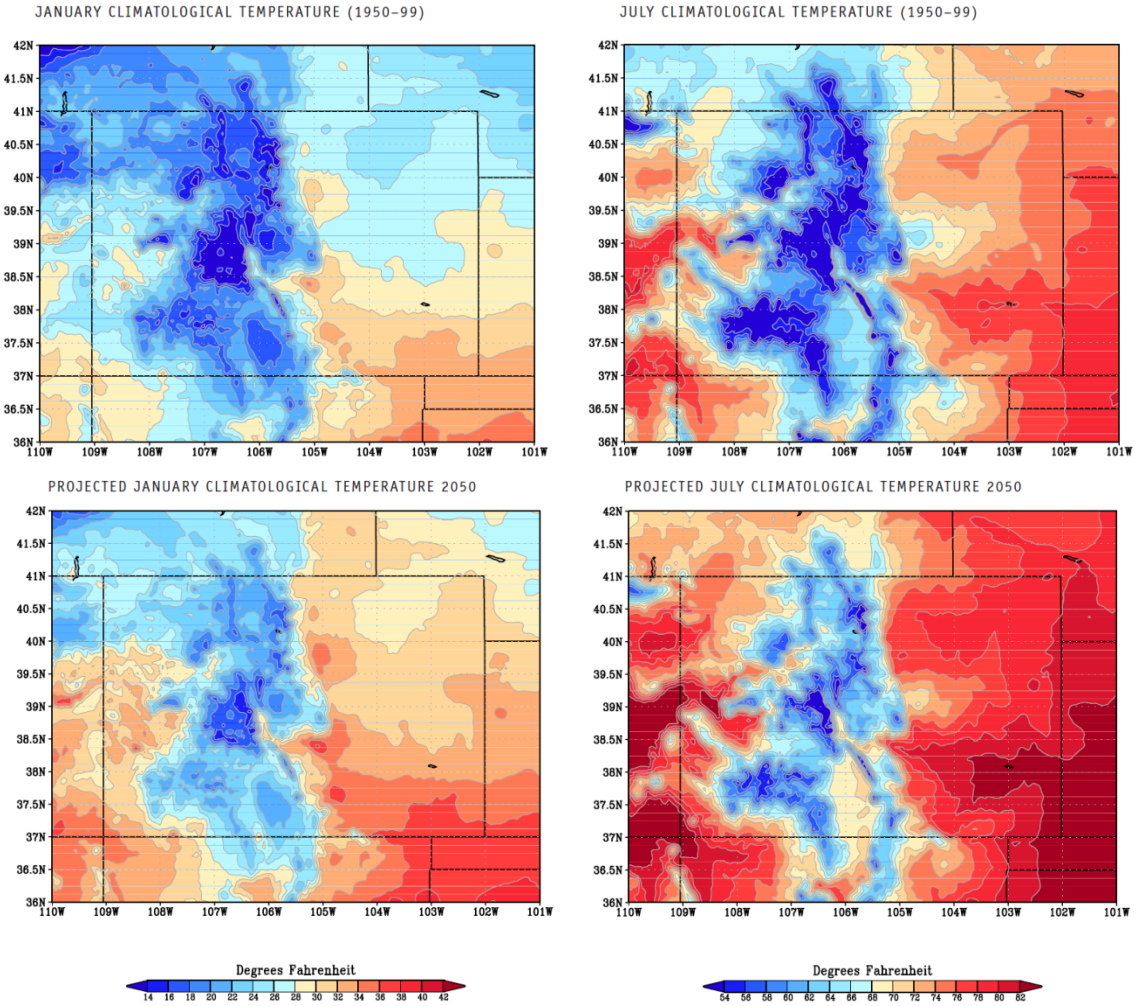


Figure 19. Observed and projected average daily temperature. Left panels: January observed average daily temperature for 1950–99 (top) and projection for 2050 (bottom). Right panels: July observed average daily temperature for 1950–99 (top) and projections for 2050 (bottom)

In Colorado, no consistent long-term trends in annual precipitation have been detected. Variability is high, making trend detection difficult and model projections do not agree whether annual mean precipitation will increase or decrease in Colorado by 2050. Although multi-model average projection shows little change in annual mean precipitation, a seasonal shift in timing of precipitation is projected, which may result in more mid-winter precipitation throughout the State, and in some areas, a decrease in the late spring and summer precipitation. Projections do show a precipitous decline in lower-elevation (below 8200 ft) snowpack across the West by the mid-21st century. Modest declines are projected (10–20%) for Colorado's high-elevation snowpack (above 8200 ft) within the same timeframe.

The timing of runoff is projected to shift earlier in the spring. In Colorado between 1978 and 2004, the onset of streamflow from melting snow has shifted earlier by two weeks which, studies suggest, is related to warming spring temperatures. Onset of spring warm spells (defined as more than seven days with temperatures above 53 °F) and a shift to earlier spring runoff may reduce late-summer stream flows. These changes are projected to occur regardless of changes in precipitation.

Colorado's temperatures have increased by approximately 2 °F between 1977 and 2006 and increasing temperatures are affecting the state's water resources. All regions examined within the state warmed during the last 30 years, except the far southeast corner, in which there was a slight cooling trend.

Mineral Extraction Impacts

Although mining brought economic benefits to Gilpin County it also had negative impacts on water quality and stream and riparian habitat. Mining activities impact terrestrial and aquatic ecosystems by production of toxic acid or alkaline drainage, and by resulting in erosion and sedimentation into aquatic systems (Windell 1992). Mining activity can alter the hydrology of streams and wetlands. Mine tailings dumped in or near wetland or riparian areas can alter surface flow and sediment fluxes (Chimner et al 2007). Placer mining activity dramatically alters physical stream and riparian habitat. Placer mining was dominated by sluicing, hydraulic mining, booming and dredging which resulted in large tracts of gravel waste in areas that were once riparian benches and streams (Rueth et al. 2002).

Mine drainage has been the most serious long-term consequence of hardrock mining. In Colorado, hardrock mining has left Colorado with 1,616 river miles polluted by mine drainage (Rueth et al. 2002) and 9,100 contaminated wetlands and lakes (Gellhorn 2002). Due to the rich mineralization of the region, Gilpin County became one of the most heavily mined areas of Colorado and now contains large numbers of abandoned mines. In the steep mountain canyons of Gilpin and Clear Creek counties there are approximately 1,600 abandoned sites that continue to be the source of water pollution (USEPA 2010). Recent field observations in Gilpin County documented numerous stream and riparian habitats that continue to be impacted by historic placer mining, mine tailings, waste piles, and mine drainage. In North Clear Creek, historic mining impacts have resulted in the inclusion of the stream in the Clear Creek/Central City Superfund site which was designated by the U.S. Environmental Protection Agency to address

heavy metal contamination associated with historic mining activity and riparian corridor improvement (USEPA 2010). Physical habitat in North Clear Creek has been greatly altered by historic mining and by recent casino development near Central City and Black Hawk that has channelized and disrupted stream habitat. Water quality in North Clear Creek has been degraded by heavy metal pollution which continues to be a severe impediment to human health (Clear Creek Watershed Foundation 2010).

Logging Impacts

The discovery of gold brought rapid population growth to Gilpin County, which initiated logging, agricultural development, and grazing. Wood was in high demand for mine timbers, sluices, housing materials, charcoal, firewood, and especially railroad ties (Rueth et al. 2002). Prior to the discovery of gold in 1859 only a handful of trappers and Native Americans passed through Gilpin County but by the summer of 1860 sixty ore mills and thirty arastras were in operation and the population had risen to 15,000 with numerous mining camps including Black Hawk, Central City, Nevadaville, Russell Gulch and Apex (Granruth 2010). Early conservationists wrote of the "wanton destruction of timber" that occurred simultaneously with mine development and the resulting "wilderness of stumps" (Wohl 2001). Between 1880 – 1890, logging was the second-largest industry in Gilpin County and by the end of the 1890s most of the mountains in and around the mining community were denuded of trees that were used for mine support timbers and lumber as well as for homes and businesses (Petersen and Borchert 2010). Throughout Gilpin County the effects of historic logging continue to alter the natural hydrology of the watershed (Figure 20).

Figure 20. Historically logged hilltop near Pile Hill, Gilpin County, 2009

Development Impacts

In the recently completed Ecological Assessment of Western Streams and Rivers, the U.S. Environmental Protection Agency reported that, in the mountains of the West, development in the riparian zone is the most common stressor of stream ecosystems. Stream and riparian wetland habitats interact to maintain functioning stream and wetland ecosystems. Structurally complex, multi-layered vegetation corridors along streams buffer stream systems against

sources of stress such as buildings, roads, mining, livestock, and agriculture. Greater than 70 percent of the streams in the West are located in the mountains and 31 percent of mountain streams in the Southern Rocky Mountains (SRM) have riparian habitat characterized as "most disturbed" (USEPA 2010). Nutrients are also common stressors in the Southern Rockies; nitrogen concentrations in the most-disturbed category were found in 40% of streams and phosphorous concentration in 24% (USEPA 2010)

Cattle tend to concentrate in riparian and wetland areas so overgrazing and trampling are more prevalent here than in other habitats (Rueth et al. 2002). Effects of livestock overgrazing include loss of streamside canopy and instream cover, increased water temperatures, increased velocities and flood tendencies and decreased streambank stability. Water quality is also affected due to increased levels of sediment, turbidity, nutrients, and pathogenic bacteria (Windell 1992). Livestock grazing in Gilpin County occurs on approximately 10,000 acres of public/private land in the Mammoth Gulch area. The grazing allotment here is managed by the USFS which currently allows seasonal cattle grazing only, from July to September for 88 cow/calf pairs (Baker 2010 pers.comm.). Field observations indicate that even with this relatively low number of livestock and short period of use, grazing has impacted wetland sustainability in Mammoth Gulch by altering vegetation condition and composition and soil characteristics and by altering physical stream habitat. In other areas of the County, such as in Golden Gate Canyon State Park, management has discontinued domestic livestock grazing and riparian vegetation and stream habitat is recovering.

Residential and municipal development has also contributed to alteration of riparian and stream habitat and ecological stress. Currently in Gilpin County there are 60 subdivisions, many with lots located in the riparian zone. Transportation corridors, including roads and railroads, are often located in the riparian zone and adjacent to most major streams in the county.

Mountain Pine Beetle

Extensive stands of lodgepole (*Pinus contorta*) ponderosa pine (*Pinus ponderosa*) and limber pine (Pinus flexilis) occur in Gilpin County. Each of these tree species is susceptible to infestation by mountain pine beetle (*Dendroctonus ponderosae*).

Lodgepole pine is a short-lived, shade-intolerant conifer that forms widespread, extensive stands in the montane and lower subalpine zones throughout the Rocky Mountains. Lodgepole establishment is episodic and linked to stand-replacing disturbances such as fire (Rondeau 2005), which is the primary disturbance type shaping the structure of lodgepole pine stands in the southern Rockies (Sibold et al. 2007). Following stand-replacing fires, lodgepole will rapidly colonize and develop into dense, even-aged stands (Rondeau 2005).

Ponderosa pine is the most widely distributed pine species in North America, ranging north-south from southern British Columbia to central Mexico and east-west from central Nebraska to the west coast (Howard 2003). In the Southern Rockies ponderosa woodlands occur in the montane and foothills zone. Ponderosa is a fire-adapted species, and mature trees have thick layers of exfoliating bark that insulate ponderosa from recurrent fire. Fire plays an important

role in structuring these ponderosa woodlands that historically formed widely spaced, park-like systems with large, old trees and little understory vegetation. However, a history of anthropogenic alteration to the natural fire regime (fire suppression) in combination with disturbances such as logging and grazing has altered most ponderosa pine forests in the Southern Rocky Mountains ecoregion (Rondeau 2001).

Limber pine occupies dry, steep, rocky well-drained, windswept, and nutrient-poor sites at elevations that range from 5,000 to 12,500 feet. In Gilpin County limber pine is a common pioneer of historically logged sites that is important in the stabilization and recovery of these disturbed areas. Limber pine is often killed by fire. Young trees are usually killed by any fire that scorches their stems but mature trees with thicker bark can survive. However, vulnerability to fire is reduced by the open stand structure that is characteristic of limber pine communities. Further, periodic fires may maintain limber pine by reducing undergrowth that carries fire (Johnson 2001). Postfire regeneration of limber pine is a consequence of seed dispersal and caching by Clark's nutcrackers (*Nucifraga columbiana*) which are the primary harvester and disperser of its seeds (Tomback and Linhart 1990).

Mountain pine beetles are a natural part of forested ecosystems and have co-existed with their host tree species for thousands of years, playing an important role in forest renewal. Human alteration of ecosystems may have increased the damage caused by these insects by increasing the vulnerability of forests to bark beetle attack. Activities that homogenize stand characteristics and increase density such as has often occurred with logging, fire suppression and replanting may have contributed to widespread bark beetle infestation (Tomback and Kendall 2002). For example, extensive logging and widespread burning in the late 19th century and fire suppression in the 20th century altered many forested watersheds in the Colorado Rocky Mountains. These events created homogenous, even-aged stands with dense forest regrowth, which are now of an age when susceptibility to bark beetle infestation is high (Romme et al. 2006). Additionally, a warming climate over the last 100 years in combination with severe drought over the last decade has probably stressed trees, reducing tree resistance to insect attack while conversely enabling bark beetle populations to increase.

MPBs are native to western North America and many ecosystems are dependent on MPB disturbance events and subsequent fire for forest renewal (Gibson et al. 2009). MPBs normally reside at endemic levels in temperate pine forests across the west where they typically attack older, larger, weaker, less vigorous trees. At endemic levels, their activity benefits many wildlife species by creating snags and downed logs which provide habitat for wildlife species such as cavity nesting birds and small mammals and the beetles themselves provide abundant and often critical food resource for insectivorous birds and mammals (Martin et al. 2006). However, during epidemic infestations, populations build exponentially and healthy trees are also attacked (Bellows et al. 1998).

Eruption to an outbreak population and subsequent widespread tree mortality can alter forest structure and processes such as water and sediment yield and wildfire extent and severity (Gibson et al. 2009). It is widely believed that insect outbreaks set the stage for severe forest

fires, but based on current knowledge, the assumed link between insect outbreaks and forest fires is not well supported or is so small as to be considered inconsequential for many forests in Colorado (Romme et al. 2006).

Altered forest processes and structure also affects wildlife populations. Impacts from the elimination of canopy cover can include declines and alteration in composition and distribution of wildlife including large ungulates, birds, small mammals, furbearers, and medium and large carnivores. Large ungulates such as elk and deer populations are affected due to a reduction in security and thermal cover (Gibson et al. 2009). Elimination of cover also fragments the forests creating large expanses of habitat that is unsuitable for many species. Fragmentation of the forested landscape is expected to have the greatest effect on wildlife species that depend on mature, structurally complex forests, such as lynx, pine marten, pine grosbeak, Hammond's flycatcher, red-backed vole and snowshoe hare (Chan-MacLeod 2006). Those species dependent on pine seeds as a food resource can also be expected to decline. These species include birds such as crossbills and small mammals such as voles (*Microtus* spp.) and squirrels (*Sciurus* spp.) (Chan-MacLeod 2006).

Insect outbreaks are a natural occurrence in almost all of the different kinds of forests in Colorado and have occurred often in the past with similar ecological effects to the outbreak that is now occurring (Lynch 2006). However, mountain pine beetle outbreaks are now occurring in parts of Colorado where such extensive insect activity has not been seen at any time during the previous hundred years and are now are killing trees at unusually high elevations that may be a significant departure from previous outbreaks (Romme et al. 2006).

Management options for MPBs can involve three levels or scales of mitigation: short-term prevention which involves use of insecticides and pheromones; long-term prevention which addresses stand condition and involves silviculture methods including thinning, patch-cutting to create a mosaic of age and size classes, and prescribed fire; and restoration. Forested landscapes that are characterized by complex structure with a variety of age classes and a diversity of tree species may be less susceptible to widespread MPB outbreaks. Restoration emphasizing habitat diversity at the landscape scale may be especially viable management strategies to achieve long-term forest health (Gibson et al. 2009).

Since 1996 the mountain pine beetle (MPB) has affected 2.3 million acres of Colorado lodgepole pine forests (CFRI 2010). Research indicates that recovery is already underway in some Colorado forests. In those forests that had a pine-dominated overstory and fir, spruce, and aspen understory prior to MPB epidemic, new conifer seedlings have colonized and beetle-infested stands are on a trajectory to return to pre-outbreak forest structure in 80 to 120 years. However, harvested and unharvested sites will differ with regard to species composition from the pine-dominated forests at the time of outbreak Harvested sites will likely be dominated by lodgepole pine while in unharvested sites, subalpine fir will likely be the dominant canopy species with aspen common in both areas (CFRI 2010). Importantly, in harvested areas lodgepole pine will be the dominant canopy and develop in stands similar to those that were attacked by the pine beetle (CFRI 2010).

DISCUSSION

Precipitation captured as snow by the high peaks of the Continental Divide is the source of much of the water that fills the streams, replenishes the groundwater, and sustains the wetlands in Gilpin County. Snowmelt from these peaks has resulted in the development of tarns, fens, and wetlands that occupy the glacially sculpted slopes and valleys below the Continental Divide. Abundant shallow groundwater derived from snowmelt has enabled the lush vegetative growth that characterizes the wetlands and flourishes on the perimeter of lakes and tarns, and that vegetative cover is essential to the long-term persistence of these wetland/aquatic communities.

These wetland and fen habitats are not only unique and fragile but are also essential to ecosystem function. Although wetlands occupy only a small percentage of Gilpin County's landscape (~0.02%), these ecosystems provide important ecosystem functions including water quality enhancement, water storage, wildlife habitat, and, because they release water throughout the growing season, they contribute to streamflow during later-summer and drought periods. Wetlands also provide important habitats and resources for many sensitive and unique animals, plants, and plant communities such as White-tailed Ptarmigan (*Lagopus leucurus*), boreal toad (*Bufo boreas boreas*), the broad-lipped twayblade orchid (*Listera convallarioides*), and communities such as wolf willow shrublands (*Salix wolfii*) – which are all documented in Gilpin County. Protecting, conserving, and restoring these high elevation source-waters is necessary to the long term sustainability of both the natural and the human-built environment.

Ecologic recovery from anthropogenic disturbance can take a long time even with active restoration efforts; it often takes much longer and has less certain outcomes without active effort. Much of the environmental legacy of mining continues to impact wetlands of the County through altered ecological and physical functions. Mining and other anthropogenic activities have degraded water quality, stream and groundwater flows, and wetland and riparian habitat as well as adjacent upland ecosystems in many areas of the county. However, some of those sites are recovering from historic disturbances. For example, many clearcut sites are naturally re-vegetating, while active restoration of wetlands and forested upland habitat is returning functionality to several ecologically important sites. One example is the Green Ranch at Golden Gate State Park, where a restored ponderosa pine (*Pinus ponderosa*) woodland ecosystem drained by several streams represents a good quality riparian woodland. Historically, this site was heavily grazed and degraded. It is now protected and managed for wildlife and watershed values and is recovering. On a mid-elevation private parcel in Lump Gulch, landowners have restored wetland habitat at the Eye of the Heart Wildlife Refuge and have instituted an environmental education program to promote environmental sustainability and instill an environmental ethic in young people. In these and other recovering sites several sensitive wildlife species and plant communities are present, suggesting that these ecosystems are functioning and providing essential resources. Bird species such as Osprey (*Pandion haliaetus*), Northern Goshawk (*Accipiter gentilis*), and Northern Pygmy Owl (*Glaucidium gnoma*) are present and successfully reproducing, indicating the presence of sufficient foraging, cover, and

breeding resources. High quality wetland communities now occupy sites at Elk Park, Golden Gate Canyon State Park, and Mammoth Gulch indicating functioning hydrology.

However, in many other areas, ongoing degradation from historic activities continues to limit ecological functions, while in other sites recent disturbances have resulted in new ecological degradation. The most harmful recent disturbances to ecosystems occur where human activities are located in sensitive habitats. These activities include residential and agricultural development, domestic livestock grazing, stream channelization and diversion, and motorized and non-motorized recreation.

Historic mining and logging-related activities continue to impact streams and wetlands in Gilpin County. Placer mining, mine tailings, and mine drainage degrade water quality and riparian habitat in streams including North Clear Creek, Elk Creek, and Montana Creek. The results of historic logging operations continue to alter the hydrology of both the North Clear Creek and South Boulder Creek watersheds. Clearcut logging at locations such as Pile Hill and Jenny Lind Gulch have not recovered despite the long time since they were completed. Ongoing consequences include an altered precipitation runoff/infiltration regime and excessive soil erosion.

Modern development impacts to wetland and stream resources in Gilpin County result from development, diversions, domestic livestock grazing, and recreation. Residential and agricultural development in riparian and wetland habitat such as has occurred along North Clear Creek, Missouri Creek, and Ralston Creek and its tributaries threatens the persistence of native riparian and wetland communities and impacts stream health. Cattle often concentrate in riparian and wetland areas causing overgrazing and trampling that results in the loss of streamside canopy cover and decreased streambank stability. Consequences include excessive erosion and water quality degradation.

Stream and riparian habitat alteration due to diversions, channelization, dams and reservoirs is ubiquitous throughout Gilpin County. Consequently many streams habitats are altered, have decreased flows, and have altered thermal regimes, all of which likely impact water quality and quantity and stream biota including fish populations. Although most diversions move water out of streams, the Moffat water tunnel is a trans-basin diversion that diverts water from the western slope and into South Boulder Creek, representing a major inflow which may further increase if plans by Denver Water to increase diversions from the Fraser River are approved. Resulting alteration of the natural flow regime alters instream habitat with impacts to macro-invertebrate and fish populations.

A dense network of dirt roads provides an abundance of opportunity for motorized recreation both on- and off-road from the alpine to the montane zone and in both upland and wetland habitats. Inappropriately placed roads and their motorized recreational users have resulted in severe vegetation damage and soil erosion, which ultimately degrades stream habitat and water quality. Alpine habitat at the campgrounds at Jenny Lake, which are primarily used by recreational vehicles, is severely altered by trampling and vegetation damage.

Non-motorized recreational users can also have negative impacts on natural systems. Recreational impacts can be mitigated by locating trails, whether for hiking or for biking, outside of sensitive habitat and ensuring that users stay on designated trails. Observations indicate that trails that access Crater, Arapahoe, Forest Lakes, and Little Echo lakes are high use trails with accompanying vegetation trampling, especially on the margins of these sensitive, high alpine lakes. Recreational hiking use of Golden Gate Canyon State Park is also high, and several trails here encroach into riparian habitat including in Frazer Meadow, Dude Hole, and Ralston Creek.

Conservation, restoration, and protection of high value wetland and upland sites are essential to the long term sustainability of natural resources in Gilpin County. Functioning wetland habitat of all types is essential to stream health, but upland habitat is also an integral aspect of wetland system health that benefits both human and wildlife populations. Conservation should begin with identifying and prioritizing high value, high quality sites for protection, as well as disturbed, at-risk sites for restoration. Ongoing habitat monitoring is essential to determine appropriate and adaptive management strategies. Prioritizing, protecting, restoring, and monitoring will be essential to maintaining healthy wetland and upland environments in Gilpin County.

Finally, CNHP would like to recommend the following conservation strategies to be considered by Gilpin County and its citizens:

1). Integrate the results and specifically the PCA's profiled in this report into Gilpin County Master Plan and other land planning and review efforts. The PCAs will assist in identifying priority areas for environmental conservation. The PCAs in this report provide a basic framework for implementing a comprehensive conservation program. The B2 and B3 sites, because they have global biological significance, are in need of priority attention. Consider incentive-based programs such as purchasing development rights or outright purchase from willing owners of land for significant sites 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 state and federal funding for conservation projects, such as those offered through the Colorado Division of Wildlife.

2). Consider the data presented in this report when reviewing activities proposed in or near Potential Conservation Areas to determine whether or not those activities may adversely affect elements of biodiversity. All of the PCAs presented contain elements of biodiversity that are of state or global significance. Weighing the biodiversity values represented by PCAs should allow planners and biologists to consider natural resource conservation when making land use decisions. Certain land uses on or near a site may affect the element(s) present there. 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 are considered, they should be compared to the maps presented herein (also available in GIS format). If a proposed project has the potential to impact a site, planning personnel should contact persons, organizations, or agencies with the appropriate biological expertise for input in the planning process. CNHP is continually updating biodiversity data throughout the state and can provide up-to-date information in the area of concern. To contact CNHP's Environmental Review Coordinator call (970) 491-7331.

3). Recognize the importance of larger, contiguous natural communities. While the PCAs identified in this report contain known locations of significant elements of natural diversity, protection of large contiguous riparian corridors or other large wetland areas may ensure that we do not lose species that have not yet been located. Work to protect large blocks of land within the watershed 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 part of our natural diversity and their needs for winter range and access to protected corridors to food and water should be taken into consideration.

4). Encourage public education outreach, functions and publications. A significant early step in the process of conserving biodiversity is educating local citizens and other stakeholders on the value that such areas offer the public. Gilpin County is rich in animal and plant diversity, and conveying the functions and values 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 Gilpin County will increase awareness of the uniqueness of the habitats within the County.

5). Increase efforts to protect biodiversity by promoting cooperation and incentives among landowners, pertinent government agencies and non-profit conservation organizations. Involve all stakeholders in land use planning. The long-term protection of natural diversity in Gilpin County will be facilitated by the cooperation of private landowners, businesses, government agencies, and non-governmental 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. By developing incentives that encourage biodiversity considerations in land-use planning, the likelihood of conserving biodiversity should increase. Such incentives will make planning for conservation a higher priority for private and public entities.

6). Develop and implement comprehensive program to address loss of wetlands. Wetlands occupy only 2% of the land in the County, but are important to plants, wildlife, and people. In conjunction with the information contained in this report, information regarding the degree and trend of loss for all wetland types (i.e., emergent marshes, riparian shrublands and forests, seeps/springs, etc.) should be sought and utilized to design and implement a comprehensive approach to the management and protection of Gilpin County wetlands.

As part of this project, all the National Wetland Inventory Maps were digitized for the County, providing so that County can now better manage their wetlands. For additional information see

U.S. Fish and Wildlife Service Wetlands Mapper http://www.fws.gov/wetlands/Data/Mapper.html, and the Colorado State Parks Best Management Practices for Wetlands http://parks.state.co.us/NaturalResources/CNAP/Publications/.

Additionally, encourage and support statewide wetland protection efforts such as the Colorado Division of Wildlife's Wetlands Program http://wildlife.state.co.us/LandWater/WetlandsProgram/. 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 Colorado State University Extension or other local agencies. Encourage communication and cooperation with landowners regarding protection of wetlands in Gilpin County.

Sites of Biodiversity Significance

The 14 most important sites in Gilpin County profiled in this section as Potential Conservation Areas (PCAs). These are sites with biodiversity ranks of B2, B3, and B4. One Site of local significance is also profiled for general informational purposes (see Table 10, Map 2).

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. Optional fields marked with an * may or may not be included in Potential Conservation Area descriptions.

PCA Profile Explanation:

Biodiversity Rank: B#
Identifies 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).

USGS 7.5-minute Quadrangle name(s): A list of USGS 7.5 minute quadrangles which contain the boundary of the PCA; all quadrangles are from Colorado unless otherwise noted.

Size: Expressed in acres.

***Elevation:** Expressed in feet.

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

***Key Environmental Factors:** A description of key environmental factors that are known to have an influence on the PCA, such as seasonal flooding, wind, geology, soil type, etc.

***Climate Description:** Where climate has a significant influence on the elements within a PCA, a brief description of climate, weather patterns, seasonal and annual variations of temperature and precipitation patterns is included.

***Land Use History:** General comments concerning past land uses within the PCA which may affect the elements occurring within the boundary.

***Cultural Features:** Where pertinent, a brief description is given of any historic, cultural, or archeological features found within the PCA.

Biodiversity Significance 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 4 for explanations of ranks and Table 5 for legal designations.

Boundary Justification: Justification for the location of the proposed PCA 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 Urgency Rank Comments:** Brief comments to justify the rating assigned to the PCA.

***Management Urgency Rank Comments:** Brief comments to justify the rating assigned to the PCA.

***Land Use Comments**: Brief comments describing the current and/or past land use as it affects those elements contained in the PCA.

***Natural Hazard Comments**: If any potential natural hazards such as cliffs, caves, poisonous plants, etc. are prominent within the PCA and relevant to a land manager or steward, comments are included along with any precautions that may need to be taken.

***Exotic Species Comments**: A description of potentially damaging exotic (i.e., alien) flora and/or fauna within the PCA, including information on location, abundance and their potential effect on the viability of the targeted elements within the PCA.

***Offsite Considerations:** Where offsite land uses or other activities (e.g., farming, logging, grazing, dumping, watershed diversion, etc.) may have a significant influence on the elements within a PCA, a brief description of these is included.

***Information Needs**: A brief summary of any information that may still be needed in order to effectively manage the PCA and the elements within it.

Mammoth Gulch

Biodiversity Rank - B2: Very High Biodiversity Significance

Protection Urgency Rank - P2: Threat/Opportunity within 5 Years

Management Urgency Rank - M3: Needed within 5 Years to Maintain Quality

U.S.G.S. 7.5-minute quadrangles: Nederland, Empire, East Portal, Central City

Size: 2,874 acres (1,163 ha) **Elevation:** 9,040 - 10,800 ft. (2,755 - 3,292 m)

General Description: This site is located on the east side of the Continental Divide, in the Front Range Mountains of Gilpin County. Lands are publicly owned in much of this site, with management by the Arapaho Roosevelt National Forest; however, numerous private parcels and mining claims are scattered throughout the site in both upland and riparian habitat. This site occurs in a northeast trending valley that is drained by a first order stream and encompasses ecological zones from the upper subalpine down to the upper montane. Steep gradient slopes characterize northwest-facing valley walls while slopes on the southeast-facing side of the valley typically have a moderate-gradient and the valley floor topography alternates between wide, low-gradient reaches and narrow, moderate-gradient reaches. Site geology is characterized primarily by two types of geologic units. The northwest-facing side of the valley and the valley floor are predominantly Precambrian age metamorphic rocks derived principally from sedimentary rocks with a composition of biotitic gneiss, schist, and migmatite and that locally contains minor hornblende gneiss, calc-silicate rock, quartzite, and marble (Tweto 1979). The southeast-facing side of the valley is mainly composed of quaternary age, unconsolidated surficial deposits and rocks from glacial drift of the Pinedale and Bull Lake glaciations and also includes some unclassified glacial deposits (Tweto 1979). At elevations above these alluvial deposits, geology is similar to geology on the north-facing valley wall with Precambrian age metamorphic rocks. Additionally, at higher elevations on the perimeter of the site, there are several areas with Precambrian age felsic and hornblendic gneisses derived principally from volcanic rocks (Tweto 1979). Soils in the upper reaches of the valley bottom and up onto south-facing toeslopes are characterized by Leighcan family, till substratum-Cryaquolls complex, 5 to 40 percent slopes, and Leighcan-Catamount families, moist complex, 5 to 40 percent slopes. In the lower reaches of the site below the now-drained Mammoth Creek reservoir, soils on the valley bottom and up onto toeslopes on both sides of the valley are characterized by Cryaquolls-Typic Cryohemists complex, 0 to 15 percent slopes; Leighcan family, till substratum, 5 to 40 percent slopes; and Cryaquolls-Gateview complex, 0 to 15 percent slopes (USDA 2010). Soils on south-facing valley wall mid- and high-slopes are characterized by a mosaic of soils including: Bross family-Rubble land-Matcher family complex, 40 to 150 percent slopes; Leighcan family, warm-Rock outcrop complex, 40 to 150 percent slopes; Leighcan family, till substratum-Cryaquolls complex, 5 to 40 percent slopes;

Rogert family, 40 to 75 percent slopes; and Leighcan family, till substratum, 40 to 75 percent slopes. Soils on north-facing valley wall mid-slopes include: Leighcan family, 40 to 75 percent slopes; Leighcan family-Rock outcrop complex, 40 to 150 percent slopes; Goosepeak-Catamount families, moist complex, 5 to 40 percent slopes; Leighcan-Catamount families, moist-Rock outcrop complex, 40 to 150 percent slopes; and on high slopes Goosepeak-Catamount families, moist complex, 5 to 40 percent slopes. Fens occur throughout this site and are located on both toeslopes and on the valley floor. Fens occupy a variety of soil types including: Leighcan family, till substratum-Cryaquolls complex, 5 to 40 percent slopes; Leighcan-Catamount families, moist complex, 5 to 40 percent slopes; Leighcan family, till substratum-Cryaquolls complex, 5 to 40 percent slopes; Cryaquolls-Typic Cryohemists complex, 0 to 15 percent slopes; and Cryaquolls-Gateview complex, 0 to 15 percent slopes (USDA 2010). Cryaquolls occur on flood plains; parent material consists of gravelly alluvium and/or gravelly glaciofluvial deposits and organic matter in the surface horizon is about 85%. The Gateview family component consists of gravelly alluvium and/or gravelly glaciofluvial deposits and has organic matter content in the surface horizon of about 2%. Cryohemists occur on basin floors; parent material consists of organic material and organic matter content in the surface horizon is about 85 percent. Leighcan family till substratum occurs on moraines and is derived from igneous and metamorphic rock; organic matter content is about 1%. Catamount family moist components occur on mountain slopes; parent material is residuum weathered from igneous and metamorphic rock and organic matter content in the surface horizon is about 85% (USDA 2010). Mammoth Gulch is drained by a first order stream which has its headwaters at James Peak Lake. James Peak Lake is located in the James Peak Wilderness Area on the Continental Divide. Snowmelt is the primary source of water that supplies both the lake and stream and also results in abundant shallow ground water flow. Shallow ground and surface water discharge from adjacent slopes has created extensive wetland complexes on slopes, benches and on the valley bottom of Mammoth Gulch. Water from these wetlands eventually flows into the stream that drains the gulch. Local wetland hydrology in this site is strongly influenced by the interaction of climate and geomorphology. Here wetland hydrology is strongly connected to shallow ground and surface water flow. Snowmelt likely contributes the largest proportion of water to these wetlands through its influence on ground and surface water dynamics. Snowmelt interacts with local geomorphology to maintain high water tables in wet meadows and fens and also exerts major control over riparian wetlands by influencing soil saturation characteristics (flooding frequency, duration, timing and depth) that results from groundwater flow and out-of-bank flooding in the riparian zone (Rocchio 2005). Additionally, by releasing water throughout the growing season, these high altitude headwater wetlands make an important contribution to late summer flows in lower elevation streams. Late summer precipitation may also be important to the fen wetlands in this site by replenishing local aquifers thereby maintaining sufficiently high water tables to support fen development (Cooper 1990). Ecosystems in the site are diverse and vary with elevation, gradient, aspect, soil moisture, and geology. Uplands are a mosaic of

slope fens, subalpine grass and forb meadows, aspen (*Populus tremuloides*) woodlands, lodgepole (*Pinus contorta*) forests, limber (*Pinus flexilis*) forests, coniferous forests that are co-dominated by Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), and lodgepole pine and mixed deciduous / coniferous forests that are co-dominated by the aforementioned tree species. Valley floor ecosystems are characterized by a diverse mosaic of wetland communities that vary with reach gradient and topographic position. Wetland systems include subalpine/montane riparian shrublands, forests and woodlands, and fens and wet meadows. Forested riparian wetlands are characterized by subalpine fir - Engelmann spruce forests with a shrub layer consisting of willow and non-willow species including especially planeleaf willow (*Salix planifolia*), red-osier dogwood (*Cornus sericea*), and thinleaf alder (*Alnus incana*) with an herbaceous layer characterized by mix of forbs and graminoids. Shrub dominated wetlands are characterized by either planeleaf willow or bog birch (*Betula nana*) with a graminoid-dominated herbaceous layer that includes species such as bluejoint reedgrass (*Calamagrostis canadensis*), water sedge (*Carex aquatilis*), and beaked sedge (*Carex utriculata*), and also forbs such as marsh marigold (*Caltha leptosepala*), elephantella (*Pedicularis groenlandica*) and queen's crown (*Sedum rhodanthum*). Fens occur throughout the site, occupying slopes, swales and the valley floor. Fens are characterized by both tree- and shrub-dominated communities. Forested fens are characterized by a tree canopy dominated by Engelmann spruce and/or subalpine fir, often with lodgepole pine intermixed and with an understory of willow such as planeleaf willow and/or non-willow shrubs such as bog birch and shrubby cinquefoil (*Dasiphora floribunda*). The herbaceous layer is always graminoid-dominated but a diverse cover of forbs is also present. Shrub fens are characterized by a shrub canopy dominated by either planeleaf willow or bog birch with an herbaceous layer dominated by graminoids but that includes a diverse cover of forbs. Dominant graminoids in fen wetlands include water sedge, beaked sedge, ebony sedge (*Carex ebenea*), silvery sedge (*Carex canescens*), golden sedge (*Carex aurea*), soft-leaved sedge (*Carex disperma*), and poor sedge (*Carex paupercula*). Common forbs include bunchberry (*Cornus canadensis),* green bog orchid (*Platanthera huronensis),* white bog orchid (*P. dilatata),* northern twayblade (*Listera convallarioides)*, marsh marigold (*Caltha leptosepala*), elephantella, queen's crown, star gentian (*Swertia perennis*), hemlock parsley (*Conioselinum scopulorum*), arrowleaf ragwort (*Senecio triangularis),* pink pyrola *(Pyrola asarifolia),* alpine speedwell (*Veronica wormskjoldii*), and Hornemann willowherb *(Epilobium hornemannii),* mountain parsley (*Cymopterus lemmonii*), monkshood (*Aconitum columbianum),* common miterwort *(Mitella pentandra),* bittercress (*Cardamine cordifolia*) and twisted-stalk (*Streptopus amplexifolius*). Soils in these fens are hummocky and the ground layer is characterized by a dense cover of mosses dominated by *Sphagnum* spp., while depressions between hummocks are typically inundated and have a dense litter layer. Native wildlife is abundant and includes coyote (*Canis latrans),* American marten (*Martes americana),* long-tailed weasel (*Mustela frenata),* short-tailed weasel *(Mustela erminea),* elk *(Cervus elaphus),* moose (*Alces alces),* mule deer (*Odocoileus hemionus*), snowshoe hare *(Lepus americanus),* common porcupine (*Erethizon*

dorsatum), pine squirrel *(Tamiasciurus hudsonicus),* golden-mantled ground squirrel (*Spermophilus lateralis*), least chipmunk (*Tamias minimus*), deer mouse *(Peromyscus maniculatus*) and western jumping mouse (*Zapus princeps*).

Key Environmental Factors: Hydrology and soils are key environmental factors influencing site biota. Specifically, shallow ground and surface water flow from adjacent slopes maintains wetland hydrology and enables the development of peat soils. Peat soils increase residence time of water and enable the development of wetland vegetation which provides the material for and enables the maintenance of peat soils.

Climate Description: Climate in Gilpin County varies dramatically with elevation, aspect and time of year. Higher elevations to the north and west are colder and wetter than lower elevations to the east and south. Temperature and precipitation varies from east to west corresponding to elevation change. Average annual temperature and length of the growing season decrease as elevation increases while average annual precipitation increases. In general, temperatures decrease at a rate of approximately 3 degrees F for every thousand feet of elevation gain. Additionally, the pattern of precipitation distribution varies from the eastern to the western parts of the county. Western locations at higher elevations receive the majority of their precipitation during late winter and early spring while eastern locations receive the majority of their moisture during early spring and summer (Siemer 1977). The site is located in the western part of the county at elevations between approximately 9,000 and 10,800 feet elevation. Here, average annual precipitation from 1971 through 2000 was 30.99 inches; coldest temperatures occurred in January with an average maximum temperature of 29.59 °F and an average minimum of 10.4 °F; warmest temperatures occurred in July with an average maximum of 70.32 °F and an average minimum temperature of 43.11 °F (Prism 2010).

Land Use History: With the discovery of native gold in Gilpin County 1858, much of the County, including the area in and surrounding the Mammoth Gulch site was extensively mined for gold and other ore minerals. To support the infrastructure and development that accompanied mining, other land uses including grazing and clearcut logging occurred throughout this site and throughout much of the County (Petersen and Borchert 2010). Additionally, a reservoir was constructed in this valley in 1932 but was deemed unsafe and was breached in 1986.

Biodiversity Significance Rank Comments (B2): This site is drawn for a good (B-ranked) occurrence of the globally imperiled (G2/S2) iron fen, Engelmann spruce / bog birch / water sedge / sphagnum spp. (*Picea engelmannii / Betula nana / Carex aquatilis / Sphagnum* spp). Other community occurrences within the site include excellent and good occurrences (A and B-ranked) of the state imperiled (GNR/S2) diamondleaf willow / beaked sedge (*Salix planifolia / Carex utriculata*) shrubland, and good (B-ranked) and fair (C-ranked) occurrences of the state rare (G4/S2S3) diamondleaf willow / bluejoint reedgrass (*Salix planifolia / Calamagrostis canadensis*).

Natural Heritage element occurrences at the Mammoth Gulch PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	(Picea engelmannii) / Betula nana / Carex aquatilis - Sphagnum angustifolium Woodland	Iron Fen	G2	S2				B	2009-08-17
Natural Communities	Salix planifolia / Calamagrostis canadensis Shrubland	Subalpine Riparian Willow Carr	G4	S2S3				C	2009-08-19
Natural Communities	Salix planifolia / Calamagrostis canadensis Shrubland	Subalpine Riparian Willow Carr	G4	S2S3				B	2009-08-16
Natural Communities	Salix planifolia / Carex utriculata Shrubland	Diamondleaf Willow / Beaked Sedge	GNR	S2				A	2009-08-17
Natural Communities	Salix planifolia / Carex utriculata Shrubland	Diamondleaf Willow / Beaked Sedge	GNR	S2				B	2009-08-16

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The boundary was drawn to encompass the ecological and hydrological processes essential to ecosystem maintenance and sustainability of the element occurrences. This wetland complex of fens, peatlands, and riparian habitat is sustained by groundwater inflows that maintain a water table at or near the ground surface for much of the year. These processes include abundant shallow surface and groundwater flow from surrounding hillslopes to enable wetland recharge with a sufficiently high water table and hydroperiod that promotes the ongoing development and maintenance of peat soils. The delineated area is likely sufficient to allow for the functioning of ecological and hydrological process that support the wetland communities and provide a buffer against direct disturbance.

Protection Urgency Rank Comments (P2): Livestock grazing and 4-wheel drive roads have altered vegetation structure and composition as well as the natural hydrologic regime. Dirt roads have interrupted and altered shallow ground and surface water flow and severely fragmented habitat. Excessive grazing has reduced vegetative cover, vigor, and recruitment, resulting in drying soils and hummock deterioration. Additionally, although vegetation cover is largely composed of native species, physiognomic complexity is diminished due to over-grazing, and community composition has been altered. Stream quality has also been impacted by

excessive grazing; excessive streambank downcutting and bank erosion has impacted stream quality with undue sedimentation.

Management Urgency Rank Comments (M3): A reduced grazing regime would greatly benefit the element occurrences as well as enhance stream quality and function. Closing dirt roads to motorized use would greatly enhance the likelihood of long-term viability.

Information Needs: Additional inventories are needed to identify and update the status of the historic and general records within and near this site.

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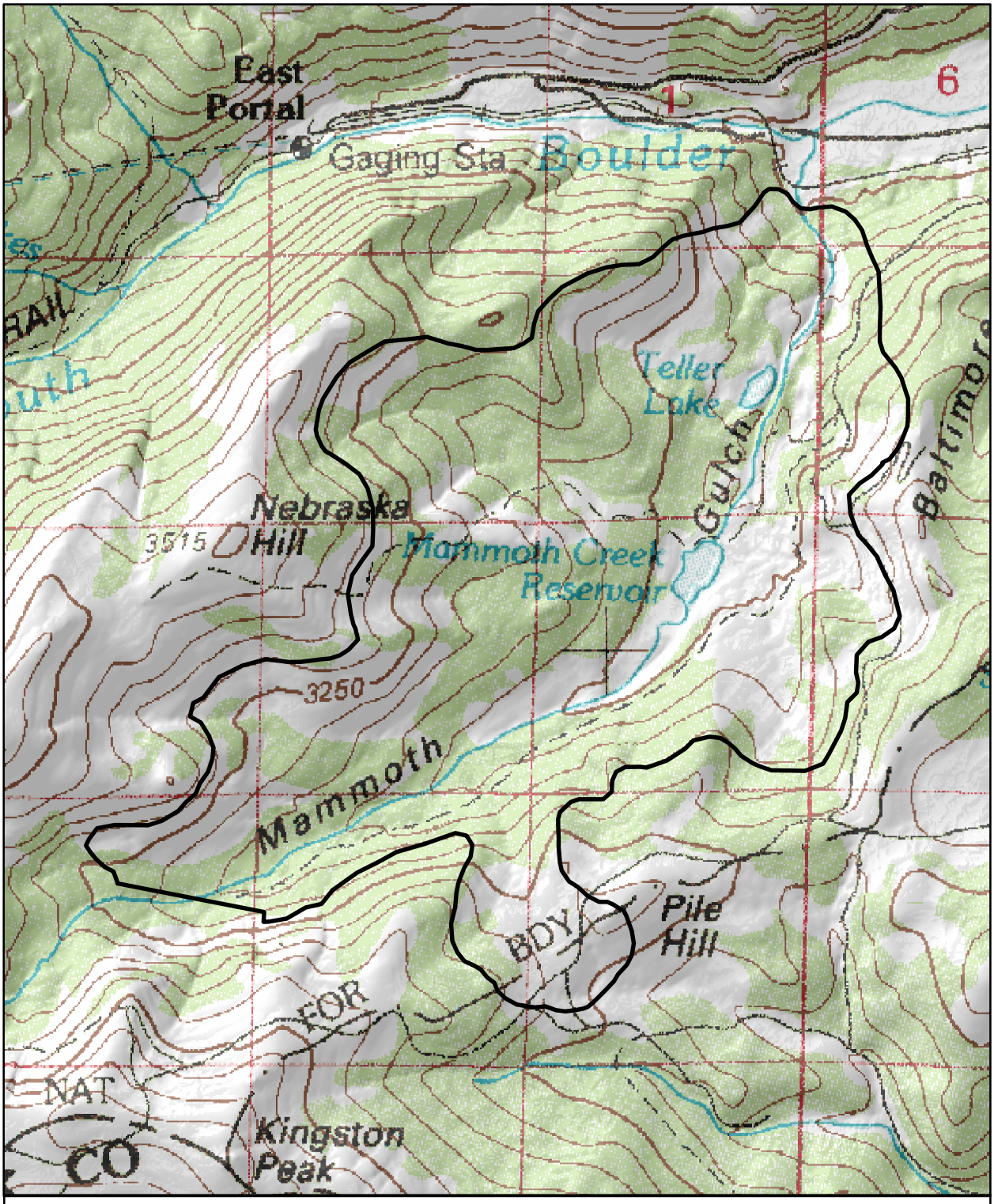

Map 3. Mammoth Gulch Potential Conservation Area, B2: Very High Biodiversity Significance

Jenny Lake

Biodiversity Rank - B3: High Biodiversity Significance

Protection Urgency Rank - P2: Threat/Opportunity within 5 Years

Management Urgency Rank - M2: Essential within 5 Years to Prevent Loss

U.S.G.S. 7.5-minute quadrangles: East Portal

Size: 386 acres (156 ha) **Elevation:** 9,100 - 11,800 ft. (2,774 - 3,597 m)

General Description: This site is located on the east slope of the Front Range in the James Peak Wilderness. The site is the head of the Jenny Creek sub-watershed which is delineated on the east by the glacially sculpted Continental Divide, on the west by a topographical transition to steep, valley walls accompanied by an ecosystem transition to subalpine forest, and on the north and south by east-west trending arêtes. At upper elevations, the Jenny Lake site encompasses alpine ecosystems down to lower subalpine systems. Glacial action during the Pleistocene carved the alpine landscape into cirques, arêtes, and steep valley walls, creating the template for the development of current day ecosystems. Alpine uplands are a mosaic of alpine tundra ecosystems including turf meadows, fellfields, snowfields, stands of scrub aspen, and talus and scree fields. Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) krummholz marks the transition between alpine and subalpine systems. Habitat in the subalpine is dominated by expansive stands of Engelmann spruce - subalpine fir forest. Canopy openings are characterized by herbaceous forb and graminoid meadows and wetlands. Wetlands in this site include slope wetlands, wet meadows and riparian and lacustrine wetlands. Riparian wetlands in the alpine are characterized by a lush cover of mesic forb species such as heartleaf bittercress (*Cardamine cordifolia*), tall chiming bells (*Mertensia ciliata*), marsh marigold (*Caltha leptosepala*), and elephantella (*Pedicularis groenlandica*). From the upper to the lower subalpine, riparian wetlands are typically characterized either by forested wetlands or willow carr communities. Forested wetlands are characterized by Engelmann spruce - subalpine fir / tall fringed bluebell forest (*P. engelmannii - A .lasiocarpa / Mertensia ciliata*) and Engelmann spruce - subalpine fir / Drummond's willow (*P. engelmannii - A. lasiocarpa / S. drummondiana*) forest. Lacustrine wetlands, at the inundated margins of Jenny Lake, are characterized by a mix of mesic graminoids and forbs such as water sedge, bluejoint reedgrass (*Calamagrostis canadensis*), and rock sedge (*Carex scopulorum*) and queen's crown (*Sedum rhodanthum*), elephantella and marsh marigold. In the lower subalpine, lacustrine wetlands on the margins of Zarlengo Lake, are characterized by willow dominated communities including planeleaf willow / bluejoint reed grass (*Salix planifolia / Calamagrostis canadensis*) and planeleaf willow / water sedge (*S. planifolia / C. aquatilis*) shrublands. Wet meadows occur on low-gradient sites throughout the subalpine. Meadow communities include small, forb-dominated fens with a lush cover of species such as bog saxifrage (*Saxifraga oregana*) and marsh

marigold and graminoid dominated sites, with shallow accumulations of peat. Graminoid communities include water sedge, bluejoint reedgrass, and few-flower spikerush (*E. quinqueflora*) herbaceous vegetation. In the alpine zone, above Jenny Lake, slope wetlands, dominated by willow shrublands, characterize the low slopes of a broad glacial cirque at the head of the valley. Habitat here is a mosaic of dense willow (*Salix spp*.) shrubland, krummholz stands of Engelmann spruce (*Picea engelmannii*), open water ponds and lush herbaceous cover in canopy openings. Wolf willow (*Salix wolfii*) with an understory of mesic forbs dominates the carr but includes other willow and non-willow shrubs especially short-fruit (*S. brachycarpa*) and planeleaf (*S. planifolia*) willow and Colorado currant (*Ribes coloradense*) and prickly currant (*R. montigenum*). Habitat patchiness results in complex vegetation physiognomy adding to the overall habitat complexity created by the wide diversity of surrounding upland communities. Herbaceous cover is light under the willow canopy, but dense in canopy openings. Herbaceous cover is dominated by forbs but no one forb species is more abundant than another. Forb species occur primarily under the canopy and include arctic gentian (*Gentiana algida),* rose gentian (*Gentianella amarella),* saffron senecio (*Senecio crocatus),* viviparous bistort (*Polygonum viviparum),* American bistort (*P. bistortoides),*fireweed *(Chamerion angustifolium),* king's crown (*Sedum integrifolium),* queen's crown (*S. rhodanthum),* star gentian (*Swertia perennis),* alpine parsley (*Oreoxis alpina),* globeflower (*Trollius albiflorus),* marsh marigold (*Caltha leptosepala),* elephantella (*Pedicularis groenlandica),* hemlock parsley (*Conioselinum scopulorum)* and subalpine arnica (*Arnica mollis)*. Graminoids occur primarily in canopy openings and include mountain sedge (*Carex scopulorum)*, water sedge (*C. aquatilis)*, ebony sedge (*C. ebenea),* new sedge (*C. nova),* Norway sedge (*C. norvegica),* tufted hairgrass (*Deschampsia caespitosa),* Drummond's rush (*Juncus drummondiana),* Merten's rush (*J. mertensianus),* alpine timothy (*Phleum alpinum),* bluejoint reedgrass (*Calamagrostis canadensis),* shortawn foxtail (*Alopecurus aequalis)* and few-flower spikerush (*Eleocharis quinqueflora).* Increaser herbaceous species occur at the east margin of the carr where trampling is high and include western yarrow (*Achillea millefolium)* and rosy pussytoes (*Antennaria rosea)*. Geology in the alpine zone and down into the subalpine is characterized as primarily either Quaternary age younger alluvium and unconsolidated surficial deposits from glacial drift of Pinedale and Bull Lake glaciations or Precambrian age metamorphic rocks derived principally from sedimentary rocks. Additionally, the lower subalpine zone has a few small areas of early Tertiary and late Cretaceous age intrusive rocks and Precambrian age metamorphic rocks derived principally from volcanic rocks (Tweto 1979). Soils on the Continental Divide and on the headwalls of the cirque below the Divide are comprised of Bross-Matcher families-Lithic Cryorthents complex. On lower gradient slopes at the base of the cirque, soils underlying the willow carr slope wetland are comprised of Leighcan family-Cryaquolls-Moran family complex. In the subalpine zone riparian soils adjacent to Jenny Creek are Cryaquolls-Gateview complex. Upland soils, adjacent to riparian habitat are Leighcan family, till substratum. In the lower subalpine, lacustrine and meadow wetland soils are characteristically Goosepeak-Catamount families, moist complex (USDA 2010). Local wetland hydrology is influenced by the interaction of climate,

geomorphology, and biotic processes. In this site, hydrology is strongly connected to shallow ground and surface water flow, which is dependent on snowmelt. Snowmelt contributes the largest proportion of water to these wetlands through its influence on ground and surface water dynamics. Snowmelt interacts with local geomorphology to maintain high water tables in slope wetlands, wet meadows and also exerts major control over riparian and lacustrine wetlands by influencing soil saturation characteristics (flooding frequency, duration, timing, and depth) that results from groundwater flow and out-of-bank flooding (Rocchio 2005). Snowmelt sustains the wetlands that lie above Jenny Lake. Water that flows through these wetlands discharges into Jenny Lake and from there into Jenny Creek making an important contribution to late-summer flows stream base flow as well as to lake and riparian habitat. Additionally, beaver (*Castor canadensis*) are primary maintainers of these wetland ecosystems (Rondeau 2001) and contribute to water storage and sediment removal. Although historic beaver activity is indicated, no recent signs of beaver activity are in evidence.

Key Environmental Factors: Climate, hydrology, geology, and biota are key driving factors that have enabled the development and maintenance of the element plant communities and animal species present in the site. A natural hydrologic regime is essential to the sustainability of elements in this site. Especially essential to wetland and stream sustainability is shallow ground and surface water flow derived from the melting snowpack and, secondarily, out-of-bank streamflows. Beaver (*Castor canadensis*) evolved with western aquatic ecosystems and are an essential environmental factor in stream and riparian wetland sustainability.

Climate Description: Climate in Gilpin County varies dramatically with elevation, aspect, and time of year. Higher elevations to the north and west are colder and wetter than lower elevations to the east and south. Temperature and precipitation varies from east to west corresponding to elevation change. Average annual temperature and length of the growing season decrease as elevation increases while average annual precipitation increases. In general, temperatures decrease at a rate of approximately 3 °F for every thousand feet of elevation gain. Additionally, the pattern of precipitation distribution varies from the eastern to the western parts of the county. Western locations at higher elevations receive the majority of their precipitation during late winter and early spring while eastern locations receive the majority of their moisture during early spring and summer (Siemer 1977). The site is located in the most western part of the county at elevations between approximately 9,000 and 11,000 feet elevation. At uppermost elevations in this site average annual precipitation from 1971 through 2000 was 35.08 inches; coldest temperatures occurred in January with an average maximum temperature of 25.45 °F and an average minimum of 6.30 °F; warmest temperatures occurred in July with an average maximum of 65.75 °F and an average minimum temperature of 33.33 °F; at the lower elevations to the east average annual precipitation from 1971 through 2000 was 28.72 inches; coldest temperatures occurred in January with an average maximum temperature of 31.41 °F and an average minimum of 8.58 °F; warmest

temperatures occurred in July with an average maximum of 73.18 °F and an average minimum temperature of 41.72 °F (Prism 2010).

Land Use History: Although much of Gilpin County was impacted by mining exploration, most of the high elevations landscape near the Continental Divide, including this site, did not see mining activity (Gilpin County 2010). The first humans to use the land in this site were likely Native Americans. Numerous sites in alpine ecosystems along the Continental Divide of the Front Range, including near the Rollins Pass area, have been identified as Paleoindian and Prehistoric age game drive sites (Benedict 2005).

Cultural Features: Paleoindian sites are potentially present.

Biodiversity Significance Rank Comments (B3): This site is drawn for a good (B-ranked) occurrence of the globally vulnerable (G3/S3) wolf willow (*Salix wolfii*) / mesic forbs shrubland and a fair (C-ranked) occurrence of the globally vulnerable (G3/S3) plant, Rocky Mountain columbine (*Aquilegia saximontana*).

Natural Heritage element occurrences at the Jenny Lake PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	Salix wolfii / Mesic Forbs Shrubland	Subalpine Riparian Willow Carr	G3	S3				B	2009-08-12
Vascular Plants	Aquilegia saximontana	Rocky Mountain columbine	G3	S3				C	2007-07-23

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The site was delineated to include ecological systems and processes that are essential to maintaining the plants and communities as well as to provide a buffer against disturbance. Climate change was also considered in boundary delineation; alpine ecosystems are especially vulnerable and species that depend on tundra may disappear as alpine tundra diminishes with the advance of trees and shrubs (USFWS 2010). Hydrology is the primary process essential to long-term wetland plant community viability. Alpine/subalpine wetlands are often isolated hydrologically from other wetlands, and easily impacted by surrounding land use (Rondeau 2001). Thus maintaining an intact and unfragmented hydrologic regime is essential to element viability. The alpine and subalpine element wetland plant communities in this site are reliant on water levels at or near the surface for much or all of the growing season (Rondeau 2001). Snowmelt from nearby surrounding ridges and slopes maintains abundant shallow ground and surface flow which contributes the primary source of water to slope and riparian wetlands.

Protection Urgency Rank Comments (P2): Alpine and upper subalpine ecosystems

are managed by the USFS. These public lands are heavily used by motorized recreationists and car campers. Stresses from motorized recreational uses on public land will likely reduce element viability within five years. An opportunity exists to mitigate threats if action is immediately taken. Lower elevation sites are in private ownership. The landowner is conservation minded and currently manages the site for wildlife values.

Management Urgency Rank Comments (M2): The natural hydrologic regime and water quality throughout the site are altered by a road grade, campgrounds, and human activity which especially impact Jenny Lake, the adjacent slope wetland and the stream reach below Jenny Lake. Additionally, a high-use, vehicle-accessed campground contributes to hydrologic alteration. Above the lake and slope wetland, the road grade alters the infiltration and runoff regime. Below the wetland, hydrologic alteration results in severe downcutting and sedimentation in the stream channel. Campgrounds that are located around the lake shore have eliminated willow habitat and disturbed wetland habitat with vegetation trampling and soil compaction, wood cutting, and copious amounts of human waste. These activities have the potential to negatively impact the occurrences. The occurrences will benefit by closing campgrounds that are located on the margins of the wetlands, on the lakeshore and in riparian habitat and closing the road to motorized access at least 1.5 miles before it reaches Jenny Lake.

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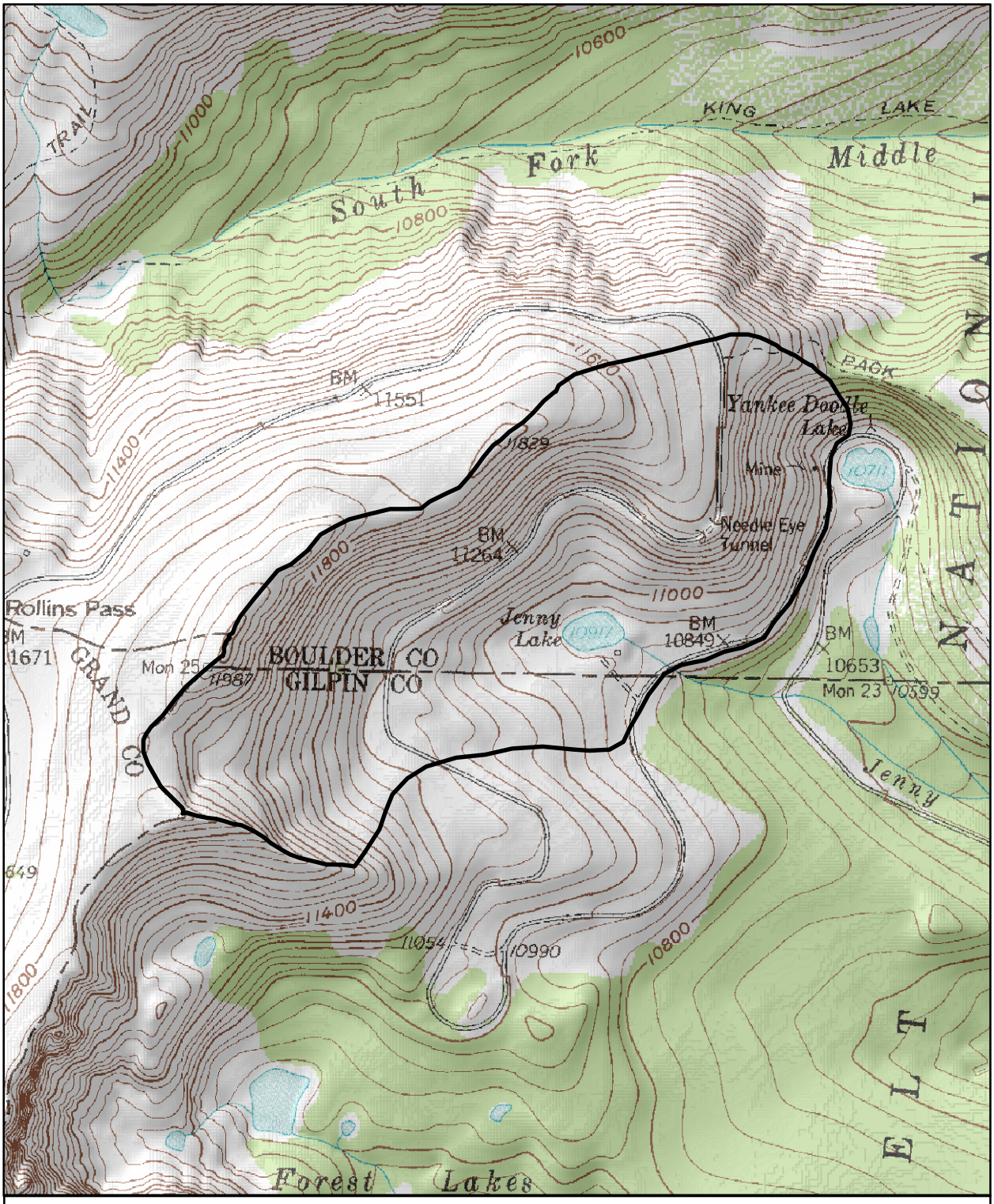

Colorado Natural Heritage Program
Colorado State University
1474 Campus Delivery
Fort Collins, CO 80523-1474
http://www.cnhp.colostate.edu

Map Date: 03/17/2011

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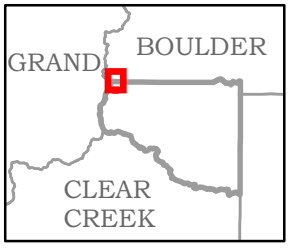
Legend

PCA Boundary

East Portal, 39105-H6

7.5 Minute Digital Raster Graphic Produced by the U.S. Geological Survey

Location in Gilpin County



Map 4. Jenny Lake Potential Conservation Area, B3: High Biodiversity Significance

Lower South Boulder Creek

Biodiversity Rank - B3: High Biodiversity Significance

Protection Urgency Rank - P2: Threat/Opportunity within 5 Years

Management Urgency Rank - M2: Essential within 5 Years to Prevent Loss

U.S.G.S. 7.5-minute quadrangles: Tungsten

Size: 2,252 acres (911 ha) **Elevation:** 7,320 - 8,448 ft. (2,231 - 2,575 m)

General Description: The Lower South Boulder Creek site is located in the northeast corner of Gilpin County and southeast Boulder County, Colorado, in a steep-walled, east-west trending canyon. The headwaters of South Boulder Creek are on the eastern slope of the Continental Divide in the mountains of the Front Range in the James Peak Wilderness. From its snowmelt origins in the alpine tundra, South Boulder Creek flows steeply downhill through spruce - fir forests to emerge in the montane zone on the valley floor. Where the stream leaves the mountains and flows into this wide, low-gradient valley, it is joined by flows from the Moffat water tunnel, which diverts water from the Williams Fork basin and Fraser River on the Western Slope to the East Slope, through the tunnel and into South Boulder Creek. From here the stream flows eastward, for approximately 20 km, across generally moderate to low gradient open terrain, to the Foothills of the lower montane zone before entering the steep-gradient, narrow canyon that characterizes the landscape of this site. The stream flows through the canyon for approximately 4.6 km before entering Gross Reservoir and the lower boundary of this site. Geology throughout the site is characterized by Precambrian age (1,650-1,730 M.Y.) granitic rocks (Tweto 1979). Soils are characterized primarily four soil types. Riparian soils occupy a narrow zone, 20-70 m wide, in the bottom of the drainages in the riparian zone and are classified as Pachic Argiustolls-Aquic Argiudolls complex, 0 to 15 percent slopes. Pachic Argiustolls occur on stream terraces; the parent material consists of alluvium derived from igneous, metamorphic, and sedimentary rock; the natural drainage class is well drained and organic matter content in the surface horizon is about 2 percent. Aquic Argiudolls occur on alluvial flats; parent material consists of alluvium derived from igneous metamorphic and sedimentary rock; the natural drainage class is poorly drained; this soil is occasionally flooded and the organic matter content in the surface horizon is about 2 percent (USDA 2010). Soils on north-facing upland slopes are classified as Bullwark-Catamount families-Rock outcrop complex, 40 to 150 percent slopes. Soils on south-facing slopes are typically Ratake-Cathedral families-Rock outcrop complex, 40 to 150 percent slopes. Ridge-tops are typically comprised of Legault-Hiwan families complex, 5 to 40 percent slopes (USDA 2010). The South Boulder Creek watershed is one of two major sub-watersheds in Gilpin County and drains northern Gilpin County and approximately 30% of the entire Boulder Creek Watershed (BASIN 2010). South Boulder Creek originates as snowmelt in the James Peak Wilderness on the east

slope of the Continental Divide. Shallow ground and surface water flow as well as numerous streams and summer rains maintain the natural flow regime in South Boulder Creek as it journeys eastward. South Boulder Creek hydrology has, however, been altered by diversions both into and out of the stream, by ground water withdrawals, by channel modification and by alteration of upland habitat. Where the stream leaves the high mountains and flows onto the valley floor, it is joined by water diverted from the west-slope, through the Moffat water tunnel and into South Boulder Creek. Numerous diversions out of South Boulder Creek and its tributaries occur across the watershed for agricultural, residential, and industrial purposes (CDSS 2010). Additionally, hundreds of wells located throughout the watershed withdraw water from the groundwater system (CDSS 2010). Habitat is a complex mosaic of plant communities that vary with slope, aspect, and soil characteristics. Upland landscape is characterized by steep (55% slope) canyon walls and rocky outcrops. Soils on these steep hillslopes are typically stable, with a thick layer of humus and duff that helps retain soil moisture and prevent erosion. Upland habitat on mesic north-facing slopes is dominated by Douglas-fir (*Pseudotsuga menziesii*) and on drier, south-facing slopes by ponderosa pine (*Pinus ponderosa*). Riparian habitat appears as a streak of bright green vegetation in the moist canyon bottom, starkly contrasting with the surrounding reds and browns of the canyon walls. Riparian habitat is dominated by a Douglas-fir / river birch (*Pseudotsuga menziesii / Betula occidentalis)* woodland that occurs as a narrow band of vegetation along the main stream channel and also occupies several side channels. Additionally, small pockets of blue spruce (*Picea pungens*) dominated woodland as well as non-willow shrublands and herbaceous wet meadows are interspersed within the Douglas-fir / river birch woodlands along both the main channel and tributaries. Other trees commonly present in the riparian zone include ponderosa and lodgepole pine (*P. contorta)* and blue spruce, which often forms, an emergent super-canopy. Woodland shrub cover is dominated by river birch but includes several willow and non-willow species such as coyote willow (*Salix exigua*) and planeleaf willow and Rocky Mountain maple (Acer glabrum), thinleaf alder (*Alnus incana*), red-osier dogwood (*Cornus sericea*) and wild sarsaparilla (*Aralia nudicaulis)*. Herbaceous cover is a mix of xeric, mesic, and hydric forbs and graminoids occurring in a patchy distribution along a soil moisture gradient. Common species in moist sites along streambanks include Hall's rush (*Juncus hallii),* Merten's rush (*J. mertensianus),* shooting star (*Dodecatheon pulchellum)* and sweet Cicely (*Osmorhiza depauperata)*. Moist cliff faces are occupied by dotted saxifrage (*Saxifraga bronchialis),* littleleaf alumroot (*Heuchera parvifolia),* and common brittle fern *(Cystopteris fragilis)*. Commonly occurring species on slightly drier sites includes star Solomonplume (*Maianthemum stellatum*) and spreading dogbane (*Apocynum androsaemifolium*). Shrublands include willow and non-willow dominated communities. Willow shrublands include mountain willow (*Salix monticola*) and Drummond's willow (*Salix drummondiana*) shrublands and non-willow communities include river birch shrublands each with an herbaceous layer dominated by a diverse cover of forbs. Other shrubs that are present include Booth's willow (*S. boothii*), Rocky Mountain maple (*Acer glabrum*) and twinberry honeysuckle *(Lonicera involucrata).* Herbaceous

cover is a rich and dense layer of xeric, mesic, and hydric species dominated by forbs but that also includes graminoids. Moist sites, along streambanks and in depressions, are occupied by forb species such as brook saxifrage (*Saxifraga odontoloma),* giant angelica (*Angelica ampla),* and green bog orchid (*Platanthera huronensis*) and by small patches of graminoids including water sedge (*Carex aquatilis*), and wooly sedge (*Carex lanuginosa*). Mesic sites are occupied by species such as baneberry (*Actaea rubra),* false Solomon's seal (*Maianthemum racemosum),* pink pyrola (*Pyrola asarifolia),* shooting star and Fendler waterleaf (*Hydrophyllum fendleri),* soft-leaved sedge (*Carex disperma),* and narrowleaf sedge *(C. eleocharis).* Margins of the shrublands, where soils are somewhat drier, are occupied by forbs such as fireweed *(Chamerion angustifolium),* and golden banner (*Thermopsis montana).* This habitat mosaic of upland habitats in juxtaposition with relatively undisturbed riparian habitat provides potential breeding habitat and refugia for a diversity of bird species. Breeding birds observed at the site include Hairy Woodpecker (*Picoides villosus*), Downy Woodpecker (*Picoides pubescens*), Rufous Hummingbird (migratory) (*Selasphorus rufus*), Broad-tailed Hummingbird (*Selasphorus platycercus*), Mountain Chickadee (*Poecile gambeli*), Pygmy Nuthatch (*Sitta pygmaea*), Steller's Jay (*Cyanocitta stelleri*), Cordilleran Flycatcher (*Empidonax occidentalis*), Warbling Vireo (*Vireo gilvus*), Dark-eyed Junco (*Junco hyemalis*), Yellow-rumped Warbler (*Dendroica coronata*), Hermit Thrush (*Catharus guttatus*), Townsend's Solitaire (*Myadestes townsendi*), American Robin (*Turdus migratorius*), American Dipper (feeding young) (*Cinclus mexicanus*), Western Tanager (*Piranga ludoviciana*) and Black-headed Grosbeak (*Pheucticus melanocephalus*).

Key Environmental Factors: Hydrology is the key environmental factor that enables the maintenance of biota at this site. Specifically, sufficient out of bank flows for an adequate duration of time are essential to the maintenance of soil moisture and other ecological processes, such as nutrient replenishment, that are essential to the long-term sustainability of this site. Annual and episodic flooding is extremely important for system maintenance and alteration of the flooding regime due to water impoundment, diversions, etc. may produce changes to plant composition as well as community composition (Rondeau 2001).

Climate Description: Temperature and precipitation vary in Gilpin County with elevation, time of year and from the east to the west. In general, lower elevations to the east and south are drier and warmer while higher elevations to the north and west are wetter and colder. Temperature also varies from the east to the west corresponding to changes in elevation. Additionally, precipitation does not fall at the same time during the year everywhere in Gilpin County. Western locations at higher elevations receive the majority of their precipitation during late winter and early spring whereas the Front Range foothills receive the majority of their moisture during spring and early summer but both mountains and foothills also receive precipitation from mid-summer thunderstorms (Siemer 1977). The lower South Boulder Creek site is located in the lower montane foothills in the northeast corner of Gilpin County at elevations between approximately 8,400 and 7,300 feet. Here,

average annual precipitation from 1971 through 2000 was 22.43 inches with May, June, July and August the wettest months; coldest temperatures occurred in January with an average maximum temperature of 36.27 °F and an average minimum of 16.63 °F; warmest temperatures occurred in July with an average maximum of 77.22 °F and an average minimum of 50.4 °F (Prism 2010).

Land Use History: Historic development at the turn of the 20th century included the building of a railroad on the north-facing slopes with associated infrastructure and, on the opposite hillslope, a flume. Along this reach both the railroad and flume are located on the hillslope high above the stream but do not currently impact stream channel condition, or riparian habitat. Rural residential development was enabled by the building of the railroad at the turn of the century and is now ubiquitous throughout the surrounding landscape.

Cultural Features: None known.

Biodiversity Significance Rank Comments (B3): This site is drawn for good (B-ranked) occurrences of two globally vulnerable (G3/S3) plant communities, Douglas-fir / river birch woodland (*Pseudotsuga menziesii / Betula occidentalis*) and thinleaf alder (*Alnus incana*) / mesic forbs riparian shrubland. Additionally, a fair occurrence (C-ranked) of the globally vulnerable (G3/S2) river birch (*Betula occidentalis)* / mesic graminoids shrubland, an excellent (A-ranked) occurrence of the state rare (G5?/S2S3) Sprengel's sedge (*Carex sprengelii*) and a good (B-ranked) occurrence of the state imperiled (G5/S1) variegated scouringrush (*Hippochaete variegata*) occur here.

Natural Heritage element occurrences at the Lower South Boulder Creek PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	Alnus incana / Mesic Forbs Shrubland	Thinleaf Alder / Mesic Forb Riparian Shrubland	G3	S3				B	2007-07-02
Natural Communities	Betula occidentalis / Mesic Graminoids Shrubland	Lower Montane Riparian Shrublands	G3	S2				C	2009-07-16
Natural Communities	Pseudotsuga menziesii / Betula occidentalis Woodland	Montane Riparian Forest	G3?	S3				B	2009-07-16
Vascular Plants	Hippochaete variegata	variegated scouringrush	G5	S1				B	2009-07-16
Vascular Plants	Carex sprengelii	Sprengel's sedge	G5?	S2S3				A	2007-07-02

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: Boundaries were drawn to encompass the immediate watershed surrounding and including the occurrences to protect against disturbance and to enable the natural ecological processes, including especially natural hydrologic processes including hydroperiod and flow regime, that are essential to the maintenance of these riparian wetlands.

Protection Urgency Rank Comments (P2): Altered flows threaten the long-term sustainability of riparian habitat. Site viability is also threatened by non-native weedy vegetation which is abundant along the railroad corridor and is invading riparian habitat. Non-native weedy plant species include Canada thistle (*Cirsium arvense),* bull thistle (*C. vulgare),* common Timothy (*Phleum pratense),* oxeye daisy (*Chrysanthemum leucanthemum*), and reed canary grass (*Phalaris arundinacea).* Additionally, downstream portions of the site are accessible from Gross Reservoir and riparian vegetation in these areas has been impacted by recreational trampling.

Management Urgency Rank Comments (M2): Maintenance of a natural flow regime would help to ensure long-term site sustainability and ecological function. Management and elimination of noxious weeds are essential to community viability. Additionally, managing recreational activities to prevent vegetation trampling would benefit the occurrence.

Land Use Comments: In addition to the main dirt road that follows the creek and the railroad line, there are numerous trails in the area that are used by horses,

hikers, mountain bikers, and dirt bikes. A small portion to the south is in Gilpin County.

Exotic Species Comments: Canada thistle (*Cirsium arvense*), common mullein (*Verbascum thapsus*) and hay grasses such as Kentucky bluegrass (*Poa pratensis*), timothy (*Phleum pratense*) and smooth brome (*Bromus tectorum*) are evident along the road, but less common close to the stream.

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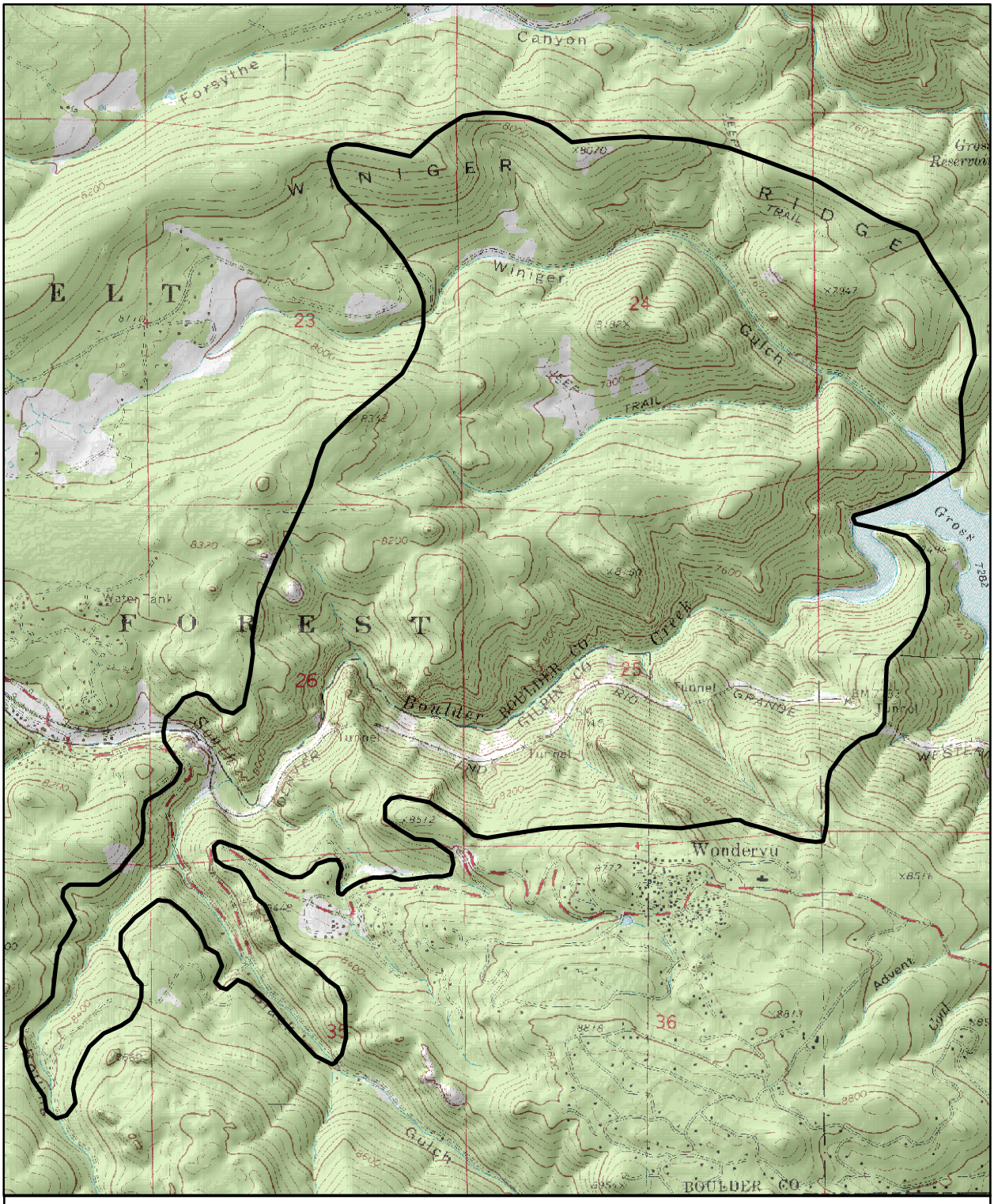
Version Date: 11/29/2010



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http://www.cnhp.colostate.edu

Map Date: 03/17/2011

0 0.2 0.4 Miles

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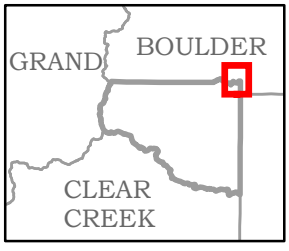
Legend

PCA Boundary

Tungsten, 39105-H4

7.5 Minute Digital Raster Graphic Produced by the U.S. Geological Survey

Location in Gilpin County



Map 5. Lower South Boulder Creek Potential Conservation Area, B3: High Biodiversity Significance

Middle and Upper South Boulder Creek

Biodiversity Rank - B3: High Biodiversity Significance

Protection Urgency Rank - P3: Definable Threat/Opportunity but not within 5 Years

Management Urgency Rank - M3: Needed within 5 Years to Maintain Quality

U.S.G.S. 7.5-minute quadrangles: Nederland, Empire, East Portal

Size: 1,967 acres (796 ha) **Elevation:** 9,100 - 10,540 ft. (2,774 - 3,213 m)

General Description: South Boulder Creek headwaters are high in the alpine zone, near the Continental Divide on the eastern slope of the Front Range in Gilpin County. Upper stream reaches lie within the James Peak Wilderness while lower stream reaches, in the valley bottom, flow through the Arapaho National Forest and private land. At the Continental Divide, the activity of ancient glaciers sculpted out cirques where now dozens of tarns, lakes, wet meadows, and fens have developed and store the melt water that sustains streamflows in South Boulder Creek. Glacial activity is also responsible for carving the steep canyon walls that characterizes topography in the upper stream reaches and the broader, low-gradient valley floor at the lower reaches of this site. Valley trend and stream flow is generally to the northeast and east but numerous north- and south-trending sub-watersheds contribute flow to South Boulder Creek. Valley geology is dominated by Precambrian age metamorphic rocks of biotitic gneiss, schist, and migmatite derived principally from sedimentary rocks. Additionally, quaternary age unconsolidated surficial deposits and rocks and glacial drift from Pinedale and Bull Lake glaciations occur on southeast-facing valley walls in the northeast portion of the site (Tweto 1979). Soils on southeast-facing valley walls are characterized by Leighcan-Catamount families, moist-Rock outcrop complex, 40 to 150 percent slopes and by Catamount family-Rubble land-Bullwark family complex, 40 to 150 percent slopes; on northwest-facing valley walls by Leighcan family, till substratum, 5 to 75 percent slopes; in the upper reaches of the valley bottom by Leighcan family, till substratum-Cryaquolls complex, 5 to 40 percent slopes; and in the lower reaches of the valley bottom by Cryaquolls-Gateview complex, 0 to 15 percent slopes. Both upland and riparian soil characteristics are important factors in stream, riparian and wetland hydrology, development, maintenance and habitat characteristics. Leighcan, Catamount and Bullwark family components occur on mountain slopes. Leighcan family natural drainage class is somewhat excessively drained and water movement in the most restrictive layer is high. Catamount family natural drainage class is excessively drained and water movement in the most restrictive layer is high; organic matter content in the surface horizon is about 85 percent. Bullwark family natural drainage class is somewhat excessively drained and water movement in the most restrictive layer is moderately high; Organic matter content in the surface horizon is about 85 percent. Soils in the valley bottom and in the riparian zone soils

consist of Leighcan family, till substratum-Cryaquolls and Cryaquolls-Gateview complex. Here the Leighcan family, till substratum component occurs on moraines; the natural drainage class is somewhat excessively drained and water movement in the most restrictive layer is high; organic matter content in the surface horizon is about 1 percent. Cryaquolls occur on floodplains; the natural drainage class is poorly drained and water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high and organic matter content in the surface horizon is about 85 percent. The Gateview family component occurs on terraces; water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low and organic matter content in the surface horizon is about 2 percent (NRCS 2010). South Boulder Creek is sustained primarily by snowmelt. Melt water that is stored in high elevation tarns, and in the soils of fens, wet meadows, and steep surrounding slopes is slowly released throughout the year, eventually discharging into South Boulder Creek and maintaining stream flows. Stream class alternates with the topography between a Rosgen class "A" or "A+" class stream that flows down steep valley walls in the upper reaches, a "C" class stream on low-gradient terraces, and where the stream emerges onto the valley floor a "B" class stream with a rapids dominated bed morphology. Copious shallow surface and groundwater flow and tributary streams from adjacent north- and south-facing slopes discharge into South Boulder Creek and make and important contribution to stream flows. Where South Boulder Creek emerges onto the valley floor stream hydrology is greatly altered due to water additions from the Moffat Water Tunnel, which diverts water from the Western slope, through the tunnel, and into South Boulder Creek. Above the point of the Moffat addition, stream hydrology has a mostly natural flow and a flow regime. Below the point of Moffat additions stream hydrology is dramatically altered both with regard to flows and flow regime (Colorado Division of Water Resources 2010). Local wetland hydrology is strongly influenced by the interaction of climate and geomorphology. Wetland hydrology in this site is intimately connected to shallow ground and surface water flow and snowmelt contributes the largest proportion of water to these wetlands through its influence on ground and surface water dynamics. Snowmelt interacts with local geomorphology to maintain high water tables in wet meadows, marshes, and fens and also exerts major control over riparian wetlands by influencing soil saturation characteristics (flooding frequency, duration, timing and depth) that results from groundwater flow and out-of-bank flooding in the riparian zone (Rocchio 2005). Additionally, by releasing water throughout the growing season, these high altitude headwater wetlands make an important contribution to late summer flows in lower elevation streams. Late summer precipitation may also be important to the fen wetlands in this site by replenishing local aquifers thereby maintaining sufficiently high water tables to support fen development (Cooper 1990). A diversity of ecosystems characterizes this site, varying with elevation, aspect, gradient, and hydrology. Upland habitats in the subalpine zone are characterized by large expanses of Engelmann spruce (*Picea engelmannii*) - subalpine fir (*Abies lasiocarpa*) forest with several other plant communities embedded within this larger forest matrix creating a complex habitat mosaic. Aspen (*Populus tremuloides*) woodlands

occur in moist swales and slopes and also in the riparian zone mixed with conifers. Stands of lodgepole pine (*Pinus contorta*) occur on drier sites, while on steep slopes with abundant shallow ground and surface water flow slope wetlands dominate. Wet meadows, willow carrs and fens have developed where slope gradient decreases and shallow ground water discharge occurs. Numerous streams traverse the site and drain the watershed. In the subalpine zone, streams are typically sustainable with appropriate width/depth ratio, structure, and abundant, high quality, bank-stabilizing vegetation. Here out-of-bank flows are common and create and maintain a variety of riparian wetland communities. However, in the lower reaches of this site stream structure is altered, out-of-bank stream flows are often inhibited by anthropogenically-induced channelization and bank-stabilizing vegetation is diminished. Conversely, anthropogenic railroad-related development that has channelized and degraded stream and riparian quality has also resulted in the creation of large, good quality, willow carrs. A variety of wetlands occur in this site, occupying depressions, swales, low slopes, and beaver ponds and stream margins. Wetlands communities in this site include herbaceous wet meadows and fens, willow carrs and conifer-dominated forested wetlands and are often characterized by an intricate mosaic of plant communities. Herbaceous wetland communities occupy slopes and riparian zones and include marsh marigold-heartleaf bittercress - tall fringed bluebells - arrowleaf ragwort (*Cardamine cordifolia - Mertensia ciliata - Senecio triangularis*) herbaceous vegetation. These wetlands are characterized by a lush diversity of plant species such as elephantella (*Pedicularis groenlandica*), marsh marigold (*Caltha leptosepala*), star gentian (*Swertia perennis*), queen's crown (*Sedum rhodanthum*), bog saxifrage (*Saxifraga oregana*), globe flower (*Trollius albiflorus*), saffron ragwort (*Senecio crocatus*) and marsh marigold. Willow (*Salix spp*.) dominated wetlands occupy the margins of beaver ponds and the riparian zones of low-gradient stream reaches. Willow communities include planeleaf willow / beaked sedge (*S. planifolia / C. utriculata*), planeleaf willow / water sedge (*S. planifolia / C. aquatilis*), Drummond's willow / beaked sedge (*S. drummondiana / C. utriculata*) and Drummond's willow / mesic forbs (*S. drummondiana* / mesic forbs). Other native graminoids and graminoid-like species that commonly occur include *Carex canescens, C. nebrascensis, C. ebenea,* and *Equisetum arvense*. Forb species include cow parsnip (*Heracleum spondylium),* meadow rue *(Thalictrum fendleri),* Richardson's geranium (*Geranium richardsonii),* arrowleaf ragwort *(Senecio triangularis),* aspen sunflower (*Helianthella quinquenervis),* tall fringed bluebells *(Mertensia ciliata),* shooting star (*Dodecatheon pulchellum),* monkshood (*Aconitum columbianum),* queen's crown *(Sedum integrifolium),* starry Solomon plume (*Maianthemum stellatum),* large-leaved avens (*Geum macrophyllum),* willowherb (*Epilobium hornemannii),* fireweed (*Chamerion angustifolium),* Mac Kloskey's violet (*Viola macloskeyi),* pink pyrola (*Pyrola asarifolia),* white bog orchid (*Platanthera dilatata),* green bog orchid (*P. huronensis),* elephantella (*Pedicularis groenlandica),* wild strawberry (*Fragaria virginiana)* and white water crowfoot (*Batrachium tricophyllum).* Forested wetlands include subalpine fir - Engelmann spruce / Drummond's willow (*Abies lasiocarpa - Picea engelmannii / S. drummondiana*) riparian wetlands and subalpine fir/marsh marigold (*A. lasiocarpa / C. leptosepala*)

fens. Herbaceous cover is characterized by a lush and dense mix of hydric forbs and graminoids with a dense ground cover of mosses. In the forested fen marsh marigold is the most abundant forb but other forb species are also present. Species occupying the wettest sites include *Trollius albiflorus,* Parry's primrose (*Primula parryi),* elephantella, and bog saxifrage. Species occupying mesic microhabitats include tall fringed bluebells, rosy paintbrush (*Castilleja rhexiifolia),* twayblade *(Listera cordata),* bellwort *(Disporum trachycarpum),* side-flowered miterwort (*Mitella stauropetala),* heartleaf bittercress, mountain bladder fern *(Cystopteris montana)* and mountain clubmoss (*Lycopodium annotinum).* Graminoid cover is diverse but less abundant than forb cover. Graminoid species include water sedge, cliff sedge (*C. scopulorum),* smallwing sedge *(C. microptera),* sheep sedge (*C. illota),* Drummond's rush (*Juncus drummondii),* chestnut rush (*J. castaneus)*, and arctic rush (*J. balticus).* A diverse mosaic of intact and connected plant communities provides breeding habitat for a diversity of bird species including Broad-tailed Hummingbird (*Selasphorus platycercus*), Red-naped Sapsucker (*Sphyrapicus nuchalis*), Dusky Flycatcher (*Empidonax oberholseri*), Hammond's Flycatcher (*Empidonax hammondii*), Warbling Vireo (*Vireo gilvus*), Red-breasted Nuthatch (*Sitta canadensis*), Ruby-crowned Kinglet (*Regulus calendula*), Golden-crowned Kinglet (*Regulus satrapa*), American Robin (*Turdus migratorius*), Hermit Thrush (*Catharus guttatus*), American Crow (*Corvus brachyrhynchos*), Wilson's Warbler(*Wilsonia pusilla*), MacGillivray's Warbler (*Oporonis tolmiei*), Dark-eyed Junco (*Junco hyemalis*), Chipping Sparrow (*Spizella passerina*), Fox Sparrow (*Passerella iliaca*), Song Sparrow (*Melospiza melodia*), Lincoln's Sparrow (*Melospiza lincolnii*), and Pine Grosbeak (*Pinicola enucleator*).

Key Environmental Factors: Hydrology is the key factor to maintaining the diversity and functionality of wetlands in this site. Out-of-bank stream flows and shallow ground and surface water flow are especially critical to maintaining wetland function in this site.

Climate Description: Climate in Gilpin County varies dramatically with elevation, aspect, and time of year. Higher elevations to the north and west are colder and wetter than lower elevations to the east and south. Temperature and precipitation varies from east to west corresponding to elevation change. Average annual temperature and length of the growing season decrease as elevation increases while average annual precipitation increases. In general, temperatures decrease at a rate of approximately 3 °F for every thousand feet of elevation gain. Additionally, the pattern of precipitation distribution varies from the eastern to the western parts of the county. Western locations at higher elevations receive the majority of their precipitation during late winter and early spring while eastern locations receive the majority of their moisture during early spring and summer (Siemer 1977). The Middle South Boulder Creek site is located in the western part of the County from elevations that range from 10,500 feet to 9,100 feet. Here, average annual precipitation from 1971 to 2000 was 49.17 inches per year; coldest temperatures occurred in January with an average maximum high of 29.3 °F and a low of 8.2 °F; warmest temperatures occurred in July with an average maximum high of 71.6 °F

and a low of 41.6 °F (Prism 2010).

Land Use History: Historical anthropogenic uses included logging, mining, grazing, and water diversions with associated railroad, road and town development.

Cultural Features: None known.

Biodiversity Significance Rank Comments (B3): This site was drawn for a good (B-ranked) occurrence of the globally vulnerable (G3?/S1) Engelmann spruce - subalpine fir / marsh marigold (*Picea engelmannii - Abies lasiocarpa / Caltha leptosepala*) forested fen and a good (B-ranked) occurrence of the state imperiled (GNR/S2) planeleaf willow / beaked sedge (*Salix planifolia / Carex utriculata*) shrub community. The state critically imperiled (G5/S1) mountain bladder fern (*Cystopteris montana*) is also found here in good to fair (BC-ranked) condition.

Natural Heritage element occurrences at the Middle and Upper South Boulder Creek PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	Picea engelmannii - (Abies lasiocarpa) / Caltha leptosepala Forest	Engelmann Spruce / White Marsh Marigold	G3?	S1				B	2009-07-07
Natural Communities	Salix planifolia / Carex utriculata Shrubland	Diamondleaf Willow / Beaked Sedge	GNR	S2				B	2009-07-05
Vascular Plants	Cystopteris montana	mountain bladder fern	G5	S1				BC	2009-07-07

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: Boundaries were mapped to encompass the landscape that is essential to maintaining the hydrologic regime that sustains the diversity of wetlands that occur throughout this site.

Protection Urgency Rank Comments (P3): Site is public land managed by the USFS with high recreational impacts and hydrologic alteration that threaten ecosystem integrity.

Management Urgency Rank Comments (M3): Management actions that would greatly benefit the integrity and sustainability of these wetlands include: closing campgrounds that are located in riparian zones; rerouting trails that go through wetlands; and reconnecting wetland and upland habitats that are fragmented by roads.

Land Use Comments: Upper reaches in the James Peak Wilderness area are reasonably well protected. Lower reaches, in the valley bottom, are managed by the Roosevelt National Forest for dispersed recreation. These lower reaches are in need of management protection to prevent stream and wetland degradation.

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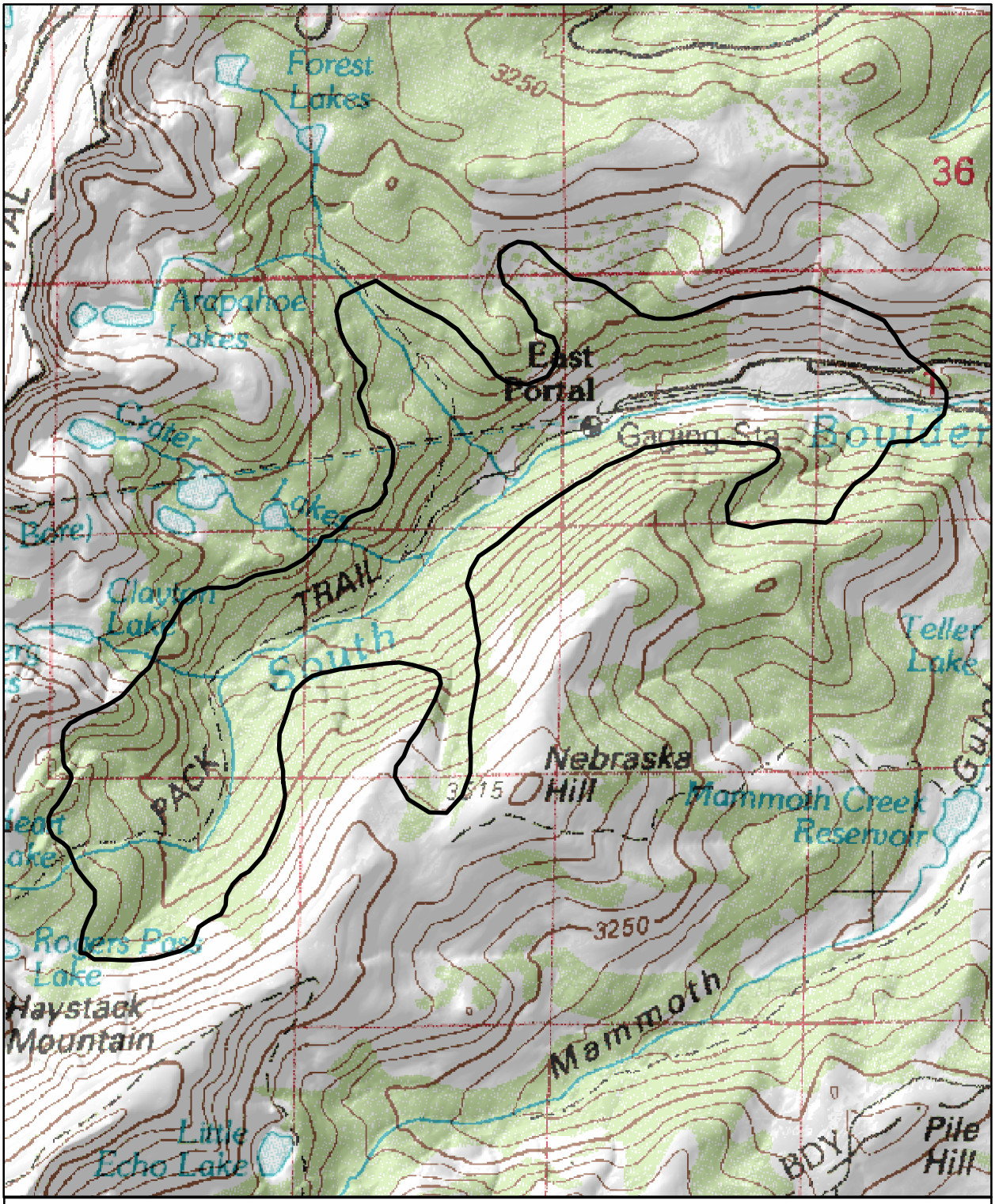

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Map Date: 03/17/2011

Miles
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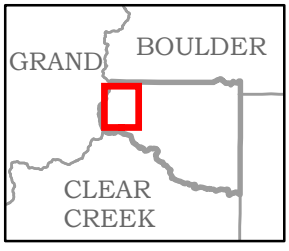
Legend

PCA Boundary

Denver West, 39105-E1

30x60 Minute Digital Raster Graphic Produced by the U.S. Geological Survey

Location in Gilpin County



Map 6. Middle and Upper South Boulder Creek Potential Conservation Area, B3: High Biodiversity Significance

Ralston Creek

Biodiversity Rank - B3: High Biodiversity Significance

Protection Urgency Rank - P2: Threat/Opportunity within 5 Years

Management Urgency Rank - M2: Essential within 5 Years to Prevent Loss

U.S.G.S. 7.5-minute quadrangles: Black Hawk

Size: 3,963 acres (1,604 ha) **Elevation:** 8,130 - 10,300 ft. (2,478 - 3,139 m)

General Description: This site is located in the eastern most part of Gilpin County within Golden Gate Canyon State Park. Landscapes in this eastern part of Gilpin County were not glaciated during the last ice age and are characterized by more gently rounded hills and broad valleys. Wind, water, and weather sculpted these lower elevation foothills, creating the rounded granitic outcrops and steep canyons that characterize this montane zone ecosystem. Surrounding upland landscape is complex and characterized by rolling hills and steep hillslopes, with rocky outcrops. North-facing slopes are dominated by a mix of Engelmann spruce (*Picea engelmannii*) and lodgepole pine (*Pinus contorta)*. South-facing slopes are dominated by a mosaic of ponderosa (*Pinus ponderosa*) forest, herbaceous meadows, and, in moist gullies, by aspen (*Populus tremuloides*) forests and stands of blue spruce. Uplands have been historically impacted by grazing, fire suppression, and logging. Ponderosa stands were likely more open and widely spaced than they are currently, with large areas dominated by grasses (Veblen and Lorenz 1991). Valley bottoms and meadows were homesteaded and developed for agriculture and ranching with consequent changes to plant species composition and habitat structure. Together, alterations to upland and wetland habitat have likely contributed to changes in the hydrologic regime. Valley bottoms, swales, and gullies are characterized by a mosaic of riparian woodlands, shrublands and herbaceous wetlands and fens. Riparian forests are characterized by aspen (*Populus tremuloides*) or by mixed aspen - blue spruce (*Populus tremuloides - Picea pungens*) woodlands with a shrub layer dominated by willow (*Salix* spp.) and an herbaceous layer dominated by forbs. Riparian shrublands are characterized by a dense canopy of willows (*Salix* spp.) with an herbaceous understory typically dominated by graminoids but in some locations dominated by forbs. Several types of forested, willow shrubland and herbaceous wetland communities occur in this site including quaking aspen / Drummond willow (*Populus tremuloides / Salix drummondiana*), mountain willow / mesic graminoid (*Salix monticola / mesic graminoid*), mountain willow / water sedge (*S. monticola / Carex aquatilis*), Bebb willow (*Salix bebbiana*), and planeleaf willow / beaked sedge (*S. planifolia / C. utriculata*) shrublands and fens. Other willow species and communities are also present including Drummond's (*S. drummondiana),* Booth (*S. boothii*) and strapleaf (*S. ligulifolia)* willow. Herbaceous wetlands are a species-rich mix of mesic and hydric graminoids, forbs or both, distributed along a soil moisture gradient. Typical herbaceous communities on inundated sites include

beaked sedge and water sedge herbaceous vegetation. Other species occupying saturated sites include common spikerush (*Eleocharis palustris),* Nebraska sedge (C. nebrascensis), soft-leaved sedge (*C. disperma*), field horsetail (*Equisetum arvense*), green bog orchid (*Platanthera huronensis*), giant angelica (*Angelica ampla),* elephantella *(Pedicularis groenlandica)* and American brooklime (*Veronica americana).* Typical species in mesic sites include wood rush (*Luzula parviflora*), Fendler's waterleaf (*Hydrophyllum fendleri*), cow parsnip (*Heracleum spondylium),* star Solomonplume *(Maianthemum stellatum),* twisted-stalk (*Streptopus amplexifolius*), shooting star (*Dodecatheon pulchellum),* blue-eyed grass (*Sisyrinchium montanum),* and large-leaved avens (*Geum macrophyllum).* Common native species on drier terraces include golden banner (*Thermopsis montana),* northern bedstraw *(Galium boreale),* scorpionweed (*Phacelia hastata),* kittentails (*Besseya plantaginea),* and edible valerian (*Valeriana edulis).* Numerous alien species occupy drier sites including especially smooth brome (*Bromus inermis*) and Canada thistle (*Cirsium arvense*). Geology is characterized by two types of rock: Precambrian age igneous granitic rocks with a dominantly silicic composition and includes granodiorite and quartz monzonoite; and Precambrian age metamorphic felsic and hornblendic gneisses that are derived principally from volcanic rocks (Tweto 1979). Soils in riparian zones are primarily of two types. Along Ralston Creek and on northeast trending tributaries, riparian soils are classified as Cumulic Cryaquolls, 0 to 3 percent slopes; the parent material consists of alluvium derived from igneous and metamorphic rock; the natural drainage class is poorly drained and meets hydric criteria. Riparian soil on the southwest-trending tributary in this site is Kittredge-Guanella complex, 3 to 9 percent slopes; the natural drainage class is well drained, water movement is moderately high and the soil does not meet hydric criteria (USDA 2010). Interestingly, a shrub-dominated fen, with 50 cm of peat, occurs in the drainage in which soils are classified as Kittredge-Guannella complex. Soils on terraces and low slopes adjacent to the riparian zone are comprised primarily of two soil types including: Ohman-Legault very gravelly sandy loams, 30 to 60 percent slopes; and Resort very gravelly sandy loam, 10 to 30 percent slopes. Upland soils are comprised primarily of: Ohman-Legault very gravelly sandy loams, 30 to 60 percent slopes; Legault very gravelly sandy loam, 15 to 30 percent slopes; Legault-Rock outcrop complex, 30 to 80 percent slopes; Rogert-Herbman-Rock outcrop complex, 30 to 70 percent slopes; and Grimstone-Peeler-Rock outcrop complex, 15 to 30 percent slopes. Each of the soil types on terraces and upland slopes are well drained or somewhat excessively drained with water movement in the most restrictive layer high. None of these soils meet hydric criteria (USDA 2010). Hydrologic features include numerous ephemeral and perennial streams, wet meadows and marshes, and ponds. Wetland hydrology is characterized and maintained by several interacting processes including shallow surface and groundwater flow, out-of-bank streamflows and historically by beaver (*Castor canadensis*). Ralston Creek drains the sub-watershed and is a 4th order Rosgen class C stream. Numerous streams flow into Ralston Creek in this site. Typically, these tributary streams begin as shallow groundwater discharge from adjacent slopes creates high soil moisture which eventually increases to create an ephemeral stream that then often becomes a permanently flowing

stream. Present development impacts on Ralston Creek have reduced the width of the riparian zone and altered stream channel structure thereby constraining natural stream processes, channelizing the stream, and altering the natural hydrologic regime. These alterations include a road that parallels the streams' left bank resulting in channelization and a power line that has been installed in the floodplain on the right bank resulting in riparian vegetation alteration. Additionally, diversions have diminished flows and dams have been constructed to provide recreational fishing opportunities. Tributary channels have been impacted by grazing and rural development. Recreational development impacts the narrow stream channel that drains Frazier Meadow which is characterized by a quaking aspen / Drummond's willow forested riparian wetland. On stream channels throughout this site sedimentation is excessive and, where vegetation is altered, streambanks are downcut and eroding. Although this site is impacted by historic and current development, the riparian wetlands provide essential breeding and foraging habitat for numerous avian species. Avian species observed during the breeding season included: Spotted Sandpiper (*Actitus macularia*), Common Snipe (*Gallinago gallinago*), White-throated Swift (*Aeronautes saxatalis*), Broad-tailed Hummingbird (*Selasphorus platycercus*), Red-naped Sapsucker (*Spyrapicus nuchalis*), Northern Flicker (*Colaptes auratus*), Downy Woodpecker (*Picoides pubescens*), Cordilleran Flycatcher (*Empidonax occidentalis*), Warbling Vireo (*Vireo gilvus*), Hermit Thrush (*Catharus guttatus*), Swainson's Thrush (*Catharus ustulatus*), American Robin (*Turdus migratorius*), Townsend's Solitaire (*Myadestes townsendi*), Violet-green Swallow (*Tachycineta thalassina*), Barn Swallow (Hirundo rustica), Tree Swallow (Tachycineta bicolor), Black-capped Chickadee (*Poecile atricapilla*), Mountain Chickadee (*Poecile gambeli*), Ruby-crowned Kinglet (*Regulus calendula*), Yellow Warbler (*Dendroica petechia*), MacGillivray's Warbler (*Oporonis Philadelphia*), Wilson's Warbler (*Wilsonia pusilla*), Common Yellowthroat (*Geothlypis trichas*), Red-winged Blackbird (*Agelaius phoeniceus*), Brown-headed Cowbird (*Molothrus ater*), Song Sparrow (*Melospiza melodia*), Lincoln's Sparrow (*Melospiza lincolnii*), Fox Sparrow (*Passerella iliaca*), and White-crowned Sparrow (*Zonotrichia leucophrys*).

Key Environmental Factors: Hydrology, including surface and groundwater flow and annual out-of-bank flows are key environmental factors essential to the maintenance of these montane riparian ecological systems (Rondeau, 2001). Importantly, these riparian systems evolved with and are highly dependent on beaver (*Castor canadensis*) activity to sustain them (Rondeau 2001). Beaver activity is integral to enhancing out-of-bank flows, recharging groundwater and raising the water table to enable maintenance of wetland and stream systems. Recent beaver activity was absent from this site (although anecdotal reports of beaver removal were heard).

Climate Description: Climate in Gilpin County varies dramatically with elevation, aspect, and time of year. Higher elevations to the north and west are colder and wetter than lower elevations to the east and south. Temperature and precipitation varies from east to west corresponding to elevation change. Average annual

temperature and length of the growing season decrease as elevation increases while average annual precipitation increases. In general, temperatures decrease at a rate of approximately 3 °F for every thousand feet of elevation gain. Additionally, the pattern of precipitation distribution varies from the eastern to the western parts of the county. Western locations at higher elevations receive the majority of their precipitation during late winter and early spring while eastern locations receive the majority of their moisture during early spring and summer (Siemer 1977). At lower elevation, eastern locations the months of April through August are typically the wettest months and July and August the warmest while December, January, and February are typically the coldest and driest months. At this site average annual precipitation from 1971 through 2000 was 23.97 inches with April (3.26 in.), May (3.20 in.), July (2.71 in.) and August (2.59 in.) the wettest months; January (0.89 in) and February (0.95 in.) were the driest months. Coldest temperatures occurred in January with an average maximum temperature of 30.83 °F and an average minimum of 12.03 °F; warmest temperatures occurred in July with an average maximum of 71.60 °F and an average minimum of 44.58 °F (Prism 2010).

Land Use History: The discovery of Gold brought rapid population growth to Gilpin County, which initiated logging, agricultural development, and grazing in areas that were not mined, such as this site. By the end of the 1890's most of the mountains in and around the mining communities and camps were denuded of trees (Petersen and Borchert 2010) and valley bottoms, especially riparian habitat and wetlands were cleared, drained and developed for agriculture.

Biodiversity Significance Rank Comments (B3): The site is drawn for a fair (C-ranked) occurrence of the globally imperiled (G2G3/S2) pale blue-eyed grass (*Sisyrinchium pallidum*). Additionally present are many fair (C-ranked) occurrences; the globally vulnerable (G3G4) deciduous riparian woodland, quaking aspen / Drummond's willow (*Populus tremuloides / Salix drummondiana*), two occurrences of globally vulnerable (G3S3) mountain willow (*Salix monticola*) / mesic graminoids shrubland, an occurrence of the globally vulnerable (G3S3) mountain willow / water sedge (*Salix monticola / Carex aquatilis*) shrubland, two occurrences of the globally vulnerable (G3?/S2) Bebb willow (*Salix bebbiana*) shrubland, an occurrence of the globally vulnerable (G3/S2) planeleaf willow / beaked sedge (*Salix planifolia / Carex utriculata*) shrubland, an occurrence of the globally apparently secure (G4/S4) Drummond's willow (*Salix drummondiana*) / mesic forbs shrubland and an occurrence of the state rare (G5/S2) plant species, broad-leaved twayblade (*Listera convallarioides*).

Natural Heritage element occurrences at the Ralston Creek PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	Salix monticola / Carex aquatilis Shrubland	Montane Riparian Willow Carr	G3	S3				C	2009-07-08
Natural Communities	Salix monticola / Mesic Graminoids Shrubland	Montane Riparian Willow Carr	G3	S3				C	2009-08-05
Natural Communities	Salix monticola / Mesic Graminoids Shrubland	Montane Riparian Willow Carr	G3	S3				C	2009-06-18
Natural Communities	Salix bebbiana Shrubland	Montane Willow Carrs	G3?	S2				C	2009-08-05
Natural Communities	Salix bebbiana Shrubland	Montane Willow Carrs	G3?	S2				C	2009-08-01
Natural Communities	Populus tremuloides / Salix drummondiana Forest		G3G4	SU				C	2009-06-22
Natural Communities	Salix drummondiana / Mesic Forbs Shrubland	Drummonds Willow / Mesic Forb	G4	S4				C	1996-09-04
Natural Communities	Salix planifolia / Carex utriculata Shrubland	Diamondleaf Willow / Beaked Sedge	GNR	S2				C	2009-06-18
Vascular Plants	Sisyrinchium pallidum	pale blue - eyed grass	G2G3	S2			BLM	C	2009-06-22
Vascular Plants	Listera convallarioides	broad - leaved twayblade	G5	S2				C	2009-06-22

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The site was delineated to include ecological systems and processes that are essential to maintaining the occurrences as well as to provide a buffer against disturbance. Climate change was also considered in boundary delineation. A potential consequence of climate change is reduced late season stream flows. Because sufficient flow is essential to the sustainability of these wetlands a land area large enough to produce abundant groundwater and stream flow is important to element sustainability.

Protection Urgency Rank Comments (P2): This site includes both public and private lands. Public lands experience intense recreational pressure. Private lands are

developed for rural residential and agricultural purposes.

The majority of the surrounding landscape is managed by Colorado State Parks. However, some of the riparian shrubland and much of the surrounding upland landscape are in private ownership. Current management in the Park and land uses in the nearby surrounding landscape, including cessation of grazing and logging, appears to be leading to some recovery of the natural hydrologic regime and upland and riparian vegetation.

Management Urgency Rank Comments (M2): Historic grazing and agricultural development altered the landscape and disrupted connectivity. Current management has ceased livestock grazing, which appears to be contributing to riparian and upland habitat recovery. However, alteration of native habitats and the natural hydrologic regime continues to occur, both within and outside of Park boundaries. Present threats emanate from roads, campgrounds, recreational development, residential development and diversions. Geology in this area is especially susceptible to erosion. Roads exacerbate erosion, resulting in excess stream sedimentation. Roads have also altered the stream channel and natural hydrologic regime and disconnected uplands from wetland habitat. Additional impacts include: private land ranching and rural development that occurs in upstream riparian habitat and on tributary streams which degrades downstream water quality and quantity; recreational development which has resulted in loss of wetland habitat, vegetation trampling and disturbance; excessive elk browse throughout upland and riparian habitat which impacts forest vigor and regeneration; and ubiquitous invasion of alien plant species. Climate models project that Colorado will warm and, in all seasons, the climate of the mountains is projected to migrate upward in elevation. Warmer temperatures will increase evaporation rates of river, streams and reservoirs. Additionally, a seasonal shift in timing of precipitation is projected and the timing of runoff is projected to shift to earlier. These changes may reduce late-summer stream flows (CWCB 2010). Riparian vegetation makes an essential contribution to: conservation of water quality and quantity; stream channel stability and function; and providing habitat for wildlife resources. Riparian wetland viability would be greatly enhanced by the following activities: willow restoration along roadways; restricting domestic livestock stream access to specific areas and fencing livestock out of the majority of riparian habitat; weed eradication; reducing elk population; limiting recreational stream and wetland access to designated sites in an effort to reduce trampling and wildlife disturbance; restoration of beaver to Ralston Creek. Additionally, on the stream corridor that drains Frazier Meadow, riparian habitat would benefit by relocating the foot trail to upland habitat.

Exotic Species Comments: Alien plant species are common throughout the site and include: *Poa pratensis, Phleum pratense, Agrostis gigantea, Trifolium pratense, Cirsium arvense, Carduus acanthoides, Taraxacum officinale, Linaria vulgaris, Cynoglossum officinale, Dipsacus fullonum, and Bromus inermis.*

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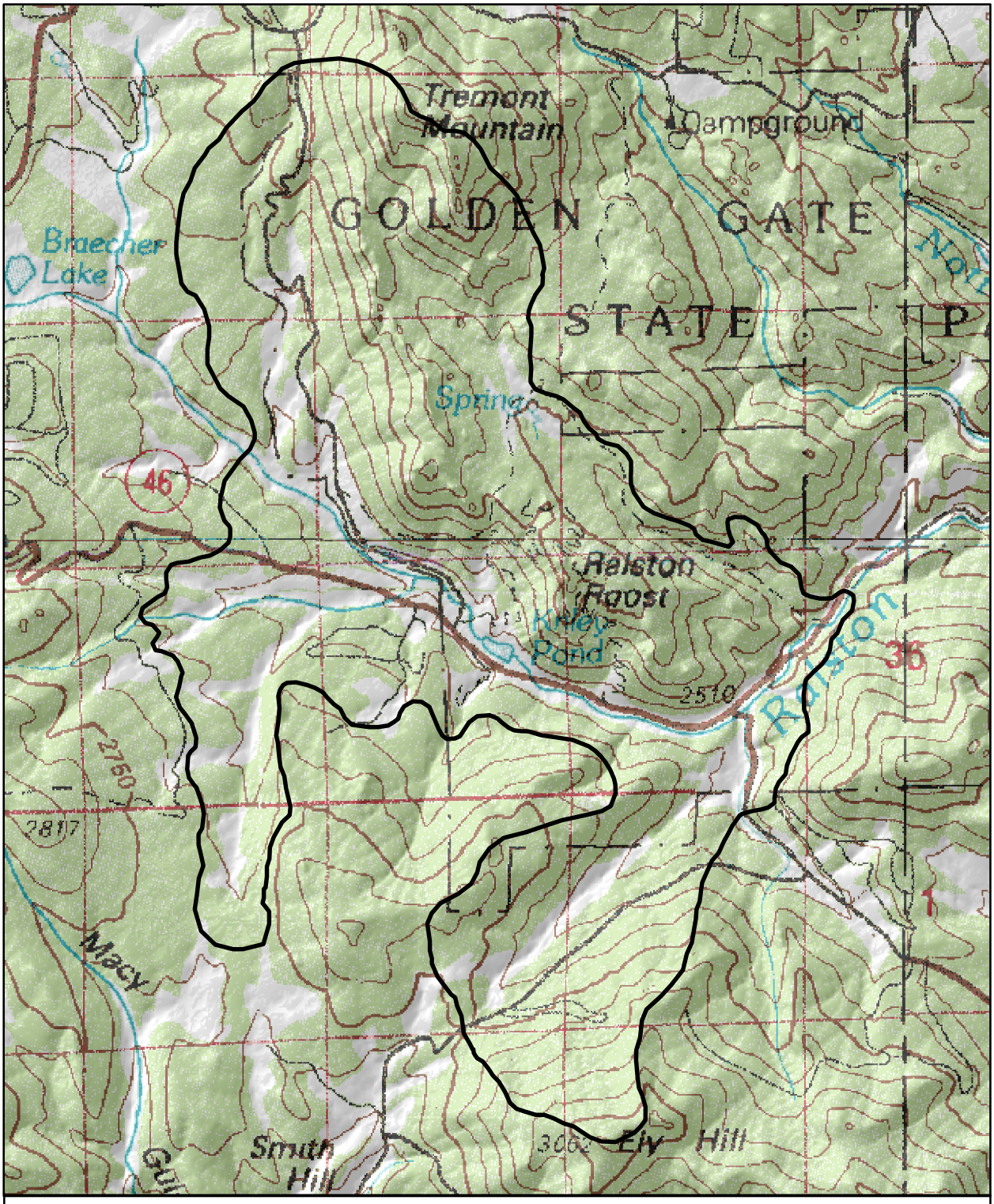
Version Author: Malone, D.G.

Version Date: 11/29/2010



Colorado Natural Heritage Program
Colorado State University
1474 Campus Delivery
Fort Collins, CO 80523-1474
http://www.cnhp.colostate.edu

Map Date: 03/17/2011

Miles
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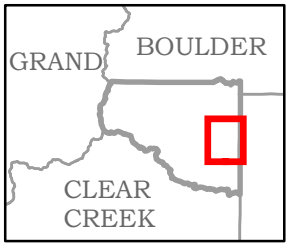
Legend

PCA Boundary

Denver West, 39105-E1

30x60 Minute Digital Raster Graphic Produced by the U.S. Geological Survey

Location in Gilpin County



Map 7. Ralston Creek Potential Conservation Area, B3: High Biodiversity Significance

Arapahoe Lakes

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P5: No Action to be Taken on this Site

Management Urgency Rank - M2: Essential within 5 Years to Prevent Loss

U.S.G.S. 7.5-minute quadrangles: East Portal

Size: 572 acres (232 ha) **Elevation:** 10,240 - 12,110 ft. (3,121 - 3,691 m)

General Description: The Arapahoe Lakes site is located on the east side of the Continental Divide in the Front Range Mountains of Gilpin County, Colorado in the James Peak Wilderness. The site encompasses complexly sculpted glacial cirques and also steep slopes below an ice-scoured ridge which delineates the eastern boundary of the cirques. High, steep ridges along the Continental Divide form the western border of the site and east-west trending ridges delineate the north and south boundaries of the site. Valley trend is generally to the east but complex topography within the cirque additionally results in north- and south-trending hillslopes, ridges, and rocky outcrops. Ecosystems in the site include alpine tundra at the highest elevations, transitioning at lower elevations to krummholz and down to subalpine systems at the lower limits of the site. Glacial activity also created the template for the formation of the numerous tarns and wetlands that are scattered throughout the site and which are the source headwaters for numerous streams that are tributary to South Boulder Creek. Geology of the surrounding ridges is composed of Precambrian age (1,700 to 1,800 m.y.) metamorphic rocks composed of biotitic gneiss, schist and migmatite. These rocks are derived principally from sedimentary rocks and locally contain minor hornblende gneiss, calc-silicate rock, quartzite, and marble. Geology of the eastern portion of the site, on steep, east-facing slopes below the cirque, is composed of Quaternary age younger alluvium and surficial deposits that are derived from glacial drift from the Pinedale and Bull Lake Glaciations (Tweto 1979). Soils in the site vary from talus and scree on high ridges and steep slopes to deep peat in depressions, swales and low slopes. Soils on the ridge of the Continental Divide are categorized as Bross-Matcher families-Lithic Cryorthents complex, 40 to 75 percent slopes. Cirque wall soils are categorized as Cirque land, 40 to 150 percent slopes. Soils on the floor of the cirque are Matcher family-Cryaquepts-Rock outcrop complex, 5 to 25 percent slopes. Steep east-facing slopes to the east of and below the cirque are Leighcan family, till substratum-Cryaquolls complex, 5 to 40 percent slopes; southeast-facing slopes are Bross family-Rubble land-Matcher family complex, 40 to 150 percent slopes (USDA 2010). Several types of wetlands occur in the site and are located on one of two types of soil units: 1) Matcher family-Cryaquepts-Rock outcrop complex, 5 to 25 percent slopes. Matcher family components occur on solifluction lobes; parent material consists of glaciofluvial deposits and/or residuum weathered from igneous and metamorphic rock; the natural drainage class is excessively drained; and organic

matter content in the surface horizon is about 85 percent. Cryaquepts components occur on glacial-valley floors; parent material consists of glaciofluvial deposits derived from igneous and metamorphic rock; the natural drainage class is poorly drained; the soil is occasionally flooded and organic matter content in the surface horizon is about 85 percent. 2) Leighcan family, till substratum-Cryaquolls complex, 5 to 40 percent slopes. The Leighcan family, till substratum component occurs on moraines; parent material consists of residuum and/or till derived from igneous and metamorphic rock. The natural drainage class is somewhat excessively drained; this soil is not flooded; and organic matter content in the surface horizon is about 1 percent. The Cryaquolls component occurs on flood plains; parent material consists of gravelly alluvium and/or gravelly glaciofluvial deposits derived from igneous and metamorphic rock; the natural drainage class is poorly drained; this soil is rarely flooded; and organic matter content in the surface horizon is about 85% (USDA 2010). Local wetland hydrology is strongly influenced by the interaction of climate and geomorphology. Wetland hydrology in this site is strongly connected to shallow ground and surface water flow and snowmelt contributes the largest proportion of water to these wetlands through its influence on ground and surface water dynamics. Snowmelt interacts with local geomorphology to maintain high water tables in wet meadows, marshes and fens and also exerts major control over riparian wetlands by influencing soil saturation characteristics (flooding frequency, duration, timing and depth) that results from groundwater flow and out-of-bank flooding in the riparian zone (Rocchio 2005). Additionally, by releasing water throughout the growing season, these high altitude headwater wetlands make an important contribution to late summer flows in lower elevation streams. Late summer precipitation may also be important to the fen wetlands in this site by replenishing local aquifers thereby maintaining sufficiently high water tables to support fen development (Cooper 1990). Ecosystems and habitats in this site are diverse, responding to wide elevational gradients, differing aspects and slope, soil and hydrology. Upland ecosystems in the alpine zone, from tree limit to the Continental Divide, include snowfields, boulder fields, scree and talus slopes, fellfields, turf meadows, and willow carrs. Fellfields are characterized by cushion plants including moss campion (*Silene acaulis*), alpine nailwort (*Paronychia pulvinata*) and alpine sandwort (*Arenaria obtusiloba*). Turf meadows are characterized by a variety of forbs and graminoids including tufted hairgrass (*Deschampsia caespitosa*) superturf (*Kobresia myosuroides*), alpine harebell (*Campanula uniflora*), and old-man-of-the-mountain (*Rydbergia grandiflora*) and, together with upland willow carrs, create a complex patchwork of plant communities that covers steep hillslopes. Upland willow carrs are typified by dense stands of barrenground willow (*Salix brachycarpa*) with an understory characterized by a mix of graminoids and forbs including tufted hairgrass, superturf, alpine pussytoes (*Antennaria alpina*), and field chickweed (*Cerastium arvense*). Large patches of superturf occupy openings in the shrub canopy and increase patch diversity. Decreasing elevation is marked by a transition from alpine tundra ecosystems to krummholz stands of Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) which then transitions to Engelmann spruce - subalpine fir forest lower down in the subalpine zone. A

variety of wetland systems with diverse plant communities and species occur in the alpine and subalpine zones of this site. Wetlands occupy depressions, swales, low slopes, and lake and stream margins. Wetlands are typically characterized by an intricate mosaic of plant communities including willow shrublands, graminoid wet meadows, and fens and forb or graminoid dominated riparian habitat. Shrub dominated wetlands are characterized by planeleaf willow (*Salix planifolia*) with a forb-dominated understory. Fens occur on low slopes and depressions and are characterized by graminoid vegetation dominated by few-flower spikerush (*Eleocharis quinqueflora*), intermixed with other graminoids including water sedge (*Carex aquatilis*), small-head sedge (*Carex illota*) and black alpine sedge (*Carex nigricans*) and forbs such as elephantella (*Pedicularis groenlandica*), marsh marigold (*Caltha leptosepala*), star gentian (*Swertia perennis*) and queen's crown (*Sedum rhodanthum*). A lush and diverse cover of forbs is found along stream margins characterized by tall fringed bluebells (*Mertensia ciliata)*, arrowleaf ragwort (*Senecio triangularis*), heartleaf bittercress (*Cardamine cordifolia),* bog saxifrage (*Saxifraga oregana*), globe flower (*Trollius albiflorus*), saffron ragwort (*Senecio crocatus*) and marsh marigold. A diverse mosaic of upland and wetland, alpine and subalpine plant communities in this site provides high quality breeding and foraging habitat for several avian and mammal species. Observed bird species included Lincoln's Sparrow (*Melospiza lincolnii*), White-crowned Sparrow (*Zonotrichia leucophrys*), Golden-crowned Kinglet (*Regulus satrapa*), Hairy Woodpecker (*Picoides villosus*), Red-breasted Nuthatch (*Sitta canadensis*), Dark-eyed Junco (*Junco hyemalis*), Pine Grosbeak (*Pinicola enucleator*) and White-tailed Ptarmigan (*Lagopus leucurus*). Observed mammal species included pika (*Ochotona princeps*), yellow-bellied marmot (*Marmota flaviventris*), chickaree (*Tamiasciurus hudsonicus*), least chipmunk (*Tamias minimus*), elk (*Cervus elaphus*) and northern pocket gopher (*Thomomys talpoides*).

Key Environmental Factors: Climate, hydrology, and geology are key driving factors that have enabled the development and maintenance of the element plant communities and animal species present in the site.

Climate Description: Climate in Gilpin County varies dramatically with elevation, aspect and time of year. Higher elevations to the north and west are colder and wetter than lower elevations to the east and south. Temperature and precipitation varies from east to west corresponding to elevation change. Average annual temperature and length of the growing season decrease as elevation increases while average annual precipitation increases. In general, temperatures decrease at a rate of approximately 3 °F for every thousand feet of elevation gain. Additionally, the pattern of precipitation distribution varies from the eastern to the western parts of the county. Western locations at higher elevations receive the majority of their precipitation during late winter and early spring while eastern locations receive the majority of their moisture during early spring and summer (Siemer 1977). The Arapahoe Lakes site is located in the most western part of the county at elevations between approximately 10,000 and 12,000 feet elevation. Here, average annual precipitation from 1971 through 2000 was 34.51 inches; coldest temperatures

occurred in January with an average maximum temperature of 23.95 °F and an average minimum of 4.55 °F; warmest temperatures occurred in July with an average maximum of 64.45 °F and an average minimum temperature of 39.02 °F (Prism 2010).

Land Use History: Although much of Gilpin County was impacted by mining exploration, most of the high elevations landscape near the Continental Divide, including this site, did not see mining exploration (Gilpin County 2010). The first humans to use the land in this site were likely Native Americans. Numerous sites in alpine ecosystems along the Continental Divide of the Front Range, including near the Rollins Pass area, have been identified as Paleoindian and Prehistoric age game drive sites (Benedict 2005).

Cultural Features: Paleoindian to Prehistoric age Native American artifacts are potentially present (Gellhorn 2002).

Biodiversity Significance Rank Comments (B4): This site is drawn to encompass three fens which are dominated by excellent (A-ranked) occurrences of the globally apparently secure (G4) but vulnerable in Colorado (S3/S4) few-flower spikerush (*Eleocharis quinqueflora*) herbaceous vegetation.

Natural Heritage element occurrences at the Arapahoe Lakes PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	Eleocharis quinqueflora Herbaceous Vegetation	Alpine Wetlands	G4	S3S4				A	2009-08-04

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The site was delineated to include ecological systems and processes that are essential to maintaining the community occurrences as well as to provide a buffer against disturbance. Climate change was also considered in boundary delineation; alpine ecosystems are especially vulnerable and species that depend on tundra may disappear as alpine tundra diminishes with the advance of trees and shrubs (USFWS 2010). Hydrology is the primary process essential to long-term wetland plant community viability. Alpine/subalpine wetlands are often isolated hydrologically from other wetlands, and easily impacted by surrounding land use (Rondeau 2001). Thus maintaining an intact and unfragmented hydrologic regime is essential to element viability. The alpine and subalpine element wetland plant communities in this site are reliant on water levels at or near the surface for much or all of the growing season (Rondeau 2001). Snowmelt from nearby surrounding ridges and slopes maintains abundant shallow ground and surface flow which contributes the primary source of water to depressional, slope and

riparian wetlands.

Protection Urgency Rank Comments (P5): This site is located in designated Wilderness.

Management Urgency Rank Comments (M2): Although this site is located in the James Peak Wilderness area and benefits from protections afforded by Wilderness designation, recreational use is high due to proximity to Front Range cities. Recreation-induced vegetation trampling and social trails are somewhat common and fragment natural communities. These activities and impacts have potentially deleterious effects on the long-term viability of the communities. Climate change is expected to drastically alter vegetation characteristics in the alpine zone (USFWS 2010). Minimizing human-caused disturbance to high-elevation habitats and connecting these habitats to facilitate migration may help species adapt to changing ecosystems. Mountain climate in Colorado is predicted to migrate upwards with resulting 10-20% declines in high-elevation snowpack (CWCB 2010). Declining snowpack may have detrimental implications for alpine wetland and stream systems as well as for lower elevation riparian/stream systems. Additionally, trees and shrubs are predicted to advance and narrow or eliminate alpine tundra ecosystems. Those species dependent on tundra habitat, including White-tailed Ptarmigan, may disappear as alpine tundra diminishes (USFWS 2010).

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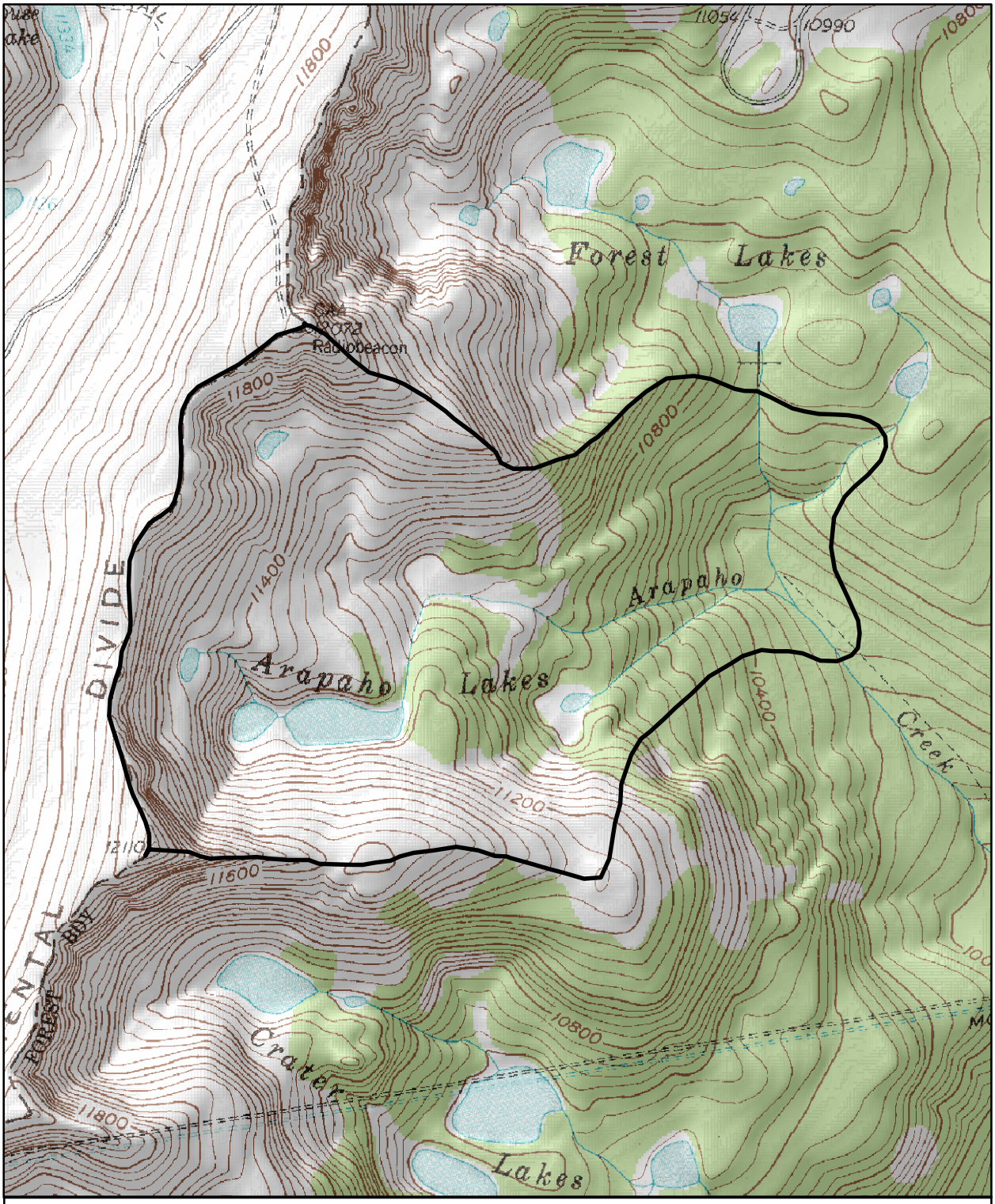

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Map Date: 03/17/2011

Miles
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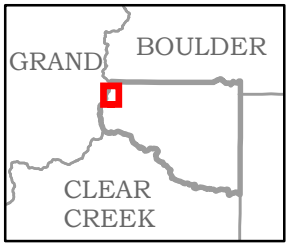
Legend

PCA Boundary

East Portal, 39105-H6

7.5 Minute Digital Raster Graphic Produced by the U.S. Geological Survey

Location in Gilpin County



Map 8. Arapahoe Lakes Potential Conservation Area, B4: Moderate Biodiversity Significance

Elk Park

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P3: Definable Threat/Opportunity but not within 5 Years

Management Urgency Rank - M3: Needed within 5 Years to Maintain Quality

U.S.G.S. 7.5-minute quadrangles: Nederland, Central City

Size: 494 acres (200 ha) **Elevation:** 10,240 - 10,948 ft. (3,121 - 3,337 m)

General Description: The Elk Park site encompasses upper montane ecosystems on the east side of the Continental Divide in the Front Range Mountains of Gilpin County, Colorado. Mid-elevation peaks and ridges surround a broad, southeast trending bowl-shaped park to the north, south, and west. Physiognomy of surrounding uplands varies between gently rounded and steep hillslopes and several low peaks. The valley bottom is a stepped series of low slopes, depressions and swales that are variably saturated. Copious shallow surface and groundwater flow from surrounding hillslopes discharge into the gently sloping park basin and eventually flow into Elk Creek. Elk creek drains the site and is a 1st order, Rosgen A/B class stream that originates as a spring on the north slopes of the site, flowing to the southeast along the northeast side of the park. Here stream habitat and riparian habitat along Elk Creek is in sustainable condition. Streambanks are well vegetated with a dense cover of high quality, bank stabilizing vegetation. Stream habitat is complex and characterized by rapids dominated bed morphology and step-pool structure. Geology of surrounding ridges and peaks and of the park in the site is primarily Precambrian age metamorphic or igneous rocks with a dominantly silicic composition, age 1,700 to 1,800 m.y. These metamorphic rocks are derived principally from sedimentary or volcanic rocks. Sedimentary rocks locally contain hornblende gneiss, calc-silicate rock, quartzite, and marble. Volcanic rocks include metabasalt, metatuff, and interbedded metagraywacke; and locally contain interlayered biotite gneiss (Tweto 1979). Soils in the valley bottom are hummocky, saturated histosols with accumulations of peat to greater than 1 meter. Valley bottom soils are classified as Cryaquolls-Leighcan family, till substratum complex, 0 to 15% slopes. Cryaquolls occur on floodplains and are derived from gravelly glaciofluvial deposits from igneous, metamorphic, and sedimentary rock. Depth to root restrictive layer is greater than 60 inches, the natural drainage class is poorly drained, with available water to a depth of 60 inches. Organic matter content in the surface horizon is about 85%. Soils from the Leighcan family occur on moraines and consist of residuum and/or till from igneous and metamorphic rock (USDA 2010). Soils on toeslopes at the base of surrounding hillslopes are Goosepeak-Catamount families, moist complex, 5 to 40% slopes. Water movement in the class is fairly high and the drainage class is well drained to excessively drained (USDA 2010). Soils on ridge tops and peaks that curve around from the northwest to the southeast,

forming the rim of the bowl that encircles the park, are classified as Lithic cryothents-Rubble land complex. Soils on south-facing upland slopes are Leighcan-Catamount families, moist complex. Valley bottom habitat is a mosaic of fens, peatlands, and riparian wetlands with vegetation that is characterized by a complex patchwork of wetland plant communities including willow and non-willow shrublands intermixed with mesic to hydric forb and graminoid meadows. An open canopy of bog birch (*Betula nana*) occupies saturated sites where fens have developed. Here the hummocky soils are covered by a dense and thick layer of mosses dominated by *Sphagnum* spp. intermixed with a few forb and graminoid species including queen's crown (*Sedum rhodanthum),* alpine meadow rue (*Thalictrum alpinum*), viviparous bistort (*Bistorta vivipara),* long-stalked starwort *(Stellaria longipes)*, spherical spikerush (*Luzula subcapitata*) and alpine timothy (*Phleum alpinum).* Planeleaf willow (*Salix planifolia*) and water sedge (*Carex aquatilis*) occupy the wettest microhabitats in the wetland mosaic. And together form a patchy mosaic of closed willow stands and dense water sedge meadows. The perimeter of the park, where soils are mesic to xeric, are occupied by several shrub/forb plant associations including bog birch, planeleaf willow, barrenground willow (*Salix brachycarpa*) and shrubby cinquefoil (*Dasiphora floribunda*). The herbaceous understory associated with each of these shrub species is dominated by a wide diversity of forbs including marsh marigold (*Caltha leptosepala),* arrowleaf ragwort (*Senecio triangularis),* monkshood *(Aconitum columbianum),* hemlock parsley (*Conioselinum scopulorum),* elephantella (*Pedicularis groenlandica)* and star gentian (*Swertia perennis)*. Graminoids are also present and include needle spikesedge (*Eleocharis acicularis)*, Drummond's rush (*Juncus drummondii),* Merten's rush (*Juncus mertensianus),* bluejoint reedgrass *(Calamagrostis canadensis)*, mountain sedge (*Carex scopulorum)* and pale sedge (*Carex canescens)*. Upland habitat is characterized by a mosaic of forests, shrublands, and xeric herbaceous meadows. North, south and east facing slopes are characterized by a mosaic of forested and grassland habitats. Krummholz stands of flagged pioneering limber pine (*Pinus flexilis),* dominate and are interspersed with patches of lodgepole pine (*Pinus contorta*) and a few small stands of Engelmann spruce - subalpine fir (*Picea engelmannii - Abies Lasiocarpa).* Xeric grasslands characterize the herbaceous layer and also occur as large habitat patches. Southwest-facing slopes are dominated by dense stands of Engelmann spruce - subalpine fir (*Picea engelmannii - Abies lasiocarpa)* forest interspersed with patches of lodgepole pine and, in moist gullies, with aspen (*Populus tremuloides)*. Xeric shrublands form an ecotonal habitat on southwest-facing slopes between spruce - fir forests and valley bottom wetlands. Shrubland - meadow habitat is characterized by a patchy mosaic of mesic shrubs including *Dasiphora floribunda* interspersed with patches of graminoids and forbs. Typical upland graminoids include *Festuca thurberi*. Typical forbs include *Oxytropis* spp., *Harbouria trachypleura* (whisk-broom parsley) and *Campanula rotundifolia*.

Key Environmental Factors: Hydrology is the key environmental factor that maintains the wetland ecosystems and communities in this site. Beaver are the primary biotic factor and shallow surface flow is the primary abiotic factor essential to maintenance of this ecological system (Rondeau 2001). Water that sustains the

wetlands is sourced from abundant shallow ground water and surface flow that discharges into the park from surrounding hillslopes.

Climate Description: Climate in Gilpin County varies dramatically with elevation, aspect and time of year. Higher elevations to the north and west are colder and wetter than lower elevations to the east and south. Temperature and precipitation varies from east to west corresponding to elevation change. Average annual temperature and length of the growing season decrease as elevation increases while average annual precipitation increases. In general, temperatures decrease at a rate of approximately 3 °F for every thousand feet of elevation gain. Additionally, the pattern of precipitation distribution varies from the eastern to the western parts of the county. Western locations at higher elevations receive the majority of their precipitation during late winter and early spring while eastern locations receive the majority of their moisture during early spring and summer (Siemer 1977). The Elk Park site is located in the western part of the county in the upper montane and subalpine zones at elevations between approximately 10,000 and 11,000 feet. Annual average precipitation at this site from 1971 to 2009 was 30.58 inches; coldest temperatures occurred in January with an average high of 27.07 °F and an average low of 8.08 °F. Warmest temperatures occurred in July with an average high of 67.68 °F and an average low of 40.32 °F (Prism 2010).

Land Use History: With the discovery of native gold in Gilpin County 1858, much of the County, including the area surrounding the Elk Park site was extensively mined for gold and other ore minerals. Additionally, to support the infrastructure and development that accompanied mining, grazing and clearcut logging occurred in the hills surrounding the site and throughout much of the County (Petersen and Borchert 2010). Field observations indicate that surrounding uplands continue to be impacted by historic logging. Some forest patches have naturally reforested with historic species, some with pioneering species such as lodgepole (*P. contorta*) or limber pine (*P. flexilis*) while other areas have crossed an ecological threshold and converted to other habitat types such as xeric meadows.

Cultural Features: None known.

Biodiversity Significance Rank Comments (B4): This site supports a mosaic of several wetland types and plant associations. Plant communities that characterize the wetland fen in this site include a good (B-ranked) occurrence of a globally unranked (GU) but imperiled in Colorado (S2) shrubland community, bog birch / Sphagnum spp. (*Betula nana / Sphagnum* spp.) and a good (B-ranked) occurrence of a globally demonstrably secure (G5/S4) shrubland community, planeleaf willow / water sedge (*Salix planifolia / Carex aquatilis*). A fair (C-ranked) occurrence of the globally vulnerable (G3/S3) reflected moonwort (*Botrychium echo*) plant species also occurs within this site.

Natural Heritage element occurrences at the Elk Park PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	Salix planifolia / Carex aquatilis Shrubland	Subalpine Riparian Willow Carr	G5	S4				B	2009-07-31
Natural Communities	Betula nana / Sphagnum spp. Shrubland	Dwarf Birch / sphagnum Shrubland	GU	S2				B	2009-08-02
Vascular Plants	Botrychium echo	reflected moonwort	G3	S3				C	2006-07-07

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The boundary was drawn to encompass the ecological and hydrological processes essential to ecosystem maintenance and sustainability of the element occurrences. This wetland complex of fens, peatlands, and riparian habitat is sustained by groundwater inflows that maintain a water table at or near the ground surface for much of the year. These processes include abundant shallow surface and groundwater flow from surrounding hillslopes to enable wetland recharge with a sufficiently high water table and hydroperiod that promotes the ongoing development and maintenance of peat soils. The delineated area should allow for the functioning of ecological and hydrological processes that support the wetland communities and provide a buffer against direct disturbance.

Protection Urgency Rank Comments (P3): This system is reliant on groundwater and any disturbances that impact water quality or quantity are a threat. Dirt roads on the periphery of the site alter shallow groundwater flow and disconnect the occurrence from adjacent upland systems. ORV use of the area is high and contributes to road-based habitat degradation including fragmentation, soil erosion, and excessive sediment runoff. Additionally, because surrounding uplands have not recovered from historic logging, hydrologic processes, such as infiltration and runoff regimes, continue to be impacted.

Management Urgency Rank Comments (M3): Potential long-term viability would be enhanced by upland forest restoration and by re-establishing connections between upland and wetland habitats.

Exotic Species Comments: No exotic species were observed although a few herbaceous increaser species were present on the periphery of the wetland site including showy pussytoes (*Antennaria pulcherrima*) and silvery cinquefoil (*Potentilla hippiana*).

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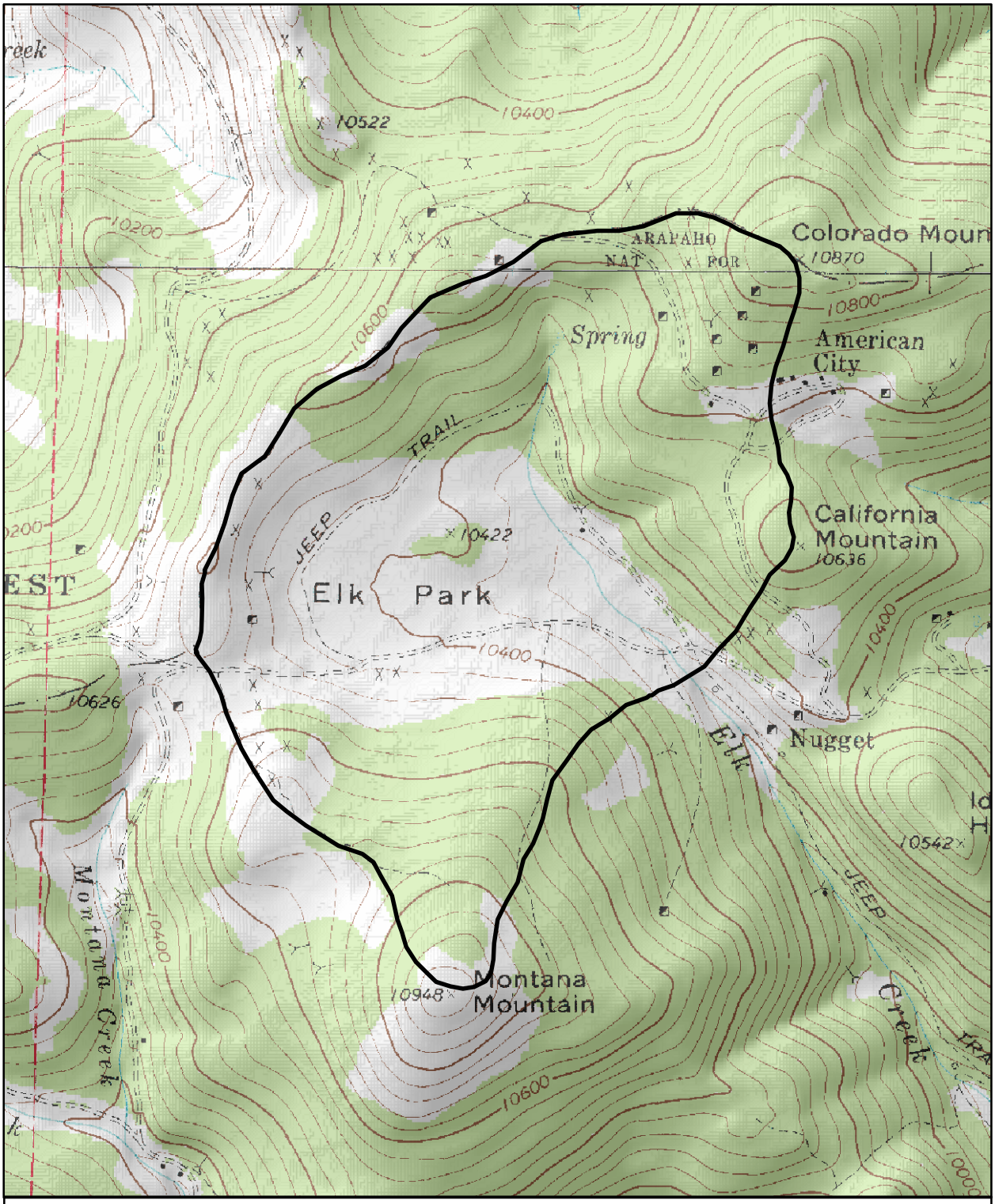

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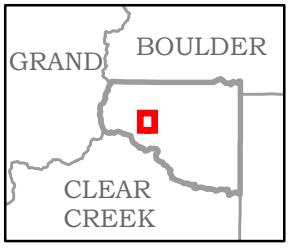
Legend

PCA Boundary

Central City, 39105-G5
Nederland, 39105-H5

7.5 Minute Digital Raster Graphics Produced by the U.S. Geological Survey

Location in Gilpin County



Map 9. Elk Park Potential Conservation Area, B4: Moderate Biodiversity Significance

Elsworth Creek

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P2: Threat/Opportunity within 5 Years

Management Urgency Rank - M2: Essential within 5 Years to Prevent Loss

U.S.G.S. 7.5-minute quadrangles: Tungsten, Nederland, Black Hawk, Central City

Size: 1,489 acres (603 ha) **Elevation:** 8,800 - 9,882 ft. (2,682 - 3,012 m)

General Description: This site is located on the east slope of the Front Range in the central part of Gilpin County, Colorado in the montane zone. Topography is characterized by rolling hills with moderate-relief. These northeast/southwest-trending hills encompass several drainages and stream headwaters that are tributaries to South Boulder Creek. Geology is characterized by northeast/southwest trending bands of rock that are classified as Precambrian age metamorphic and igneous rocks. The ridgetop on the west side of the site is metamorphic rock derived principally from volcanic rock and is comprised of felsic and hornblendic gneisses that includes metabasalt, metatuff, and interbedded metagraywacke and locally contains interlayered biotite gneiss. Geology in the center of the site, where Lump Gulch is located, is metamorphic rock derived principally from sedimentary rocks and is comprised of biotitic gneiss, schist, and migmatite and locally contains minor hornblende gneiss, calc-silicate rock, quartzite, and marble. Geology on the east side of the site, which Ellsworth Creek runs through, is granitic rock (Tweto 1979). Soils are also distributed as northeast/southwest trending bands of soil. The most common soil in the site is classified as Goosepeak-Catamount families, moist complex, 5 to 40 percent slopes. On the east-facing hillslope on the west side of the site there is a narrow band of soil classified as Leighcan family, 40 to 75 percent slopes with a small area at the toeslope that is Rogert family, 5 to 40 percent slopes. Hillslope soils on the east side of the site are either Legault-Rock outcrop complex, 30 to 80 percent slopes or Bullwark-Catamount families-Rubble land complex, 5 to 40 percent slopes. In valley bottoms along stream courses and in the channel bed soils are classified as Cryaquolls-Gateview complex, 0 to 15 percent slopes and, on one small reach on Ellsworth Creek, Legault very gravelly sandy loam, 15 to 30 percent slopes. Cryaquolls occur on flood plains and the parent material consists of gravelly alluvium and/or gravelly glaciofluvial deposits derived from igneous, metamorphic, and sedimentary rock; the natural drainage class is poorly drained and organic matter content in the surface horizon is about 85%. The Gateview family component occurs on terraces and the parent material also consists of gravelly alluvium and/or gravelly glaciofluvial deposits derived from igneous, metamorphic, and sedimentary rock; the natural drainage class is well drained and organic matter content in the surface horizon is about 2 percent (NRCS 2010). Hydrologic features include streams, wet meadows, marshes and ponds. Site

hydrology is characterized and sustained by several water sources and ecological processes including shallow surface and groundwater flow, springs and seeps, out-of-bank streamflows and beaver (*Castor canadensis*) activity. The site encompasses five first-order headwater streams that coalesce to form two second-order streams, Ellsworth Creek and Lump Gulch, which then unite to create one third-order stream, Lump Gulch. Numerous active beaver ponds occur on Lump Gulch which has resulted in channel restoration and modification, increased water storage, out-of-bank flows and late-season streamflows, and enhanced wetland development. There is no recent beaver activity on Ellsworth Creek but evidence of historic activity is abundant. Habitat is a mosaic of upland and riparian forest, shrublands and wetlands. Upland plant communities are characterized by a mosaic of forested communities including lodgepole pine (*Pinus contorta),* ponderosa pine (*Pinus ponderosa)* and Engelmann spruce - subalpine fir (*Picea engelmannii - Abies lasiocarpa)* forests and quaking aspen (*Populus tremuloides)* woodlands. Riparian habitat is a mosaic of forested, shrub and herbaceous plant communities that includes quaking aspen / thinleaf alder (*Populus tremuloides / Alnus incana*) woodlands interspersed with stands of Colorado blue spruce (*Picea pungens*), Drummond's willow (*Salix drummondiana*) / mesic forbs and mountain willow (*Salix monticola*) / mesic forbs shrublands. Wet meadows are dominated by graminoids especially water sedge (*Carex aquatilis*) and beaked sedge (*Carex utriculata*). In Lump Gulch, soils are peaty, although the peat is not currently deep enough to classify the area as a fen. However, historical anecdotal reports indicate that at the turn of the 20th century peat mining occurred in the area of the Lump Gulch site, indicating that, historically, the area was likely a fen. Beaver have been reintroduced to Lump Gulch. Results include greatly enhanced stream flows, restoration of wetland vegetation and wildlife species including moose (*Alces alces*), chorus frogs (*Pseudacris triseriata*), greenback cutthroat trout (*Oncorhynchus clarkii stomias*) and a good diversity of bird species such as Ring-necked Duck (*Aythya collaris*), Mallard (*Anas platyrhynchos),* Cordilleran Flycatcher (*Empidonax occidentalis*), Warbling Vireo (*Vireo gilvus*), Fox Sparrow (*Passerella iliaca*), Lincoln's Sparrow (*Melospiza lincolnii*), Song Sparrow (*Melospiza melodia*), Broad-tailed Hummingbird (*Selasphorus platycercus*), Black-headed Grosbeak (*Pheuticus melanocephalus*), Cedar Waxwing (Bombycilla cedrorum), Great Blue Heron (*Ardea herodias*), Williamson's Sapsucker (*Sphyrapicus thyroideus*), Red-naped Sapsucker (*Sphyrapicus nuchalis*), and Red-winged Blackbird (*Agelaius phoeniceus).*

Key Environmental Factors: Hydrology, including surface and groundwater flow, is the key environmental factor necessary to maintain this ecological system (Rondeau, 2001). Here, ecological systems and their hydrology evolved with and are highly dependent on beaver activity. In those sites where beaver are present native riparian plant communities are thriving. Where beaver were historically present but are now absent natural communities and stream flows are altered. In this system, beaver activity is integral to enhancing out-of-bank flows, recharging groundwater, and raising the water table to enable maintenance of wetland and stream systems.

Climate Description: Temperature and precipitation vary in Gilpin County with elevation, time of year and from the east to the west. In general, lower elevations to the east and south are drier and warmer while higher elevations to the north and west are wetter and colder. Temperature also varies from the east to the west corresponding to changes in elevation. Additionally, precipitation does not fall at the same time during the year everywhere in Gilpin County. Western locations at higher elevations receive the majority of their precipitation during late winter and early spring whereas the Front Range foothills receive the majority of their moisture during spring and early summer but both mountains and foothills also receive precipitation from mid-summer thunderstorms (Siemer 1977). The Ellsworth Creek site is located in the lower montane foothills in the central eastern part of Gilpin County at an elevation of approximately 9,000 feet. Here, average annual precipitation from 1971 through 2000 was 22.43 inches with May, June, July and August the wettest months; coldest temperatures occurred in January with an average maximum temperature of 36.27 °F and an average minimum of 16.63 °F; warmest temperatures occurred in July with an average maximum of 77.22 °F and an average minimum of 50.4 °F (Prism 2010).

Land Use History: Mining was common throughout the area including throughout this site. Mining included placer and below ground mineral mining and peat mining. Currently, rural residential development occurs throughout this site.

Cultural Features: Antique mining machinery and equipment is found throughout this site.

Biodiversity Significance Rank Comments (B4): The site is drawn for a fair (C-ranked) occurrence of the globally vulnerable (G3/S3) plant community, quaking aspen / thinleaf alder (*Populus tremuloides / Alnus incana*). This site also harbors fair (C-ranked) occurrences of the globally apparently secure (G4/S3) montane willow (*Salix monticola*) / mesic forbs shrubland and the state rare (G5/S2) plant, broad-leaved twayblade (*Listera convallarioides*).

Natural Heritage element occurrences at the Elsworth Creek PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	Populus tremuloides / Alnus incana Forest	Montane Riparian Forests	G3	S3				C	2009-07-01
Natural Communities	Salix monticola / Mesic Forbs Shrubland	Montane Riparian Willow Carr	G4	S3				C	2009-06-30
Vascular Plants	Listera convallarioides	broad - leaved twayblade	G5	S2				C	2009-06-30

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The boundary was drawn to encompass the ecological and hydrological processes essential to ecosystem maintenance and sustainability of the element occurrences. Field reconnaissance indicates that stream and wetland hydrology is dependent on shallow surface flow and groundwater discharge. Reintroduction of beaver would benefit the element and promote long-term stream and riparian habitat sustainability.

Protection Urgency Rank Comments (P2): Upland and riparian development has altered the natural hydrologic regime within the sub-watersheds in this site and fragmented the landscape. Roads, residential development, small residential dams, wetland dredging, and historic mining impacts contribute to habitat alteration. Connections between upland and wetland/riparian habitat are diminished by development. Natural ecological processes are limited by both historic and recent development. Riparian functions are compromised where beaver have been removed due to decreased out-of-bank flows and reduced water storage. Additionally, domestic wells are the primary water supply for residences in this site. Due to geologic characteristics of the area, groundwater withdrawals very likely impact stream and wetland hydrology. Historic beaver (*Castor canadensis*) activity was responsible for maintaining wetland and stream functions. Beaver have been extirpated from the site and both stream and riparian habitat are transitioning. Historically, the surrounding hillslopes were developed for mining and associated infrastructure and these uses continue to impact the landscape. Ubiquitous rural, residential development characterizes current land uses. Upland habitat has been altered by logging, mining, and residential development. Abandoned mines with associated infrastructure and impacts are ubiquitous throughout the surrounding landscape. Upland forests are structurally simplified with only one or two age classes of dominant tree species, low vertical habitat patchiness, and low recruitment. Pine beetle infestation is heavy. Soils are shallow, with little humus and are highly erodible.

Management Urgency Rank Comments (M2): Restoration of a natural hydrologic regime is essential to the viability of the occurrences.

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Version Author: Malone, D.G.

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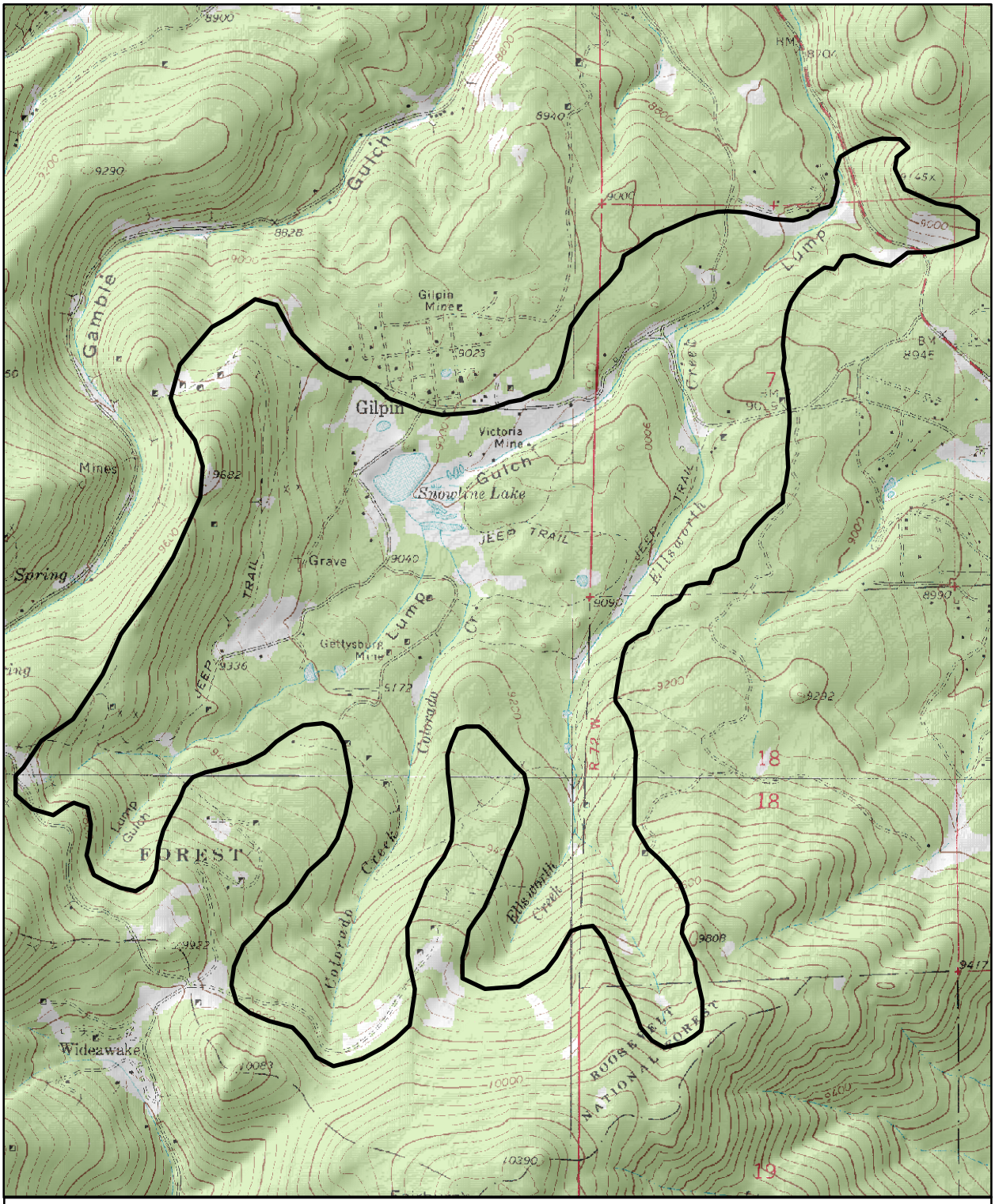

Map 10. Elsworth Creek Potential Conservation Area, B4: Moderate Biodiversity Significance

Forest Lakes

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P5: No Action to be Taken on this Site

Management Urgency Rank - M3: Needed within 5 Years to Maintain Quality

U.S.G.S. 7.5-minute quadrangles: East Portal

Size: 642 acres (260 ha) **Elevation:** 10,400 - 12,072 ft. (3,170 - 3,680 m)

General Description: The Forest Lakes site is located on the east side of the Continental Divide, in the James Peak Wilderness. High ridges along the Continental Divide delineate the western border of the site and east-west trending ridges delineate north and south boundaries. The site extends from the alpine down into the subalpine zones and encompasses complexly sculpted glacial cirques, with arêtes. Terrain varies from gentle to steep slopes with rock outcrops and cliffs, as well as glacially sculpted, terraced, slopes below the cirque. Valley trend is generally to the east and southeast but complex topography within the cirque also results in north- and south-trending hillslopes and ridges. Ecosystems in the site include alpine tundra at the highest elevations, transitioning at lower elevations to krummholz and then down to subalpine systems at the lower elevations of the site. Glacial activity also created the template for the formation of the numerous tarns and wetlands that are distributed like paternoster lakes throughout the site and which are the headwaters for numerous streams that are tributaries to South Boulder Creek. Site geology is composed of two types of rock units. Rocks that comprise the walls of the cirque, from the Continental Divide down to the toeslopes, are Precambrian age (1,700-1,800 m.y.) metamorphic units composed of biotitic gneiss, schist, and migmatite. These rocks are derived principally from sedimentary rocks and locally contain minor hornblende gneiss, calc-silicate rock, quartzite, and marble. Toeslopes and the floor of the cirque and slopes below are Quaternary age younger alluvium and surficial deposits that are comprised of glacial drift of the Pinedale and Bull Lake Glaciations with some unclassified glacial deposits (Tweto 1979). Soils in the Forest Lakes site vary with elevation and corresponding to glacial activity. On the crest and high slope of the Continental Divide, Bross-Matcher families-Lithic Cryorthents complex occur on 5 to 40 percent slopes. Upper and mid-slopes of the cirque walls are comprised of Cirque land. Small basins in the cirque with 5 to 25 percent slopes are Bross family-Cryaquepts complex. On low slopes and on the floor of the cirque and extending down onto the slopes below the terminus of the cirque, soils are comprised of Leighcan family, till substratum-Cryaquolls complex on 5 to 40 percent slopes. Numerous wetlands occur in this site and most are located on soils of the Leighcan family, till substratum-Cryaquolls complex. The Leighcan family, till substratum component occurs on moraines; parent material consists of residuum and/or till derived from igneous and metamorphic rock. Depth to a root restrictive layer is greater than 60

inches; the natural drainage class is somewhat excessively drained; this soil is not flooded and is not ponded; and organic matter content in the surface horizon is about 1 percent. The Cryaquolls component occurs on flood plains; parent material consists of gravelly alluvium and/or gravelly glaciofluvial deposits derived from igneous and metamorphic rock; depth to a root restrictive layer is greater than 60 inches; the natural drainage class is poorly drained; this soil is rarely flooded and is not ponded; and organic matter content in the surface horizon is about 85% (USDA 2010). Local wetland hydrology is strongly influenced by the interaction of climate and geomorphology. Wetland hydrology in this site is strongly connected to shallow ground and surface water flow and snowmelt contributes the largest proportion of water to these wetlands through its influence on ground and surface water dynamics. Snowmelt interacts with local geomorphology to maintain high water tables in wetlands and also exerts major control over riparian wetlands by influencing soil saturation characteristics (flooding frequency, duration, timing, and depth) that results from groundwater flow and out-of-bank flooding in the riparian zone (Rocchio 2005). Additionally, by releasing water throughout the growing season, these high altitude headwater wetlands make an important contribution to late summer flows in lower elevation streams. Late summer precipitation may also be important to the fen wetlands in this site in replenishing local aquifers thereby maintaining sufficiently high water tables to support fen development (Cooper 1990). Ecosystems and habitats in this site are diverse, responding to wide elevational gradients, differing aspects, slope, geology, soil, and hydrology. Upland ecosystems in the alpine zone include snowfields, boulder fields, scree and talus slopes, fellfields, turf meadows, gopher gardens and willow carrs. Snow distribution controls vegetation in the alpine. Krummholz stands mark the transition between alpine and subalpine systems and are characterized by stunted, patchy stands of subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*) with intervening patches of wolf (*Salix wolfii*) and barrenground (*Salix brachycarpa*) willow and dry meadow grasses including superturf (*Kobresia myosuroides*) and tufted hairgrass (*Deschampsia caespitosa*). The transition to the subalpine is also marked by a change in topography. Topography is characterized by a series of slopes and terraces that have been produced by glacial action and subsequent mass wasting of morainal material. The effect has been to produce paternoster tarns, wet meadows, marshes and fens that are connected by streams and shallow ground and surface water flow. Slopes are typically dominated by stands of Engelmann spruce - subalpine fir (*Abies lasiocarpa - Picea engelmannii)* forest that are interspersed with mesic or hydric herbaceous meadows, and low shrubs and herbs occupying canopy openings and rocky outcrops. Terraces and low-gradient slopes, swales and depressions are occupied by a complex mosaic of wetland plant communities and are typically ringed by spruce - fir forest. Often a solifluction lobe has formed at the downslope margin of the terraces and is occupied by willow shrubs (*Salix* spp.) and a diverse layer of forbs. Wetland plant communities include willow shrublands, graminoid wet meadows, marshes and fens and also riparian wetlands. Shrub dominated wetlands are characterized by planeleaf willow (*Salix planifolia*) with a forb-dominated understory. Fens occur on low slopes, depressions and adjacent to

tarns and are characterized by graminoid vegetation dominated by few-flower spikerush (*Eleocharis quinqueflora*), intermixed with other graminoids including water sedge (*Carex aquatilis*), little sedge (*Carex paupercula),* silvery sedge (*C. canescens),* Rocky Mountain sedge *(C. scopulorum),* small-head sedge (*C. illota),* black alpine sedge (*C. nigricans),* and new sedge (*C. nova),* and a few forb species including marsh marigold (*Caltha leptosepala),* and elephantella (*Pedicularis groenlandica).* Fringe wetlands often occur along the margins of tarns and are dominated by mesic graminoids including water sedge, bluejoint reedgrass (*Calamagrostis canadensis*) and needle spikerush (*Eleocharis acicularis*). Streams often run through or adjacent to the fens connecting the wetlands and tarns. Stream riparian habitat is characterized by a lush cover of heartleaf bittercress-tall fringed bluebells-arrowleaf ragwort (*Cardamine cordifolia - Mertensia ciliata - Senecio triangularis* and *Caltha leptosepala)* herbaceous vegetation. Wet meadows, hummocks, mesic sites and fen margins are characterized by a rich diversity of forbs that includes globeflower (*Trollius albiflorus),* queen's crown (*Sedum rhodanthum),* northern gentian *(Gentianella amarella),* bog saxifrage (*Saxifraga oregana),* hemlock parsley *(Conioselinum scopulorum),* alpine speedwell *(Veronica wormskjoldii),* Gray's angelica (*Angelica grayi),* saffron ragwort (*Senecio crocatus)* and star gentian (*Swertia perennis).*

Key Environmental Factors: Climate, hydrology, and geology are key driving factors that have enabled the development and maintenance of the plant communities and animal species present in the site.

Climate Description: Climate in Gilpin County varies dramatically with elevation, aspect and time of year. Higher elevations to the north and west are colder and wetter than lower elevations to the east and south. Temperature and precipitation varies from east to west corresponding to elevation change. Average annual temperature and length of the growing season decrease as elevation increases while average annual precipitation increases. In general, temperatures decrease at a rate of approximately 3 °F for every thousand feet of elevation gain. Additionally, the pattern of precipitation distribution varies from the eastern to the western parts of the county. Western locations at higher elevations receive the majority of their precipitation during late winter and early spring while eastern locations receive the majority of their moisture during early spring and summer (Siemer 1977). The Forest Lakes site is located in the western most part of the County from the Continental Divide at an elevation of 12,072 feet, southeast down to an elevation of 10,400 feet. Here, average annual precipitation from 1971 to 2000 was 34.34 inches per year; coldest temperatures occurred in January with an average maximum high of 25.9 °F and a low of 6.51 °F; warmest temperatures occurred in July with an average maximum high of 66.45 °F and a low of 39.06 °F (Prism 2010).

Land Use History: Although much of Gilpin County was impacted by mining exploration, most of the high elevations landscape near the Continental Divide, including this site, did not see mining exploration (Gilpin County 2010). The first humans to use the land in this site were likely Native Americans. Numerous sites in

alpine ecosystems along the Continental Divide of the Front Range, including near the Rollins Pass area, have been identified as Paleoindian and Prehistoric age game drive sites (Benedict 2005).

Cultural Features: Paleoindian to Prehistoric age Native American artifacts are potentially present (Gellhorn 2002).

Biodiversity Significance Rank Comments (B4): This site is drawn to encompass five fens which are dominated by an excellent (A-ranked) occurrence of the globally apparently secure (G4/S3S4) few-flower spikerush (*Eleocharis quinqueflora*) herbaceous vegetation.

Natural Heritage element occurrences at the Forest Lakes PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	Eleocharis quinqueflora Herbaceous Vegetation	Alpine Wetlands	G4	S3S4				A	2009-08-11

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The site was delineated to include ecological systems and processes that are essential to maintaining the wetlands and provide a buffer against disturbance. Climate change was also considered in boundary delineation; alpine ecosystems are especially vulnerable and species that depend on tundra may disappear as alpine tundra diminishes with the advance of trees and shrubs (USFWS 2010). Hydrology is the primary process essential to long-term wetland plant community viability. Alpine/subalpine wetlands are often isolated hydrologically from other wetlands, and easily impacted by surrounding land use (Rondeau 2001). Thus, maintaining an intact and unfragmented hydrologic regime is essential to element viability. The wetlands in this site are reliant on water levels at or near the surface for much or all of the growing season (Rondeau 2001). Snowmelt from nearby surrounding ridges and slopes maintains abundant shallow ground and surface flow which contributes the primary source of water to depressional, slope and riparian wetlands.

Protection Urgency Rank Comments (P5): The site is located in the James Peak Wilderness Area and is afforded protections provided by wilderness designation.

Management Urgency Rank Comments (M3): Although this site is located in the James Peak Wilderness area and benefits from protections afforded by Wilderness designation, recreational use is high due to proximity to Front Range cities. Recreational trails and numerous undesignated trails and camp sites occur, resulting in trampling of vegetation and fragmentation. These activities have a potentially deleterious effect on the communities. Additionally, mountain climate in Colorado

is predicted to migrate upwards with resulting 10-20% declines in high-elevation snowpack (CWCB 2010). Declining snowpack may have detrimental implications for alpine wetland and stream systems as well as for lower elevation riparian/stream systems.

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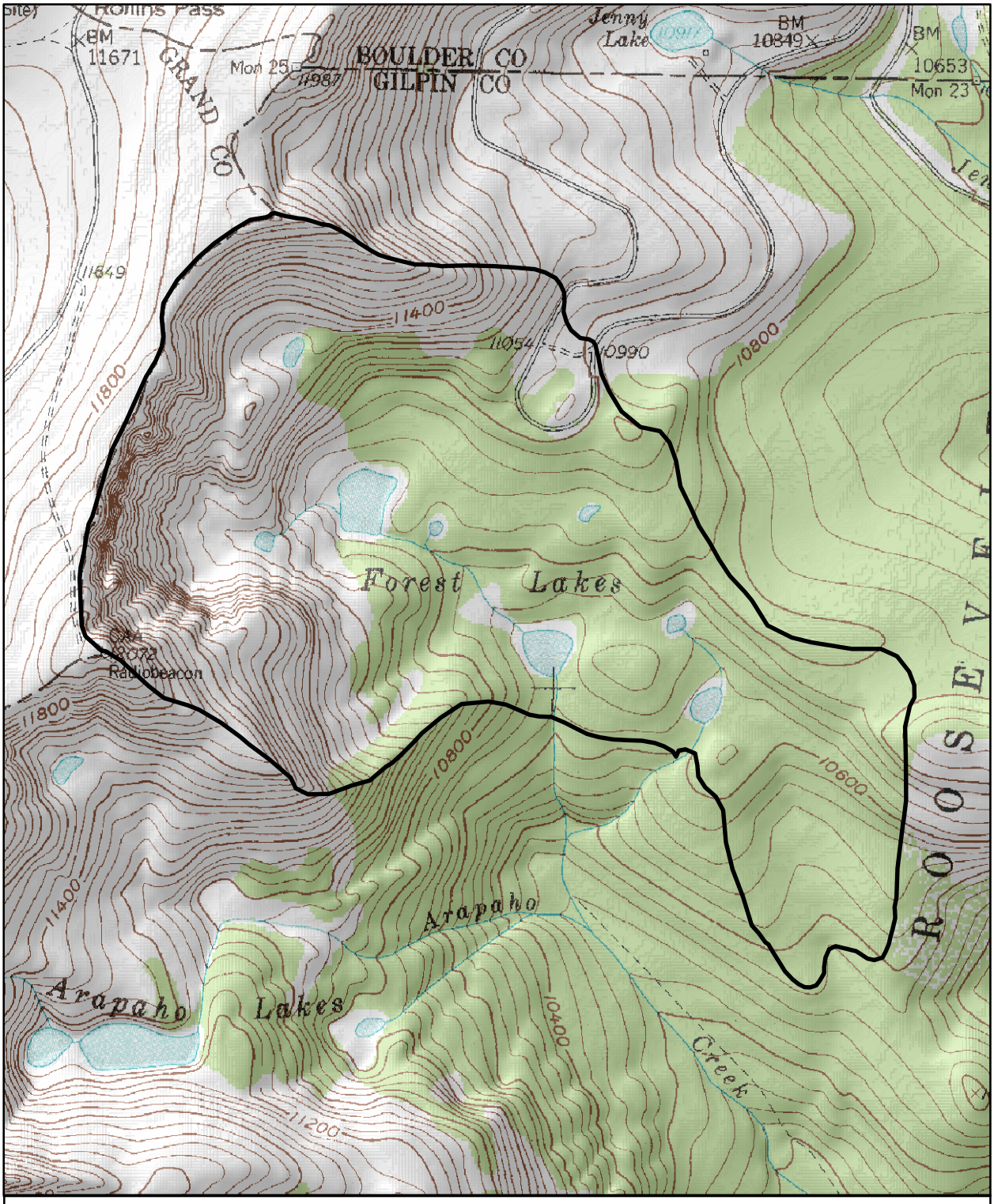

Colorado Natural Heritage Program
Colorado State University
1474 Campus Delivery
Fort Collins, CO 80523-1474
http://www.cnhp.colostate.edu

Map Date: 03/17/2011

Miles
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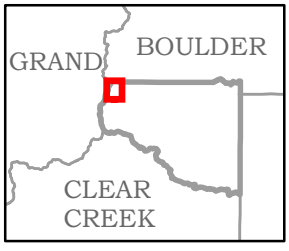
Legend

PCA Boundary

East Portal, 39105-H6

7.5 Minute Digital Raster Graphic Produced by the U.S. Geological Survey

Location in Gilpin County



Map 11. Forest Lakes Potential Conservation Area, B4: Moderate Biodiversity Significance

Iceberg Lake

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M3: Needed within 5 Years to Maintain Quality

U.S.G.S. 7.5-minute quadrangles: Empire, East Portal

Size: 1,610 acres (651 ha) **Elevation:** 10,840 - 12,030 ft. (3,304 - 3,667 m)

General Description: Iceberg Lakes site is located on the east side of the Continental Divide in the James Peak Wilderness. The western border of the site is the Continental Divide, east-west trending ridges delineate the north and south boundaries of the site and the eastern boundary occurs where topography transitions from low gradient terraces to a steep valley walls. Valley trend is generally to the east but the glacially sculpted topography has created north- and south-trending hillslopes, ridges, and rocky outcrops. Glacial action and subsequent mass wasting of morainal material produced a landscape characterized by glacial cirques, arêtes, steep slopes, low-gradient benches, and terraces. This complexly sculpted landscape provides the template for the development of a diverse mosaic of ecosystems and natural communities. Ecosystems in the site include high elevation alpine tundra, krummholz and upper subalpine forests, each with a diversity of both upland and wetland habitats. Alpine zone ecosystems are an intricate mosaic of snowfields, rock cliffs, fellfields, willow carrs and turf meadows, talus and scree slopes with patterned ground intervene on steeper slopes, and slope and riparian wetlands. Fellfields are characterized by cushion plants including moss campion (*Silene acaulis*), alpine nailwort (*Paronychia pulvinata*) and alpine sandwort (*Arenaria obtusiloba*). Turf meadows are characterized by a variety of forbs and graminoids including tufted hairgrass (*Deschampsia caespitosa*), superturf (*Kobresia myosuroides*), alpine harebell (*Campanula uniflora*), and old-man-of-the-mountain (*Rydbergia grandiflora*) and, together with upland willow carrs, create a complex patchwork of plant communities that cover steep hillslopes. Upland willow carrs are typified by dense stands of barrenground willow (*Salix brachycarpa*) with an understory characterized by a mix of graminoids and forbs including tufted hairgrass, superturf, alpine pussytoes (*Antennaria alpina*), and field chickweed (*Cerastium arvense*). Large patches of superturf occupy openings in the shrub canopy and increase patch diversity. Decreasing elevation is marked by a transition from alpine tundra ecosystems to krummholz stands of Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) with exposed, rocky ridges occupied by bristlecone pine (*Pinus aristata*). Subalpine uplands are characterized by Engelmann spruce - subalpine fir forest. Openings in the forest canopy are characterized by herbaceous meadows, tarns and slope and depressional wetlands. A variety of wetland ecosystems, with a diversity of plant communities and species, occur in both alpine and subalpine ecosystems of this site occupying depressions, swales, low

slopes, and the margins of lakes, tarns, and streams. Alpine wetland communities include willow-dominated fens, forb-dominated wet meadows and riparian zones and graminoid-dominated lacustrine wetlands. Willow (*Salix spp*.) dominated fens occur on a series of low-gradient, southeast-facing terraces located on lowslopes, at the base of the steep slopes that form the Continental Divide. These willow carrs are characterized by an association of planeleaf willow / bluejoint reedgrass (*S. planifolia / Calamagrostis canadensis*) and extend up onto adjacent hillslopes where they are sustained by copious shallow surface and groundwater flow. Soils in the fens are saturated and hummocky with peat formation to 50 cm. Riparian and lacustrine wetlands are characterized by a linear mosaic of planeleaf willow/mesic forb communities and herbaceous vegetation dominated by communities of heartleaf bittercress - tall chiming bells - arrowleaf ragwort (*Cardamine cordifolia - Mertensia ciliata - Senecio triangularis*) herbaceous vegetation. Subalpine wetlands include herbaceous fens, forested and shrub wetlands, wet meadows, and riparian and lacustrine wetlands. Fens occur on low slopes and in depressions, often at the base of rock cliffs, and are characterized by graminoid communities dominated by few-flower spikerush (*Eleocharis quinqueflora*) and by mountain sedge / marsh marigold communities (*Carex scopulorum / Caltha leptosepala*). Other graminoids and forbs are typically also present and include species such as water sedge (*C. aquatilis*), small-head sedge (*C. illota*) and black alpine sedge (*C. nigricans*), elephantella (*Pedicularis groenlandica*), star gentian (*Swertia perennis*) and queen's crown (*Sedum rhodanthum*). Soils are saturated to inundated and contain accumulations of peat from 50 cm to 75 cm deep. Subalpine riparian plant communities are characterized by a lush and diverse cover of forbs with a mosaic of marsh marigold and heartleaf bittercress-tall chiming bells-arrowleaf ragwort herbaceous vegetation. Subalpine lacustrine wetlands include herbaceous and forested communities. Herbaceous lacustrine wetlands are a mosaic of forb and graminoid communities including heartleaf bittercress-tall chiming bluebells-arrowleaf ragwort, marsh marigold, and water sedge. Forested wetlands are characterized by communities of subalpine fir - Engelmann spruce / water sedge (*Abies lasiocarpa - Picea engelmannii / Carex aquatilis*). This diverse mosaic of upland and wetland, alpine and subalpine plant communities provides high quality breeding and foraging habitat for several avian and mammal species. Notable avian species present include White-tailed Ptarmigan (*Lagopus leucurus*), Pine Grosbeak (*Pinicola enucleator*), Golden-crowned Kinglet (*Regulus satrapa*) and Clark's Nutcracker (*Nucifraga columbiana*). Each of these bird species requires foraging and breeding resources that are only provided by intact, native plant communities. For instance, extensive willow carr habitat is essential for the survivability of White-tailed Ptarmigan; five-needled pines, such as bristlecone, provide an essential food resource for Clark's Nutcracker; and Pine Grosbeaks prefer to forage in open forests for seeds and buds and require very large, contiguous forested landscape to take advantage of fluctuating food supplies (Sibley 2001). Local wetland hydrology is strongly influenced by the interaction of climate and geomorphology. Glacial activity created the template for the formation of the tarns and wetlands that occur throughout the site and the interaction of climate and geomorphology provides the environmental characteristics that support the

development of wetlands. Wetland hydrology in this site is strongly connected to shallow ground and surface water flow and snowmelt contributes the largest proportion of water to these wetlands through its influence on ground and surface water dynamics. Snowmelt interacts with local geomorphology to maintain high water tables in wet meadows, marshes, and fens and also exerts major control over riparian wetlands by influencing soil saturation characteristics (flooding frequency, duration, timing, and depth) that results from groundwater flow and out-of-bank flooding in the riparian zone (Rocchio 2005). Additionally, by releasing water throughout the growing season, these high altitude headwater wetlands make an important contribution to late summer flows in lower elevation streams. Importantly, these wetlands are the headwaters for numerous streams that flow through the site and are tributaries to South Boulder Creek. Geology of the surrounding ridges is primarily composed of Precambrian age metamorphic rocks that are derived principally from sedimentary rock. Rocks are comprised of biotitic gneiss, schist, and migmatite and locally contain minor hornblende gneiss, calc-silicate rock quartzite and marble (Tweto 1979). Soils on the rim of the Continental Divide are comprised of Bross-Matcher families-Lithic Cryorthents complex, 40 to 75 percent slopes. Steep slopes of alpine cirques are comprised of Cirque land, 40 to 150 percent slopes while soils on low slopes and in the basin of the cirque are Matcher family-Cryaquepts-Rock outcrop complex, 5 to 25 percent slopes. In the subalpine zone soils are primarily either Bross-Matcher families-Lithic Cryorthents complex, 5 to 40 percent slopes or Leighcan-Catamount families, moist-Rock outcrop complex, 40 to 150 percent slopes (USDA 2010).

Key Environmental Factors: Climate, hydrology, geology, and biota are key driving factors that have enabled the development and maintenance of the element plant communities and animal species present in the site. A natural hydrologic regime is essential to the sustainability of elements in this site. Especially essential to wetland and stream sustainability is shallow ground and surface water flow derived from the melting snowpack and, secondarily, out-of-bank streamflows.

Climate Description: Climate in Gilpin County varies dramatically with elevation, aspect, and time of year. Higher elevations to the north and west are colder and wetter than lower elevations to the east and south. Temperature and precipitation varies from east to west corresponding to elevation change. Average annual temperature and length of the growing season decrease as elevation increases while average annual precipitation increases. In general, temperatures decrease at a rate of approximately 3 °F for every thousand feet of elevation gain. Additionally, the pattern of precipitation distribution varies from the eastern to the western parts of the county. Western locations at higher elevations receive the majority of their precipitation during late winter and early spring while eastern locations receive the majority of their moisture during early spring and summer (Siemer 1977). The Iceberg Lake site is located in the most western part of the county at elevations between approximately 12,000 and 10,800 feet elevation. Mid elevations in this site received an average annual precipitation, from 1971 through 2000, of 34.85 inches;

coldest temperatures occurred in January with an average maximum temperature of 23.83 degrees F and an average minimum of 4.03 °F; warmest temperatures occurred in July with an average maximum of 63.48 °F and an average minimum temperature of 38.59 °F (Prism 2010).

Land Use History: Although much of Gilpin County was impacted by mining exploration, most of the high elevations landscape near the Continental Divide, including this site, did not see mining exploration (Gilpin County 2010). The first humans to use the land in this site were likely Native Americans. Numerous sites in alpine ecosystems along the Continental Divide of the Front Range have been identified as Paleoindian and Prehistoric age game drive sites (Benedict 2005).

Cultural Features: Paleoindian to Prehistoric age Native American artifacts are potentially present (Gellhorn 2002).

Biodiversity Significance Rank Comments (B4): The site is drawn for the presence of a variety of wetlands. There are three fens characterized by excellent (A-ranked) occurrences of the state rare (G4/S2S3) planeleaf willow / bluejoint reedgrass (*Salix planifolia / Calamagrostis canadensis*) shrubland, an herbaceous fen which is characterized by an excellent (A-ranked) occurrence of the state vulnerable (G4/S3S4) few-flowered spikerush (*Eleocharis quinqueflora*) herbaceous vegetation, and a fair (C-ranked) occurrence of an apparently secure (G4/S4) planeleaf willow / marsh marigold (*Salix planifolia / Caltha leptosepala*) shrubland.

Natural Heritage element occurrences at the Iceberg Lake PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	Eleocharis quinqueflora Herbaceous Vegetation	Alpine Wetlands	G4	S3S4				A	2009-08-15
Natural Communities	Salix planifolia / Calamagrostis canadensis Shrubland	Subalpine Riparian Willow Carr	G4	S2S3				A	2009-08-18
Natural Communities	Salix planifolia / Calamagrostis canadensis Shrubland	Subalpine Riparian Willow Carr	G4	S2S3				A	2009-08-03
Natural Communities	Salix planifolia / Calamagrostis canadensis Shrubland	Subalpine Riparian Willow Carr	G4	S2S3				A	2009-08-15
Natural Communities	Salix planifolia / Caltha leptosepala Shrubland	Subalpine Riparian Willow Carr	G4	S4				C	1995-07-17

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The site was delineated to include ecological systems and processes that are essential to maintaining the communities as well as to provide a buffer against disturbance. Climate change was also considered in boundary delineation; alpine ecosystems are especially vulnerable and species that depend on tundra may disappear as alpine tundra diminishes with the advance of trees and shrubs (USFWS 2010). Hydrology is the primary process essential to long-term wetland plant community viability. Alpine/subalpine wetlands are often isolated hydrologically from other wetlands, and easily impacted by surrounding land use (Rondeau 2001). Thus maintaining an intact and unfragmented hydrologic regime is essential to element viability. The alpine and subalpine wetland plant communities in this site are reliant on water levels at or near the surface for much or all of the growing season (Rondeau 2001). Snowmelt from nearby surrounding ridges and slopes maintains abundant shallow ground and surface flow which contributes the primary source of water to depressional, slope and riparian wetlands.

Protection Urgency Rank Comments (P4): Alpine sites are located in designated Wilderness Area; subalpine sites are located in U.S.F.S. managed lands.

Management Urgency Rank Comments (M3): Subalpine sites receive high recreational pressure and are impacted by trampling. Trampling and related recreational impacts have the clear potential to degrade the viability of the

occurrences. The occurrences would benefit by the closing of social trails and rerouting trails out of riparian zones and wetland habitats. Currently, alpine sites are not threatened with recreational impacts; however, climate change is expected to drastically alter vegetation characteristics in the alpine zone (USFWS 2010). Minimizing human-caused disturbance to high-elevation habitats and connecting these habitats to facilitate migration may help species adapt to changing ecosystems. Mountain climate in Colorado is predicted to migrate upwards with resulting 10-20% declines in high-elevation snowpack (CWCB 2010). Declining snowpack may have detrimental implications for alpine wetland and stream systems as well as for lower elevation riparian/stream systems. Additionally, trees and shrubs are predicted to advance and narrow or eliminate alpine tundra ecosystems. Those species dependent on tundra habitat, including White-tailed Ptarmigan may disappear as alpine tundra diminishes (USFWS 2010).

Information Needs: Additional inventories are needed to identify and update the status of the historic and general records within and near this site.

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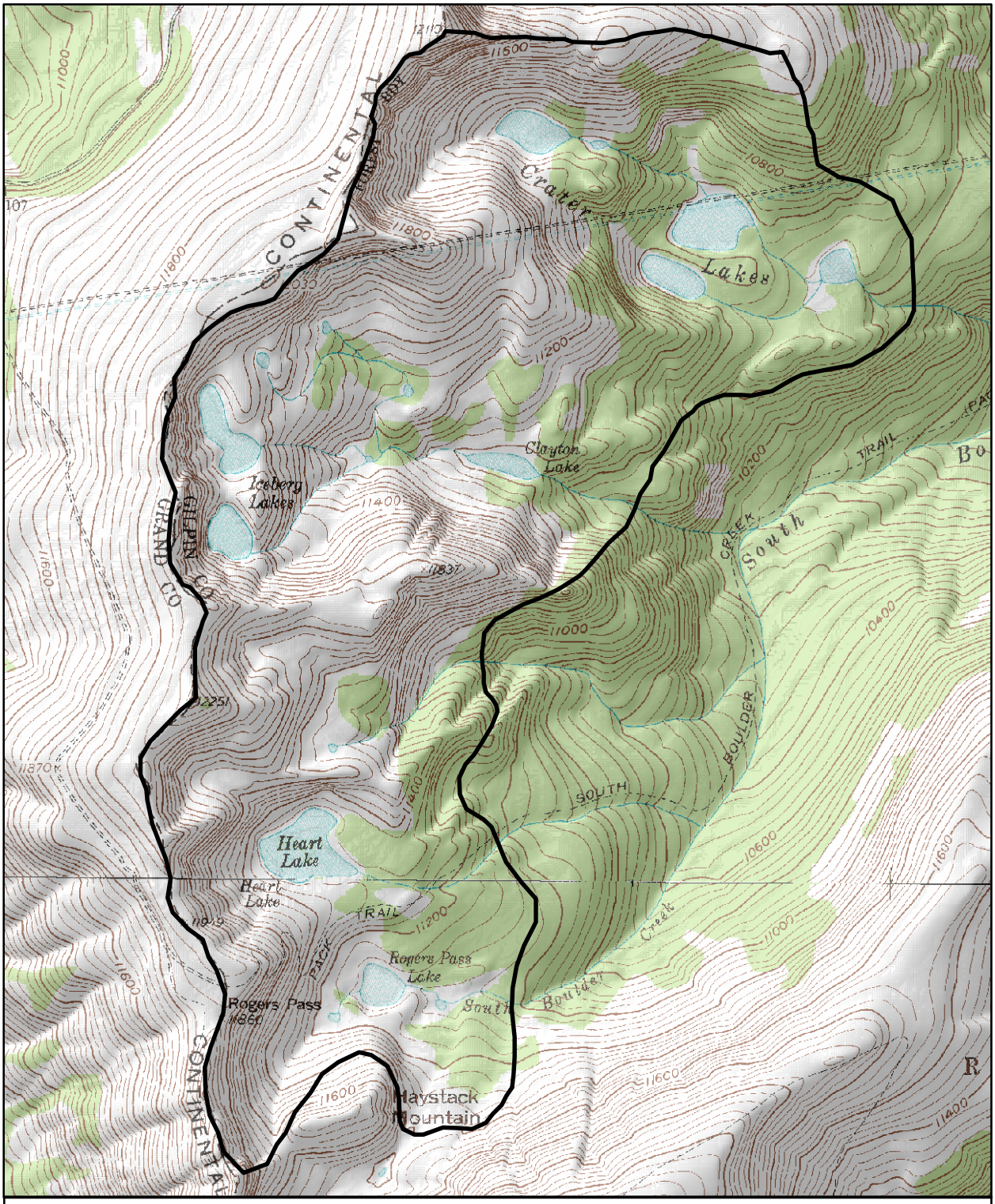

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Map Date: 03/17/2011

0 0.2 0.4 Miles

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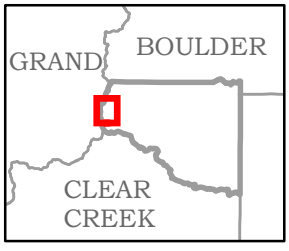
Legend

PCA Boundary

Empire, 39105-G6
East Portal, 39105-H6

7.5 Minute Digital Raster Graphics Produced by the U.S. Geological Survey

Location in Gilpin County



Map 12. Iceberg Lake Potential Conservation Area, B4: Moderate Biodiversity Significance

James Peak

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P3: Definable Threat/Opportunity but not within 5 Years

Management Urgency Rank - M2: Essential within 5 Years to Prevent Loss

U.S.G.S. 7.5-minute quadrangles: Empire

Size: 1,074 acres (435 ha) **Elevation:** 10,500 - 13,294 ft. (3,200 - 4,052 m)

General Description: The James Peak site is located on the east slope of the Front Range in the James Peak Wilderness in Gilpin County, Colorado. James Peak and the Continental Divide form the western boundary of this site which encompasses two glacial cirques and extends from the alpine zone down into the upper subalpine. North and south boundaries are defined by glacially sculpted, east-west trending ridges and the eastern boundary by a topographic transition to steep valley walls. Large tarns occur in each of the two cirques that were excavated by glaciers during the Pleistocene ice age. These cirques are the headwaters for Mammoth Gulch and the source of numerous first order streams that flow through the site. Glacial action carved a complex landscape leaving arêtes, low ridges, rocky cliff faces, steep valley walls and gently sloping terraces and morainal deposits that created the template for the development of current-day ecosystems. Upland ecosystems in the alpine zone are an expansive and complex mosaic of snowfields, rocky outcrops, willow carrs, turf meadows, fellfields, and talus and scree slopes and glacially carved rock outcrops. Bristlecone pine (*Pinus aristata*) occupies rocky ridges between cirques and tarns and are scattered across the landscape below the Continental Divide. Krummholz stands of Engelmann spruce - subalpine fir (*Picea engelmannii - Abies lasiocarpa*) signal the transition to upper subalpine zone forests which are also dominated by extensive stands of spruce and fir. A variety of wetland ecosystems with diverse plant communities and species occur in both the alpine and subalpine zones of this site. Wetland systems include riparian and lacustrine, depressional and slope wetlands, often with deep accumulations of peat that have resulted in fen development. These wetlands are characterized by an intricate and diverse mosaic of plant communities that includes willow (*Salix spp*.) shrublands, graminoid-dominated wet meadows, fens and lacustrine sites and forb-dominated riparian habitat. Shrub dominated wetlands occur on lake and stream margins and in depressions and are characterized by a community mosaic of planeleaf willow (*Salix planifolia*) with a forb-dominated understory and graminoid-dominated herbaceous vegetation that includes water sedge (*C. aquatilis*) and mountain sedge (*C. scopulorum*). Soils in these depressional wetland sites are typically saturated or inundated and contain moderate accumulations of peat, to 50 cm deep, that is underlain by glacial till. Riparian habitat is characterized by a lush and diverse cover of forbs with communities of heartleaf bittercress - tall fringed bluebells - arrowleaf

ragwort (*Cardamine cordifolia - Mertensia ciliata - Senecio triangularis*) and marsh marigold (*Caltha leptosepala*) herbaceous vegetation. Fens also occur on low-gradient slopes and are characterized by herbaceous cover dominated by few-flower spikerush (*Eleocharis quinqueflora*). Other graminoids and forbs are also present distributed along a soil moisture gradient with hydric species dominating the site. Typical herbaceous species include water sedge (*Carex aquatilis*), mountain sedge (*C. scopulorum*), small-head sedge (*C. illota*) and black alpine sedge (*C. nigricans*), elephantella (*Pedicularis groenlandica*), marsh marigold (*C. leptosepala*), star gentian (*Swertia perennis*) and queen's crown (*Sedum rhodanthum*), bog saxifrage (*Saxifraga odontoloma*) and rosy paintbrush (*Castilleja rhexiifolia*). Geology on the Continental Divide and down into the cirque is primarily Precambrian age metamorphic rock derived principally from sedimentary rock that is composed of biotitic gneiss, schist and migmatite. Additionally, a northeast trending area at the middle of the cirque and an area at the lower and eastern side of the site are composed of Precambrian age metamorphic felsic and hornblendic gneisses derived principally from volcanic rocks (Tweto 1979). Soils in the site vary from talus and scree on high ridges and steep slopes to deep peat in depressions, swales and low slopes. On the crest of the Continental Divide as well as on east-west trending ridges of the cirque walls, soils are classified as Bross family-Rubble land-Matcher family complex, 40 to 150 percent slopes and Bross-Matcher families-Lithic Cryorthents complex, 5 to 40 percent slopes. On high and mid slopes of the cirques soils are classified as Cirque land, 40 to 150 percent slopes. Low slopes and cirque basin soils are characterized as Bross family-Cryaquepts complex, 5 to 25 percent slopes. Soils on low-gradient slopes that underlie slope wetlands are Leighcan family, till substratum-Cryaquolls complex, 5 to 40 percent slopes (USDA 2010). Local wetland hydrology is strongly influenced by the interaction of climate, geomorphology, and biota. Wetland hydrology in this site is strongly connected to shallow ground and surface water flow and snowmelt contributes the largest proportion of water to these wetlands through its influence on ground and surface water dynamics. Snowmelt interacts with local geomorphology to maintain high water tables in wet meadows, marshes, and fens and also exerts major control over riparian wetlands by influencing soil saturation characteristics (flooding frequency, duration, timing and depth) that results from groundwater flow and out-of-bank flooding in the riparian zone (Rocchio 2005). Additionally, by releasing water throughout the growing season, these high altitude headwater wetlands make an important contribution to late summer flows in lower elevation streams. Finally, in a positive feedback process, the native plant communities in this site contribute to the maintenance of wetland hydrology by slowing runoff, insulating soils and by adding organic matter that increases the water holding capacity of soils. Within the boundaries of this site the local natural hydrologic regime is intact; wetlands are connected with uplands and there is no evidence of recent anthropogenic wetland alteration. Copious shallow ground and surface water discharge from adjacent, steep, alpine hillslopes sustains wetland development and maintenance. Stream and channel habitat are in sustainable condition: banks are stable and well vegetated; erosion is in balance with deposition; channel structure is diverse; and width/depth ratio is appropriate to the stream

class.

Key Environmental Factors: Climate, hydrology, and geology are key driving factors that have enabled the development and maintenance of the element plant communities and animal species present in the site. A natural hydrologic regime is essential to the sustainability of elements in this site. Especially essential to wetland and stream sustainability is shallow ground and surface water flow derived from the melting snowpack and, secondarily, out-of-bank streamflows which replenishes shallow groundwater and is essential to riparian vegetation and stream stability.

Climate Description: Climate in Gilpin County varies dramatically with elevation, aspect and time of year. Higher elevations to the north and west are colder and wetter than lower elevations to the east and south. Temperature and precipitation varies from east to west corresponding to elevation change. Average annual temperature and length of the growing season decrease as elevation increases while average annual precipitation increases. In general, temperatures decrease at a rate of approximately 3 °F for every thousand feet of elevation gain. Additionally, the pattern of precipitation distribution varies from the eastern to the western parts of the county. Western locations at higher elevations receive the majority of their precipitation during late winter and early spring while eastern locations receive the majority of their moisture during early spring and summer (Siemer 1977). The James Peak site is located in the most western part of the county at elevations between approximately 13,000 and 10,500 feet elevation. Average annual precipitation from 1971 through 2000 was 36.45 inches; coldest temperatures occurred in January with an average maximum temperature of 23.25 °F and an average minimum of 2.66 °F; warmest temperatures occurred in July with an average maximum of 61.27 °F and an average minimum temperature of 36.18 °F(Prism 2010).

Land Use History: Although much of Gilpin County was impacted by mining exploration, most of the high elevations landscape near the Continental Divide, including this site, did not see mining exploration (Gilpin County 2010). The first humans to use the land in this site were likely Native Americans. Numerous sites in alpine ecosystems along the Continental Divide of the Front Range, including near the Rollins Pass area, have been identified as Paleoindian and Prehistoric age game drive sites (Benedict 2005).

Cultural Features: Paleoindian to Prehistoric age Native American artifacts are potentially present (Gellhorn 2002).

Biodiversity Significance Rank Comments (B4): This site is drawn for an excellent (A-ranked) occurrence of the state vulnerable (G4/S3) wetland fen community, few-flowered spikerush (*Eleocharis quinqueflora*).

Natural Heritage element occurrences at the James Peak PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	Eleocharis quinqueflora Herbaceous Vegetation	Alpine Wetlands	G4	S3S4				A	2009-08-20

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The site was delineated to include ecological systems and processes that are essential to maintaining the wetlands as well as to provide a buffer against disturbance. Climate change was also considered in boundary delineation; alpine ecosystems are especially vulnerable and species that depend on tundra may disappear as alpine tundra diminishes with the advance of trees and shrubs (USFWS 2010). Hydrology is the primary process essential to long-term wetland plant community viability. Alpine/subalpine wetlands are often isolated hydrologically from other wetlands, and easily impacted by surrounding land use (Rondeau 2001). Thus maintaining an intact and unfragmented hydrologic regime is essential to element viability. The element wetland plant communities in this site are reliant on water levels at or near the surface for much or all of the growing season (Rondeau 2001). Snowmelt from nearby surrounding ridges and slopes maintains abundant shallow ground and surface flow which contributes the primary source of water to these depressional, slope and riparian wetlands.

Protection Urgency Rank Comments (P3): Site is located in the James Peak Wilderness but numerous inholdings are present.

Management Urgency Rank Comments (M2): Although the majority of the site is in designated Wilderness and protected, adjacent upland habitat, not included in Wilderness, is fragmented by roads. Upland habitat characteristics and condition, in large part, determine stream and wetland condition. Thus, roads in this adjacent tundra habitat have the clear and likely potential of degrading vegetation, fragmenting ecosystems, altering system hydrology and impacting downslope stream and wetland ecosystems. Additionally, although the majority of the landscape is in Wilderness, numerous inholding mining claims occur throughout the landscape and in this site. Development of these sites would negatively impact Wilderness values and ecosystem function. Closing 4-wheel drive roads to vehicles would greatly benefit upland and wetland ecosystem sustainability. Acquisition and inclusion of private inholdings into the Wilderness area would protect ecological values.

Information Needs: Additional inventories are needed to identify and update the status of the historic and general records within and near this site.

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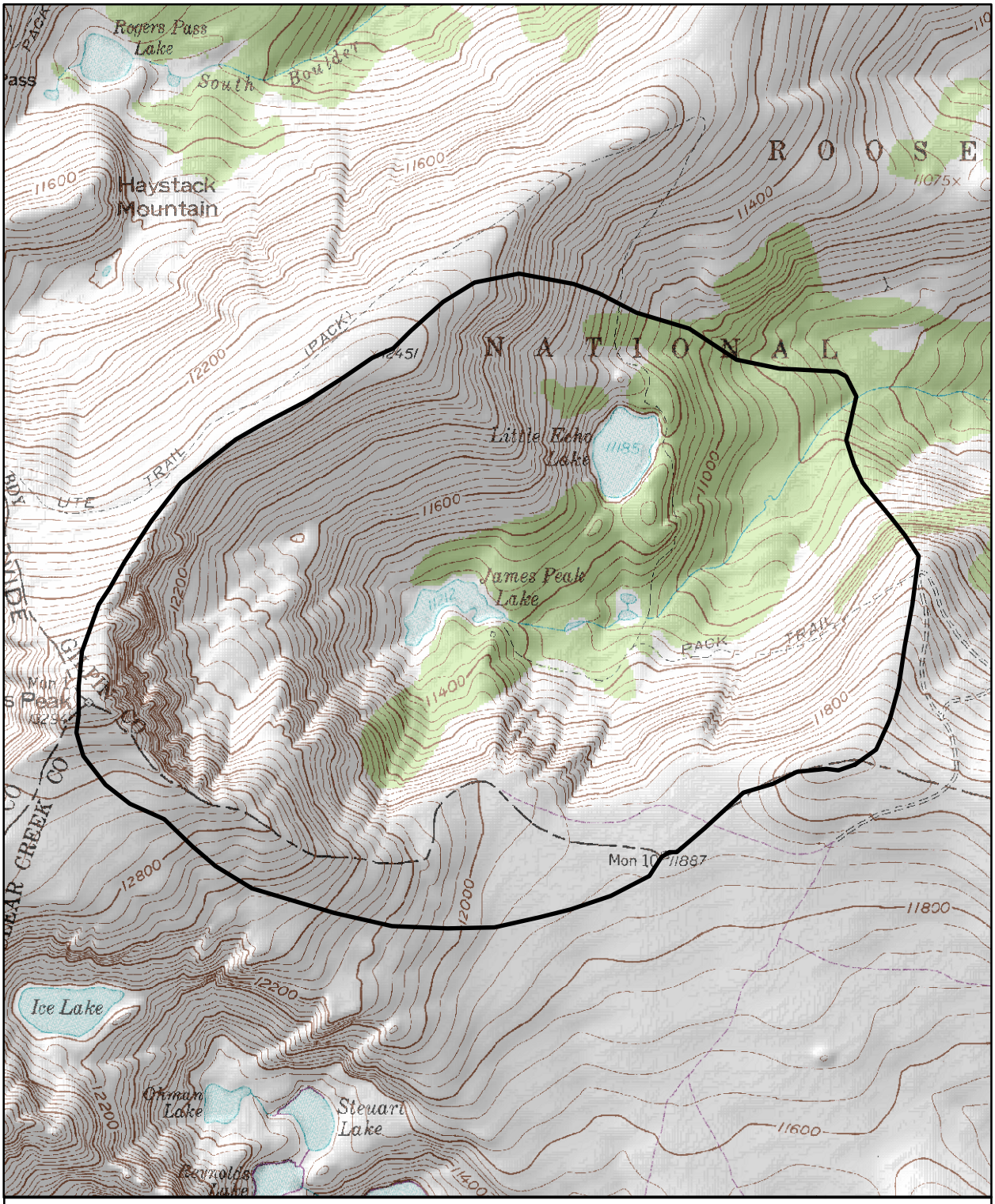

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Map Date: 03/17/2011

Map 13. James Peak Potential Conservation Area, B4: Moderate Biodiversity Significance

Macy Gulch

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P3: Definable Threat/Opportunity but not within 5 Years

Management Urgency Rank - M3: Needed within 5 Years to Maintain Quality

U.S.G.S. 7.5-minute quadrangles: Black Hawk

Size: 1,214 acres (491 ha) **Elevation:** 8,500 - 9,600 ft. (2,591 - 2,926 m)

General Description: Landscapes in this part of Gilpin County were not glaciated during the last ice age and boast gently rounded hills and broad valleys. This landscape is complex, with a mosaic of habitats responding to differences in slope, aspect, soil moisture, and topographic position. Ponderosa forests occur on ridge tops and southwest-facing slopes. Northeast-facing slopes support mixed coniferous and deciduous forests of aspen, Engelmann spruce and lodgepole pine. Drier hillslopes and swales support grasslands and meadows. A variety of wetland types occupy valley bottoms, swales, low-gradient slopes, and solifluction terraces. Valley bottoms host a mosaic of riparian forest, willow (*Salix* spp.) shrubland, and herbaceous wet meadows. Riparian forests are characterized by aspen (*Populus tremuloides*) / tall forb woodlands. Willow shrubs include mountain willow / bluejoint reedgrass (*Salix monticola / Calamagrostis canadensis*) and mountain willow / mesic forbs. Slope wetlands and swales are characterized by mesic graminoids and mesic forbs including water sedge (*Carex aquatilis*) and arctic rush (*Juncus balticus*). Many of the upland hillslopes have a low gradient (2-4%) and shallow groundwater discharge has resulted in soil slumping and the formation of solifluction terraces where small wetland fens have developed. Uplands have been impacted by grazing, fire suppression, and logging. Historically, ponderosa stands were likely more open and widely spaced than they are currently, with large areas dominated by grasses (Veblen and Lorenz 1991). Valley bottoms and meadows were homesteaded and developed for agriculture and ranching with consequent changes in vegetation composition and structure. Together, upland and wetland habitat alteration has likely contributed to changes in the hydrologic regime. This complex mosaic of habitats creates a diversity of breeding habitats for birds. Observed upland and riparian breeding birds include Broad-tailed Hummingbird (*Selasphorus platycercus*), Williamson's Sapsucker (*Sphyrapicus thyroideus*), Northern Flicker (*Colaptes auratus*), Hairy Woodpecker (*Picoides villosus*), Red-naped Sapsucker (*Sphyrapicus ruber*), Olive-sided Flycatcher (*Contopus cooperi*), Western Wood-Peewee (*Contopus sofdidulus*), Cordilleran Flycatcher (*Empidonax occidentalis*), Warbling Vireo (*Vireo gilvus*), Plumbeous Vireo (*Vireo plumbeus*), House Wren (*Troglodytes aedon*), Tree Swallow (*Tachycineta bicolor*), Mountain Chickadee (*Poecile gambeli*), Pygmy Nuthatch (*Sitta pygmaea*), Red-breasted Nuthatch (*Sitta canadensis*), Ruby-crowned Kinglet (*Regulus calendula*), Mountain Bluebird (*Sialia currucoides*), Western Bluebird

(*Sialia mexicana*), Townsend's Solitaire (*Myadestes townsendi*), American Robin (*Turdus migratorius*), Stellar's Jay (*Cyanocitta stelleri*), Yellow-rumped Warbler (*Dendroica coronata*), Vespers Sparrow (*Pooecetes gramineus*), White-crowned Sparrow (*Zonotrichia leucophrys*), Lincoln's Sparrow (*Melospiza lincolnii*), Black-headed Grosbeak (*Pheuticus melanocephalus*), Western Tanager (*Piranga ludoviciana*), Chipping Sparrow (*Spizella passerine*), Dark-eyed Junco (*Junco hyemalis*), Cassin's Finch (*Carpodacus cassinii*), and Pine Siskin (*Carduelis pinus*). Geology is primarily composed of Precambrian age metamorphic rock that is derived principally from sedimentary rock (Tweto 1979). Riparian soils are classified as Kittredge-Guanella complex, 9 to 30 percent slopes. The Kittredge component occurs on alluvial fans while the Guanella component is on mountain slopes. Both are well drained and do not meet hydric criteria. Upland hillslopes are of primarily two types; Resort-Cathedral-Rubble land complex, 30 to 60 percent slopes and Ohman-Legault very gravelly sandy loams, 30 to 60 percent slopes. Each of the upland soil types are well drained or somewhat excessively well drained (USDA 2010). Wetland hydrology in this site is dependent on shallow surface flow. Riparian wetlands have developed where the valley gradient decreases and abundant shallow ground and surface water discharge enables the development of wetland vegetation. Eventually, with the accumulation of flow and an increase in valley gradient, stream channels have formed that drain the valleys. Stream banks in these valleys are typically well-vegetated with high quality riparian plant species, and banks are stable. Although the natural hydrologic regime has been altered by historic grazing and agricultural development these activities have ceased in the Park and vegetation as well as the hydrologic regime appears to be recovering.

Key Environmental Factors: Hydrology, including surface and groundwater flow and annual out-of-bank flows are key environmental factors essential to the maintenance of these montane riparian ecological systems (Rondeau, 2001). These riparian systems evolved with and are highly dependent on beaver (*Castor canadensis*) activity to sustain them (Rondeau, 2001). Beaver activity is integral to enhancing out-of-bank flows, recharging groundwater, and raising the water table to enable maintenance of wetland and stream systems. Recent beaver activity was absent from this site.

Climate Description: Climate in Gilpin County varies dramatically with elevation, aspect, and time of year. Higher elevations to the north and west are colder and wetter than lower elevations to the east and south. Temperature and precipitation varies from east to west corresponding to elevation change. Average annual temperature and length of the growing season decrease as elevation increases while average annual precipitation increases. In general, temperatures decrease at a rate of approximately 3 degrees F for every thousand feet of elevation gain. Additionally, the pattern of precipitation distribution varies from the eastern to the western parts of the county. Western locations at higher elevations receive the majority of their precipitation during late winter and early spring while eastern locations receive the majority of their moisture during early spring and summer (Siemer 1977). At lower

elevation eastern locations the months of April through August are typically the wettest months and July and August the warmest while December, January, and February are typically the coldest and driest months. At this site average annual precipitation from 1971 through 2000 was 20.11 inches with April (2.53 in.), May (2.99 in.), June (2.20 in.) and July (2.45 in.) the wettest months; January (0.66 in) and February (0.74 in.) were the driest months. Coldest temperatures occurred in January with an average maximum temperature of 33.30 °F and an average minimum of 14.74 °F; warmest temperatures occurred in July with an average maximum of 73.45 °F and an average minimum of 47.01 °F (Prism 2010).

Land Use History: The discovery of gold brought rapid population growth to Gilpin County, which initiated logging, agricultural development, and grazing in areas that were not mined, such as this site. By the end of the 1890's most of the mountains in and around the mining communities and camps were denuded of trees (Petersen and Borchert 2010) and valley bottoms, especially riparian habitat and wetlands were cleared, drained, and developed for agriculture. This site is located in Green Ranch in Golden Gate State Park which was historically ranched.

Biodiversity Significance Rank Comments (B4): This site is drawn for a fair (C-ranked) occurrence of the globally vulnerable (G3/S3) mountain willow / bluejoint reedgrass (*Salix monticola / Calamagrostis canadensis)* shrubland.

Natural Heritage element occurrences at the Macy Gulch PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	Salix monticola / Calamagrostis canadensis Shrubland	Montane Willow Carr	G3	S3				C	2009-06-20

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The boundary includes ecological systems and processes that are essential to maintaining the community as well as to provide a buffer against disturbance. Climate change was also considered in boundary delineation. Abundant shallow groundwater discharge and surface water flow is essential to the sustainability of these wetlands; thus, a large area with intact upland vegetation is critical to adequate ground and surface water flow in wetland and stream habitat.

Protection Urgency Rank Comments (P3): This site includes public and private lands. Public lands are managed for wildlife. Private lands are developed for rural residential and agricultural purposes. Although the majority of the site is managed by Colorado State Parks, a large area is in private ownership and developed. Current Park management includes cessation of grazing and logging, which appears to be leading to some recovery of the natural hydrologic regime and upland and

riparian vegetation. Additionally, this area has special elk hunting regulations.

Management Urgency Rank Comments (M3): Historic agricultural development continues to impact this site. Current vegetation impacts result from high elk populations and overbrowsing which has reduced vigor and recruitment. Additionally, alien plant species are ubiquitous in upland habitat. The occurrence would greatly benefit from reduced browsing and eradication of alien plant species.

Natural Hazard Comments: Alien plant species are common throughout the site and include *Poa pratensis, Phleum pratense, Agrostis gigantea, Trifolium pratense, Cirsium arvense, Carduus acanthoides, Taraxacum officinale, Linaria vulgaris, Cynoglossum officinale, Dipsacus fullonum, Bromus inermis,* and *Rumex crispus.*

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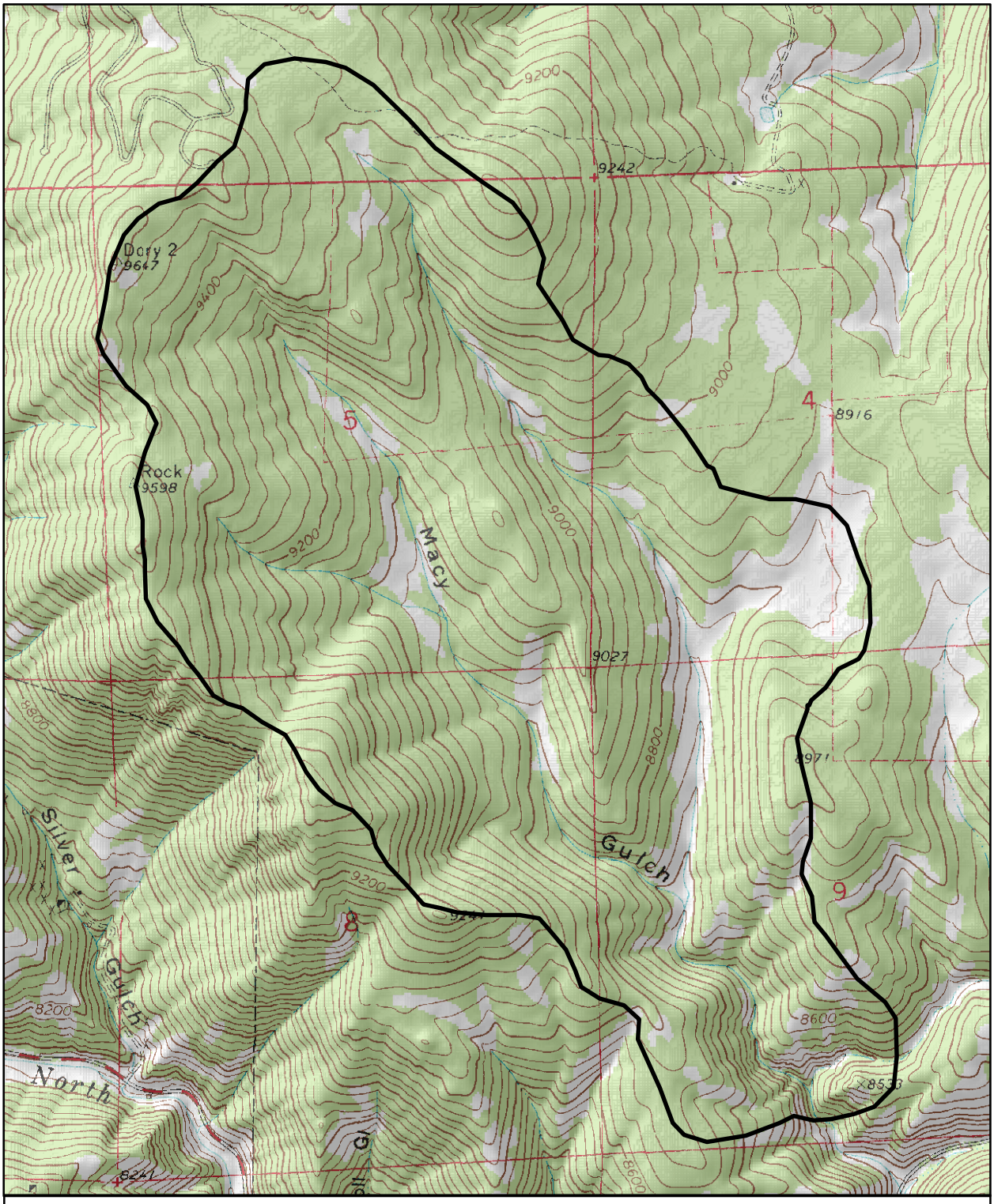

Map 14. Macy Gulch Potential Conservation Area, B4: Moderate Biodiversity Significance

Miner's Gulch

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P3: Definable Threat/Opportunity but not within 5 Years

Management Urgency Rank - M3: Needed within 5 Years to Maintain Quality

U.S.G.S. 7.5-minute quadrangles: Central City

Size: 314 acres (127 ha) **Elevation:** 10,100 - 10,800 ft. (3,078 - 3,292 m)

General Description: This Miners Gulch site is located in the mid to lower subalpine zone on the east slope of the Front Range in Gilpin County. Topography is characterized by mid-elevation, moderate gradient slopes and valleys. Miners Gulch drains the site and is a 1st order, Rosgen Class "B" stream. Ecosystems are a mosaic of subalpine conifer forests, slope wetlands, herbaceous meadows and riparian woodlands and shrublands. Historically, Engelmann spruce - subalpine fir (*Picea engelmannii - Abies lasiocarpa)* forests likely dominated the upland landscape. Now, remnants of these spruce - fir forests occur on moister hillslopes while pioneering limber pine (*Pinus flexilis)* forests occupy logged tracts and herbaceous wet meadows and fens occupy openings in the forest canopy. This site occupies a southeast-trending hillslope with uplands that are characterized by a dense cover of spruce - fir forest that is interspersed with wet meadows and fens. Abundant shallow ground water discharge and surface water flow has created numerous wetlands, ephemeral and perennial streams and ponds throughout this site. Slope wetland fens are characterized by a dense, lush and species-rich vegetation composition and diverse structure. An intricate mosaic of open water ponds and streams, herbaceous wet meadows, and woodlands and shrublands creates a structurally complex habitat. Riparian woodlands are characterized by a spruce - fir / tall chiming bells (*Picea engelmannii - Abies lasiocarpa / Mertensia ciliata*) forest. Wet meadows on the margin of fen are characterized by shrubby cinquefoil with a graminoid-dominated herbaceous layer. Fens are characterized by several communities including Engelmann spruce - subalpine fir / water sedge (*A. lasiocarpa - P. engelmannii / C. aquatilis*) woodlands; planeleaf willow / water sedge (*Salix planifolia / C. aquatilis*) shrublands; and by water sedge herbaceous vegetation intermixed with a diversity of forbs. Other herbaceous species include mountain sedge (*C. scopulorum),* Merten's rush (*Juncus mertensianus),* bluejoint reedgrass (*Calamagrostis canadensis),* elephantella (*Pedicularis groenlandica),* marsh marigold (*Caltha leptosepala),* brook saxifrage (*Saxifraga odontoloma),* green bog orchid (*Platanthera huronensis),*white bog orchid *(P. dilatata),* willowherb *(Epilobium hornemannii),* heart-leaf bittercress (*Cardamine cordifolia),* queen's crown (*Sedum rhodanthum),* twisted stalk (*Streptopus amplexifolius),* arrowleaf ragwort (*Senecio triangularis),* pink pyrola (*Pyrola asarifolia),* and alpine bistort (*Polygonum viviparum)*. Geology is composed of Precambrian metamorphic rocks (age 1,700-1,800 m.y.)

including biotitic gneiss, schist, and migmatite that are derived principally from sedimentary rocks. Wetland soils are saturated to inundated with peat development to 75 cm. Soils are classified as two types; Leighcan family, till substratum, 5 to 40 percent slopes and Leighcan family, 5 to 40 percent slopes. Leighcan family till substratum is an extremely bouldery component that occurs on mountain slopes and consists of residuum and/or till derived from igneous and metamorphic rock. Leighcan family also occurs on mountain slopes but consists of colluvium over residuum weathered from igneous and metamorphic. For both soil types the natural drainage class is somewhat excessively drained and water movement in the most restrictive layer is high. Organic matter content in the surface horizon is about 1 percent (USDA 2010). Hydrology is characterized by groundwater discharge. The site is a lush mosaic of slope wetland fens, wet meadows, and ponds that are maintained by abundant shallow groundwater and surface flow. Fens are reliant on groundwater flow that maintains a high water table and seasonally to permanently saturated soils. At this site these ecological processes are nearly intact; on the periphery of the site 4-wheel-drive roads and trails alter groundwater flow and fragment the landscape.

Key Environmental Factors: Hydrology, and specifically shallow groundwater and surface flow, are key environmental factors that maintain the wetland ecosystems and element communities in this site.

Climate Description: Climate in Gilpin County varies dramatically with elevation, aspect and time of year. Higher elevations to the north and west are colder and wetter than lower elevations to the east and south. Temperature and precipitation varies from east to west corresponding to elevation change. Average annual temperature and length of the growing season decrease as elevation increases while average annual precipitation increases. In general, temperatures decrease at a rate of approximately 3 °F for every thousand feet of elevation gain. Additionally, the pattern of precipitation distribution varies from the eastern to the western parts of the county. Western locations at higher elevations receive the majority of their precipitation during late winter and early spring while eastern locations receive the majority of their moisture during early spring and summer (Siemer 1977). The Miners Gulch site is located in the central south-western part of the county in the upper montane and subalpine zones at elevations between approximately 10,400 and 10,800 feet. Annual average precipitation at this site from 1971 to 2009 was 28.77 inches; wettest months were March (3.09 in), April (3.78 in) and May (3.09 in); coldest temperatures occurred in January with an average high of 27.79 °F and an average low of 9.10 °F. Warmest temperatures occurred in July with an average high of 68.47 °F and an average low of 41.25 °F (Prism 2010).

Land Use History: Mining was ubiquitous throughout this region of Gilpin County. With the discovery of native gold in Gilpin County 1858, much of the County, including the area surrounding the Miners Gulch site, was extensively mined for gold and other ore minerals and placer mining in area streams was common.

Additionally, to support the infrastructure and development that accompanied mining, grazing and clearcut logging occurred in the hills surrounding the site and throughout much of the County (Petersen and Borchert 2010). Field observations indicate that surrounding uplands continue to be impacted by historic logging. Some forest patches have naturally reforested with historic species, some with pioneering species such as lodgepole (*P. contorta*) or limber pine (*P. flexilis*) while other areas have crossed an ecological threshold and converted to other habitat types such as xeric meadows.

Cultural Features: None known.

Biodiversity Significance Rank Comments (B4): This site is drawn for a good (B-ranked) occurrence of the state rare (G4/S3) subalpine fir - Engelmann spruce / water sedge (*Abies lasiocarpa - Picea engelmannii / Carex aquatilis*) woodland fen.

Natural Heritage element occurrences at the Miner's Gulch PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Natural Communities	Abies lasiocarpa - Picea engelmannii / Carex aquatilis Forest	Subalpine Riparian / wetland Forest	G4	S3				B	2009-07-29

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The delineated area allows for the functioning of ecological and hydrological process that support the wetland community and provide a buffer against direct disturbance. This wetland complex of fens, wet meadows, streams and ponds and riparian habitat is reliant on groundwater inflows that maintain a water table at or near the ground surface for much of the year. These processes include abundant shallow surface and groundwater flow from surrounding hillslopes to enable wetland recharge with a sufficiently high water table and hydroperiod that promotes the ongoing development and maintenance of peat soils.

Protection Urgency Rank Comments (P3): Land ownership is a patchwork of public land managed by the USFS and by private lands with no protection.

Management Urgency Rank Comments (M3): Although upland landscapes are impacted from historic mining-related development, habitats are recovering. However, current levels and extent of recreational road use inhibits complete recovery and continues to alter landscape connectivity and the natural hydrologic regime. Additionally, numerous private inholdings are present within the site which, if developed, may alter ecological processes essential to the maintenance of the wetlands and fens. Wetland and upland habitat sustainability would benefit by road closures and restoration.

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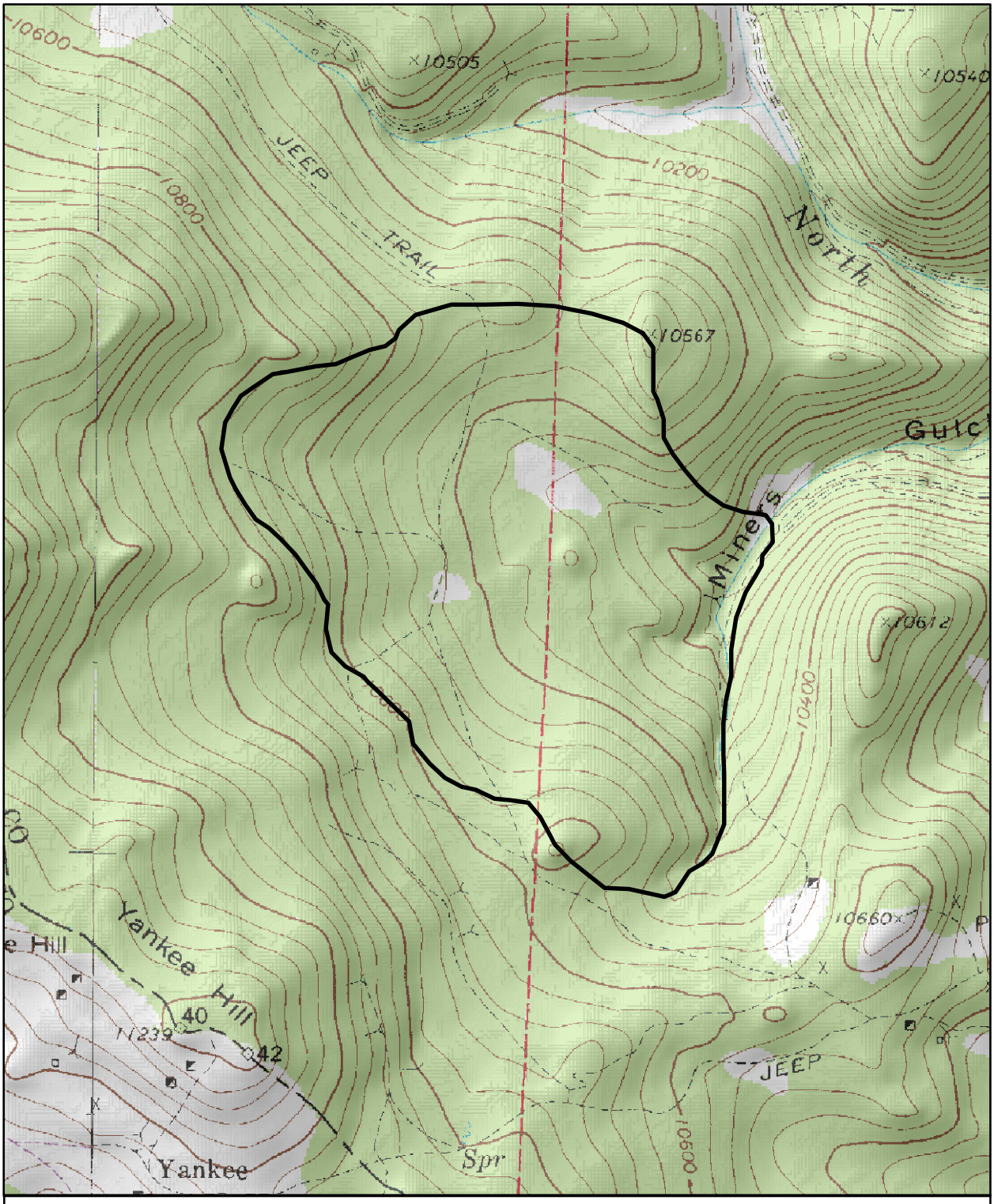
Version Author: Malone, D.G.

Version Date: 11/29/2010



Colorado Natural Heritage Program
Colorado State University
1474 Campus Delivery
Fort Collins, CO 80523-1474
http://www.cnhp.colostate.edu

Map Date: 03/17/2011

0 0.1 0.2 Miles

N

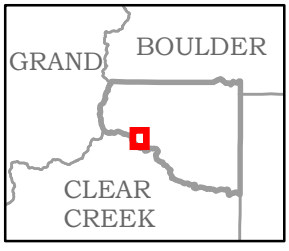
Legend

PCA Boundary

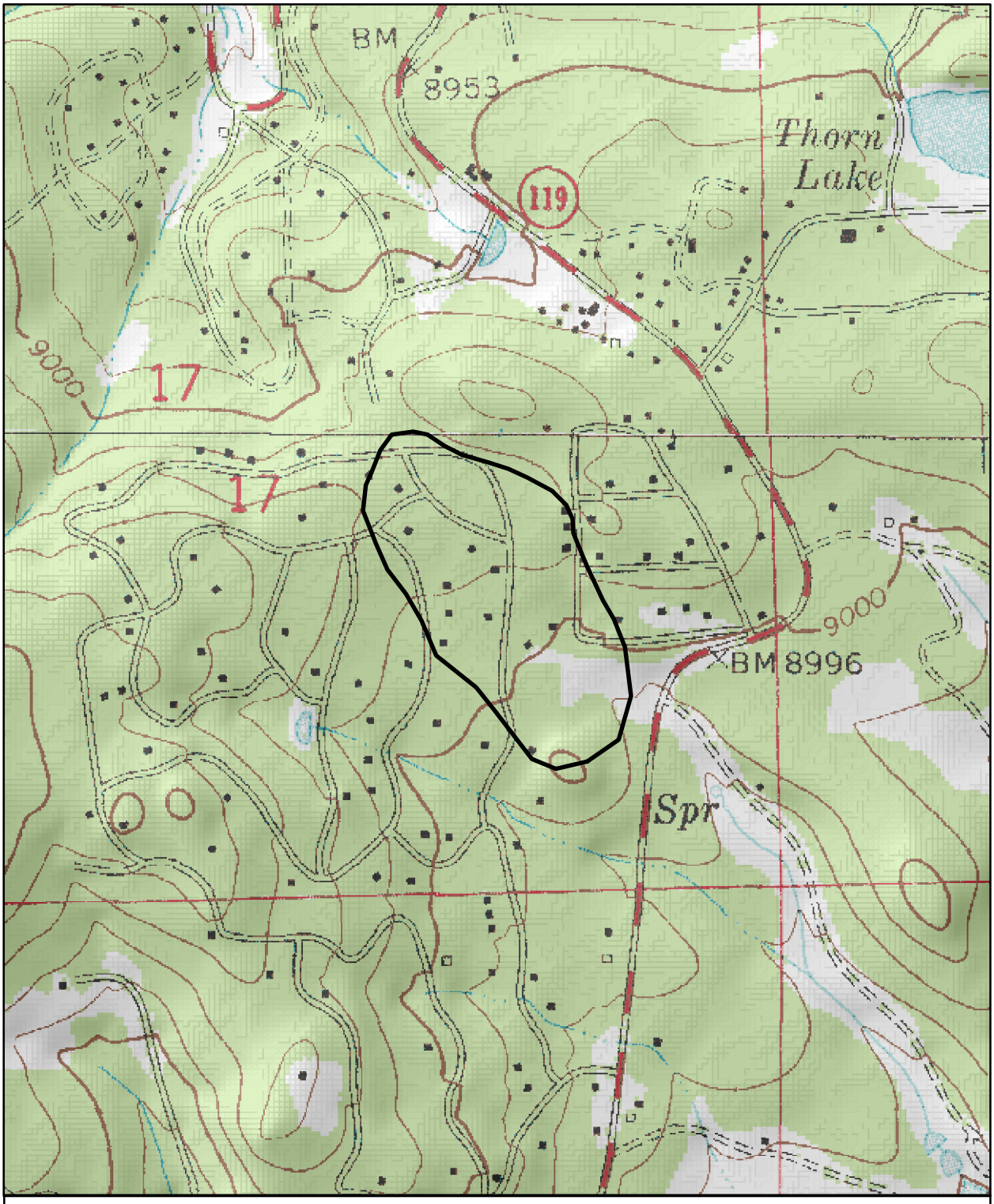
Central City, 39105-G5

7.5 Minute Digital Raster Graphic Produced by the U.S. Geological Survey

Location in Gilpin County



Map 15. Miner's Gulch Potential Conservation Area, B4: Moderate Biodiversity Significance



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http://www.cnhp.colostate.edu

Map Date: 04/26/2011

0 0.1 0.2 Miles

N

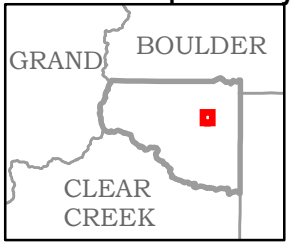
Legend

PCA Boundary

Black Hawk, 39105-G4

7.5 Minute Digital Raster Graphic Produced by the U.S. Geological Survey

Location in Gilpin County



Map 16. Library Park Fen Potential Conservation Area, SLS; Site of Local Significance

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