Survey of Critical Wetlands and Riparian Areas in Hinsdale County, Colorado

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Knowledge to Go Places

Survey of Critical Wetlands and Riparian Areas in Hinsdale County, Colorado

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EXECUTIVE SUMMARY

Hinsdale County is in the San Juan Mountains of southwest Colorado. It predominantly contains alpine and subalpine elevation zones, but grades into upper montane zones in limited areas. It is one of the least populated counties in Colorado and contains significant portions of designated Wilderness Area. With greater than 95% of the land area in public ownership, Hinsdale County has large expanses of contiguous natural habitat with minimal anthropogenic impacts. The Colorado Mineral Belt traverses the San Juan Mountains through the northwest corner of Hinsdale County. Historically, mining was a major industry. This combination of history and natural resources is the basis of the current tourism that drives the economy in the region.

Due to its high elevation Hinsdale County is comparatively moist relative to other areas inthe Arid West. Wetlands and riparian areas comprise less than 2% of the land area in Colorado, but cover about 8% of Hinsdale County. Although these areas occupy very little of the landscape, they support a disproportionate amount of biodiversity. Although the rate of wetland loss in Hinsdale County is difficult to quantify, it is clear that many wetlands have been lost or profoundly altered from their pre-settlement state. Mining, construction of reservoirs, water diversions, agriculture, grazing, and development have had impacts on wetlands in the study area. With limited areas of floodplain due to the rugged volcanic and glaciated landscape of Hinsdale County fertile soils and available water for irrigation make productive areas for agriculture relatively scarce. Since the nineteenth century, hydrological diversions have been developed for irrigation and drinking water supplies; there are several trans-basin water developments in Hinsdale County. Such activities have eliminated or altered some wetlands, and created other wetlands very different from those in existence prior to European settlement.

This survey of critical wetland resources of Hinsdale County is part of ongoing surveys of critical biological surveys of Colorado counties conducted by CNHP. In 2005, the Colorado Natural Heritage Program (CNHP) received funding from the Colorado Department of Natural Resources (CDNR) through a grant from the U.S. Environmental Protection Agency (EPA), Region 8 to survey for critical wetlands within Hinsdale County. With additional funding from the U.S. Forest Service, Bureau of Land Management, and Colorado Division of Wildlife, CNHP performed wetland surveys in Hinsdale County for two field seasons, 2006 and 2007. The goal of the project was to systematically identify the localities of rare, threatened, or endangered species dependent on wetland and riparian areas and the locations of significant natural wetland and riparian plant communities. Identification of sites containing natural heritage resources will allow conservation of these resources for future generations, and proactive planning to avoid land use conflicts in the future.

Field surveys began in June of 2006 and continued through the end of September with an additional field season in July and August of 2007. Wetlands and riparian areas occurring on private lands adjacent to public lands were given the highest priority for inventory. Such locations were identified by: (1) examining existing biological data for rare or imperiled plant and animal species and significant plant communities (collectively

called elements) from the Colorado Natural Heritage Program's database, (2) accumulating additional existing information on these elements and, (3) input from the Gunnison Office of the Bureau of Land Management, U.S. Forest Service, and the Colorado Division of Wildlife, and (4) conducting extensive field surveys. Areas that were found to contain significant elements were delineated as Potential Conservation Areas. These areas were prioritized by their biological urgency (the most rare or imperiled) and their ability to maintain viable populations of the elements (degree of threat).

Results of the 2006-2007 Hinsdale County survey confirm that there are many wetland and riparian areas with high biological significance. Several rare plants and animals depend on these areas for survival. All together one amphibian, two birds, three fish, one mollusk, 45 wetland or riparian communities, and one imperiled wetland plant species of concern have been documented in Hinsdale County in this report. The CNHP database currently houses more than 70 wetland and riparian element occurrence records within Hinsdale County. As part of this project, thirty new element occurrence records were created and 24 element occurrence records were updated.

CNHP has identified 52 Potential Conservation Areas (PCAs) in or partially contained in Hinsdale County. Thirty-seven of these PCAs address wetland or riparian elements and are presented in this report. CNHP believes these sites include those wetlands that most merit conservation efforts, while emphasizing that protecting only these sites will, in no way, adequately protect all the values associated with wetlands and riparian areas in Hinsdale County. Despite the best efforts during one field season, it is likely that some elements that are present were not documented during the survey due to either lack of access, phenology (reproductive timing) of species, or time constraints. Future surveys will likely identify additional areas of biological significance that have not been identified in this report. The delineation of PCA boundaries in this report does not confer any regulatory protection on recommended areas. They are intended to be used to support wise planning and decision making for the conservation of these significant areas. Additional information may be requested from Colorado Natural Heritage Program, 254 General Services Building, Colorado State University, Fort Collins, CO 80523.

Of the 37 PCAs presented in this report, ten were of **very high biodiversity significance (B2)**, sixteen were of **high biodiversity significance (B3)**, and eleven were is of **moderate biodiversity significance (B4)**. Of the 37 PCAs presented in this report, twenty were newly created based on fieldwork from 2006-2007. Fifteen of these PCAs include private and/or state lands. Among the PCAs for biodiversity elements not presented in this report there is one that is of outstanding biodiversity significance (B1) that addresses the globally rare stonecrop gilia (*Gilia sedifolia*), an alpine plant only known from one site in the world (Anderson 2004). Additional B2 sites include several for the Uncompaghre Frittilary (*Boloria improba acrocnema*).

The results of the survey will be available to the public on the CNHP website (http:\\www.cnhp.colostate.edu).

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INTRODUCTION

Hinsdale County is located at the top of the San Juan Mountains in southwest Colorado. It predominantly contains alpine and subalpine elevation zones, but grades into upper montane zones in select areas. It is one of the least populated counties in Colorado and contains significant portions of designated Wilderness Area. With greater than 95% of the land area in public ownership, Hinsdale County has large expanses of contiguous natural habitat with minimal anthropogenic impacts. The Colorado Mineral Belt traverses the San Juan Mountains through the northwest corner of Hinsdale County. Historically, mining was a major industry. This combination of history and natural resources is the basis of the current tourism that drives the economy in the region.

Although Hinsdale County is relatively moist due to its high elevation it is still part of the arid West. Wetlands and riparian areas comprise less than 2% of the land area in Colorado (Dahl 1990), but are mapped as covering 8% of Hinsdale County, which is not dissimilar to other counties in the San Juan Mountains (National GAP Analysis Program 2007). Although these areas occupy very little of the landscape, they support a disproportionate amount of biodiversity. According to the Colorado Division of Wildlife (CDOW), wetlands and riparian areas are critical to 75% of the wildlife species known or that likely occur in the state for all or for some portion of their life cycle (Colorado Division of Wildlife 2008). Due to the large areas of natural habitat, Hinsdale County provided an excellent study area for surveying wetland and riparian areas and the natural ecological processes that maintain them.

Wetlands are defined as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (Environmental Protection Agency 2008). Riparian areas are adjacent to surface or groundwater of perennial or ephemeral water bodies including rivers, streams, lakes, ponds, or playas. They are vegetated with plant communities that are distinctly different than the surrounding uplands (Colorado Division of Wildlife 2008). Until recently, most people viewed wetlands as a hindrance to productive land use. Consequently, many wetlands across North America were purposefully drained. Since 1986, wetlands have been lost at a rate of 58,500 acres/year (Dahl 2000). In Colorado an estimated 1 million acres of wetlands (50% of the total for the state) were lost prior to 1980 (Dahl 1990).

Although the rate of wetland loss in Hinsdale County is difficult to quantify, it is clear that many wetlands have been lost or profoundly altered from their pre-settlement state. Mining, construction of reservoirs, water diversions, agriculture, grazing, and development have had impacts on wetlands throughout the study area. Fertile soils and available water for irrigation make floodplains productive areas for agriculture. Since the nineteenth century, hydrological diversions have been developed for irrigation and drinking water supplies. Such activities have eliminated or altered some wetlands, and created other wetlands very different from those in existence prior to European settlement. With the current economic pressures and land use conversion, plus a lack of

comprehensive wetland protection programs, wetlands may continue to be lost or dramatically altered.

Although Colorado has diverse biological resources, the numbers and locations of these organisms and their habitats are not fully understood. Landowners, local and state governments, federal agencies, and non-profit organizations, particularly in rapidly growing parts of Colorado, are expressing a desire to better understand their natural heritage resources. The Colorado Natural Heritage Program (CNHP) approached this project with the intent of addressing this need. This survey of critical biological resources of Hinsdale County is part of an ongoing biological inventory of Colorado counties by CNHP. To date, similar inventories have been conducted in all or parts of 26 Colorado counties. CNHP has completed the Comprehensive Statewide Wetland Characterization and Classification Project (Carsey et al. 2003), which compiled data from multiple sources to produce a comprehensive wetland classification for the state of Colorado.

This survey of critical wetland resources of Hinsdale County is part of ongoing surveys of critical biological surveys of Colorado counties conducted by CNHP. To date, similar inventories have been conducted in all or parts of 33 Colorado counties. In 2005, the Colorado Natural Heritage Program (CNHP) received funding from the Colorado Department of Natural Resources (CDNR) through a grant from the U.S. Environmental Protection Agency (EPA), Region 8 to survey for critical wetlands within Hinsdale County. With additional funding from the U.S. Forest Service, Bureau of Land Management, and Colorado Division of Wildlife, CNHP performed wetland surveys in Hinsdale County for two field seasons, 2006 and 2007. The goal of the project was to systematically identify the localities of rare, threatened, or endangered species dependent on wetland and riparian areas and the locations of significant natural wetland and riparian plant communities. Identification of sites containing natural heritage resources will allow conservation of these resources for future generations, and proactive planning to avoid land use conflicts in the future.

CNHP's wetland work provides input to the Wetlands Initiative Partners (e.g., The Nature Conservancy) and the Colorado Wetlands Partnership by identifying potential sites for protection and restoration. Finally, the results of this survey will be incorporated into the National Vegetation Classification System and supports ongoing Vegetation Index of Biological Integrity (VIBI) development.

This *Survey of Critical Wetlands and Riparian Areas in Hinsdale County, Colorado* used the methods that are employed worldwide throughout Natural Heritage Programs and Conservation Data Centers. The 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.

The locations of biologically significant areas were identified by:

- Examining existing biological data for rare or imperiled plant and animal species and significant plant communities (collectively called **elements)**;
- Accumulating additional existing information (e.g., interviews of local experts)
- Conducting extensive field surveys.

Locations in the county with wetlands and riparian areas of natural heritage significance (those places where these elements have been documented) are presented in this report as Potential Conservation Areas (PCAs). The goal of 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. The best available knowledge of each species' habitat and 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.

The 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. The 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 they are compatible with protection of natural heritage resources and sensitive species. Please note that these boundaries are based primarily on our understanding of the ecological systems that occur at a site. 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.

CNHP uses the Heritage Ranking Methodology to prioritize conservation actions by identifying those areas that have the greatest chance of conservation success for the most imperiled elements. The sites are prioritized according to their **biodiversity significance rank**, or "B-rank," which ranges from B1 (outstanding significance) to B5 (general or statewide significance). These 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). See the section on Natural Heritage Ranking System for more details. The B1-B3 sites are the highest priorities for conservation actions. Based on current knowledge, the sites in this report represent areas CNHP recommends for protection in order to preserve the natural heritage of Hinsdale County.

This document should be considered a tool for managing lands that support rare wetland species and plant associations within Hinsdale County, although there are limitations to the information within it. In particular, the survey work was conducted over a one-year period. The distribution and abundance of all organisms change with time, and it is

anticipated that the conservation areas described in the report will also change with time. Also, many areas of Hinsdale County were not surveyed due to limitations of time, plant phenology, and land access. This report only includes information from readily observed species or from areas that biologists received permission to visit. Finally, this report does not include all wetland species or associations found within Hinsdale County. This project specifically targeted the organisms that are tracked by CNHP (CNHP has a methodology specific to Natural Heritage Programs and this study was intended to survey for those species believed to be the most rare or the least known). The primary objective was to identify biologically significant wetlands within Hinsdale County.

In addition to presenting prioritized PCAs, this report also includes a section with summaries of selected plants and plant communities that are known to be found within the PCAs.

THE NATURAL HERITAGE NETWORK RANKING SYSTEM AND BIOLOGICAL DIVERSITY

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

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

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

Colorado is inhabited by some 800 vertebrate species and subspecies, and tens of thousands of invertebrate species. In addition, the state has approximately 4,600 species of plants (vascular and nonvascular) and more than 450 recognized plant communities that represent terrestrial and wetland ecosystems. It is this rich natural heritage that has provided the basis for Colorado's diverse economy. Some components of this heritage have always been rare, while others have become imperiled with human-induced changes in the landscape. This decline in biological diversity is a global trend resulting from human population growth, land development, and subsequent habitat loss. Globally, the loss in species diversity has become so rapid and severe that Wilson (1988) has compared the phenomenon to the great natural catastrophes at the end of the Paleozoic and Mesozoic eras.

The need to address this loss in biological diversity has been recognized for decades in the scientific community. However, many conservation efforts made in this country were not based upon preserving biological diversity; instead, they primarily focused on preserving game animals, striking scenery, and locally favored open spaces. To address

the absence of a methodical, scientifically-based approach to preserving biological diversity Dr. Robert Jenkins of The Nature Conservancy pioneered the Natural Heritage Methodology in the early 1970s.

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

The Natural Heritage Methodology is used by Natural Heritage Programs throughout North, Central, and South America, forming an international database network. The 85 Natural Heritage Network data centers are located in each of the fifty U.S. states, eleven Canadian provinces and territories, and many countries in Latin America and the Caribbean. This network enables scientists to monitor the status of species from a state, national, and global perspective. Information collected by the Natural Heritage Programs can provide a means to protect species before the need for legal endangerment status arises. It can also enable conservationists and natural resource managers to make informed, objective decisions in prioritizing and focusing conservation efforts.

What is Biological Diversity?

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

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

Genetic Diversity — the genetic variation within a population and among populations of a plant or animal species. The genetic makeup of a species varies between populations within its geographic range. Loss of a population results in a loss of genetic diversity for that species and a reduction of total biological diversity for the region. Once lost, this unique genetic information cannot be reclaimed.

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

Community Diversity — the variety of plant communities within an area that represent the range of species relationships and inter-dependence. These communities may be diagnostic of or even restricted to an area. The U.S. National Vegetation Classification (USNVC) is the accepted national standard for vegetation and it defines a community as an "assemblage of species that co-occur in defined areas at certain times and that have the potential to interact with one another" (Anderson et al. 1998).

Landscape Diversity — the type, condition, pattern, and connectedness of natural communities. A landscape consisting of a mosaic of natural communities may contain one multifaceted ecosystem, such as a wetland ecosystem. A landscape also may contain several distinct ecosystems, such as a riparian corridor meandering through shortgrass prairie. Fragmentation of landscapes, loss of connections and migratory corridors, and loss of natural communities all result in a loss of biological diversity for a region.

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

Colorado's Natural Heritage Program

To place this document in context, it is useful to understand the history and functions of the Colorado Natural Heritage Program (CNHP). CNHP is the state's primary comprehensive biological diversity data center, gathering information and field observations to help develop statewide conservation priorities. After operating in the Colorado Division of Parks and Outdoor Recreation for fourteen years, the Program was relocated to the University of Colorado Museum in 1992, and then to the College of Natural Resources at Colorado State University in 1994, where it has operated since.

The multi-disciplinary team of scientists, planners, and information managers at CNHP gathers comprehensive information on the rare, threatened, and endangered species and significant plant communities of Colorado. Life history, status, and locational data are incorporated into a continually updated data system. Data maintained in the Colorado Natural Heritage Program database are an integral part of ongoing research at CSU and reflect the observations of many scientists, institutions and our current state of knowledge. These data are acquired from various sources, with varying levels of accuracy, and are continually being updated and revised. Sources include published and unpublished literature, museum and herbaria labels, and field surveys conducted by knowledgeable naturalists, experts, agency personnel, and our own staff of botanists, ecologists, and zoologists.

All Natural Heritage Programs house data about imperiled species and plant associations and are implementing use of the Biodiversity Tracking and Conservation System (BIOTICS) developed by NatureServe. This database includes taxonomic group, global and state rarity ranks, federal and state legal status, observation source, observation date, county, township, range, watershed, and other relevant facts and observations. BIOTICS also has an ArcView based mapping program for digitizing and mapping occurrences of rare plants, animals, and plant communities. These rare species and plant communities are referred to as "elements of natural diversity" or simply "elements."

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

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

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

CNHP has effective working relationships with several state and federal agencies, including the Colorado Department of Natural Resources, the Colorado Division of Wildlife, the Bureau of Land Management, the U.S. Forest Service, the U.S. Fish and Wildlife Service, and the Department of Defense. Numerous local governments and private entities, such as consulting firms, educators, landowners, county commissioners,

and non-profit organizations, also work closely with CNHP. Use of the data by many different individuals and organizations encourages a cooperative and proactive approach to conservation, thereby reducing the potential for conflict.

The Natural Heritage Ranking System

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

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

To determine the status of species within Colorado, CNHP gathers information on plants, animals, and plant 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 vulnerable to extinction than something found in twenty-one places. Also of importance are the size of the geographic range, the number of individuals, the trends in both population and distribution, identifiable threats, and the number of protected occurrences.

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

information for animal and plant species considered extremely imperiled to vulnerable in the state (S1 - S3). Several factors, such as rarity, evolutionary distinctiveness, and endemism (specificity of habitat requirements), contribute to the conservation priority of each species. Certain species are "watchlisted," meaning that specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted. A complete description of each of the Natural Heritage ranks is provided in Table 1.

Table 1. Definition of Natural Heritage Imperilment Ranks.

G/S1	Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or 1,000 or fewer individuals), or because some factor of its biology makes it especially vulnerable to extinction.
G/S2	Imperiled globally/state because of rarity (6 to 20 occurrences, or 1,000 to 3,000 individuals), or because other factors demonstrably make it very vulnerable to extinction throughout its range.
G/S3	Vulnerable through its range or found locally in a restricted range (21 to 100 occurrences, or 3,000 to 10,000 individuals).
G/S4	Apparently secure globally/state, though it may be quite rare in parts of its range, especially at the periphery. Usually more than 100 occurrences and 10,000 individuals.
G/S5	Demonstrably secure globally/state, though it may be quite rare in parts of its range, especially at the periphery.
G/SX	Presumed extinct globally, or extirpated within the state.
G#?	Indicates uncertainty about an assigned global rank.
G/SU	Unable to assign rank due to lack of available information.
GQ	Indicates uncertainty about taxonomic status.
G/SH	Historically known, but usually not verified for an extended period of time.
G#T#	Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.
S#B	Refers to the breeding season imperilment of elements that are not residents.
S#N	Refers to the non-breeding season imperilment of elements that are not permanent residents. Where no consistent location can be discerned for migrants or non-breeding populations, a rank of SZN is used.
SZ	Migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected.
SA	Accidental in the state.
SR	Reported to occur in the state but unverified.
S?	Unranked. Some evidence that species may be imperiled, but awaiting formal rarity ranking.

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

This single rank system works readily for all species except those that are migratory. Those animals that migrate may spend only a portion of their life cycles within the state. In these cases, it is necessary to distinguish between breeding, non-breeding, and resident species. As noted in Table 1, ranks followed by a "B," 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.

Legal Designations for Rare Species

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

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. This factor takes into account aspects 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 aspects such as a species having access to habitats and resources.

Table 2. 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 species or subspecies of native wildlife that have been removed from the state threatened or endangered list within the last five years; are proposed for federal listing (or are a federal listing "candidate species") and are not already state listed; have experienced, based on the best available data, a downward trend in numbers or distribution lasting at least five years that may lead to an endangered or threatened status; or are otherwise determined to be vulnerable in Colorado.

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 and 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 3.

Table 3. Element Occurrence Ranks and their Definitions

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

Potential Conservation Areas

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

The 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;
- maintenance of surface water quality within the PCA and the surrounding watershed;
- maintenance of the hydrologic integrity of the groundwater;
- land intended to buffer the PCA against future changes in the use of surrounding lands;
- exclusion or control of invasive exotic species;
- land necessary for management or monitoring activities.

The boundaries presented are meant to be used for conservation planning purposes and have no legal status. The proposed boundary does not automatically recommend exclusion of all activity. Rather, the boundaries designate ecologically significant areas in which land managers may wish to consider how specific activities or land use changes within or near the PCA affect the natural heritage resources and sensitive species on which the PCA is based. Please note that these boundaries are based on our best estimate of the primary area supporting the long-term survival of targeted species and plant 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.

Off-Site Considerations

Frequently, all necessary ecological processes cannot be contained within a PCA of reasonable size. For example, taken to the extreme, the threat of ozone depletion could expand every PCA to include the entire planet. The boundaries described in this report indicate the immediate, and therefore most important, area to be considered for protection. Continued landscape level conservation efforts that may extend far beyond PCA boundaries are necessary as well. This will involve regional efforts in addition to coordination and cooperation with private landowners, neighboring land planners, and state and federal agencies.

Ranking of Potential Conservation Areas

CNHP uses element and element occurrence ranks to assess the overall biological diversity significance of a PCA, which may include one or many element occurrences. Based on these ranks, each PCA is assigned a biological diversity rank (or B-rank). See Table 4 for a summary of these B-ranks.

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 5 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 4. Natural Heritage Program Biodiversity Significance 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 rangewide (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.

Table 5. 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 use management or land stewardship action required to maintain element occurrences at the potential conservation area.

A management action may include biological management (prescribed burning, removal of exotics, mowing, etc.) or people and site management (building barriers, 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 6 summarizes M-ranks and their definitions.

Table 6. 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.

Sites of Local Significance

Sites of Local Significance (SLS) are sites that include good examples of species or natural communities that may be too small or whose biological or ecological significance is not great enough to be considered exemplary in a statewide context. Therefore, these sites do not meet the minimum criteria for a PCA. However, they do contribute to the character of the local area and the overall local diversity of plants and communities present, and therefore warrant consideration at some planning level. SLS typically include sites that were surveyed but do not contain tracked species or communities. In some cases they are based on plot data where the full extent of a community is not known and the surveyed areas do not meet the minimum size requirement for an occurrence.

WETLAND DEFINITIONS, REGULATIONS, AND CONDITION ASSESSMENTS

Wetland Definitions

The federal regulatory definition of a jurisdictional wetland is found in the regulations used by the U.S. Army Corps of Engineers (Corps) for the implementation of a dredge and fill permit system required by Section 404 of the Clean Water Act Amendments (Mitsch and Gosselink 1993). According to the Corps, wetlands are "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstance do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." For Corps programs, a wetland boundary must be determined according to the mandatory technical criteria described in the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987). In order for an area to be classified as a jurisdictional wetland (i.e., a wetland subject to federal regulations), it must have all three of the following criteria: (1) wetland plants; (2) wetland hydrology; and (3) hydric soils.

The U.S. Fish and Wildlife Service defines wetlands from an ecological point of view. Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979) states that "wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water." Wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes (wetland plants); (2) the substrate is predominantly undrained hydric soil; and/or (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year. This definition only requires that an area meet one of the three criteria (vegetation, soils, or hydrology) in order to be classified as a wetland.

CNHP prefers the wetland definition used by the U.S. Fish and Wildlife Service, because it recognizes that some areas display many of the attributes of wetlands without exhibiting all three characteristics required to fulfill the Corps' criteria. Additionally, riparian areas, which often do not meet all three of the Corps' criteria, should be included in a wetland conservation program. Riparian areas perform many of the same functions as other wetland types, including maintenance of water quality, storage of floodwaters, and enhancement of biodiversity, especially in the western United States (National Research Council 1995).

Wetland Regulation in Colorado

Wetlands in Colorado are currently regulated under the authority of the Clean Water Act. A permit issued by the Corps is required before placing fill in a wetland and before dredging, ditching, or channelizing a wetland. The Clean Water Act exempts certain filling activities, such as normal agricultural activities.

The 404(b)(1) guidelines, prepared by the Environmental Protection Agency in consultation with the Corps, are the federal environmental regulations for evaluating

projects that will impact wetlands. Under these guidelines, the Corps is required to determine if alternatives exist for minimizing or eliminating impacts to wetlands. When unavoidable impacts occur, the Corps requires mitigation. Mitigation may involve creation or restoration of similar wetlands in order to achieve an overall goal of no net loss of wetland area.

The U.S. Fish and Wildlife Service has conducted inventories of the extent and types of our nation's wetlands. The Cowardin et al. (1979) classification system provides the basic mapping units for the U.S. National Wetlands Inventory (NWI). Photo-interpretation and field reconnaissance was used to refine wetland boundaries according to the wetland classification system. The information is summarized on 1:24,000 and 1:100,000 maps.

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

In Colorado, the U.S. Fish and Wildlife Service, Region 6 has digital information available in the San Luis Valley, along the Front Range, and Montezuma County. The digital data is based on aerial photography from the 1980s (U.S. Fish and Wildlife Service 2008). Printed maps are available for most of the state http://www.fws.gov/nwi/.

Colorado Division of Wildlife Riparian Maps

The Colorado Division of Wildlife (CDOW) riparian mapping project is a cooperative, interagency, multi-jurisdictional effort to provide spatial data of riparian and wetland habitat in Colorado. It supports a coordinated effort among agencies and land managers to protect and manage these important habitats by providing basic locational information on which habitats occur in what areas and regions. Partner agencies include the U.S. Forest Service, the Bureau of Land Management, the Environmental Protection Agency, the San Isabel Foundation, Great Outdoors Colorado, Ducks Unlimited, and the Colorado Natural Heritage Program. This effort began in 1990 and to date portions of approximately half of the quadrangles in Colorado have been mapped (Colorado Division of Wildlife 2008). Approximately 30% of the mapping in Hinsdale County has been completed; quadrangle maps in the northern third of the county have been completed or partially delineated.

The mapping methodology used in this effort is photo interpretation of National Aerial Photography Program (NAPP) color infrared (CIR) aerial photos. Photos used to map wetland and riparian vegetation were taken in 1988 (McClean personal communication 2005). Riparian and wetland vegetation is mapped in stereo (using 3-dimensions) at a scale of 1:24,000 for a 7.5' USGS quadrangle map. Vegetation is delineated using the classification scheme presented in Table 7. Vegetation classes are identified on the CIR photos by color and structure and then by texture. Delineations of vegetation used line features for riparian corridors less than eighty feet wide and longer than five hundred feet. Polygon features were used where riparian vegetation was greater than eighty feet wide and a half an acre in size. Dominant and subdominant vegetation categories are identified. Delineated lines and polygons are then scanned into GIS (Colorado Division of Wildlife 2008). See Figure 1 for an example of a CDOW riparian mapping overlay on a quadrangle map.

Table 7. Colorado riparian habitat mapping project classification scheme

(http://ndis1. nrel. colostate. edu/riparian/ClassScheme.htm).

CATEGORY	MAP CODE
RIPARIAN DECIDUOUS TREES	
Riparian Deciduous Tree - General	RT
Riparian Deciduous Tree - Aspen	RT1
Riparian Deciduous Tree - Cottonwood	RT2
Riparian Deciduous Tree - Russian Olive	RT3
Riparian Deciduous Tree - Birch	RT4
Riparian Deciduous Tree - Boxelder	RT5
Riparian Deciduous Tree - Green Ash	RT6
Riparian Deciduous Tree - Mulberry	RT7
RIPARIAN EVERGREEN	
Riparian Evergreen Tree - General	RE
Riparian Evergreen Tree - Blue Spruce	RE1
Riparian Evergreen Tree - Engleman Spruce	RE2
Riparian Evergreen Tree - Douglas Fir	RE3
Riparian Evergreen Tree - Lodgepole Pine	RE4
Riparian Evergreen Tree - Spruce/Fir	RE5
Riparian Evergreen Tree - Ponderosa Pine	RE6
Riparian Evergreen Tree - Cedar/Juniper	RE7
Riparian Evergreen Tree - Pinon/Juniper	RE8
Riparian Evergreen Tree - Juniper	RE9
RIPARIAN SHRUBS	
Riparian Shrub - General	RS
Riparian Shrub - Willow	RS1
Riparian Shrub - Tamarisk	RS2
Riparian Shrub - Alpine Willow	RS3
Riparian Shrub - Gambel Oak	RS4
Riparian Shrub - Sagebrush	RS5
Riparian Shrub - Alder	RS6
RIPARIAN HERBACEOUS	
Riparian Herbaceous - General	RH
Riparian Herbaceous - Cattails/Sedges/Rushes	RH1

CATEGORY	MAP CODE
(With permanent standing water)	
Riparian Herbaceous - Sedges/Rushes/Mesic Grasses (Waterlogged or Moist Soils)	RH2, RH3
WATER BODIES	
Open Water - Standing	OW1
Open Water - Riverine	OW2
Open Water - Canal	OW3
Open Water - Ephemeral	OW4
OTHER RIPARIAN	
Unvegetated	NV
Sandbar	SB
NON-RIPARIAN	
Upland Tree	UT
Upland Shrub	US
Upland Grass	UG
Upland Grass (Subirrigated Fields)	UG1
Irrigated Agriculture (Note: Only occurs as a subdominant class)	IA, AI, IR
Non-Riparian	X
Both polygon features and line features are mapped using this classification scheme, color infrared (CIR) aerial photographs, 7.5 minute topographic base maps and a minimum mapping unit (MMU) of 0.5 acres. This classification scheme utilizes a dominant/subdominant methodology of describing riparian habitat. Unless a polygon is at least 75% homogeneous, the dominant category is listed first followed by a slash (/) and the subdominant category. Example: RT1/RS1 = Aspen/Willow with aspen being the dominant category within the mapped polygon. NOTE: categories and map codes are condensed and lumped for certain National Forests. See CDOW (2006) for details.	

Wetland Functions and Ecological Services

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

- Groundwater recharge—the replenishing of below ground aquifers.
- Groundwater discharge—the movement of groundwater to the surface (e.g., springs).
- Floodflow alteration—the temporary storage of potential flood waters.
- Sediment stabilization—the protection of stream banks and lake shores from erosion.
- Sediment/toxicant retention—the removal of suspended soil particles from the water, along with toxic substances that may be adsorbed to these particles.
- Nutrient removal/transformation—the removal of excess nutrients from the water, in particular nitrogen and phosphorous. Phosphorous is often removed via sedimentation; transformation includes converting inorganic forms of nutrients to organic forms and/or the conversion of one inorganic form to another inorganic form (e.g., NO_3- converted to N_2O or N_2 via denitrification).

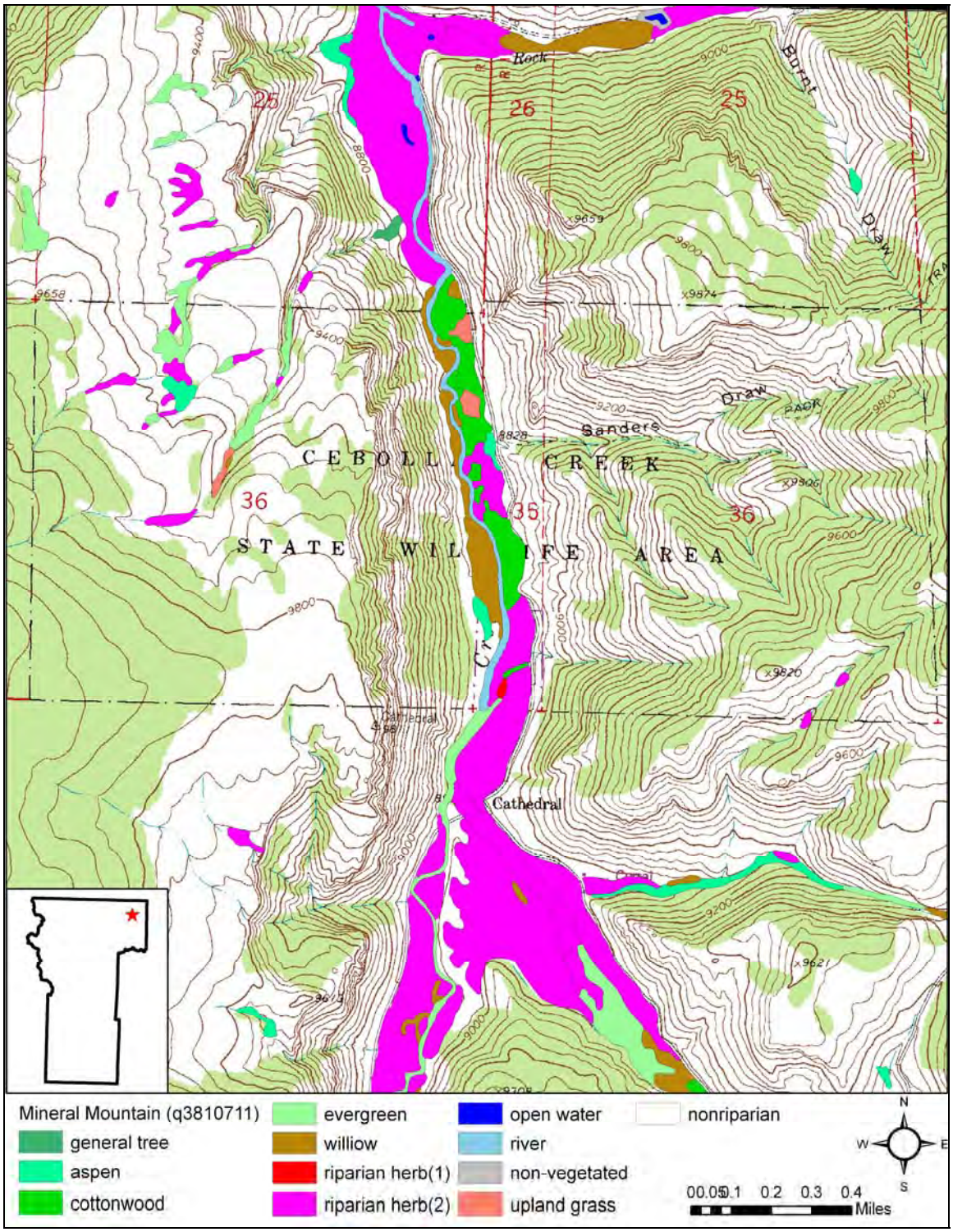


Figure 1. Colorado Division of Wildlife riparian mapping example at Cebolla Creek State Wildlife Area.

- Production export—the supply organic material (dead leaves, soluble organic carbon, etc.) to the base of the food chain.
- Aquatic diversity/abundance—wetlands support fisheries and aquatic invertebrates.
- Wildlife diversity/abundance—wetlands provide habitat for wildlife.

When these wetland functions have an identifiable economic value to society they are referred to as ecological services. For example, the wetland function of floodflow alteration is the temporary storage of water. This function provides the ecological service of flood abatement, which can prevent monetary damage to resources. "Values" are subject to societal perceptions, whereas "functions" are biological or physical processes that occur in wetlands regardless of the value placed on them by society (National Research Council 1995). The actual value attached to any given function or value listed above depends on the needs and perceptions of society. Two additional values that are independent of wetland function identified by Adamus and Stockwell (1983) include recreation and uniqueness/heritage value. Wetlands provide areas for fishing, bird watching, and other forms of recreation. Wetlands also support rare and unique plants, animals, and plant associations.

Groundwater Recharge and Discharge

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

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

Dynamic Surface Water Storage and Flood Attenuation

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

(particular those species with many small stems), coarse woody debris, surface roughness, and size of the wetland.

Many wetlands have a high capacity to store or delay floodwaters that occur from peak flow, gradually recharging the adjacent groundwater table. Indicators of flood storage include: debris along streambanks and in vegetation, low gradient, formation of sand and gravel bars, high density of small and large depressions, and dense vegetation. Thus wetlands are capable of detaining moving water from in-channel flow or overbank flow for a short duration when the flow is outside of its channel.

Sediment/Shoreline Stabilization

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

Removal/Retention of Imported Nutrients, Toxicants, and Sediments

Nutrient cycling, or the abiotic and biotic processes that convert elements from one form to another, is a fundamental ecosystem process, which maintains a balance between living biomass and detrital stocks (Brinson et al. 1995). Disrupting nutrient cycles could cause an imbalance between the two resulting in one factor liming the other. Thus, impacts to aboveground primary productivity or disturbances to the soil, which may cause a shift in nutrient cycling rates, could change soil fertility, alter plant species composition, and affect potential habitat functions. Indicators of wetlands with intact nutrient cycling need to be considered relative to wetlands within the same hydrogeomorphic class/subclass. Such indicators include high aboveground primary productivity and high quantities of detritus, within the range expected for that particular hydrogeomorphic class of wetlands.

Nutrient retention/removal is the storing and/or transformation of nutrients within the sediment or vegetation. Inorganic nutrients can be transformed into an organic form and/or converted to another inorganic form via microbial respiration and redox reactions. For example, denitrification, which is a process that is mediated by microbial respiration, results in the transformation of nitrate (NO_3^-) to nitrous oxide (N_2O) and/or molecular nitrogen (N_2). Nutrient retention/removal may help protect water quality by retaining or transforming nutrients before they are carried downstream or are transported to underlying aquifers. Particular attention is focused on processes involving nitrogen and phosphorus, as these nutrients are usually of greatest importance to wetland systems (Kadlec 1979). Nutrient storage may be for long-term (greater than 5 years) as in peatlands or depressional marshes or short-term (30 days to 5 years) as in riverine wetlands. Some indicators of nutrient retention include: high sediment trapping; organic matter accumulation; presence of free-floating, emergent, and submerged vegetation; and permanently or semi-permanently flooded areas.

Sediment and toxicant trapping is the process by which suspended solids and chemical contaminants are retained and deposited within the wetland. Deposition of sediments can

ultimately lead to removal of toxicants through burial, chemical break down, or temporary assimilation into plant tissues (Boto and Patrick 1979). Most vegetated wetlands are excellent sediment traps, at least in the short term. Wetland characteristics indicating this function include: dense vegetation, deposits of mud or organic matter, a gently sloped gradient, and location next to beaver dams or human-made detention ponds/lakes.

Production Export/Food Chain Support

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

General Wildlife and Fish Habitat Diversity and Uniqueness

Habitat includes those physical and chemical factors, which affect the metabolism, attachment, and predator avoidance of the adult or larval forms of fish, and the food and cover needs of wildlife. Wetland characteristics indicating good fish habitat include: deep, open, non-acidic water, no barriers to migration, well-mixed (high oxygen content) water, and high vegetation cover. Wetland characteristics indicating good wildlife habitat are: good edge ratio, islands, high plant diversity, diversity of vegetation structure, and a sinuous and irregular basin.

Habitat diversity refers to the number of habitat types (e.g. Cowardin wetland classes, USNVC plant associations) present at each site. Thus, a site with emergent, scrub/shrub, and forested wetland habitat would have high habitat diversity. The presence of open water in these areas also increases the habitat diversity at a site. Uniqueness is as a value expresses the general distinctiveness of the wetland in terms of relative abundance of similar sites occurring in the same watershed, size, geomorphic position, peat accumulation, mature forested areas, and the replacement potential.

Wetland Condition Assessment

For past county wetland survey and assessment projects, CNHP performed qualitative, descriptive functional assessments of wetlands. These assessments provided a rapid determination of each wetland's functional integrity based on qualitative indicators of structure, composition, and land use listed above according to the best professional judgment of CNHP ecologists. Assumptions required for most functional assessments include selecting a combination of measured variables that adequately represent wetland function and that such a combination results in an estimation of the degree to which the function is being performed. However, recent analysis suggests that most functional assessments are not rapid and do not directly measure functions (Cole 2006).

Given CNHP's goal of this survey in Hinsdale County is to identify and prioritize ecologically significant wetlands, surveys focused on assessing the ecological integrity or condition of each wetland rather than specific ecological functions, services or values. Condition assessments are 'holistic' in that they consider ecological integrity to be an "integrating super-function" (Fennessy et al. 2004). They 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. This measure of wetland condition assumes that ecological functions follow similar trends. 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. CNHP's element occurrence ranking process 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.

Hydrogeomorphic (HGM) Classification

Among other wetland classification approaches (e.g., Cowardin classes, USNVC plant associations), the hydrogeomorphic, or HGM, approach to wetland classification has been developed for Colorado by the Colorado Geological Survey, with help from the U.S. Army Corps of Engineers, other government agencies, academic institutions, the Colorado Natural Heritage Program, and representatives from private consulting firms (Colorado Geological Survey et al. 1998). This approach was based on a classification of wetlands according to their hydrology (water source and direction of flow) and geomorphology (landscape position and shape of the wetland). Thus it is called a "hydrogeomorphic" classification (Brinson 1993). There were four hydrogeomorphic classes present in Colorado: riverine, slope, depression, and mineral soil flats (Table 8). Within a geographic region, HGM wetland classes were further subdivided into subclasses. A subclass included all those wetlands that have essentially the same characteristics and perform the same functions.

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

Table 8. Hydrogeomorphic wetland classes in Colorado with examples in Hinsdale County (Colorado Geological Survey et al. 1998).

Class	Geomorphic setting	Water Source	Water Movement	Subclass	Examples in PCAs
Riverine	In riparian areas along rivers and streams	Overbank flow from channel	One-directional and horizontal (down-stream)	R1-steep gradient, low order streams	Riparian communities in upper reaches flowing out of the alpine zone
				R2-moderate gradient, low to middle order	Brush Creek at Cannibal Point, East Fork of Powderhorn Creek
				R3-middle elevation, moderate gradient along small/mid-order stream	Cebolla Creek
				R4-low elevation canyons or plateaus	Lake Fork of the Gunnison River, Los Pinos River
				R5-low elev. floodplains	Rio Grande River
Slope	At the base of slopes, e.g., along the base of the foothills; also, places where porous bedrock overlying non-porous bedrock intercepts the ground surface.	Groundwater	One-directional, horizontal (to the surface from groundwater)	S1-alpine and subalpine fens on non-calcareous substrates.	Mineral Creek, Upper Rambouillet Park, Rincon la Osa, Wager Gulch
				S2-subalpine and montane fens on calcareous substrates	No examples of this fen type were found in Hinsdale County
				S3-wet meadows at middle elev.	Mountaintop wetlands the Cannibal Plateau
				S4-low elevation meadows	Lower reaches of Weminuche Creek.
Depressional	In depressions caused by	Shallow ground	Generally two-	D1-mid to high elevation	Elk Lakes Fen, North Fork of Sand

Class	Geomorphic setting	Water Source	Water Movement	Subclass	Examples in PCAs
	glacial action (in the mountains) or oxbow ponds of floodplains. Lake, reservoir, and pond margins are also included.	water	directional, vertical: flowing into and out of the wetland in the bottom and sides of the depression	basins with peat soils or lake fringe without peat	Creek
				D2-low elevation basins that are permanently or semi-permanently flooded	Lake margin wetlands around Lake San Cristobal
				D3-low elevation basin with seasonal flooding	Depressional wetlands in Rio Grande River floodplain
				D4-low elevation basins that are temporarily flooded	Abandoned beaver ponds
				D5-low elevation basins that are intermittently flooded	Dry Lake
Mineral Soil Flat	Topographically flat wetland	Precipitation and groundwater	Two directional	F1-low elevation with seasonal high water table	No examples of this wetland type were found in Hinsdale County

HGM assumes that the highest, sustainable functional capacity is achieved in wetland ecosystems and landscapes that have not been subject to long-term anthropogenic disturbance. Under these conditions, the structural components and physical, chemical, and biological processes in the wetland and surrounding landscape are assumed to be at a dynamic equilibrium, which allows maximum ecological function (Smith et al. 1995). If a wetland is to be designated a reference standard for a given subclass of wetlands, it must meet these criteria. The need to locate reference wetlands is compatible with CNHP's efforts to identify those wetlands with the highest biological significance, in that the least disturbed wetlands will often be those with the highest biological significance.

PROJECT BACKGROUND

Location of Study Area

Hinsdale County is located in the heart of the San Juan Mountains along the Continental Divide in southwest Colorado (Figure 2). It encompasses 1,118 square miles (289,561 ha) in the Southern Rocky Mountains and ranges in elevation from 7,600 to 14,314 feet (2,320-4,363 m). However, greater than 98% of the county is above 8,200 feet (2,500 m). The lowest elevation occurs at the outflow of the Piedra River from Hinsdale County on the southern border. The highest elevations occur in northwest Hinsdale County where the five peaks over 14,000 feet occur: Uncompahgre Peak (14,309'), Handies Peak (14,048'), Redcloud Peak (14,034'), Wetterhorn Peak (14,015'), and Sunshine Peak (14,001'). Additionally, there are many 13,000-foot summits (including Granite Peak and the Rio Grande Pyramid) as well as high plateaus like the Cannibal Plateau and Finger Mesa. Lake City, in north-central Hinsdale County, is the county seat (Figure 3).

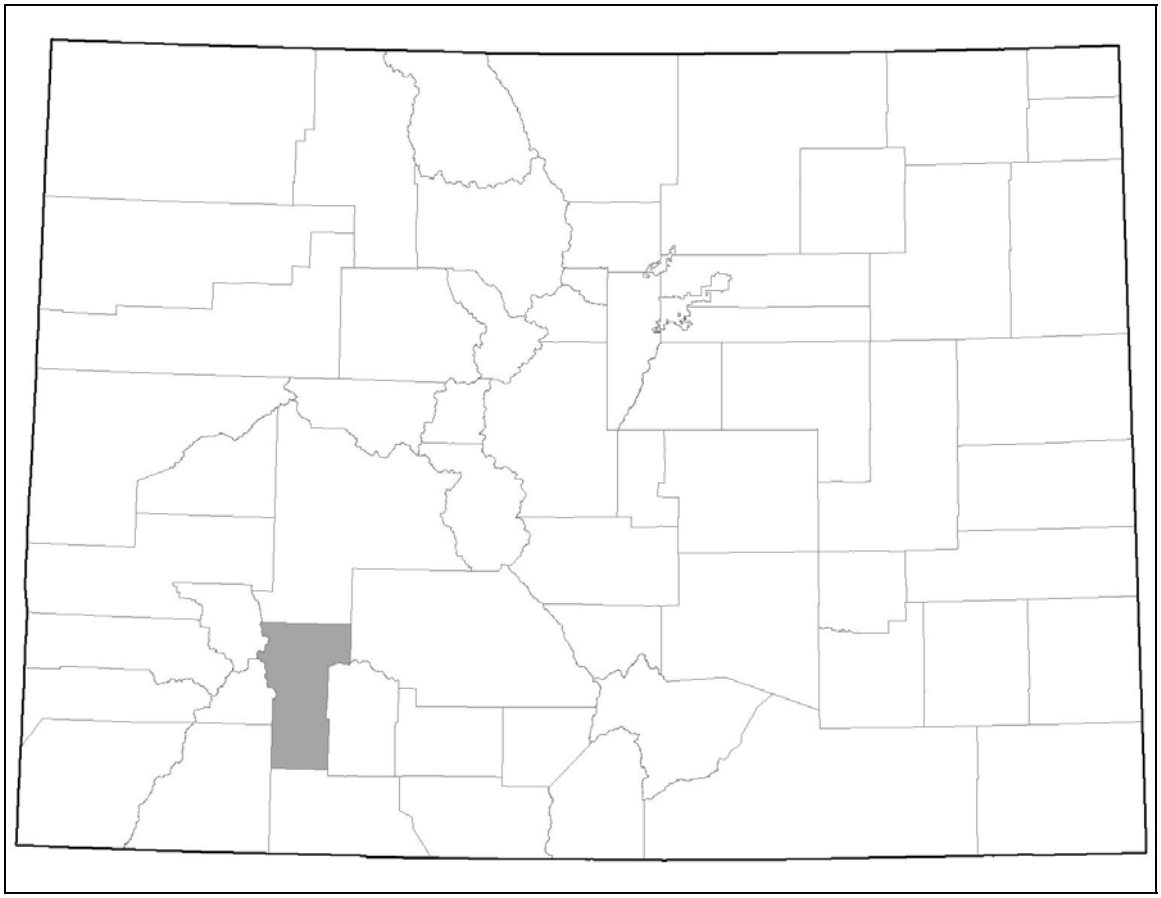


Figure 2. Location of Hinsdale County in Colorado.

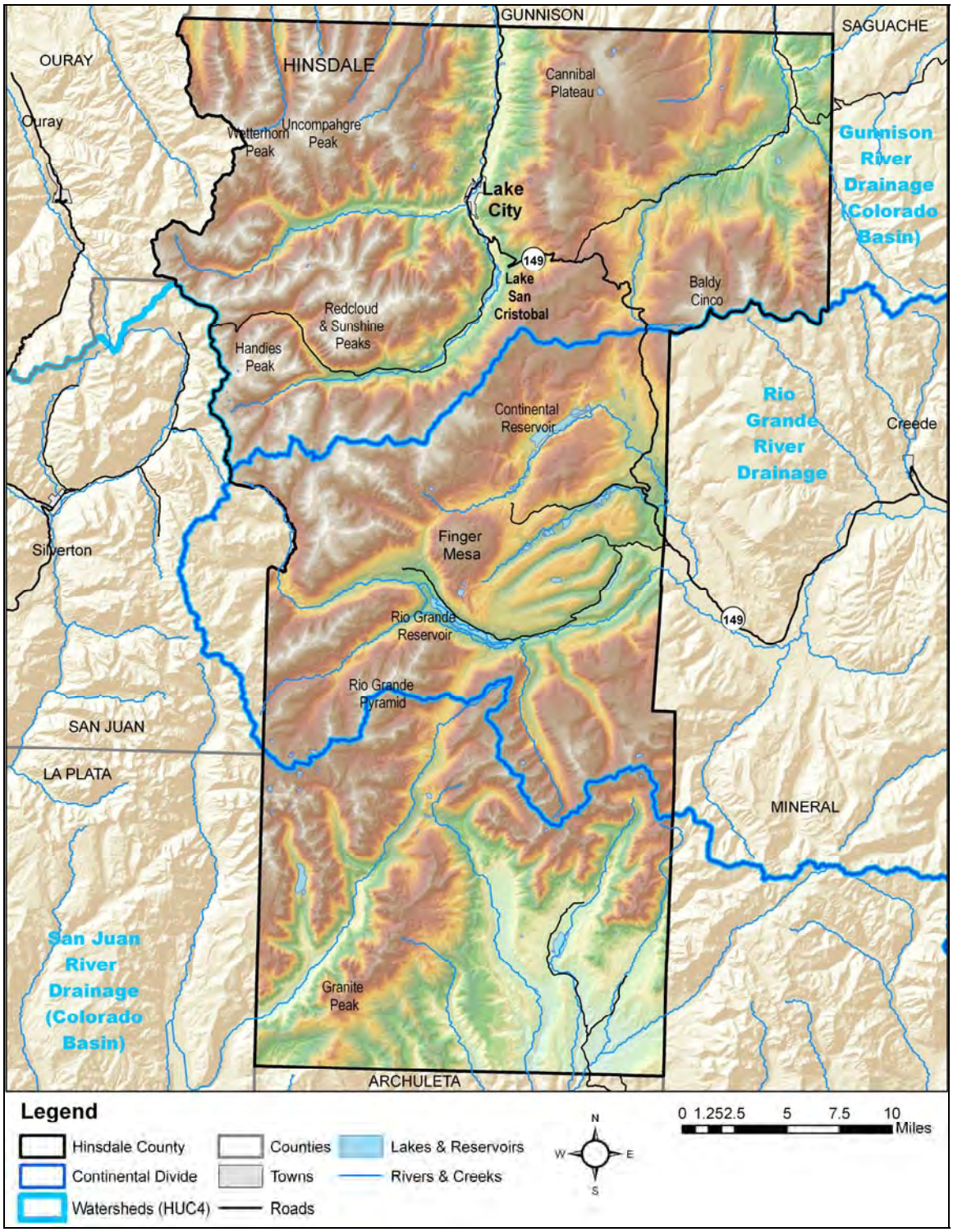


Figure 3. Elevation and place names within Hinsdale County.

Ecoregions

Hinsdale County is entirely within the South Central Highlands section of the Southern Rocky Mountains ecoregion as defined by The Nature Conservancy (modified from Bailey 1994; Figure 4a). The Southern Rocky Mountains ecoregion extends from southern Wyoming to northern New Mexico; the San Juan Mountains comprise the southwestern zone of the Southern Rocky Mountain ecoregion. The ecoregion spans a large elevation range as it includes major mountain systems and the intervening valley and parks (Neely et al. 2001). The South Central Highlands is characterized by high elevations, steep slopes, and jagged ridges and mountain crests that rise out of glaciated valleys.

Chapman et al. (2006) defined ecoregional subsections on the basis of vegetation and geologic substrate. Subsections of the southwestern zone of the Southern Rocky Mountain ecoregion are shown in Figure 4b. These subsections display the extent of alpine systems and subalpine forest in the county; alpine systems (or those above treeline) comprise 36% of the land area in Hinsdale County. Subalpine forests are categorized by crystalline, sedimentary, and volcanic based on bedrock geology in Chapman et al. (2006), but together they cover 53% of the county. Mid-elevation forests similarly are split by bedrock geology, but together cover around 12% of the land area in Hinsdale County. Grassland parks and foothill shrubland ecoregional subsections each occur on less than one percent of the land surface in the county.

Climate

Climate in the San Juan Mountains is highly variable. Within Hinsdale County it tends to vary with elevation and topography. Elevation and orientation of mountain ranges affect general air movements in Colorado and these affect local climatic conditions (Doesken et al. 2003). Wind patterns in Hinsdale County area are difficult to generalize but are often southwesterlies (Hunter and Spears 1975). Climate data for the past one hundred years was accessed via PRISM (Spatial Climate Analysis Service 2008) as well as from the Western Regional Climate Center (2008). Rain and snowfall can vary widely from year to year on both regional and local scales. Average annual precipitation in the county ranges from approximately 11 inches (29 cm) to greater than 50 inches (127 cm; Figure 5). Much of Hinsdale County receives considerable precipitation. Higher elevations in the northwest and west-central areas of the county generally receive approximately 43 inches (106 cm) of precipitation annually. However, there are pockets around the highest peaks, the fourteen-thousand-foot summits in the northwest corner of the county as well as the high mountains in the southwest corner, where average annual precipitation can be 50-60 inches (127-152 cm). Relatively dry areas include the valleys of the lower Lake Fork of the Gunnison River downstream from Lake City, the lower reaches of the Rio Grande Reservoir, and the high plateaus. The high plateaus, like the Cannibal Plateau in northern Hinsdale County and Finger Mesa in the center of the county, receive approximately 30 inches (76.2cm) of annual precipitation.

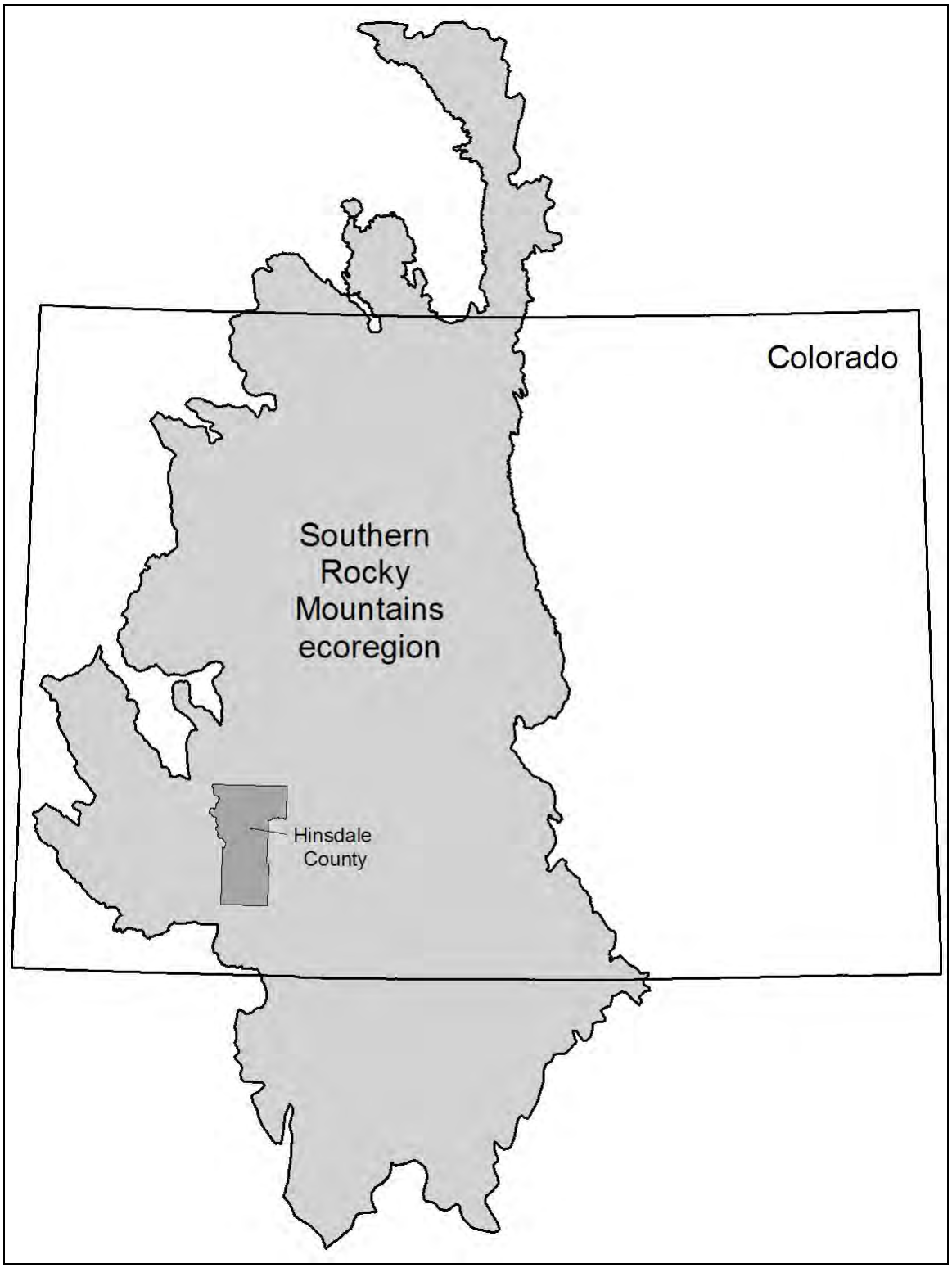


Figure 4a. Position of Hinsdale County within the Southern Rocky Mountain ecoregion.

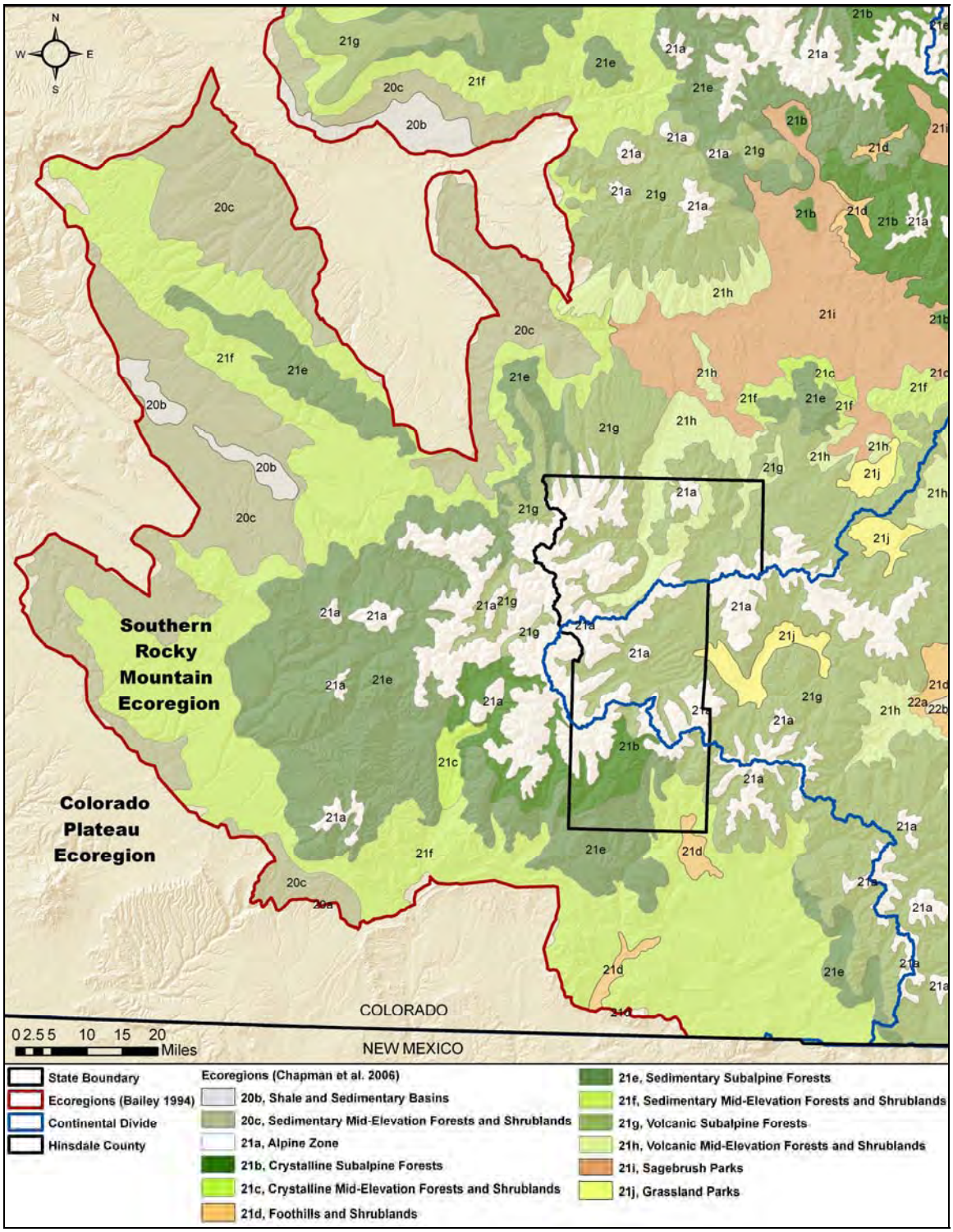


Figure 4b. Subsections in Hinsdale County (Chapman et al. 2006).

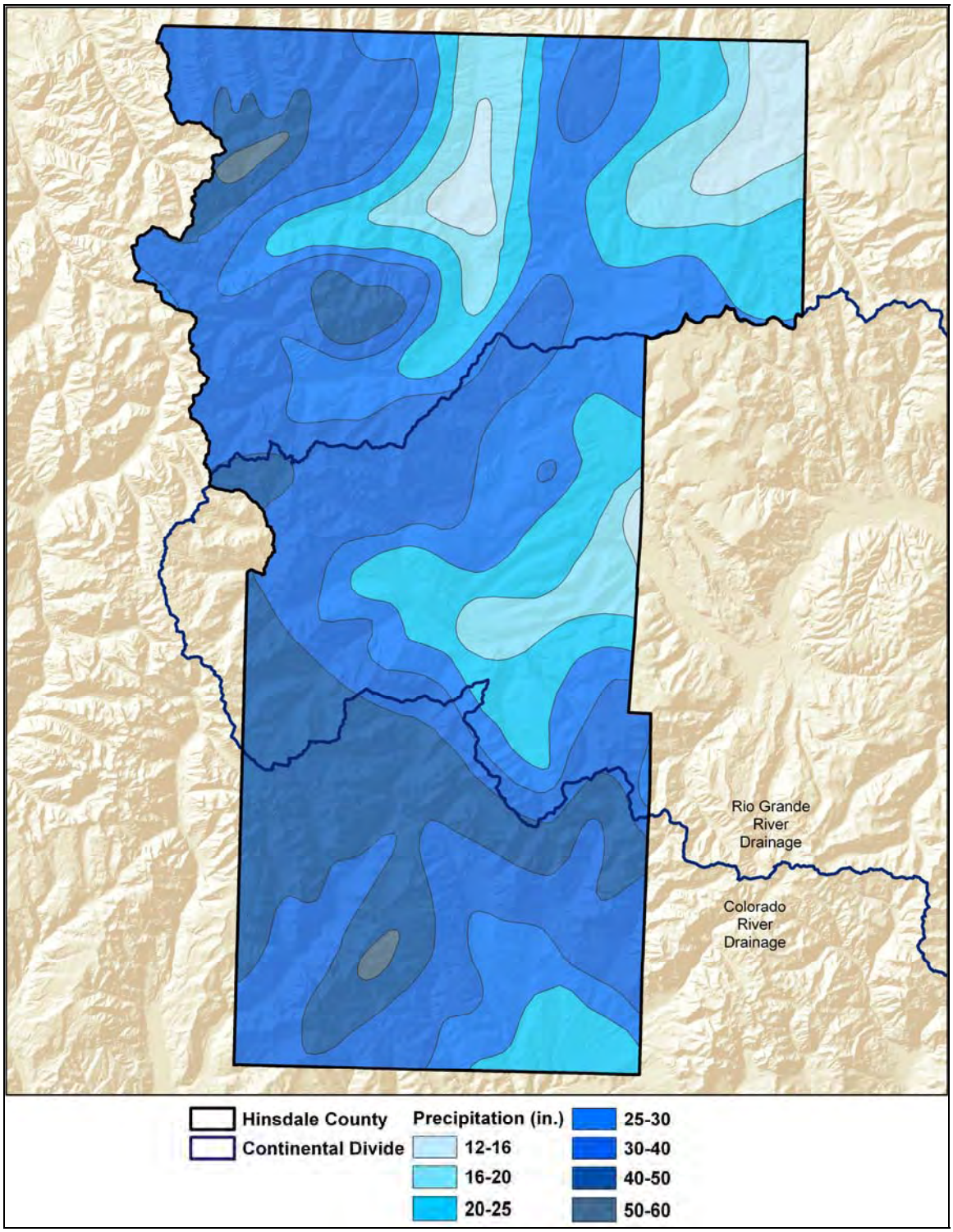


Figure 5. Annual precipitation in Hinsdale County.

The distribution of precipitation throughout the year on average is fairly uniform. Winter storms with northern storm track are frequent throughout the season but large snow accumulation events stem from cyclonic flow from the south; subtropical moisture pulled into these systems can produce storms with high precipitation. These types of storms have produced the historic blizzards and subsequent avalanches in the region (Blair et al. 1996). These storms often occur in March and April, which generally tend to be the snowiest months (Western Regional Climate Center 2008). The short growing season in Hinsdale County is ushered in with snowmelt beginning in May. June tends to be the driest month, but it is followed by greater prevalence of summer storms in July and August (Western Regional Climate Center 2008). Thunderstorms are common in the mid- to late summer as wind patterns often shift to more southerly directions providing monsoonal moisture to convection storms (Doesken et al. 2003).

Average annual maximum temperature ranges from 55.7 ºF in Lake City (with a monthly average range of 34.3 – 77.1 ºF; Western Regional Climate Center 2008) to 43.2ºF (with a range of 40.0 to 49.0 ºF) at high elevations nearby (Spatial Climate Analysis Service 2008). Average annual maximum temperature on Finger Mesa is 49.2ºF (ranging between 45.6 and 53.4 ºF). Valleys in Hinsdale County tend to be cooler because of cold air drainage. Summers are hot with July tending to be the hottest month. Average annual minimum temperatures range from 22.5ºF in Lake City (with a range of monthly averages of -1.9 – 44.6 ºF) to 17.3 ºF at high elevations (with monthly averages ranging from (3.3 – 35.1 ºF). Lowest average temperatures occur in January (Western Regional Climate Center 2008).

Although significant snowpack above 10,000 feet tends to linger into June, spring runoff from snowmelt generally begins in mid- to late May in Hinsdale County. Average peak discharge at the Lake Fork of the Gunnison River is 957 cfs (±350 cfs) and peaks around mid-June (Figure 6; U.S. Geological Survey 2007). Snowpack in the three major watersheds in Hinsdale County are shown in Table 9 and show the variability in winter moisture within the San Juan Mountains. During the winter of 2006, the Rio Grande and San Juan River watersheds had basin-wide snowpack that was well below average, whereas snowpack in the Upper Gunnison River watershed was near average for most of the winter months. However, snow totals were low throughout the region by June. In 2007, the Gunnison and San Juan watersheds were largely below average and the Rio Grande River watershed was near average for snow depths (National Water and Climate Center 2008).

The San Juan Mountains, like the rest of Colorado, was still recovering from drought conditions during the study period as evidenced by water storage in the Rio Grande Reservoir. The Rio Grande Reservoir storage dipped below average in August of 2001. Although it regained to nearly average during the summer of 2005, it neared a historical low in the summer of 2006. However, it returned to average capacity by the summer of 2007 (Natural Resources Conservation Service 2008)

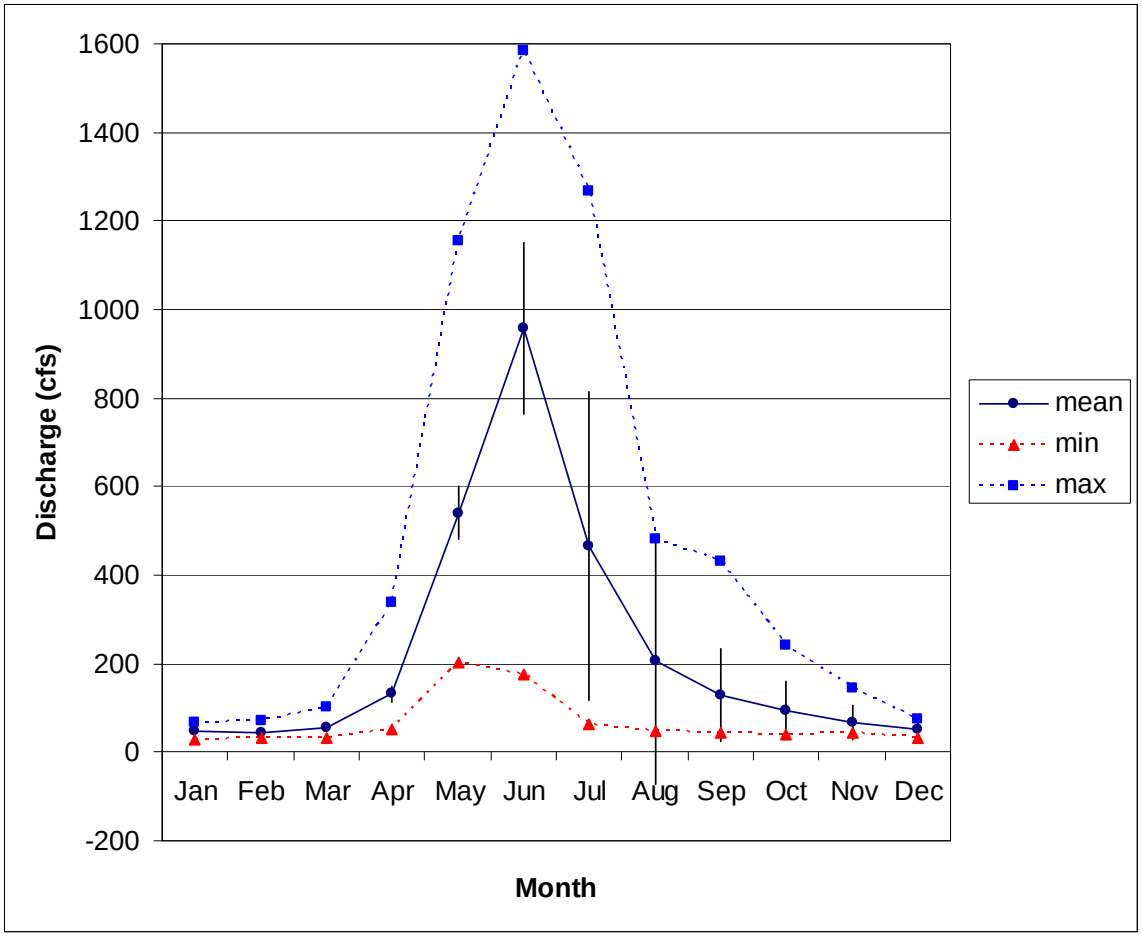


Figure 6. Annual average water discharge of the Lake Fork of the Gunnison River.

Table 9. Percent of average snowpack in the three major watersheds in Hinsdale County.

Year	Basin	Month					
2006		January	February	March	April	May	June
	Gunnison	98	97	84	94	56	38
	Rio Grande	34	43	40	64	40	11
	San Juan	47	53	46	68	44	6
2007							
	Gunnison	93	77	81	66	47	26
	Rio Grande	94	102	93	70	69	53
	San Juan	77	76	78	58	52	47

Geology

Embedded within the San Juan Mountains, Hinsdale County contains striking landforms that have resulted from its geologic history. These distinctive landforms were created primarily by volcanic activity over several periods of geologic time followed by multiple glaciations with subsequent post-glacial processes (Blair et al. 1996). The tumultuous geologic history led to highly fractured bedrock and complex patterns of rock types. The various ash, lava, and landslide deposits associated with volcanic events each have different erosion and deformation characteristics. Bedrock types in Hinsdale County are diverse ranging from Precambrian basement rocks to Quaternary alluvium (National GAP Analysis Program 2005). Spatial juxtaposition of bedrock types are shown in Figure 7 and listed in Table 10.

After a succession of cyclic uplift and erosion, a major period of volcanic activity ensued about 35 million years ago (Tertiary). The first stage of volcanic activity spewed lava and ash that covered wide swaths of the region and these deposits were smothered by explosive pyroclastic ash flows emitted during the second phase of volcanism where catastrophic eruptions were so strong the mountains collapsed into calderas. Fifteen overlapping calderas pock the landscape in the San Juan Mountains, each with its own characteristic ash flows (Steven and Lipman 1975). The Uncompahgre and Lake City calderas partially occur in Hinsdale County. Henson Creek and the Lake Fork of the Gunnison River flow from the bowl shape of the Lake City caldera. The primary volcanic bedrock types in Hinsdale County include Hinsdale Formation (porphyritic rhyolite, andesite, and basalt) and Sunshine Peak tuff (silicic rhyolite; Blair et al. 1996).

The Colorado Mineral Belt is a southwest to northeast trending zone that extends roughly from Durango to Boulder; it crosses through the northwestern quarter of Hinsdale County. Precambrian mountain building episodes created the faults, fractures, and shear zones that became conduits for molten magma and hydrothermal action in the Tertiary volcanic activity (Colorado Geological Survey 2003). Similarly, volcanic events themselves created additional conduits; the collapse of the Silverton and Lake City calderas created concentric and radial faults that became open vein deposits (Blair et al. 1996). Minerals dissolved in molten magma and groundwater flowed through these fissures and concentrated into ore deposits (Hopkins and Hopkins 2000). Hydrothermal activity in Hinsdale County and elsewhere in the San Juan Mountains were laden with precious metals of gold, silver, zinc, and copper (Blair et al. 1996). Significant mining districts formed in Lake City and those in Silverton and Ouray were nearby; Hinsdale County primarily had gold and silver mining (Western Mining History 2008).

Glaciation was a primary driver of modern geomorphology in the San Juan Mountains and in Hinsdale County. The San Juan Mountains endured multiple glaciations with as many as fifteen series noted in the last two million years (Blair et al. 1996). Atwood and Mather (1932) show the distribution of glaciers and their directions of flow in the

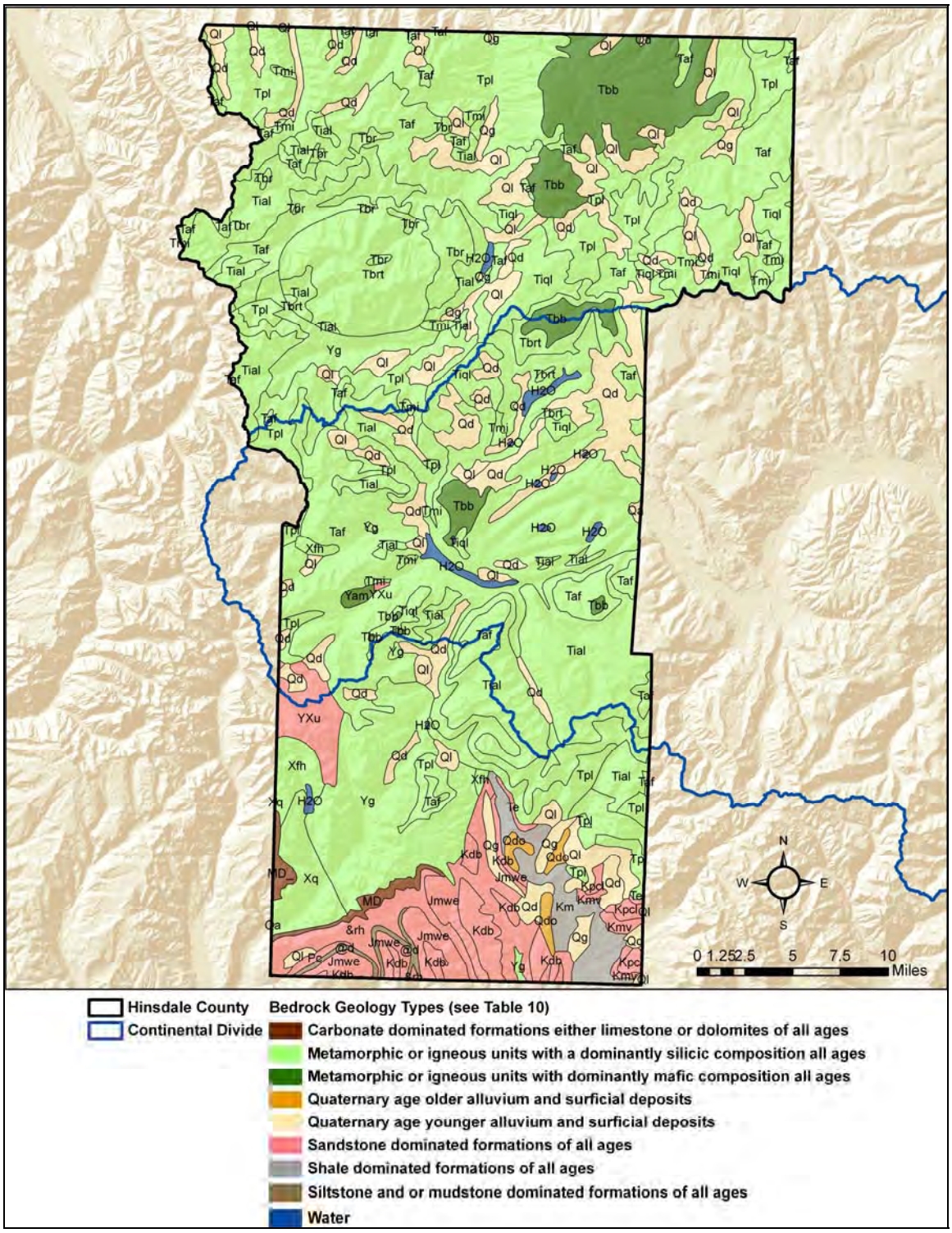


Figure 7. Geology of Hinsdale County (National GAP Analysis Program 2006).

Table 10. Bedrock types in Hinsdale County.

Symbol	SUBSTRATE	Name	Acres	Percent of Total
&rh	Sandstone dominated formations of all ages	RICO AND HERMOSA FORMATIONS--Arkosic sandstone, conglomerate, shale, and limestone. Includes at base in some areas siltstone and shale of Molas Formation, or Larsen Quartzite	8774.8	1.2
@d	Siltstone and or mudstone dominated formations of all ages	DOLORES FORMATION--Red siltstone, shale, sandstone, and limestone-pellet conglomerate	2198.8	0.3
H2O	Water	Water	3905.3	0.5
Jmwe	Sandstone dominated formations of all ages	MORRISON, WANAKAH, AND ENTRADA FORMATIONS	19383.7	2.7
Kdb	Sandstone dominated formations of all ages	DAKOTA SANDSTONE AND BURRO CANYON FORMATION--Sandstone, shale, and conglomerate	10308.9	1.4
Km	Shale dominated formations of all ages	MANCOS SHALE--Intertongues complexly with units of overlying Mesaverde Group or Formation; lower part consists of a calcareous Niobrara equivalent and Frontier Sandstone and Mowry Shale Members; in areas where the Frontier and Mowry Members (Kmfm), or th	11446.1	1.6
Kmv	Sandstone dominated formations of all ages	MESAVERDE GROUP, UNDIVIDED--Sandstone and shale	1939.1	0.3
Kpcl	Sandstone dominated formations of all ages	PICTURED CLIFFS SANDSTONE AND LEWIS SHALE	2235.7	0.3
MD	Carbonate dominated formations either limestone or dolomites of all ages	LEADVILLE LIMESTONE (MISSISSIPPIAN), GILMAN SANDSTONE (MISSISSIPPIAN OR DEVONIAN), DYER DOLOMITE (MISSISSIPPIAN? AND DEVONIAN), AND PARTING FORMATION (DEVONIAN, QUARTZITE AND SHALE)	2442.4	0.3
MD_	Carbonate dominated formations either limestone or dolomites of all ages	LEADVILLE, GILMAN, DYER, PARTING, AND SAWATCH FORMATIONS	1591.7	0.2
Pc	Sandstone dominated formations of all ages	CUTLER FORMATION--Arkosic sandstone, siltstone, and conglomerate	824.0	0.1
Qa	Quaternary age younger alluvium and surficial deposits	MODERN ALLUVIUM--Includes Piney Creek Alluvium and younger deposits	337.3	0.0
Qd	Quaternary age younger alluvium and surficial deposits	GLACIAL DRIFT OF PINEDALE AND BULL LAKE GLACIATIONS--Includes some unclassified glacial deposits	48524.3	6.7
Qdo	Quaternary age older alluvium and surficial deposits	OLDER GLACIAL DRIFT (PRE-BULL LAKE AGE)	2824.3	0.4
Qg	Quaternary age younger alluvium and surficial deposits	GRAVELS AND ALLUVIUMS (PINEDALE AND BULL LAKE AGE)--Includes Broadway and Louviers Alluviums	6838.9	1.0
Ql	Quaternary age younger alluvium and surficial	LANDSLIDE DEPOSITS--Locally includes talus, rock-glacier, and thick colluvial deposits	35511.6	4.9

Symbol	SUBSTRATE	Name	Acres	Percent of Total
	deposits			
Taf	Metamorphic or igneous units with a dominantly silicic composition all ages	ASH-FLOW TUFF OF MAIN VOLCANIC SEQUENCE (AGE IN SAN JUAN MOUNTAINS 26-30 M.Y.; IN SOUTH PARK 29-32 M.Y.)--Includes many named units	188938.5	26.3
Tbb	Metamorphic or igneous units with dominantly mafic composition all ages	BASALT FLOWS AND ASSOCIATED TUFF, BRECCIA, AND CONGLOMERATE OF LATE-VOLCANIC BIMODAL SUITE (AGE 3.5-26 M.Y.)--Includes basalts of Hinsdale Formation in San Juan Mountains, Servilleta Formation in San Luis Valley, and many other occurrences	39034.4	5.4
Tbr	Metamorphic or igneous units with a dominantly silicic composition all ages	RHYOLITIC INTRUSIVE ROCKS AND FLOWS OF LATE-VOLCANIC BIMODAL SUITE	8327.1	1.2
Tbrt	Metamorphic or igneous units with a dominantly silicic composition all ages	ASH-FLOW TUFF OF LATE-VOLCANIC BIMODAL SUITE (AGE 22-23 M.Y.)	33458.8	4.7
Te	Sandstone dominated formations of all ages	EOCENE PREVOLCANIC SEDIMENTARY ROCKS--Arkosic sand and bouldery gravel of Echo Park Alluvium and Blanco Basin Formation (arkosic mudstone, sandstone, and conglomerate)	650.4	0.1
Tial	Metamorphic or igneous units with a dominantly silicic composition all ages	INTRA-ASH FLOW ANDESITIC LAVAS Age of upper parts of uppermost Tertiary units is problematic. These parts have historically been assigned to the Pliocene. Successive reductions in radiometric age of the base of the Pliocene in Europe to 7 m.y. (Lambert,	87228.4	12.1
Tiql	Metamorphic or igneous units with a dominantly silicic composition all ages	INTRA-ASH-FLOW QUARTZ LATITIC LAVAS	31589.6	4.4
Tmi	Metamorphic or igneous units with a dominantly silicic composition all ages	MIDDLE TERTIARY INTRUSIVE ROCKS (AGE 20-40 M.Y.)--Intermediate to felsic compositions	3934.5	0.5
Tpl	Metamorphic or igneous units with a dominantly silicic composition all ages	PRE-ASH-FLOW ANDESITIC LAVAS, BRECCIAS, TUFFS, AND CONGLOMERATES (GENERAL AGE 30-35 M.Y.)--Includes several named units	93541.6	13.0
Xfh	Metamorphic or igneous units with a dominantly silicic composition all ages	FELSIC AND HORNBLENDIC GNEISSES, EITHER SEPARATE OR INTERLAYERED--Includes metabasalt, metatuff, and interbedded metagraywacke; locally contains interlayered biotite gneiss. Derived principally from volcanic rocks	5990.7	0.8
Xq	Metamorphic or igneous units with a dominantly silicic composition all ages	QUARTZITE, CONGLOMERATE, AND INTERLAYERED MICA SCHIST	9428.8	1.3

Symbol	SUBSTRATE	Name	Acres	Percent of Total
Yam	Metamorphic or igneous units with dominantly mafic composition all ages	ALKALIC AND MAFIC ROCKS IN SMALL PLUTONS, AND DIABASE AND GABBRO DIKES	884.9	0.1
Yg	Metamorphic or igneous units with a dominantly silicic composition all ages	GRANITIC ROCKS OF 1,400-M.Y. AGE GROUP (AGE 1,350-1,480 M.Y.)?Includes Silver Plume, Sherman, Cripple Creek, St. Kevin, Vernal Mesa, Curecanti, Eolus, and Trimble Granites or Quartz Monzonites; also, San Isabel Granite of Boyer (1962) and unnamed graniti	49043.8	6.8
YXu	Sandstone dominated formations of all ages	UNCOMPAHGRE FORMATION (OLDER THAN GRANITES OF 1,400-M.Y. AGE GROUP AND YOUNGER THAN GRANITES OF 1,700-M.Y. AGE GROUP)--Quartzite, slate, and phyllite METAMORPHIC ROCKS (Age 1,700-1,800 m.y.)	8262.5	1.1

mountain during the last significant glacial advance around 18,000 years ago (Colorado Geological Survey 2003, Blair et al. 1996). The highest peaks in Hinsdale County likely were not completely engulfed by ice and were nunataks or rock islands (Blair et al. 1996). As glaciers recede, the landforms they created were exposed—U-shaped valleys, hanging valleys, horns, arêtes, and cirques are commonplace in Hinsdale County.

Non-volcanic bedrock comprises a small percentage of rock types in Hinsdale County and include sedimentary formations (Paleozoic and Mesozoic) and Quaternary alluvium from post-glacial and modern erosion processes. Hinsdale County has limited areas at the south end of the county where softer sedimentary bedrock occurs. This area has a complex pattern of bedrock layers including Rico, Hermosa, Cutler, Dolores, Entrada, Morrison, Burro Canyon, and Dakota Formations (Tweto 1979). The series of glaciations in the San Juan Mountains left an intricate pattern of alluvial terraces and drift deposits in glaciated valleys in Hinsdale County. Although only the more recent glacial events are surfically evident, layers include alluvium from Pinedale and Bull Lake glaciations.

Soils

Soils in Hinsdale County have not been completely mapped. Northern Hinsdale County is covered by soil mapping in the Gunnison area (Hunter and Spears 1975). Generally soils are shallow and rocky in the uplands with sandy loams and rocky outcrops predominating. Grassland areas tend to accumulate greater depths and loamy soils like Bosler sandy loam at lower elevations and Mord, Sunshine, and Youman-Passar loams at subalpine elevations. Forested areas are characterized by Woodhall extremely rocky loam (5 to 50 percent slopes) and Posant very rocky loam (10 to 60 percent slopes) under mid-elevation forests, with Nutras stony loam (10 to 50 percent slopes), Shule and sapinero loams (10 to 50 percent slopes), Vulcan gravelly sandy loam (10 to 35 percent slopes), and Wetterhorn stony loam (10 to 55 percent slopes) at subalpine. Alpine areas tend to have Meredith very stony loam (8 to 50 percent slopes). Riparian areas tend to

have fine-textured, alluvial soils with coarse materials in the matrix; in northern Hinsdale County, these are primarily defined by Gas Creek sandy loam (both 0 to 1 and 1 to 5 percent slopes), Parlin-Mergel gravelly loam (5 to 45 percent slopes), and Fola cobbly sandy loam (1 to 8 percent slopes). Pockets of histosols dot the landscape marking small fens.

Rivers

Hinsdale County is one of only four counties in southwest Colorado that straddle the Continental Divide. The Divide winds through the center of Hinsdale County such that the central portion of the county comprises the headwaters of the Rio Grande River and flows eastward to the Gulf of Mexico, whereas the northern and southern portions of Hinsdale County are in the Colorado River drainage that flows west to the Pacific Ocean (Figure 8). The northern portion of Hinsdale County drains the Upper Gunnison River basin that joins the Colorado River downstream. The southern portion of the county forms the headwaters of the Piedra River, a major tributary of the San Juan River, which flows south into New Mexico. The Rio Grande headwaters begin just to the west of Hinsdale County in adjacent San Juan County before flowing west to east through the middle of Hinsdale County before entering the San Luis Valley and continuing to the Gulf of Mexico.

Current impacts to water quantity and quality in Hinsdale County include reservoirs, surface water diversions, and mining activity. Three major reservoirs occur in Hinsdale County, two in the Rio Grande Drainage—the Rio Grande Reservoir and the Continental Reservoir—and one in the San Juan River drainage—the Williams Creek Reservoir in the southern portion of the county. Several naturally occurring lakes exist in Hinsdale County, including Lake San Cristobal, the second largest natural lake in Colorado, and Emerald Lake in the Upper San Juan River area in the southwestern portion of the county. Myriad small glacial lakes occur in the high country. Seven major trans-basin diversions transfer water from the Colorado River side of the drainage to the Rio Grande Basin, four of which are in Hinsdale County (Topper et al. 2003). Water quality in Hinsdale County is naturally impacted by heavy metals and acidity in the Lake Fork of the Gunnison drainage (Colorado Geological Survey 2003). Poor water quality in this watershed is exacerbated by anthropogenic impacts from mining activity. Historically, mining was the major industry in Hinsdale County. Acid mine drainage negatively impacts water quality in the Lake Fork of the Gunnison from headwaters area downward (Krabacher et al. 2006). Mining activity can also alter the hydrology of wetlands; mine tailings dumped in or near wetland or riparian areas can alter surface flow and sediment fluxes (Chimner et al. 2007).

Surface water comprises the vast majority of water inputs in Hinsdale County (Topper et al. 2003). Annual precipitation recharges volcanic rock aquifers in Hinsdale County. Water chemistry in these aquifers tends to be highly variable. Wells that access these

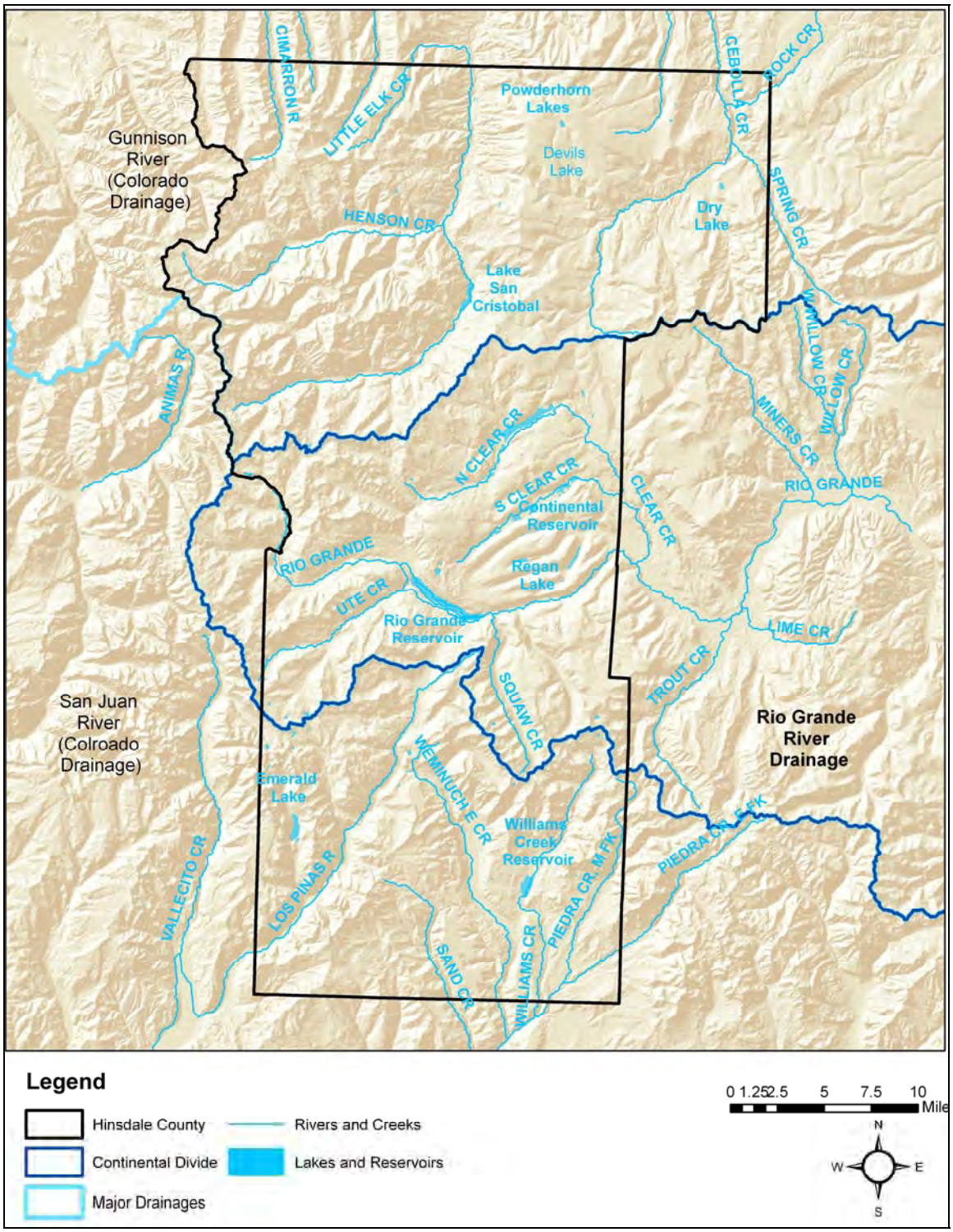


Figure 8. Major drainages in Hinsdale County.

water sources are primarily clustered around Henson Creek and the Lake Fork of the Gunnison River as well as along the Rio Grande River. Alluvial aquifers associated with the San Juan, Rio Grande, and Lake Fork of the Gunnison Rivers are virtually non-existent in the Hinsdale County portion of these drainages. The southern end of Hinsdale County is at the northeastern side of the San Juan Basin. Groundwater from alluvial and shallow-bedrock is tapped for irrigation, ranching, and domestic water supply in the Piedra River valley.

Ecological Systems

The glacial history, geology, and elevation within Hinsdale County lead to a limited range of ecological systems. Ecological systems are dynamic assemblages of plant and animal communities that occur together on the landscape, unified by similar ecological processes (e.g., climate as moderated by elevation and natural disturbance processes) and/or underlying abiotic environmental factors or gradients (e.g., bedrock geology and hydrology). Ecological systems in the county range from alpine tundra at high elevations throughout the county to montane forests in lower reaches of the major river valleys.

The diversity of ecological systems in Hinsdale County may be best described along the elevation gradient contained within it. At the highest elevations, exposed rock forms a mosaic with alpine tundra. These communities of tiny shrubs, cushion plants, and grasses transition to wind-flagged krummholz before grading into subalpine forests dominated by Engelman spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*). These spruce-fir forests in turn grade into upper montane forests of mixed conifers and aspen (*Populus tremuloides*). Lodgepole or limber pine (*Pinus contorta* and *Pinus flexilis*) with small patches of bristlecone pine (*Pinus aristata*) grade into Douglas-fir (*Pseudotsuga menziesii*), often on north-facing slopes. Ponderosa pine (*Pinus ponderosa*) is limited to the lowest elevations in Hinsdale County, in uplands along lower reaches of the Lake Fork of the Gunnison in the north and the Piedra River in the south. The foothills between the mountains and plains are characterized by Gambel oak (*Quercus gambelii*) scrub and/or mountain mahogany (*Cercocarpus montanus*) shrublands that blanket the dry, shallow soils of hogbacks and often intermingle with confer woodlands on slopes. Grasslands occupy valleys and are scattered in areas of deeper soils throughout the montane and foothill areas in the county.

With the restricted elevation range in Hinsdale County, there is a concurrent low diversity of riparian ecological systems. These riparian systems are defined based on elevation and vegetation structure. These are linear systems that often form ecotones between upland and wetland systems (NatureServe 2003). Riparian systems in Hinsdale County primarily include Upper Montane/Subalpine Riparian Forest and Woodland and Upper Montane/Subalpine Riparian Shrubland ecological systems with limited expression of Lower Montane Riparian Woodland (Rondeau 2001). Given the elevation and precipitation in Hinsdale County, there are also expressions of unique fen wetlands, which will be discussed below.

The subalpine and upper montane zones have two systems, Upper Montane/Subalpine Riparian Forest and Woodland and Upper Montane/Subalpine Riparian Shrubland. These occupy elevations between 8000 to 11,000 feet (2440-3350 m) depending on aspect and topography. Riparian forests and woodlands tend to occur on steeper gradients and in narrower valleys relative to shrublands, which tend to occupy broad shallow valleys in this elevation zone. Upper Montane/Subalpine Riparian Forest and Woodlands comprise riparian corridors dominated by Engelman spruce-fir, blue spruce (*Picea pungens*), and aspen with spruce-fir occupying the subalpine and blue spruce and aspen occurring in the upper montane. Understories of these forests can be shrubby or herbaceous depending on soil characteristics and stream gradient. Upper Montane/Subalpine Riparian Shrubland are characterized by several willow species (*Salix bebbiana, S. boothii, S. drummondiana, S. geyeriana, S. monticola, S. brachycarpa, S. planifolia, S. wolfii*), thinleaf alder (*Alnus incana*), river birch (*Betula occidentalis*), red-osier dogwood (*Cornus sericea*), and shrubby cinquefoil (*Dasiphora fruticosa*). Several willows, barrenground willow (*Salix brachycarpa*), planeleaf willow (*S. planifolia*), and wolf willow (*S. wolfii*), tend to occupy the subalpine, whereas the remainder of the shrubs are more prevalent in the upper montane zone. Predominant understory species in these shrublands tend to be graminoids, especially sedges (*Carex* spp.) but wetter areas are often dominated by forbs (Rondeau 2001, Redders 2000). Broad, glaciated valleys have lower-gradient , sinuous stream with well-developed willow carrs.

Riparian corridors in the lower montane elevation zone generally occur in V-shaped valleys in Hinsdale County between 6000 and 9000 feet (1830-2740 m). They are strongly dominated by narrowleaf cottonwood (*Populus angustifolia*) and generally have a somewhat well-defined to a well-defined shrub layer comprised of various species. Shrubs include thinleaf alder, river birch, red-osier dogwood, chokecherry (*Prunus virginiana*), and various willows. They often occur in monotypic stands but also form very diverse, mixed stands. These systems usually form immediately adjacent to river and stream reaches and in small patches surrounding springs. Herbaceous understories in these systems are highly variable.

Variability in vegetation composition and spatial juxtaposition of tree and shrub species often reflects a patchy mosaic resulting from the dynamics of flooding. The severity and periodicity of flooding at local scales strongly influences the vegetation composition and structure that occurs at a site as well as the successional pathways that ensue (Campbell and Green 1968, Douhovnikoff et al. 2005). Watershed characteristics influence the flood regime, affecting the magnitude and frequency of flood events. These characteristics contribute to the pattern of annual hydrographs, the pattern of sediment delivery, and the characteristics of the sediment (Baker and Walford 1995). Vegetation and soil characteristics also have an impact on flooding. Vegetation and soils in the arid West have less ability to absorb and intercept rainfall relative to more humid regions. This lower ability to attenuate runoff leads to larger maximum flood peaks and flash flood potentials. Flooding in more arid regions is thus more likely to cause landform change (Osterkamp and Friedman 2000). As the scale of rainfall events that may induce flooding, like thunderstorm downbursts, is often local, unpredictable and relatively

infrequent, channel and vegetation characteristics can be widely variable over space and time (Friedman and Lee 2002).

Fens

Where cool, moist conditions persist—such as at higher elevations in the Southern Rocky Mountains—constant soil saturation provided by upwelling groundwater creates anaerobic conditions in the deeper soil layers. Lack of oxygen combined with cold temperatures dramatically slows or inhibits decomposition leading to the accumulation of organic material in soils, or the formation of peat (Mitsch and Gosselink 1993). Peat accumulation in the Arid West occurs very slowly; estimates range from 10-41 cm (4-16 inches) per 1,000 years (U.S. Fish and Wildlife Service Region 6 1997). In the Southern Rocky Mountains, a wetland is considered a peatland or fen if organic matter (peat) accumulation is at least 40 cm or 16 inches (U.S. Fish and Wildlife Service Region 6 1997). These montane fens also occur as a "small patch" type of system. The intricate relationship of environmental conditions that maintain fens stems from landscape position, groundwater, and climate. Fens usually form where groundwater intercepts the soil surface, often at low points within the landscape or on slopes at higher elevation where climatic conditions do not continuously favor decomposition processes (Crum 1988, Sjors and Gunnarsson 2002, Mitsch and Gosselink 1993, Rondeau 2001).

Water chemistry of fen wetlands reflects the type of bedrock through which the groundwater flows. There are several categories of peatlands that are derived from distinct water chemistry affiliated with different types of bedrock geology. For example, mineral-rich groundwater of extremely rich fens is basic after percolating through enriched bedrock like dolomites and limestones high in calcium and magnesium bicarbonates and sulfates (Cooper 1996). In contrast, iron fens are mineral-rich but highly acidic; they occur in areas where bedrock contains significant amounts of pyrite (FeS_2), which reacts with groundwater and oxygen to form sulfuric acid (Sares 2005, Cooper and Arp 1998). Iron fens are rare and are largely restricted to the mineral belt of Colorado (Cooper and Arp 1998). They are characterized by limonite precipitate of pyrite that forms local terrace surfaces for peat accumulation, and therefore for fen development. Characteristic flora includes dwarf birch (*Betula nana*), sphagnum mosses (especially *Sphagnum angustifolium, S. russowii, S. fimbriatum,* and *S. squarrosum*), and sedges (*Carex aquatilis, C. canescens,* and *C. utriculata*) (Cooper and Arp 1998, Carsey et al. 2003).

Fauna

In the San Juan Mountains the physical threshold where temperature begins to outweigh moisture as the main limiting factor to biological processes occurs between 7,600-8,200 feet (2,300-2,500 m; Blair et al. 1996). With greater than 98 % of the land area occurring at or above 8,200 feet, the fauna of Hinsdale County have greater adaptations for temperature regulation. Adaptations for cold temperatures are various, but include breeding in heat-trapping ponds, foraging actively during the day when it is warmest, and achieving maturity quickly and at small body sizes (Marchand 1996).

Rare species affiliated with wetlands and riparian areas in Hinsdale County include fish, amphibians, freshwater snails, and several bird species. Fish include the Rio Grande (or Round tail) Chub (*Gila pandora*), as well as both the Colorado River Cutthroat Trout (*Oncorhynchus clarkii* pleuriticus) and Rio Grande Cutthroat Trout (*Oncorhynchus clarkii virginalis*). Boreal Toads (*Bufo boreas*) used to occur more commonly in the San Juan Mountains, but is now very limited in its occurrence there (Boreal Toad Conservation Strategy Team 1997). The Mossy Valvata is a freshwater snail that is usually found in high calcium aquatic habitats affiliated with rooted aquatic vegetation (Massachusetts Natural Heritage & Endangered Species Program 2008). Two bird species of note are the Black Swift (*Cypseloides niger*) and Southwestern Willow Flycatcher (*Empidonaxtraillii*). Black Swifts nest in cool microclimates on rock faces that are near waterfalls or in dripping caves (Lack 1956). The Southwestern Willow Flycatcher is a small passerine that is on the federally endangered species list. It nests in thickets, scrubby and brushy areas often affiliated with riparian corridors. Current threats to the Southwest Willow Flycatcher are primarily driven by alteration of its riparian habitat (including habitat loss, modification, and fragmentation) and brood parasitism (Finch and Stoleson 2000).

Land Ownership

Approximately 95% of the land within Hinsdale County is in public ownership (Figure 9). U.S. Forest Service lands comprise the majority of land in the county with nearly 560,000 acres (226,500 ha), which is about 78% of the land area. Of this total, approximately 272,500 acres (110,300ha) are designated Wilderness Area, including portions of the La Garita, Weminuche, and Big Blue Wilderness Areas. The Bureau of Land Management manages nearly 125,000 acres (50,300 ha) in northern Hinsdale County, which comprises about 17% of the total land area in the county. The State of Colorado owns nearly 3000 acres (1200ha) and manages it as state wildlife area, but this is less than 0.5% of the total land area in the county. Privately-owned land comprises approximately 4.5% of the land area and is largely centered along major riparian corridors like the Lake Fork of the Gunnison, the Rio Grande, and the Piedra rivers as well as Weminuche Creek.

Land Use History

Prior to exploration of the San Juan Mountains by the Spanish, what is now Hinsdale County and its environs were Ute territory. As the Spanish settled farther north into New Mexico they looked northward for trade as the Ute were more friendly than the Comanche to the south (Blair et al. 1996). This was followed by Spanish miners exploring the area. Trade and exploration were minimal until the late 1880's when attention remained on the San Juan Mountains for their mining potential. Mining districts developed and competed for business. However, Lake City was established in 1874 and grew rapidly in character with mining boom towns of the period (Wright and Wright 1964). Its population peaked around 1879 when approximately 4000 people lived in the town. It served a chain of mining camps upstream along Henson Creek including Sherman and Capitol City. Locations of mines and mining activity was concentrated in the northern portion of the county (Figure 10). The difficult terrain of the San Juans

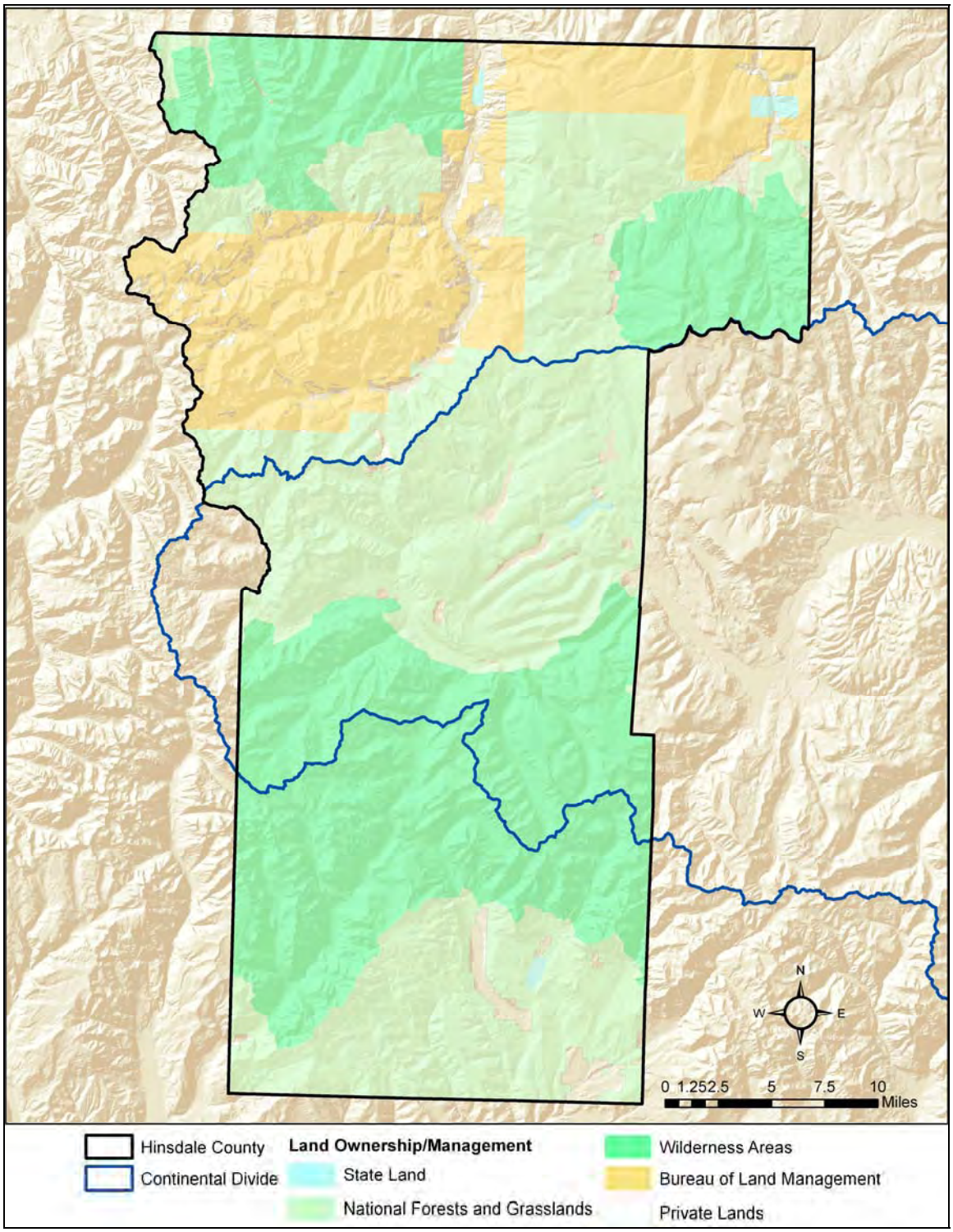


Figure 9. Land ownership in Hinsdale County.

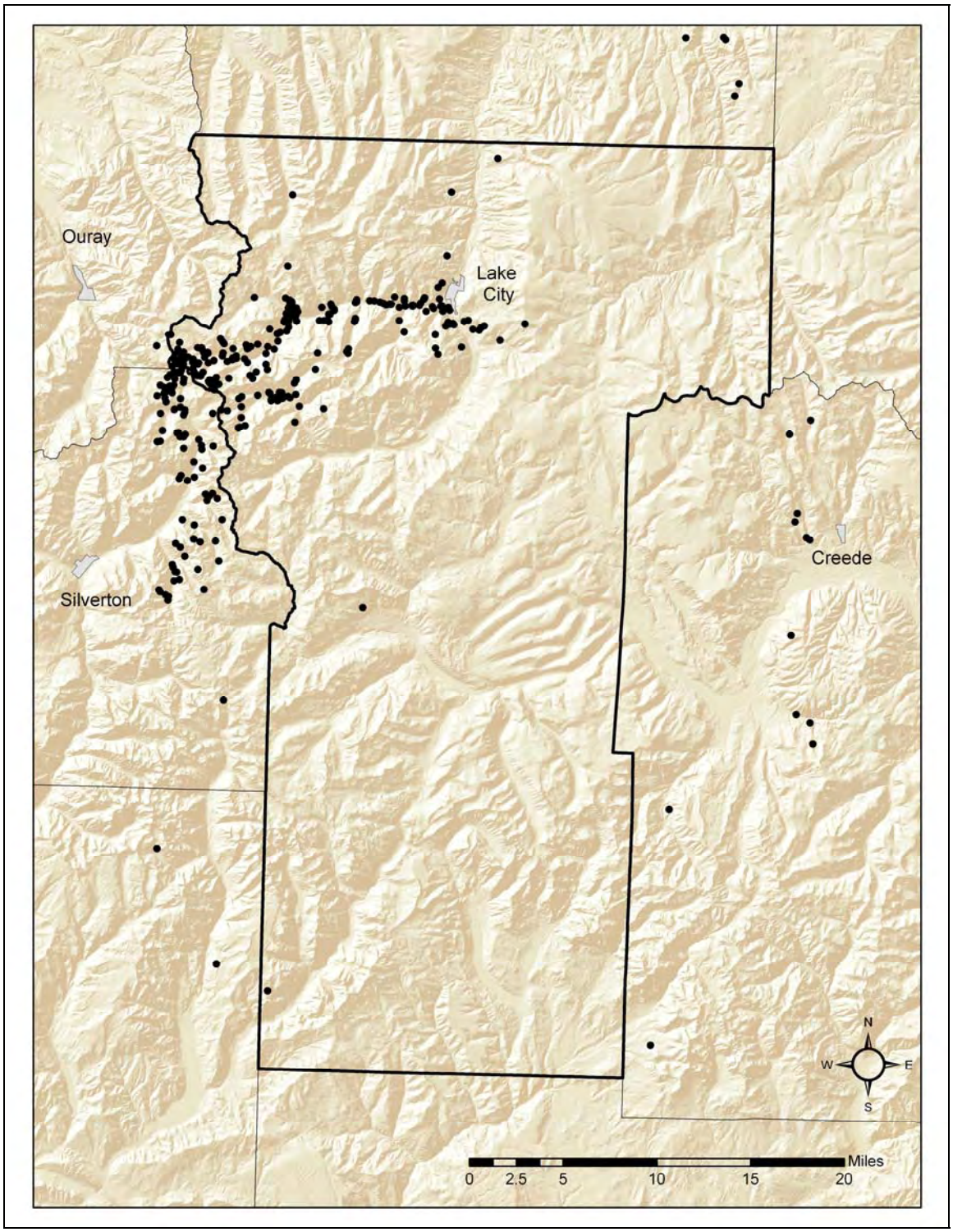


Figure 10. Locations of mines and mining activity in the vicinity of Hinsdale County.

hampered major transportation corridors. The last silver rush occurred in the early 1890's followed by the crash of silver prices in 1893.

Population

Hinsdale County, with an estimated population size of 819, ranks 62nd (second only to adjacent San Juan County) in the state. Most of the county's population is concentrated in Lake City. The population has more than doubled since 1980 with the majority of this growth occurring in the 1980s. The population of Hinsdale County increased by approximately 10% between 1990 and 2000 (U.S. Census Bureau 2008).

CONSERVATION ASSESSMENT

Potential Impacts to Biological Diversity in Hinsdale County

General threats that may affect biodiversity on a large, landscape-level scale in Hinsdale County are summarized below. We understand that the issues discussed below are often important parts of a healthy economy and contribute to the well being of our society. We mention these general "impacts to biodiversity" with the hope that good planning can minimize the impacts where critical habitat resides.

Hydrological Modifications

River impoundment in the form of lakes, reservoirs, irrigation ditches, and canals can affect aquatic dependent plants and animals (Chien 1985, Friedman et al. 1998). Three reservoirs currently affect water flow in Hinsdale County and a possible outflow control structure on Lake San Cristobal is currently being discussed. Annual flooding is a natural ecological process that can be severely altered by the construction of dams, reservoirs, and other water diversions. These water diversions and impoundments have altered the normal high peak flows that were once a part of the natural hydrological regimes of the rivers and their tributaries. These periodic floods are necessary for continued viability of most riparian vegetation. For example, many plants, including cottonwood trees, reproduce primarily with flooding events (Rood and Mahoney 1990). As plant composition changes in response to alterations in the flooding regime, the composition of the aquatic and terrestrial fauna may also change.

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

Many wetlands not associated with fluvial processes have been altered by irrigation practices, water diversions, and groundwater withdrawals. Many historical wetlands, such as seeps and springs, have been lost or altered due to water "development" projects, such as water diversions or impoundments. The number of species supported by a manmade pond with minimal edge habitat is generally less than the number supported by an extensive intact seep and spring wetland or naturally occurring pond.

Development
Residential development is a localized but increasing impact in Hinsdale County, especially near Lake City and in scattered areas throughout the rest of the county. Development creates a number of stresses, including habitat loss and fragmentation, introduction and proliferation of non-native plant species, fire suppression, and predation and disturbance from domestic animals (dogs and cats) (Oxley et al. 1974, Coleman and Temple 1994). Increasing human density in an area can lead to a change in the composition of wildlife populations (e.g., numbers of foxes and coyotes may increase, or number of bird species present may decrease), and may also alter movement patterns and behavior of wildlife. Loss of habitat to development is considered irreversible.

Recreation
Recreation, once very local and perhaps even unnoticeable, is increasing and having a greater impact on natural ecosystems in Hinsdale County. Different types of recreation (e.g., motorized versus non-motorized activities) typically have different effects on ecosystem processes. All-terrain vehicles (ATVs) can disrupt migration and breeding patterns of many animal species and fragment habitat for native resident species. This activity can also threaten rare plants found in non-forested areas. ATVs have also been identified as a vector for spreading invasive non-native plant species.

Non-motorized recreation, mostly hiking but also some mountain biking and rock climbing, presents a different set of issues (Cole and Knight 1990, Knight and Cole 1991; Miller et al. 1998, 2001). Wildlife behavior can be significantly altered by repeat visits of hikers or bicyclists. Trail placement should consider the range of potential impacts on the ecosystem. Considerations include minimizing fragmentation by leaving large undisturbed areas of wildlife habitat where possible (Colorado Department of Natural Resources 1998). Miller et al. (1998) found lower nest survival for grassland birds adjacent to trails; they also found that grassland birds were more likely to nest away from trails with a zone of influence approximating 250 feet (75 meters). Alpine areas, mountain lakes, and riparian zones are routes and destinations for many established trails. Thus, impacts to native vegetation (mainly trampling) in these areas can be high.

Fragmentation and Edge Effects
Edges are simply the outer boundary of an ecosystem that abruptly grades into another type of habitat (e.g., edge of a Gambel oak scrub next to a grassland; Forman and Godron 1986). Edges are often created by naturally occurring processes such as floods, fires, and wind. Edges can also be created by human activities such as roads, trails, timber harvesting, agricultural practices, and rangeland management. Edges are often dominated by plant and animal species that are adapted to disturbance. As the landscape is increasingly fragmented by large-scale, rapid anthropogenic conversion, these edges become increasingly abundant in areas that may have had few “natural” edges. The overall reduction of large landscapes jeopardizes the existence of specialist species (e.g., forest interior birds), may increase non-native species, and may limit the mobility of species that require large landscapes or a diversity of landscapes for their survival (e.g., large mammals or migratory waterbirds).

Roads
There is a complex, dense network of roads in many parts of Hinsdale County due primarily to mining, agricultural uses and residential development. Expansion of the existing road network in some areas will detrimentally affect the biodiversity of the region. Roads are associated with a wide variety of impacts to natural communities, including invasion by non-native plant species, increased depredation and parasitism of bird nests, increased impacts of pets, fragmentation of habitats, erosion, pollution, and road mortality (Noss et al. 1997).

Roads function in a variety of ways for different species. They can act as conduits for or barriers to dispersal, and as habitats, and therefore, as sources or sinks for some species. Roads create edges along otherwise unfragmented landscapes, thus creating habitat for some species (Forman 1995). Road networks crossing landscapes can increase erosion and alter local hydrological regimes. Runoff from roads may impact local vegetation via contribution of heavy metals and sediments. Road networks interrupt horizontal ecological flows, alter landscape spatial patterns, and therefore inhibit important interior species (Forman and Alexander 1998).

Effects on wildlife can be categorized as road avoidance and mortality due to vehicular collisions (roadkill). Traffic noise appears to be the most important variable in road avoidance, although visual disturbance, pollutants, and predators moving along a road are alternative hypotheses as to the cause of avoidance (Forman and Alexander 1998). Songbirds appear to be sensitive to remarkably low noise levels, even to noise levels similar to that of a library reading room (Reijnen et al. 1995); thus, these species will not be located along roads.

Non-native Species
Although non-native species are mentioned repeatedly as stresses in the above discussions because they may be introduced through so many activities, they are included here as a general threat as well. Non-native plants or animals can have wide-ranging impacts. Non-native plants can increase dramatically under the right conditions and dominate a previously natural area (e.g., a native grassland adjacent to a railroad right-of-way). This can generate secondary effects on animals (particularly invertebrates) that depend on native plant species for forage, cover, or propagation. Effects of non-native fishes include competition that can lead to local extinctions of native fishes and hybridization that corrupts the genetic stock of the native fishes. Non-native pasture grasses that are prevalent in Hinsdale County wetlands include timothy (*Phleum pretense*), redtop (*Agrostis gigantea*), Kentucky bluegrass (*Poa pratensis*), smooth brome (*Bromus inermis*), Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), common dandelion (*Taraxacum officinalis*), sweet clovers (*Melilotus* spp.), white Dutch clover (*Trifolium repens*), red clover (*Trifolium pratense*), and quackgrass (*Elytrigia repens*).

Livestock Grazing
Domestic livestock grazing has been a traditional livelihood in Hinsdale County since the late 1800s and has left a broad and sometimes subtle impact on the landscape. However,

some range management practices can adversely affect the region's biological resources. Many riparian areas in Hinsdale County are used for rangeland. Because there is little surface water available in the county, riparian areas often serve as the only available water. Additionally, riparian areas are often areas of the highest production of grasses and forbs. Long-term, incompatible livestock use of wetland and riparian areas can potentially erode stream banks, cause streams to downcut, lower the water table, alter channel morphology, impair plant regeneration, establish non-native species, shift community structure and composition, degrade water quality, and diminish general riparian and wetland functions (Windell et al. 1986). Depending on grazing practices and local environmental conditions, impacts can be minimal and largely reversible (slight shifts in species composition) to severe and essentially irreversible (extensive gullying and introduction of non-native forage species).

Logging

Most logging operations require a network of roads. The impacts from roads can result in threats to biodiversity (see "Roads" for more detailed discussion). Other logging impacts include loss of wildlife habitat, habitat fragmentation, soil erosion, and lower water quality for aquatic species. The U.S. Forest Service monitors logging closely; nonetheless, problems can still occur (Husong and Alves 1998). The effects of logging on biodiversity have not been determined in Hinsdale County.

Recommended Conservation Strategies

Conservation Strategies can be classified as three major types:

1. Land protection accomplished through conservation easements, land exchanges, long term leases, purchase of mineral, grazing, or water rights, acquisition, or government regulation;

2. Management of the land influenced so that significant resources are protected; and

3. Public education about the significant ecological values of the county to engender support for land use decisions that protect these values.

The first step in facilitating any of the conservation strategies suggested above is to identify the significant elements of biodiversity and their locations in the county. This report and the accompanying GIS data provide information necessary for this first step. The next step is to use this information to conserve these elements and the areas that support them. The PCA descriptions within this report provide protection and management suggestions for most areas identified during the inventory. However, some general recommendations for conservation of biological diversity in Hinsdale County are given here.

1. Develop and implement a plan for protecting the Potential Conservation Areas profiled in this report, with most attention directed toward areas with a biodiversity rank of B1, B2 and B3. The PCAs in this report provide a basic framework for implementing a comprehensive conservation program. The B1, 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 or the Farm Bill. Continue to promote cooperation among local entities to preserve the county's biodiversity. Encourage county leadership to institutionalize consideration of significant biological resources in land use planning. There are no B1 sites for wetland or riparian areas in Hinsdale County, however there are several for endemic upland plants. Several of the B2 sites, however, highlight the importance of iron fens.

2. Use this report in the review of proposed activities in or near Potential Conservation Areas to determine whether or not activities adversely affect elements of biodiversity. All of the PCAs presented contain elements of biodiversity of state or global significance. Weighing the biodiversity 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. Range-restricted species may be especially vulnerable to habitat destruction, while 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. The Colorado Natural Heritage Program routinely conducts site-specific environmental reviews and should be considered a valuable resource. Also, 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. Other key partners, such as the Colorado Division of Wildlife, can be valuable resources as well, particularly in evaluating potential impacts to biological resources not tracked by CNHP (e.g., game species).

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 areas in each vegetation type, especially where these are connected, may ensure that we do not lose species that have not yet been located. Work to protect large blocks of land in each of the major vegetation types in the

county, and avoid fragmenting large natural areas unnecessarily with roads, trails, etc. Although large migrating animals like deer and elk are not tracked by CNHP as rare species, they are 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. Fragmentation of the landscape also affects smaller animals and plants, opening more edge habitats and introducing exotic species. Encourage cluster developments that designate large common areas for preservation of natural communities, as an alternative to scattering residences over the landscape with a house on each 35-acre parcel. Work with developers early in the planning process to educated them about the benefits of retaining natural areas. Locate trails and roads to minimize impacts on native plants and animals. See Forman and Alexander (1998) for an excellent review of the literature on the ecological effects of roads. See *Planning Trails with Wildlife in Mind* published by the State Trails Program (Colorado Department of Natural Resources 1998) for suggestions regarding planning trails with minimum impacts to wildlife.

4. 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 Hinsdale County will be facilitated by the cooperation of private landowners, businesses, government agencies, and non-government organizations. Efforts to provide stronger ties among federal, state, local, and private interests involved in the protection or management of natural lands will increase the chance of success. 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.

5. Promote wise management of the biodiversity resources that exist within Potential Conservation Areas. Development of a site-specific conservation plan is a necessary component of the long-term protection of a PCA. Because some of the most serious impacts to Hinsdale County's ecosystems are at a large scale (e.g., altered hydrology, residential encroachment, and non-native species invasion), considering each area in the context of its surroundings is critical. Several organizations and agencies are available for consultation in the development of conservation plans, including the Colorado Natural Heritage Program, the Colorado Division of Wildlife, the Natural Resources Conservation Service, The Nature Conservancy, and various academic institutions. With the current rate of population growth in Colorado, rare and imperiled species will likely decline if not given appropriate protection or management attention.

Coordinate with managers of public parks or other public lands that support sensitive biological resources. Engage local citizens, groups, and organizations (e.g., schools, 4-H clubs, Native Plant Society) in assisting with management and monitoring projects on public lands. Make a concerted effort to involve individual landowners in conservation dialogue, as applicable.

6. Stay informed and involved in public land management decisions. Approximately 95% percent of Hinsdale County is publicly owned. The Bureau of Land Management owns approximately thirty-five percent and the U.S. Forest Service approximately ten percent. The State and the Department of Defense own approximately eight percent and one percent, respectively. Many of the PCAs in Hinsdale County are on public land and may be protected from development, but not from incompatible uses. Even ownership is not always secure, since federal and state agencies are becoming more and more involved in land exchanges. Encourage protection for the most biologically significant sites on public lands by implementing compatible management activities designated in Forest Management Plans, Grazing Management Plans, etc.

7. Continue inventories and monitoring where necessary, including inventories for species that cannot be surveyed adequately in one field season and continue inventories on lands that CNHP could not access in 2006-2007. Not all targeted inventory areas can be surveyed in one field season due to several factors, including lack of access, phenology of species, or time constraints. Because some species are ephemeral or migratory, completing an inventory in one field season is often difficult. Despite the best efforts during one field season, it is likely that some elements were not documented during the survey. Thus, it is recommended that this report and the data included within it serve as a guide for subsequent surveys of Hinsdale County.

8. Continue to take a proactive approach to weed and exotic species control. Recognize that weeds affect both agriculture and native plant communities. Discourage the introduction and/or sale of non-native species that are known to significantly impact natural areas. These include, but are not limited to, exotic, invasive species such as tamarisk, Russian olive, dalmation toadflax (*Linaria dalmatica*), purple loosestrife (*Lythrum salicaria*), and non-native fish species. Further, natural area managers, public agencies, and private landowners should be encouraged to remove these species from their properties. Enforce the use of weed-free forage on horse trails. Encourage the use of native species for revegetation and landscaping efforts. Ideally, seed should be locally harvested. This includes any seeding done on county road right-of-ways. The Colorado Natural Areas Program has published a book entitled *Native Plant Revegetation Guide for Colorado* that describes appropriate species to be used for revegetation. This resource is available on the World Wide Web at http://www.parks.state.co.us/home/publications.asp#CNAP.

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

Consider developing a community conservation website to provide information on natural resources, biological diversity, and conservation opportunities in Hinsdale County. Enlist the assistance of local media in public education efforts.

10. Develop and implement comprehensive program to address loss of wetlands. In conjunction with the information contained in this report, information regarding the degree and trend of loss for all wetland types (i.e., salt meadows, emergent marshes, riparian forests, seeps/springs, etc.) should be sought and utilized to design and implement a comprehensive approach to the management and protection of Hinsdale County wetlands. Encourage and support statewide wetland protection efforts such as CDOW's Wetlands Program. County governments are encouraged to support research efforts on wetlands to aid in their conservation. Countywide education on the importance of wetlands could be implemented through the county extension service or other local agencies. Encourage communication and cooperation with landowners regarding protection of wetlands in Hinsdale County.

METHODS

The methods for assessing and prioritizing conservation needs over a large area are necessarily diverse. The Colorado Natural Heritage Program follows a general method that is continuously being developed specifically for this purpose. The Natural Heritage Survey described in this report was conducted in several steps summarized below. Additionally, input from the Gunnison Office of the Bureau of Land Management, U.S. Forest Service, and the Colorado Division of Wildlife were sought at all stages.

Collect Available Information

CNHP databases were updated with information regarding the known locations of species and significant plant communities within Hinsdale County. A variety of sources were searched for this information. The Colorado State University museums and herbarium were searched, as were plant and animal collections at the University of Colorado, Rocky Mountain Herbarium, and local private collections. The Colorado Division of Wildlife provided extensive data on a range of species. 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 also entered into CNHP databases.

Identify Rare or Imperiled Species and Significant Plant Communities with the Potential to Occur in the Study Area

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

The information collected in the previous step was used to refine a list of potential species and natural plant communities and to refine our search areas. In general, species and plant communities that have been recorded from Hinsdale County or from adjacent counties, are included in this list. Species or plant communities preferring habitats that are not included in this study area were removed from the list. Over 120 rare species and significant plant communities were targeted in these surveys. Given the limited amount of time and funding for this research, 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 (G1-G3) and/or because they are known to occur in areas that are subject to various development pressures such as hydrological alterations and residential development.

The amount of effort given to the inventory for each of these elements was prioritized according to the element's global status rank. Globally rare (G1-G3) elements were given highest priority; globally common (G4 or G5) elements that are rare in the state (S1-S3) were of a lower priority.

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 aerial photographs, geology maps, vegetation surveys, 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. These areas focused on private lands. Additional TIAs were identified by the Bureau of Land Management, the U.S. Forest Service and the Colorado Division of Wildlife.

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 ranks of G1-G3 were the primary target of our inventory efforts. Although species with lower (less rare) Natural Heritage imperilment 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 by asking local stakeholders. Landowners were then either contacted 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

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, breeding birds cannot be surveyed outside of the breeding season, and plants are often not identifiable without flowers or fruit that are only present during certain times of the year.

The methods used in the surveys vary according to the elements that were being targeted. In most cases, the appropriate habitats were visually searched in a systematic fashion that would attempt to cover the area as thoroughly as possible in the given time. Some types of organisms require special techniques to document their presence. These are summarized below:

- Amphibians: visual observation and capture using aquatic dip nets
- Mammals: live traps, pitfall traps and mist nets
- Birds: visual observation or identification by song or call
- Plants: visual observation
- Plant communities: visual observation

The 2006-2007 survey of Hinsdale County focused on wetland and riparian plants and plant communities. 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 its ease or difficulty of protecting) of the occurrence. These factors are combined into an element occurrence rank, useful in refining conservation priorities. See the previous section on Natural Heritage Methodology for more about element occurrence ranking.

Site visits and assessments were conducted on the following two levels:

(1) Roadside or adjacent land assessments: Many of the sites could be viewed at a distance from a public road. While on the ground the field scientist can see, even from a distance, many features not apparent on maps and aerial photos. The road assessments determined the extent of human and livestock impacts on the targeted inventory area (TIA), which can include ditching, adventive plant species, plant species indicative of intensive livestock use, stream bank destabilization, major hydrologic alterations, extensive cover of non-native plant species, or new construction. Sites with one or more of these characteristics were generally excluded as potential conservation areas and no extensive data were gathered at these areas.

(2) On-site assessments: On-site assessments were the preferred method as it is the only technique that can yield high-confidence statements concerning the known or potential presence of rare and imperiled elements or excellent examples of common natural communities. On-site assessments are also the most resource intensive because of the effort required to contact landowners. In a few 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 CHHP was unable to contact the landowner during the time frame of this study.

Delineate Potential Conservation Areas

Finally, since the objective for this inventory is to prioritize specific areas for conservation efforts, Potential Conservation Area (PCA) boundaries were delineated. The goal of the PCA is to identify a land area that can provide the habitat and ecological processes upon which a particular element occurrence, or suite of element occurrences, depends for its continued existence. The best available knowledge about each species' life history is used in conjunction with information about topographic, geomorphic, 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;
- maintenance of surface water quality within the PCA and surrounding watershed;
- maintenance of the hydrologic integrity of the groundwater;
- land intended to buffer the PCA against future changes in the use of surrounding lands;
- exclusion or control of invasive exotic species;
- land necessary for management or monitoring activities.

Delineate Sites of Local Significance

After PCAs and NCAs have been delimited, the remaining data collected is evaluated for inclusion as Sites of Local Significance (SLS). These are sites that include good

condition but small size or of species or natural communities that are common and already documented in the study area. However, they do contribute to the character of the local area and the overall local diversity of plants and communities present, and therefore warrant consideration at some planning level.

RESULTS

One hundred thirty-eight Targeted Inventory Areas (TIAs) for wetland and/or riparian areas were identified for evaluation during the 2006 field season. Twenty-one additional TIAs were targeted in 2007. Eighty-four TIAs (61%) were visited during 2006 and 18 (86%) were visited in 2007 (Figure 11); an effort was made to select TIAs that potentially had natural hydrology, native species composition, and vegetation structure intact. Of the 102 TIAs visited, 30 (29%) were addressed within Potential Conservation Areas and two (1%) became sites of local significance. Due to time limitations, 57 (36%) of the TIAs were not visited. All TIAs are shown on Figure 11.

Results of the 2006-2007 Hinsdale County wetland and riparian survey confirm that there are many wetland and riparian areas with high biological significance. Several rare plants and animals depend on these areas for survival. All together one amphibian, two birds, three fish, one mollusk, 45 wetland or riparian communities, and one imperiled wetland plant species of concern have been documented in Hinsdale County in this report (Table 11). The CNHP database currently houses more than 70 wetland and riparian element occurrence records within Hinsdale County. As part of this project, thirty new element occurrence records were created and 24 element occurrence records were updated.

CNHP has identified 52 Potential Conservation Areas (PCAs) in or partially contained in Hinsdale County. Thirty-seven of these PCAs address wetland or riparian elements and are presented in this report. The distribution of the PCAs is shown in Figure 12, they are listed in Table 12, and profiled in Appendix A. Fifteen of these PCAs include private and/or state lands. Of the 37 PCAs presented in this report, ten were of very high biodiversity significance (B2), sixteen were of high biodiversity significance (B3), and eleven were is of moderate biodiversity significance (B4). Of the 37 PCAs presented in this report, twenty were newly created based on fieldwork from 2006-2007. Four existing wetland or riparian PCAs were updated with changes in site boundaries and in element occurrences of interest. Among the PCAs for biodiversity elements not presented in this report there is one that is of outstanding biodiversity significance (B1) that addresses the globally rare stonecrop gilia (*Gilia sedifolia*), an alpine plant only known from one site in the world (Anderson 2004). Additional B2 sites include several for the Uncompaghre Frittilary (*Boloria improba acrocnema*). Two Sites of Local Significance were developed in Hinsdale County and are discussed after the PCAs in Appendix B.

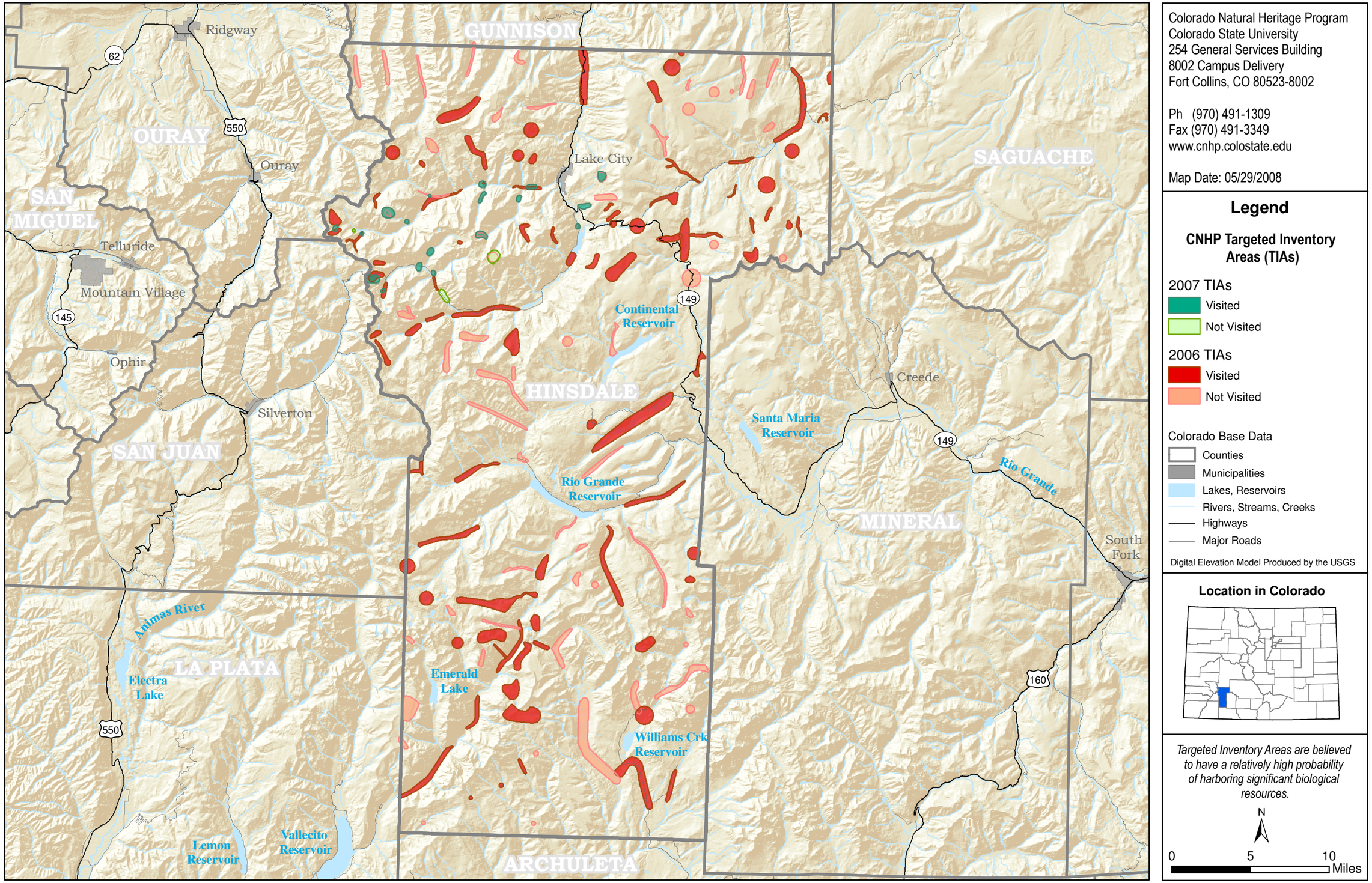


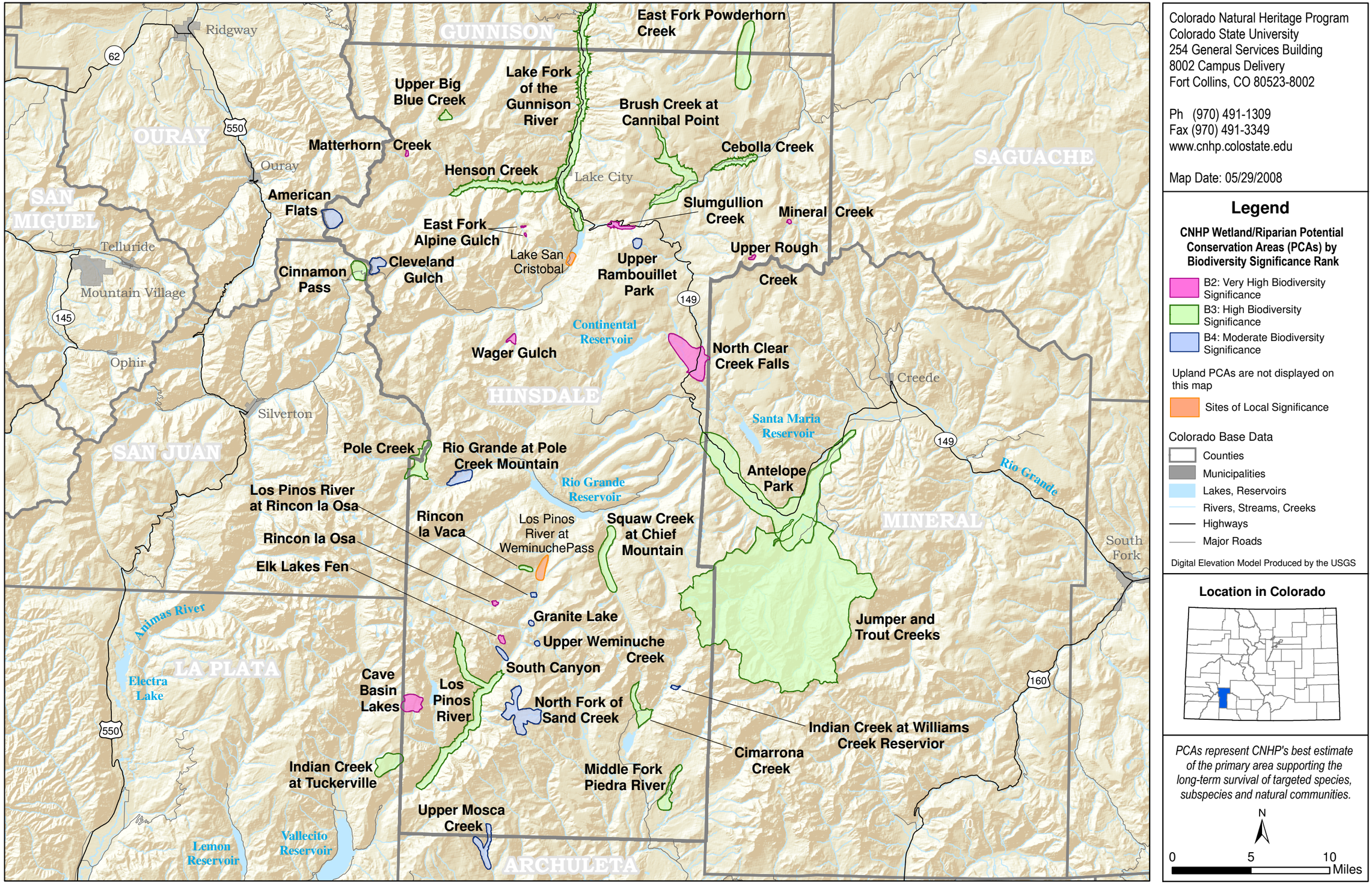
Figure 11. CNHP Targeted Inventory Areas in Hinsdale County

Table 11. List of known wetland and riparian elements of concern for Hinsdale County. *

Element	Common Name	Grank	Srank	Federal Sensitive
AMPHIBIANS				
Bufo boreas pop. 1	Boreal Toad (Southern Rocky Mountain Population)	G4T1Q	S1	USFS
BIRDS				
Cypseloides niger	Black Swift	G4	S3B	USFS
Empidonax traillii extimus	Southwestern Willow Flycatcher	G5T1T2	SNA	
FISH				
Gila pandora	Rio Grande Chub	G3	S1?	BLM/USFS
Oncorhynchus clarkii pleuriticus	Colorado River Cutthroat Trout	G4T3	S3	USFS
Oncorhynchus clarkii virginalis	Rio Grande Cutthroat Trout	G4T3	S3	BLM/USFS
MOLLUSKS				
Valvata sincera	Mossy Valvata	G5	S3	
NATURAL COMMUNITIES				
(Picea engelmannii) / Betula glandulosa / Carex aquatilis - Sphagnum angustifolium Woodland	Iron Fen	G2	S2	
Abies lasiocarpa - Picea engelmannii / Carex aquatilis Forest	Subalpine Riparian/wetland Forest	G4	S3	
Abies lasiocarpa / Alnus incana Forest	Montane Riparian Forests	G5	S5	
Abies lasiocarpa / Mertensia ciliata Forest	Montane Riparian Forests	G5	S5	
Abies lasiocarpa / Ribes (montigenum, lacustre, inerme) Forest	Coniferous Wetland Forests	G5	S3	
Abies lasiocarpa / Salix drummondiana Forest	Montane Riparian Forest	G5	S4	
Abies lasiocarpa / Trautvetteria caroliniensis Forest	Subalpine Fir/Carolina Tasselrue	G3	S2?	
Alnus incana - Salix drummondiana Shrubland	Montane Riparian Shrubland	G3	S3	
Cardamine cordifolia - Mertensia ciliata Herbaceous Vegetation	Alpine Wetlands	G4	S4	
Carex aquatilis Herbaceous Vegetation	Montane Wet Meadows	G5	S4	
Carex illota Herbaceous Vegetation	Alpine Wetlands	GUQ	S2	
Carex limosa Herbaceous Vegetation	Montane Wetland	G2	S1S2	
Carex microptera Herbaceous Vegetation	Montane Wetland	G4	S2?	
Carex nigricans - Juncus drummondii Herbaceous Vegetation	Alpine Wetlands	GU	S2	
Carex pellita Herbaceous Vegetation	Montane Wet Meadows	G3	S3	

Carex utriculata Herbaceous Vegetation	Beaked Sedge Montane Wet Meadows	G5	S4	
Eleocharis quinqueflora Herbaceous Vegetation	Alpine Wetlands	G4	S3S4	
Picea pungens / Alnus incana Woodland	Montane Riparian Forests	G3	S3	
Populus angustifolia - Picea pungens / Alnus incana Woodland	Montane Riparian Forests	G3	S3	
Populus angustifolia / Alnus incana Woodland	Montane Riparian Forest	G3	S3	
Salix boothii / Mesic Forbs Shrubland	Booth's Willow/Mesic Forb	G3	S3	
Salix drummondiana / Calamagrostis canadensis Shrubland	Lower Montane Willow Carrs	G3	S3	
Salix drummondiana / Mesic Forbs Shrubland	Drummonds Willow/Mesic Forb	G4	S4	
Salix geyeriana - Salix monticola / Calamagrostis canadensis Shrubland	Montane Willow Carrs	G3	S3	
Salix geyeriana - Salix monticola / Carex aquatilis Shrubland	Montane Riparian Willow Carr	GU	S3	
Salix geyeriana - Salix monticola / Mesic Graminoid Shrubland	Montane Riparian Willow Carr	GU	S3	
Salix monticola / Carex utriculata Shrubland	Montane Riparian Willow Carr	G3	S3	
Salix monticola / Mesic Forbs Shrubland	Montane Riparian Willow Carr	G4	S3	
Salix monticola / Mesic Graminoids Shrubland	Montane Riparian Willow Carr	G3	S3	
Salix planifolia / Calamagrostis canadensis - Carex aquatilis Shrubland	Subalpine Riparian Willow Carr	G3	S2S3	
Salix planifolia / Calamagrostis canadensis Shrubland	Subalpine Riparian Willow Carr	G4	S2S3	
Salix planifolia / Caltha leptosepala Shrubland	Subalpine Riparian Willow Carr	G4	S4	
Salix planifolia / Carex aquatilis Shrubland	Subalpine Riparian Willow Carr	G5	S4	
Salix planifolia / Carex utriculata Shrubland	Diamondleaf Willow / Beaked Sedge	GNR	S2	
Salix planifolia / Mesic Forbs Shrubland	Planeleaf Willow/Mesic Forbs	G4	S4	
Salix wolfii / Mesic Forbs Shrubland	Subalpine Riparian Willow Carr	G3	S3	
PLANTS				
Eriophorum altaicum var. *neogaeum*	Altai cottongrass	G4?T3T4	S3	USFS

*Fact sheets or characterizations abstracts for many of these elements are in Appendix C.



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Map Date: 05/29/2008

Legend

CNHP Wetland/Riparian Potential Conservation Areas (PCAs) by Biodiversity Significance Rank

- B2: Very High Biodiversity Significance
- B3: High Biodiversity Significance
- B4: Moderate Biodiversity Significance

Upland PCAs are not displayed on this map

- Sites of Local Significance

Colorado Base Data

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

Digital Elevation Model Produced by the USGS

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.

N

0 5 10 Miles

Figure 12. CNHP Wetland/Riparian Potential Conservation Areas and Sites of Local Significance in Hinsdale County

Table 12. Hinsdale County wetland and riparian Potential Conservation Areas.

Potential Conservation Area	Protection Urgency Rank	Management Urgency Rank
B2: Very High Biodiversity Significance		
Cave Basin Lakes	P4	M4
East Fork Alpine Gulch	P4	M4
Elk Lakes Fen	P4	M5
Matterhorn Creek	P3	M3
Mineral Creek	P4	M4
North Clear Creek Falls	P3	M3
Rincon la Osa	P4	M5
Slumgullion Creek	P3	M3
Upper Rough Creek	P4	M4
Wager Gulch	P3	M4
B3: High Biodiversity Significance		
Antelope Park	P2	M3
Brush Creek at Cannibal Point	P4	M3
Cebolla Creek	P3	M3
Cimarrona Creek	P5	M4
Cinnamon Pass	P3	M3
East Fork Powderhorn Creek	P5	M3
Henson Creek	P3	M3
Indian Creek at Tuckerville	P5	M4
Jumper and Trout Creeks	P4	M4
Lake Fork of the Gunnison River	P3	M3
Los Pinos River	P3	M4
Middle Fork Piedra River	P3	M3
Pole Creek	P4	M3
Rincon la Vaca	P5	M5
Squaw Creek at Chief Mountain	P5	M4
Upper Big Blue Creek	P4	M5
B4: Moderate Biodiversity Significance		
American Flats	P4	M4
Cleveland Gulch	P4	M4
Granite Lake	P4	M5
Indian Creek at Williams Creek Reservior	P5	M4
Los Pinos River at Rincon La Osa	P5	M3
North Fork of Sand Creek	P4	M4
Rio Grande at Pole Creek Mountain	P3	M4
South Canyon	P5	M5
Upper Mosca Creek	P4	M4
Upper Rambouillet Park	P4	M4
Upper Weminuche Creek	P5	M4

DISCUSSION

Wetland and Riparian Natural Communities

General patterns of riparian biodiversity in Hinsdale County are dictated by elevation, landform, stream gradient, and groundwater chemistry. Thus, different areas have different expressions of wetland and riparian biodiversity. General areas with distinct patterns include high elevation wetlands, glaciated valleys; and large rivers. Alpine and subalpine riparian systems are the most common.

Headwaters of riparian systems flow down from alpine areas throughout much of Hinsdale County, often from glaciated cirques. These riparian systems often drop rapidly in elevation. High-elevation riparian communities begin in alpine meadowns. Mesic herbaceous meadows with black alpine sedge (*Carex nigricans*) and Drummond rush (*Juncus drummondii*) or wet meadows and seeps often have water sedge and marsh marigold (*Caltha leptosepala*). Also at high elevations, alpine willow carrs of planeleaf willow (*Salix planifolia*) and wolf willow (*Salix wolfii*) intermingle with and then transition to spruce-fir (*Picea engelmanii – Abies lasiocarpa*) riparian communities. Aspen (*Populus tremuloides*) begins to enter the canopy forming mixed aspen-evergreen and then aspen-dominated reaches depending on beaver activity. Lower in the montane zone, the tree canopy (as well as the underlying shrub layer) of the riparian corridor becomes very diverse before transitioning to narrowleaf cottonwood (*Populus angustifolia*) at approximately 8,000 feet (2,440 m). The shrub layers in these corridors are often dense and very diverse. They seldom form extensive monotypic stands, instead forming intermingled patches.

Due to its high elevation, much of Hinsdale County receives significant precipitation. Coupled with low average temperatures, decomposition in wetlands tends to be slow enough for significant organic matter accumulation and thus the development of Montane Fen Ecological Systems (Rondeau 2001). Several fens were documented throughout the high elevations of Hinsdale County. Common plant associations that define fens in this area include water sedge (*Carex aquatilis*) Herbaceous Vegetation, few-flowered spikerush (*Eleocharis quinquefolia*) Herbaceous Vegetation, smallwing sedge (*Carex microptera*) Herbaceous Vegetation, and planeleaf willow (*Salix planifolia*) shrublands with various understory composition. Rare plant communities associated with fens in Hinsdale County include small-head sedge (*Carex illota*) herbaceous Vegetation, mud sedge (*Carex limosa*) Herbaceous Vegetation, and woolly sedge (*Carex pellita*) Herbaceous Vegetation. These communities are highlighted in the Elk Lakes Fen PCA, North Fork of Sand Creek PCA, Mineral Creek PCA, Upper Rambouillet Park PCA, and Rincon la Osa PCA.

Unique groundwater chemistry in the mountains of the Colorado Mineral Belt creates specialized iron fens; high elevations outside of the Mineral Belt. Iron fens are a special subset of montane fens in Colorado (Cooper and Arp 1998). Although previously

thought to occur in Hinsdale County, iron fens were found and documented during the 2006-2007 field surveys. These are specialized fens with acidic, mineral-rich. The diagnostic plant association in this fen is Engelmann spruce / resin birch / water sedge / sphagnum (*Picea engelmannii / Betula glandulosa / Carex aquatilis / Sphagnum* spp.) Shrublands. These systems are highlighted in Upper Rough Creek, Slumgullion Creek, Matterhorn Creek, Wager Gulch, and East Fork Alpine Gulch PCAs.

With the extensive glaciation that occurred in the San Juan Mountains, there are many examples of glaciated valleys and hanging valleys in Hinsdale County. Glaciated valleys tend to have sinuous creeks in the broad, U-shaped bottoms. These riparian corridors tend to develop wide willow carrs. Tall willows are common and dominant species tend to include Booth willow (*Salix boothii*), Geyer willow (*S. geyeriana*), and mountain willow (*S. monticola*). Herbaceous understories are variable but most often are dominated by graminoids like water sedge (*Carex aquatilis*), beaked sedge (*C. utriculata*), bluejoint (*Calamagrostis canadensis*). Beaver activity is common. Brush Creek at Cannibal Point, North Clear Creek Falls, East Fork Powderhorn Creek, Pole Creek, and Rio Grande at Pole Creek PCAs have examples of these systems.

The larger rivers in Hinsdale County, like the Lake Fork of the Gunnison and the Rio Grande, occur at lower elevations. These montane riparian ecological systems have deciduous tree canopies with or without a conifer component (generally of Douglas fir, *Pseudotsuga menziesii*). Shrubs are common and tend to include alder (*Alnus incana*) and/or river birch (*Betula occidentalis*) in addition to occasional tall willows. The Lake Fork of the Gunnison PCA is the best example of this system.

Fauna

Cutthroat trout

Hinsdale County is unique in that it is one of three counties in Colorado that supports two subspecies of cutthroat trout. Both the Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) and the Rio Grande cutthroat trout (*O. c. virginalis*) are native to and found within Hinsdale County. There are less than 10 populations of Colorado River cutthroat in Hinsdale County, one of which (Shaw Creek) is considered a conservation population by Hirsch et al. (2006) in that it displays "unique life history traits and ecological characteristics in the presence of hybridization." The other populations of Colorado River cutthroat are considered management or recreation populations that are supplemented by stocking efforts and are maintained for the purpose of recreational fishing. The Rio Grande cutthroat trout is found in less than 15 streams and lakes within Hinsdale County. All populations within the county are considered recreation populations which are “refugia populations created through periodic stocking of genetically pure Rio Grande cutthroat trout from wild or captive brood stocks” (Alves et al. 2004).

Boreal toad

The boreal toad (*Bufo boreas*) was once common in many parts of Colorado, including the San Juan Mountains. However, this amphibian has been steadily declining for the

past twenty years (Goettl 1997). There are around 71 breeding sites known in Colorado that comprise 38 separate populations (Boreal Toad Recovery Team 2005). However, only two of these populations are considered viable. The Jumper and Trout Creek PCA that spans the Hinsdale-Mineral county border is the only known breeding population remaining for the boreal toad in the San Juan Range.

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TEMPLATE DESCRIPTION

The 37 Hinsdale County PCAs documented in this report are profiled in this section. The PCAs are organized in ascending order according to their Biodiversity Rank (e.g., B1 to B5). They are listed alphabetically within B-rank category. Although the amount of information we have on the PCAs is highly variable, each PCA profile includes the following information:

Biodiversity Rank (B-rank): 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 Table 4 for rating criteria for the biodiversity ranks.

Protection Urgency Rank (P-rank): An estimate of the timeframe in which conservation protection should occur. This rank generally refers to the need for a major change of protective status (e.g., ownership or designation as a natural area). Please see Table 5 for the definitions of the ranks.

Management Urgency Rank (M-rank): An estimate of the timeframe in which conservation management should occur. Using best scientific estimates, this rank refers to the need for management in contrast to protection (legal, political, or administrative measures). See Table 6 for the definitions of the ranks.

Location: General location and specific road/trail directions.

Legal Description: U.S.G.S. 7.5-minute quadrangle name.

General Description: A brief narrative describing the topography, vegetation, current use, and size of the potential conservation area. Common names are used along with the scientific names.

Key Ecological Processes: A list of natural disturbance or environmental properties that define the vegetation within a PCA.

Biodiversity Comments: A synopsis of the rare species and significant plant communities that occur in the PCA. A table within the PCA profile lists the element occurrences found within the PCA, their rarity ranks, the occurrence ranks, federal and state agency designations, and the last observation date. When the same element is listed more than once in the table, it is because there are multiple element occurrences of that element within the PCA. Where there is more than one element occurrence in the PCA, the occurrence(s) of primary of concern is in boldface in the table. See Table 1 for explanations of global and state imperilment ranks and Table 2 for legal designations.

Boundary Justification: Justification for the location of the preliminary conservation planning boundary delineated in this report, which includes all known occurrences of natural heritage resources and, in some cases, adjacent lands required for their protection.

Protection Comments: A summary of major land ownership issues that may affect the PCA and the element(s) in the PCA.

Management Comments: A summary of PCA management issues that may affect the long-term viability of the PCA.

Please note that the boundaries presented are meant to be used for conservation planning purposes and have no legal status. **The proposed boundary does not automatically recommend exclusion of all activity.** Rather, the boundaries designate ecologically significant areas in which land manager may wish to consider how specific activities or land use changes within or near the PCAs 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.

Cave Basin Lakes

Biodiversity Rank - B2: Very High Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Emerald Lake

Size: 780 acres (316 ha) **Elevation:** 11,570 - 12,250 ft. (3,527 - 3,734 m)

General Description: The site occupies a level, open area above and west of Emerald Lake. The area is just above timberline and is dotted with numerous small lakes and wetlands. Wetlands are dominated by water sedge (*Carex aquatilis*) and marsh marigold (*Caltha leptosepala*), with planeleaf willow (*Salix planifolia*), tufted hairgrass (*Deschampsia caespitosa*), elephant head (*Pedicularis groenlandica*), American bistort (*Polygonum bistortoides*), Redpod stonecrop (*Rhodiola rhodantha*), mosses, star gentian (*Swertia perennis*), sedges (*Carex dioeca*, *Carex nova*, *Carex chalciolepis*, *Carex ebenea*, and *Carex canescens),* Rocky Mountain fringed gentian *(Gentianopsis thermalis)*, alpine timothy (*Phleum alpinum*), Eastwood's podistera (*Podistera eastwoodiae*), Drummond's rush (*Juncus drummondii*), heartleaf bittercress (*Cardamine cordifolia*) and Rocky Mountain hemlockparsley (*Conioselinum scopulorum*). There are small patches of Altai cottongrass (*Eriophorum altaicum* ssp. *neogaeum*) as well as the more common tall cottongrass (*Eriophorum angustifolium*). The rocky uplands consist of metamorphic rocks, derived from sedimentary and volcanic rocks and have alpine meadow vegetation.

Biodiversity Significance Rank Comments (B2): The site contains an excellent (A-ranked) occurrence of a globally imperiled (G2G3/S2S3) plant, Rothrock townsend-daisy (*Townsendia rothrockii*), and an excellent (A-ranked) occurrence of a plant variety that is globally vulnerable (T3T4/S3), Altai cottongrass (*Eriophorum altaicum* var. *neogaeum*).

Natural Heritage element occurrences at the Cave Basin 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
Vascular Plants	Townsendia rothrockii	Rothrock townsend - daisy	G2G3	S2S3				A	2005-09-99
Vascular Plants	Eriophorum altaicum var. neogaeum	Altai cottongrass	G4?T3T4	S3			USFS	A	2005-08-26

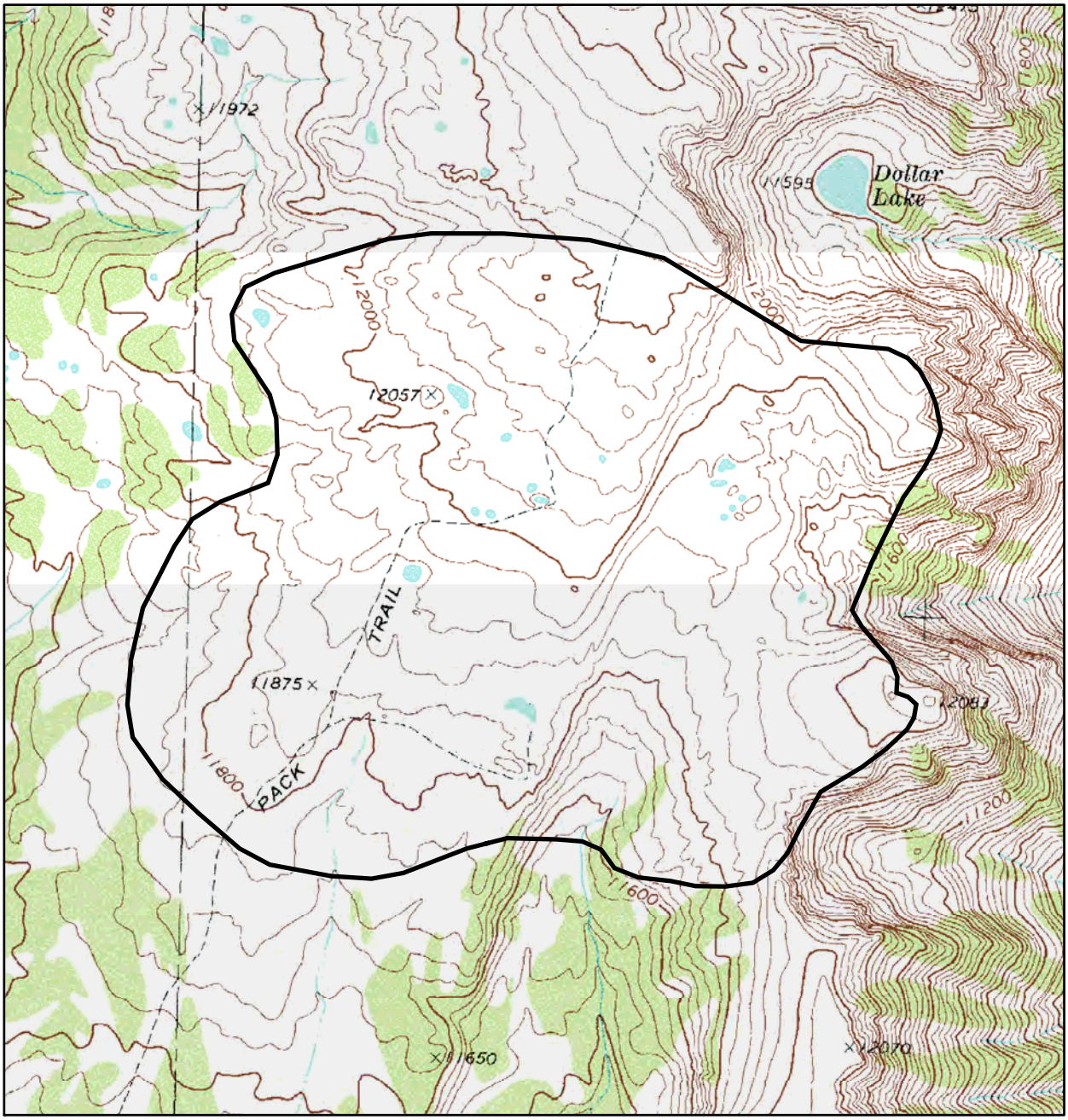
** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The boundary was drawn to include habitat that supports the Rothrock townsend-daisy and the Altai cottongrass occurrences. Both upland and wetland areas are included.

Protection Urgency Rank Comments (P4): The site is within the Weminuche Wilderness and is well protected.

Management Urgency Rank Comments (M4): The area gets very light use from hikers and horseback riders.

Version Author: Lyon, M.J.
Version Date: 10/16/2005



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Map Date: 05/27/2008

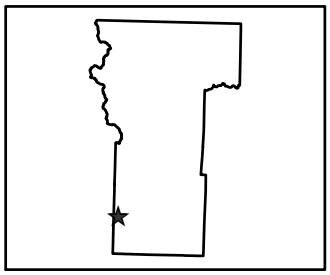
Legend

PCA Boundary

Emerald Lake, 37107-E4

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

Location in Hinsdale County



Cave Basin Lakes Potential Conservation Area, B2: Very High Biodiversity Significance

East Fork Alpine Gulch

Biodiversity Rank - B2: Very High Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Lake San Cristobal

Size: 29 acres (12 ha) **Elevation:** 10,200 - 10,800 ft. (3,109 - 3,292 m)

General Description: This site is situated along the East Fork of Alpine Gulch, a first order tributary of Henson Creek. It is drawn for an iron fen, a specialized peatland type localized along the mineral belt of the Colorado Rockies. Peatlands are wetlands defined by having organic soils histosols) with 40 cm peat accumulations in the upper 80 cm (USDA 2006). Iron fens in the southern Rocky Mountains are characterized by iron-rich, acidic hydrology, limonite deposits, and a unique assemblage of acid tolerant bryophytes and vascular plants. Groundwater feeding these wetlands filters through mineral-rich fractured rocks, saturating peat layers to form hardened sheets of oxidized iron (Cooper and Arp 1998). Within the site iron fen vegetation occurs in two sections along the main East Fork and a lower tributary. Hydrology for the wetland originates within the Lake City caldera between Grass and Red Mountains. Bedrock geology consists of igneous rocks of the Tertiary Age, specifically, rhyolitic intrusive rocks and flows and ash-flow tuffs (Steven 1974, Tweto 1979). Groundwater is mineral-rich and acidic along both tributaries creating limonite sheets and extensive aluminum deposition along stream beds. Soils are histosols and sandy clays with 10-25 cm histic epipedons. Diagnostic species within the wetlands include sphagnum (*Sphagnum* sp.), Engelmann spruce (*Picea engelmannii*), water sedge (*Carex aquatilis*), and bluejoint (*Calamagrostis canadensis*). Resin birch (*Betula glandulosa*), although absent from this occurrence, is considered a diagnostic species of this wetland type. The section of iron fen vegetation along the main drainage occurs as a small seep wetland with multiple areas of shallow, open water. This section is inundated throughout, with consistent cover of water sedge and Engelmann spruce along upper reaches. The lower section occurs as a narrow riparian community along a small, Type A tributary. The riparian corridor is dominated by a dense carpet of sphagnum, a consistent canopy of Engelmann spruce, with bluejoint as the dominant herbaceous species. Sphagnum in both sections occurs along edges and along microtopographic rises throughout. Beaver ponds and old dams are consistent along the lower patch. Limonite forms extensive sheets along middle reaches. Species composition is low due to mineral-rich, acidic hydrology. Surrounding uplands exhibit limited use and little disturbance. There is no vehicular access in the area and an old road to the cabins along the eastern tributary is no longer evident. Exotic species were observed along old road access and trail, but are not extensive or present within wetlands. Forested uplands are

moderate to steeply sloped with mixed quaking aspen (*Populus tremuloides*), Engelmann spruce, and subalpine fir (*Abies lasiocarpa*) woodlands. Open meadows in surrounding uplands are dominated by mixed graminoids with patches of big sagebrush (*Artemisia tridentata*) and shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*).

Key Environmental Factors: Key environmental factors influencing species composition of the wetland is iron-rich, acidic, perennial hydrology.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt and flooding, wet summers, and a late summer "monsoon" season.

Land Use History: An old homestead with five cabins is present along the upper reaches of the small eastern tributary.

Biodiversity Significance Rank Comments (B2): This site is drawn for an excellent (A-ranked) occurrence of the globally imperiled (G2/S2) wetland community, Engelmann spruce / resin birch / water sedge - sphagnum iron fen (*(Picea engelmannii) / Betula glandulosa / Carex aquatilis - Sphagnum angustifolium* woodland).

Natural Heritage element occurrences at the East Fork Alpine 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 glandulosa / Carex aquatilis - Sphagnum angustifolium Woodland	Iron Fen	G2	S2				A	2006-08-22

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

Boundary Justification: Boundaries include portions of the main East Fork of Alpine Gulch and one of its upper, eastern tributaries. Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all ecological processes necessary to the maintenance of the wetland and upstream activities such as mining activities on Red or Grassy Mountain, deforestation, improper livestock grazing or recreational use, development, or water diversion could be detrimental to the site.

Protection Urgency Rank Comments (P4): The site is managed by the BLM, but no special protection measures are in place. Currently there are no threats to the occurrence.

Management Urgency Rank Comments (M4): The area is managed for recreation and is not heavily used at this time. Anthropogenic disturbances observed in the drainage do not appear recent. The trail along the main Alpine Gulch drainage is heavily used due to its proximity to Lake City.

Land Use Comments: Predominant land use is recreation.

Natural Hazard Comments: Natural hazards include spring flooding and avalanche danger.

Exotic Species Comments: White clover (*Trifolium repens*) and common dandelion (*Taraxacum officinale*) are present along trails and old roads, with very low to no cover within wetlands.

Off-Site Considerations: An old homestead with four cabins is present along the lower tributary. The road grade along the drainage is not apparent and use has been very limited in recent years. Hydrology may have been altered in this area to accommodate living along the drainage.

Version Author: Jones, J.R.
Version Date: 10/15/2006

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Map Date: 12/11/2006

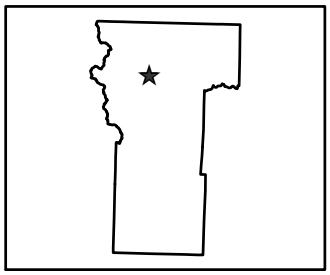
Legend

PCA Boundary

Lake San Cristobal, 37107-H3

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

Location in Hinsdale County



East Fork Alpine Gulch Potential Conservation Area, B2: Very High Biodiversity Significance

Elk Lakes Fen

Biodiversity Rank - B2: Very High Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M5: Not Needed; No Threats Anticipated

U.S.G.S. 7.5-minute quadrangles: Granite Lake

Size: 107 acres (43 ha) **Elevation:** 11,250 - 11,440 ft. (3,429 - 3,487 m)

General Description: This site is drawn for a wetland complex that occurs as an open-basin, lake-fill peatland surrounded by subalpine forest. Peatlands are peat accumulating wetlands characterized by organic soils (histosols) with 40 cm peat accumulations in the upper 80 cm (USDA 2006). In this region, fens are dependent on groundwater , with minimal secondary inputs from other hydrologic sources (Cooper and Arp 1998). At this fen morphologic features include flat to sloping peat soils, patterning, a small deep water lake, shallow pools, and floating mat. The wetland is inundated throughout, with many areas of shallow, standing water. The small lake along the lower reaches supports a large area of floating mat grading up to anchored peat mat. The floating mat forms as peat accumulation expand out over open water, weaving a quaking peat layer. Communities on floating mat are considered stable due to the ability to fluctuate with water levels (Chadde et al. 1998). Hydrology appears to originate from northern and western slopes above the site; water flows through these upper, sloping areas in small rivulets to the lower lake. Soils are fibric to hemic in decomposition. Bedrock geology consists of metamorphic and igneous rocks of the Precambrian Age, specifically Eolus Granite (Steven 1974, Tweto 1979). Fens are common throughout the surrounding area; they create a mosaic with forested uplands and high quality wildlife habitat. Evidence of wildlife use includes scat, tracks, and a small wallow. The surrounding uplands consist of Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) dominated forests with whortleberry (*Vaccinium myrtillus*) as a common understory layer. Site encompasses three distinct plant associations along flat to moderately sloping peat soils. Mud sedge (*Carex limosa*) herbaceous vegetation occurs as a fringe community within the larger fen complex. Mud sedge dominated vegetation is concentrated along lower reaches as a floating mat community around a small, deep-water lake. Floating peat at this site is characterized by hummocked areas of dense vegetation interspersed with areas of open peat and shallow water. The eastern side of the lake supports a broader band of this type possibly due to prevailing winds and wave action. Codominant species include fewflower spikerush (*Eleocharis quinqueflora*), water sedge (*Carex aquatilis*), and to a lesser extent Northwest Territory sedge (*Carex utriculata*). Boreal bog sedge (*Carex magellanica*), which is structurally similar to the diagnostic species, mud sedge, is also found at the site. Deadfall from surrounding uplands creates linear microhabitats within fen. Perched slightly above this community on both sides of the lake and extending

north and south is a consistent fewflower spikerush dominated herbaceous community occurring along inundated terraces and slopes. Other common species include water sedge and elephanthead lousewort (*Pedicularis groenlandica*), with bluejoint (*Calamagrostis canadensis*) and tufted hairgrass (*Deschampsia caespitosa*) occurring along hummocked areas. A small area of diamondleaf willow (*Salix planifolia*) dominated fen present at the upper reaches of the site. Predominant land use in the area is for recreation including hiking, hunting, and horseback riding. Vehicular use is restricted.

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are low gradient and general geomorphologic features, subalpine elevation, groundwater discharge, and prevailing winds.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B2): This site is drawn for an excellent (A-ranked) occurrence of the globally imperiled (G2/S1S2) mud sedge herbaceous vegetation wetland community (*Carex limosa* herbaceous vegetation).

Natural Heritage element occurrences at the Elk Lakes Fen 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	Carex limosa Herbaceous Vegetation	Montane Wetland	G2	S1S2				A	2006-08-02

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all ecological processes necessary to the maintenance of the site and activities in surrounding uplands such as deforestation, improper livestock grazing or recreational use, development, or water diversion could be detrimental to the site.

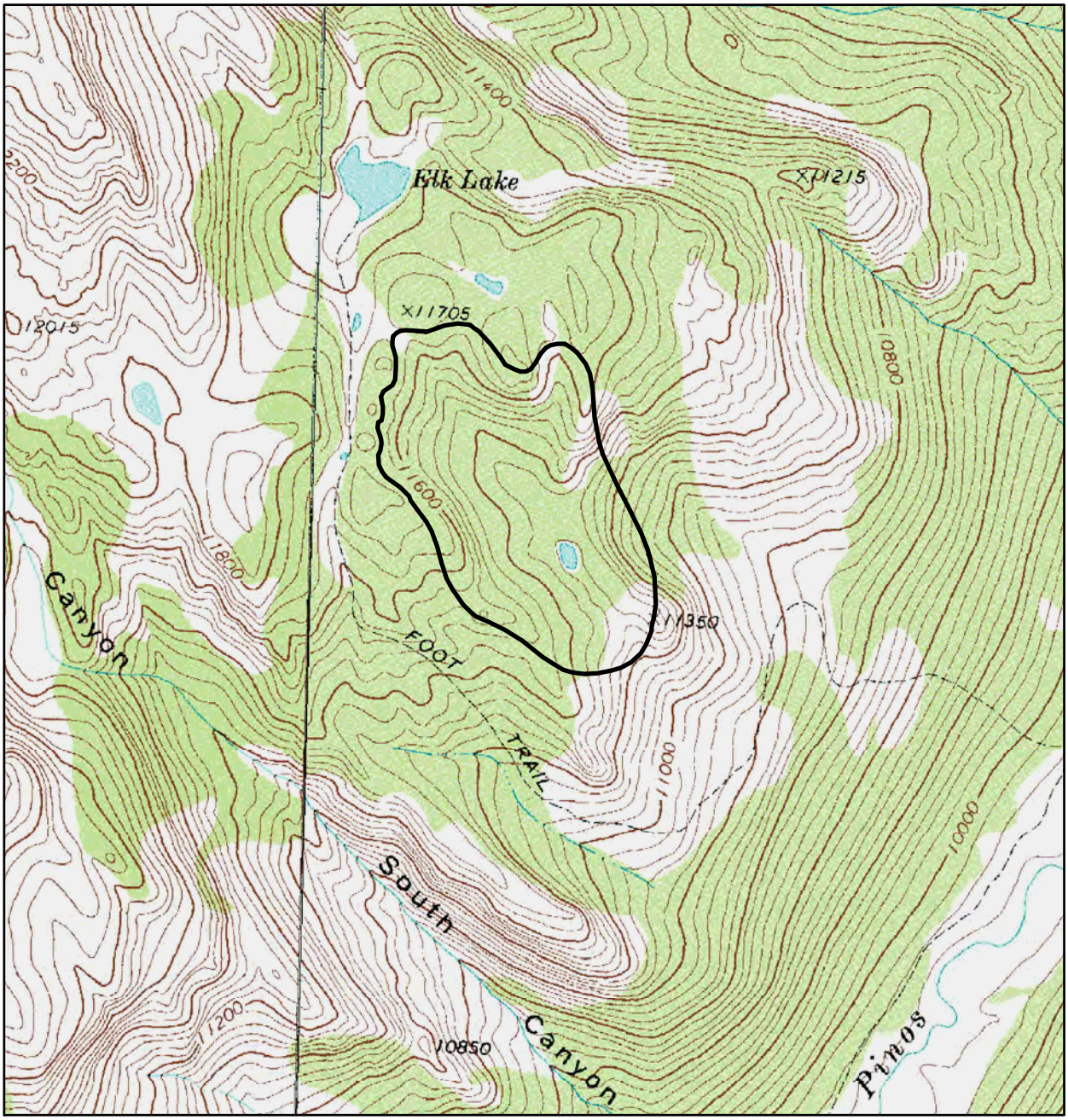
Protection Urgency Rank Comments (P4): There are currently no threats. Site is contained in the Weminuche Wilderness managed by the USFS in the San Juan National Forest.

Management Urgency Rank Comments (M5): No management is needed at this

time.

Land Use Comments: Predominant land use is recreation, including hiking, camping, hunting, and horseback riding.

Version Author: Jones, J.R.
Version Date: 10/15/2006



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Map Date: 12/11/2006

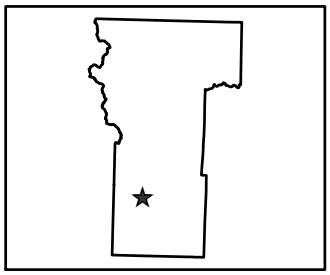
Legend

PCA Boundary

Granite Lake, 37107-E3

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

Location in Hinsdale County



Elk Lakes Fen Potential Conservation Area, B2: Very High Biodiversity Significance

Matterhorn Creek

Biodiversity Rank - B2: Very 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: Uncompahgre Peak

Size: 35 acres (14 ha) **Elevation:** 11,650 - 11,780 ft. (3,551 - 3,591 m)

General Description: This site is drawn for an iron fen, a specialized peatland type localized along the mineral belt of the Colorado Rockies. The wetland is situated just below treeline along the upper reaches of the Matterhorn Creek in a wide, open valley. Soils along the drainage are highly erodible forming a gullied, moderately sloping drainage adjacent to the site. Iron-rich groundwater originates along the eastern slopes of the drainage below Iron Beds. Within the wetland, fen vegetation surrounds an extensive area of limonite ledges fed by multiple iron-rich springs. Springs continue along both sides of limonite deposits, creating a large slope wetland that flows into the upper reaches of Matterhorn Creek. The wetland is classified as an iron fen. Peatlands are wetlands defined by having organic soils (histosols) with 40 cm peat accumulations in the upper 80 cm (USDA 2006). Peatlands are dependent on groundwater, with minimal secondary inputs from other hydrologic sources (Cooper and Arp 1998). Iron fens in the southern Rocky Mountains are characterized by iron-rich, acidic hydrology, limonite deposits, and a unique assemblage of acid tolerant bryophytes and vascular plants. Groundwater feeding these wetlands filters through mineral-rich fractured rocks, saturating peat layers to form hardened sheets of oxidized iron (Cooper and Arp 1998). Acidic hydrology of iron fens is similar to true bogs and poor fens while ion concentrations are comparable to rich fens (Cooper and Arp 1998). Fen vegetation is concentrated below multiple slope seeps along both sides of the predominant iron spring. Vegetation is dominated by water sedge (*Carex aquatilis*), sphagnum (*Sphagnum* sp.), and bluejoint (*Calamagrostis canadensis*). Sphagnum forms dense carpets and hummocks dispersed throughout saturated areas. Saturated areas with perennial groundwater below the main spring have formed extensive sheets of limonite and support very little vegetation aside from liverworts and a few islands of water sedge. Bluejoint codominates with sphagnum along drying edges and microtopographic rises, water sedge codominates along saturated area. Engelmann spruce (*Picea engelmannii*) occurs as a trace, colonizing layer. Resin birch (*Betula glandulosa*) is often a diagnostic species in iron fens, but does not occur at this site, which may be a factor of the elevational range of the species. Diamond-leaf willow (*Salix planifolia*) occurs as a dense layer with water sedge along the southern edge of the fen on mineral soils and is intermittent along northern reaches. Adjacent uplands are dominated by xeric, variable alpine meadows with common species including

Ross' avens (*Geum rossii*), creeping sibbaldia (*Sibbaldia procumbens*) and patches of Engelmann spruce. Surrounding gentle meadows slope into steep scree fields and bedrock. Disturbances in the area include the Matterhorn/Wetterhorn Peak pack trail, which crosses the initial, southern spring and late season sheep grazing. Structure from old road present within fen, but site has recovered from former use as roadway.

Key Environmental Factors: Key factors influencing species composition are upper subalpine elevation, iron-rich, acidic, perennial hydrology, and moderate slope.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B2): This site is drawn for an excellent (A-ranked) occurrence of the globally imperiled (G2/S2) iron fen wetland community, *(Picea engelmannii) / Betula glandulosa / Carex aquatilis - Sphagnum angustifolium* woodland).

Natural Heritage element occurrences at the Matterhorn 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) / Betula glandulosa / Carex aquatilis - Sphagnum angustifolium Woodland	Iron Fen	G2	S2				A	2006-08-21

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

Boundary Justification: Boundaries are drawn to include portions of surrounding areas important to the maintenance of site hydrology and 1,000 ft of buffered uplands based on an analysis of the Bibliography of Impacts to Wetlands (Keate 2004). Boundaries also include areas in the surrounding uplands that may influence the site such as an adjacent pack trail and uplands with late-season sheep grazing. This should account for natural hydrologic processes important to the maintenance of the wetland such as seasonal flooding, groundwater recharge, surface flows, and adjacent drainage. However, the boundary does not include all hydrological processes necessary to the maintenance of site hydrology and activities such as mining, improper livestock grazing, water diversion, and intense recreational use could be detrimental to the site.

Protection Urgency Rank Comments (P3): The site is protected generally by the USFS as part of the Uncompahgre Wilderness within the Uncompahgre National Forest. Possible threats include impacts by sheep grazing and adjacent pack/hiking trail.

Management Urgency Rank Comments (M3): Matterhorn Peak Trail crosses lower, southern-most spring. Re-routing this section of the trail could avert possible impacts to this spring. The site has been trampled and grazed by sheep. There is a sign indicating the site as a restoration area, but there is no exclosure to ensure the site is not used for grazing.

Land Use Comments: Predominant land use in the area and surrounding uplands is recreation and sheep grazing.

Natural Hazard Comments: Avalanche danger is likely high during the fall, winter, and spring seasons due to the severity of surrounding slopes.

Exotic Species Comments: No exotic species were observed in the area. Pack trail may act as a conduit for exotic species introduction. Monitoring of species composition along trail could help maintenance of site quality.

Off-Site Considerations: Past mining and prospects in the surrounding uplands may impact site viability.

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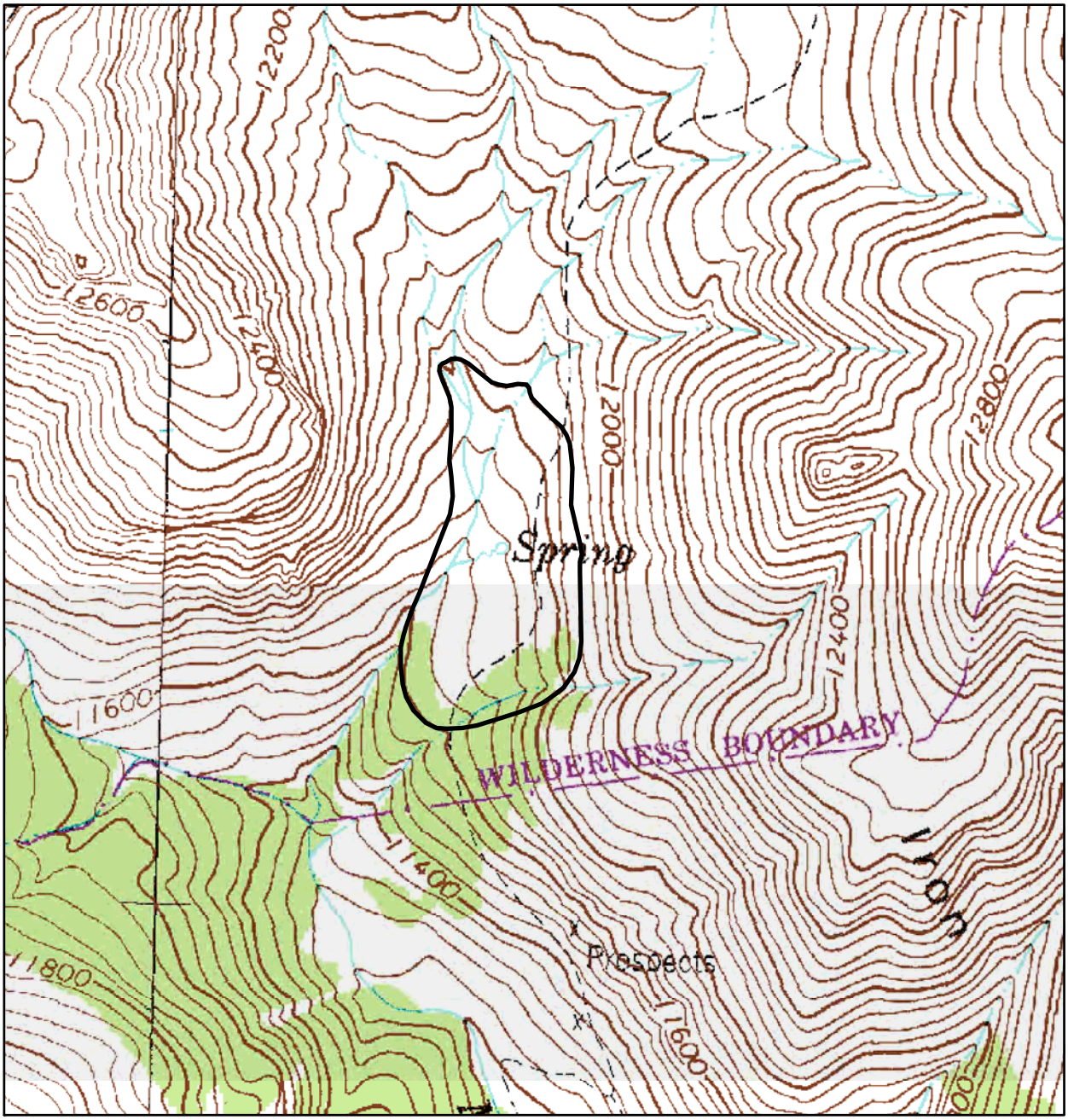
Version Date: 10/15/2006



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Map Date: 12/11/2006

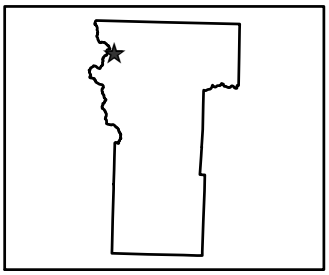
Legend

PCA Boundary

Uncompahgre Peak, 38107-A4

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

Location in Hinsdale County



Matterhorn Creek Potential Conservation Area, B2: Very High Biodiversity Significance

Mineral Creek

Biodiversity Rank - B2: Very High Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Baldy Cinco

Size: 37 acres (15 ha) **Elevation:** 10,680 - 10,860 ft. (3,255 - 3,310 m)

General Description: This site is drawn for a small, isolated fen wetland in the La Garita Wilderness. It occurs along the upper reaches of Mineral Creek, a second order tributary of Cebolla Creek. The site is a closed-basin, lake-fill peatland with multiple small inlets and rivulets throughout. It lies along the junction of Quaternary landslide deposits and Tertiary igneous rocks, specifically intra-ash-flow quartz latitic lavas (Steven 1974, Tweto 1979). Wetland and local topography is likely a result of glacial activity during the Quaternary Age. The wetland is a fen, a type of peatland classified by soil development and hydrology. Peatlands are wetlands defined by having organic soils (Histosols) with 40 cm peat accumulations in the upper 80 cm (USDA 2006). Peatlands are dependent on groundwater, with minimal secondary inputs from other hydrologic sources (Cooper and Arp 1998). Specifically, this wetland is a small, lake-fill peatland formed by the expansion of vegetation and peat accumulations over the surface of open water. Site has a large area of floating mat towards the center and grounded peat accumulations along edges. Floating mat is the quaking peat layer over water formed during the lake-fill process. Plant communities on floating mat are considered stable due to the ability to fluctuate with water levels (Chadde et al. 1998). The fen wetland forms a mosaic of two distinct, herbaceous communities. Mud sedge (*Carex limosa*) herbaceous vegetation dominates the central floating mat, covering approximately 35% of the wetland. Characteristic species include mud sedge, Northwest Territory sedge (*Carex utriculata*), and buckbean (*Menyanthes trifoliata*). This area is surrounded by an extensive area of grounded peat mat dominated by a woolly sedge (*Carex pellita*) herbaceous community. Woolly sedge is consistent and dominant throughout this area. Other species found along the anchored peat mat include water sedge (*Carex aquatilis*), Northwest Territory sedge, silvery sedge (*Carex canescens*), bluejoint (*Calamagrostis canadensis*), and threepetal bedstraw (*Galium trifidum*). This community dominates approximately 65% of the wetland as a dense, consistent herbaceous strata grading to a small edge occurrence of water sedge and Northwest Territory sedge. Northwest Territory sedge forms a dense patch along the southwestern edge of the wetland and along small, rivulets with standing water. Kentucky bluegrass (*Poa pratensis*) was observed along upland edges of the wetland, but no exotic species were found in the wetland. Uplands to the west of the wetland grade to steep talus slopes and those to the east have mixed quaking aspen (*Populus*

tremuloides) and Engelmann spruce (*Picea engelmannii*) forest that slopes down towards Mineral Creek. Evidence of beaver activity is present along small outlets, but dams are no longer stable. Multiple game trails were observed in adjacent, forested uplands and light grazing was observed in the wetland. Trails in adjacent Mineral and Rough Creek drainages are restricted to foot and horse travel as part of the La Garita Wilderness. There are few anthropogenic disturbances in the surrounding uplands.

Key Environmental Factors: Key environmental factors influencing the species composition of the wetland are subalpine elevation, groundwater discharge, and topography.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B2): This site is drawn for an excellent (A-ranked) occurrence of the globally imperiled (G2/S1S2) mud sedge (*Carex limosa*) montane wetland community. The site also encompasses a good (B-ranked) occurrence of the globally vulnerable (G3/S3) woolly sedge (*Carex pellita*) montane wet meadows community.

Natural Heritage element occurrences at the Mineral 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	Carex limosa Herbaceous Vegetation	Montane Wetland	G2	S1S2				A	2006-08-23
Natural Communities	Carex pellita Herbaceous Vegetation	Montane Wet Meadows	G3	S3				B	2006-08-23

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all ecological processes necessary to the maintenance of the site and activities in surrounding uplands such as deforestation, improper livestock grazing, development, or water diversion could be detrimental to the site.

Protection Urgency Rank Comments (P4): The site is protected generally by the USFS within the La Garita Wilderness of the Gunnison National Forest and exhibits

no immediate threats.

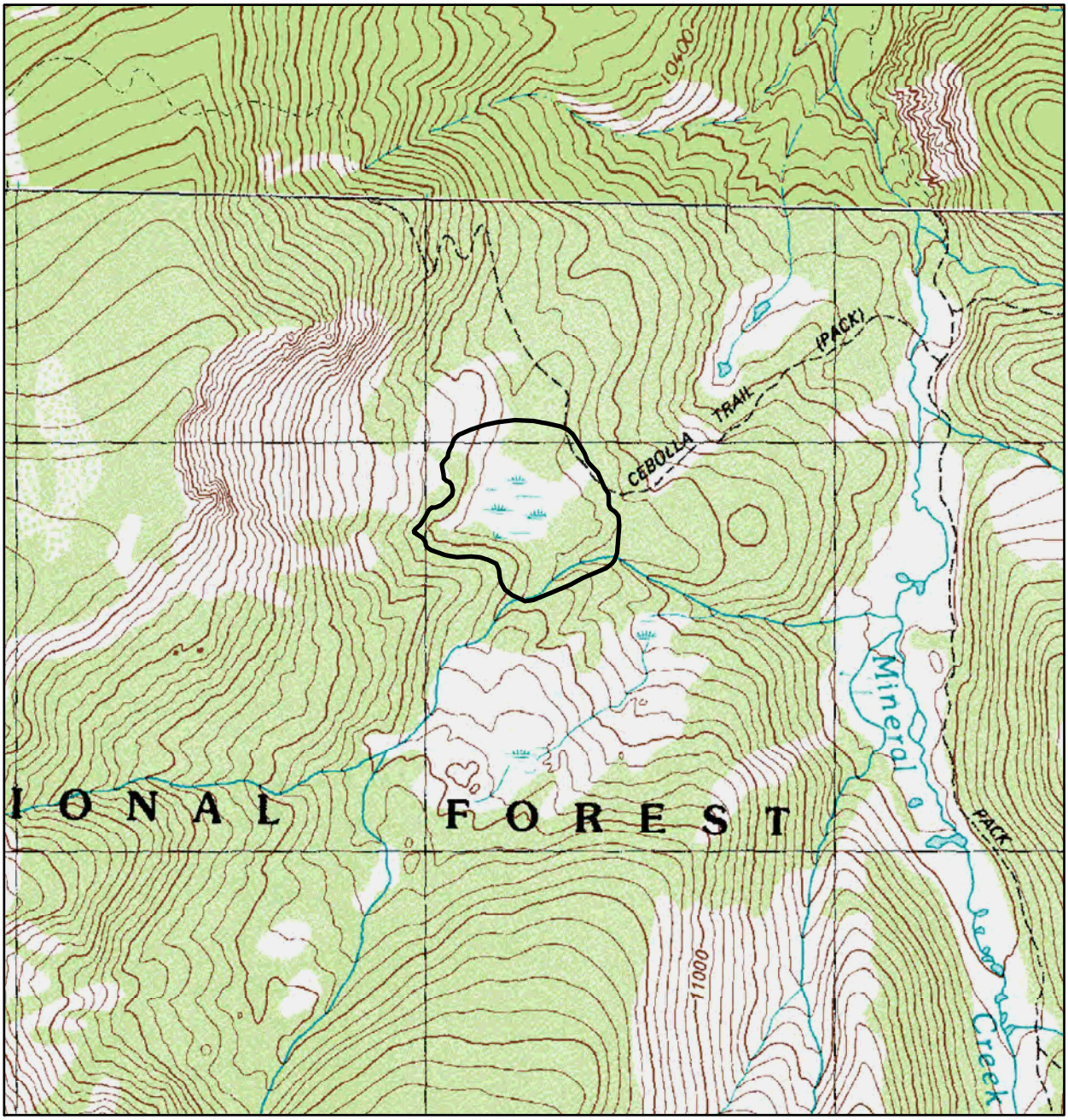
Management Urgency Rank Comments (M4): The site does not exhibit any anthropogenic disturbance, but may need future management if use of adjacent trail increases or if exotic species along the trail increase.

Land Use Comments: The area is used predominantly for recreation including hunting, hiking, camping, and horseback riding.

Natural Hazard Comments: Avalanche danger is likely high during the fall, winter, and spring seasons due to the severity of western slopes.

Exotic Species Comments: Kentucky bluegrass (*Poa pratensis*) was observed along upland edges of the wetland, but no exotic species were found in the wetland.

Version Author: Jones, J.R.
Version Date: 10/15/2006



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Map Date: 12/11/2006

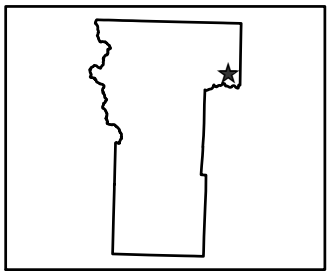
Legend

PCA Boundary

Baldy Cinco, 37107-H1

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

Location in Hinsdale County



Mineral Creek Potential Conservation Area, B2: Very High Biodiversity Significance

North Clear Creek Falls

Biodiversity Rank - B2: Very 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: Hermit Lakes, Slumgullion Pass

Size: 2,298 acres (930 ha) **Elevation:** 9,820 - 10,600 ft. (2,993 - 3,231 m)

General Description: The site comprises a wide, open, glaciated valley at the lower reaches of Spring Creek and its confluence with the North Fork of Clear Creek. The riparian corridor is a mosaic of dense tall shrub copses with patches of herbaceous vegetation. The wetland is concentrated along the creek and dry floodplain with dense willow cover along the creek edge and mesic areas and open, patchy cover along drying areas. Dry openings support a patchy distribution of Colorado tansy-aster (*Machaeranthera coloradoensis*). Bedrock geology consists of glacial drift of the Quaternary Age in the valley bottom (Steven 1974, Tweto 1979). The wetland is dominated by a dense, tall shrub layer of park willow (*Salix monticola*) and Geyer's willow (*Salix geyeriana*), with park willow being more common along mesic reaches and Geyer's willow along drying edges. Other shrubs present include diamondleaf willow (*Salix planifolia*), shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*), strapleaf willow (*Salix ligulifolia*), and whitestem gooseberry (*Ribes inerme*). Graminoid species include Baltic rush (*Juncus balticus*), tufted hairgrass (*Deschampsia caespitosa*), and alpine timothy (*Phleum alpinum*). The herbaceous layer is variable throughout with drier areas dominated by forbs and weedy graminoid species and mesic areas by native graminoids. Exotic species include Kentucky bluegrass (*Poa pratensis*), common dandelion (*Taraxacum officinale*), and white clover (*Trifolium repens*). Dry areas also support Colorado tansy-aster. Other species associated with openings and dry rocky soils include shrubby cinquefoil, prairie sagewort (*Artemisia frigida*), beautiful cinquefoil (*Potentilla pulcherrima*), Fendler's sandwort (*Eremogone fendleri*), mat penstemon (*Penstemon caespitosus*), and Arizona fescue (*Festuca arizonica*). Disturbances include livestock grazing, hydrologic alterations, an adjacent highway, and recreational use. Evident grazing impacts include tunneling in willows, exotic species component, trampling, and sloughing along stream banks. Surrounding uplands are dominated by a large, xeric, subalpine grassland with patches of shrubby cinquefoil grading up into Engelmann spruce (*Picea engelmannii*) dominated forested areas.

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are montane elevation, low gradient, extensive floodplain, and dry, rocky uplands.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B2): This site is drawn for two good (B-ranked) occurrences of the globally imperiled (G2/S2) Colorado tansy-aster (*Machaeranthera coloradoensis*). The site also includes a good (B-ranked) occurrence of the state rare (GU/S3) park willow - Geyer's willow / mesic graminoid (*Salix monticola - Salix geyeriana* / mesic graminoid) montane riparian willow carr and an extant occurrence of the state rare (G4/S3) Black Swift (*Cypseloides niger*).

Natural Heritage element occurrences at the North Clear Creek Falls PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Birds	Cypseloides niger	Black Swift	G4	S3B			USFS	E	2000-07-25
Natural Communities	Salix geyeriana - Salix monticola / Mesic Graminoid Shrubland	Montane Riparian Willow Carr	GU	S3				B	2006-06-21
Vascular Plants	Machaeranthera coloradoensis	Colorado tansy - aster	G2	S2			USFS	B	1995-09-07
Vascular Plants	Machaeranthera coloradoensis	Colorado tansy - aster	G2	S2			USFS	B	1998-09-15

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetlands such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all ecological processes necessary to the maintenance of the site and activities such as improper livestock grazing or recreational use, development, or water diversion could be detrimental to the site.

Protection Urgency Rank Comments (P3): The site is managed by the USFS within the Rio Grande National Forest. There are currently no immediate threats. Both the rare plants and wetland are viable.

Management Urgency Rank Comments (M3): Reduction or temporary removal of grazing may encourage native species to reestablish and possibly retain dominance over encroaching exotics.

Land Use Comments: Predominant land uses include recreational use and livestock

grazing.

Exotic Species Comments: Exotic species found include Kentucky bluegrass (*Poa pratensis*), common dandelion (*Taraxacum officinale*), and white clover (*Trifolium repens*). These species are concentrated in disturbed, drying areas.

Off-Site Considerations: Off-site considerations include highway use and maintenance, recreational uses, and livestock grazing.

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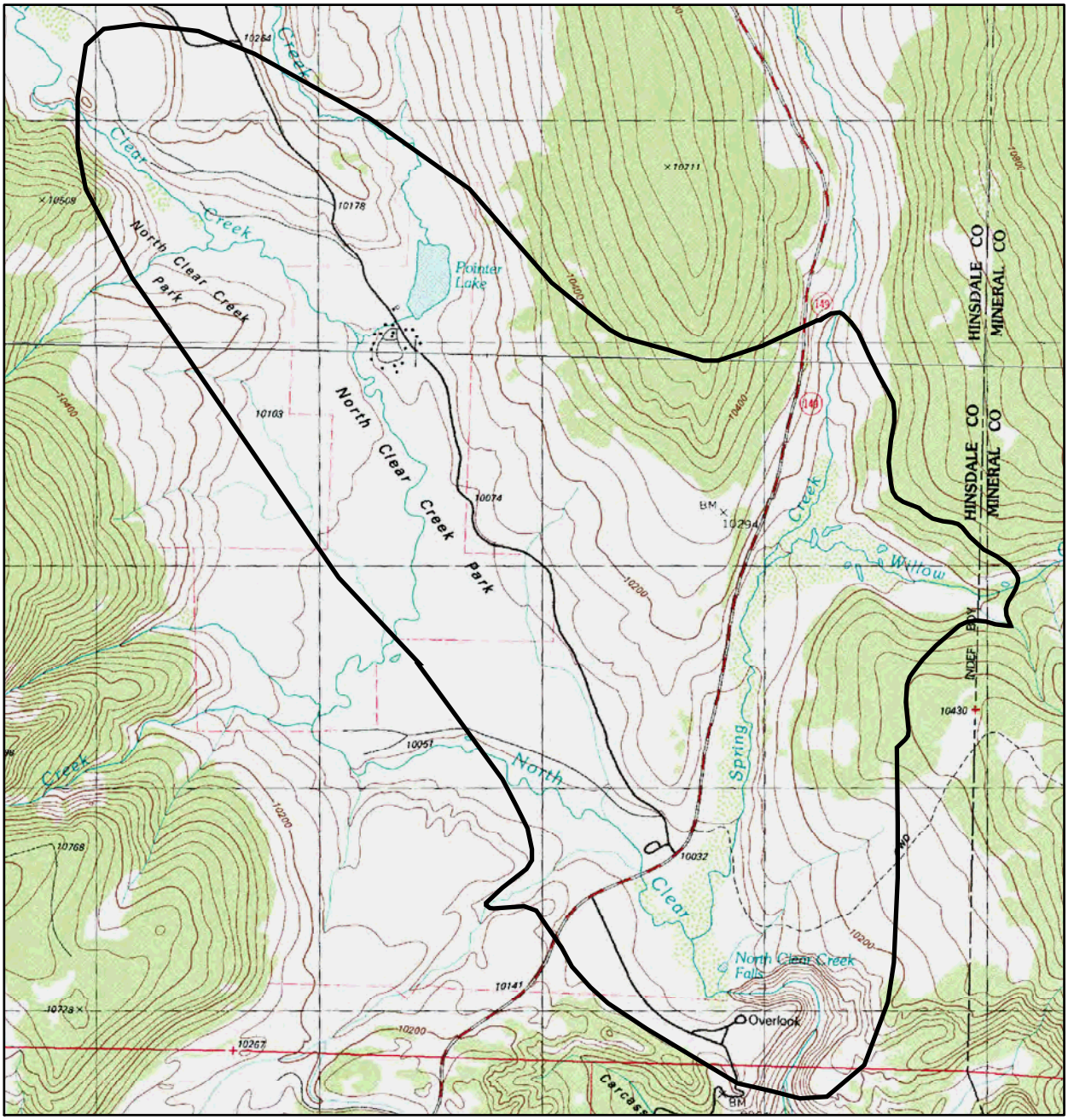
Version Date: 10/15/2006



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Map Date: 12/11/2006

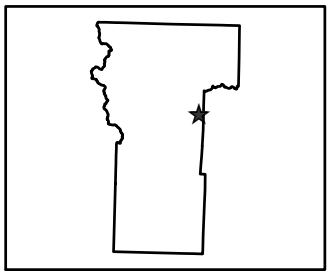
Legend

PCA Boundary

Slumgullion Pass, 37107-H2
Hermit Lakes, 37107-G2

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

Location in Hinsdale County



North Clear Creek Falls Potential Conservation Area, B2: Very High Biodiversity Significance

Rincon la Osa

Biodiversity Rank - B2: Very High Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M5: Not Needed; No Threats Anticipated

U.S.G.S. 7.5-minute quadrangles: Rio Grande Pyramid, Weminuche Pass

Size: 59 acres (24 ha) **Elevation:** 11,120 - 11,480 ft. (3,389 - 3,499 m)

General Description: This site is drawn for a small, lake-fill peatland along the Rincon la Osa drainage, a second order tributary of the Pine River. The site is a flat to gently sloping, open-basin fen with multiple small inlets and rivulets throughout. General geology consists of metamorphic and igneous rocks of the Precambrian Age, specifically, Eolus Granite (Steven 1974, Tweto 1979). The Rincon la Osa drainage opens into a wide glaciated valley above this point. The wetland may be a result of glacial activity during the Quaternary Age. Soils are inundated throughout consisting of well-developed fibric to hemic peat accumulations. The wetland is a fen type peatland due to soil development and hydrology. Peatlands are wetlands defined by having organic soils (histosols) with 40 cm peat accumulation in the upper 80 cm (USDA 2006). In this region, peatlands are fens and dependent groundwater with minimal secondary inputs from other hydrologic sources (Cooper and Arp 1998). Specifically, this wetland is a small, lake-fill peatland formed by the expansion of vegetation and peat accumulations over the surface of open water. The site has a large area of floating mat towards the center and grounded peat accumulations along edges. The floating mat is the quaking peat layer over water formed during the lake-fill process. Plant communities on floating mats are considered stable due to the ability to fluctuate with water levels (Chadde et al. 1998). The unique herbaceous community forms a consistent layer of floating peat with hummocked areas of dense vegetation interspersed with areas of open peat and shallow water. Floating mat is dominated by mud sedge (*Carex limosa*), fewflower spikerush (*Eleocharis quinqueflora*), and buckbean (*Menyanthes trifoliata*). Northwest Territory sedge (*Carex utriculata*) and buckbean form a dense band around open water at the center of the wetland. Other species present include water sedge (*Carex aquatilis*), narrowleaf cotton-grass (*Eriophorum angustifolium*), and sphagnum (*Sphagnum* sp.). A small band of grounded peat at the edge of the floating mat is dominated by a fewflower spikerush community. Surrounding uplands are dominated by Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) forests with mixed meadow openings. Small fen wetlands, common throughout adjacent drainages, are dominated by fewflower spikerush and sedge (*Carex* sp.) communities. The number of quality wetlands interspersed with subalpine forest and meadows in the area create high quality wildlife habitat. There are very few anthropogenic disturbances in drainages or surrounding uplands. Travel is restricted to foot and horse travel along trails in adjacent Rincon la Osa and

Rincon la Vaca drainages as part of the Weminuche Wilderness.

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are topography, gentle gradient, prevailing winds, subalpine elevation, perennial hydrology, and seasonal flooding.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer monsoon season.

Biodiversity Significance Rank Comments (B2): This site is drawn for an excellent (A-ranked) occurrence of the globally imperiled (G2/S1S2) mud sedge (*Carex limosa*) herbaceous vegetation community.

Natural Heritage element occurrences at the Rincon la Osa 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	Carex limosa Herbaceous Vegetation	Montane Wetland	G2	S1S2				A	2006-08-04

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all hydrologic processes necessary to the maintenance of site hydrology and activities such as deforestation, improper livestock grazing or recreational use, development, or water diversion could be detrimental to the site.

Protection Urgency Rank Comments (P4): The site is manage by the USFS as part of the Weminuche Wilderness in the San Juan National Forest. There are currently no threats.

Management Urgency Rank Comments (M5): No management is needed at this time.

Land Use Comments: Predominant land use in the area is for recreational purposes including hiking, horseback riding, camping, and hunting. There are multiple hunting outfitters based along the Pine River that likely use this area during the fall hunting seasons.

Natural Hazard Comments: Natural hazards include avalanche danger and spring

flooding.

Exotic Species Comments: No exotics were observed at the site. Exotics observed on the main Rincon la Osa trail include Kentucky bluegrass (*Poa pratensis*) and timothy (*Phleum pratense*).

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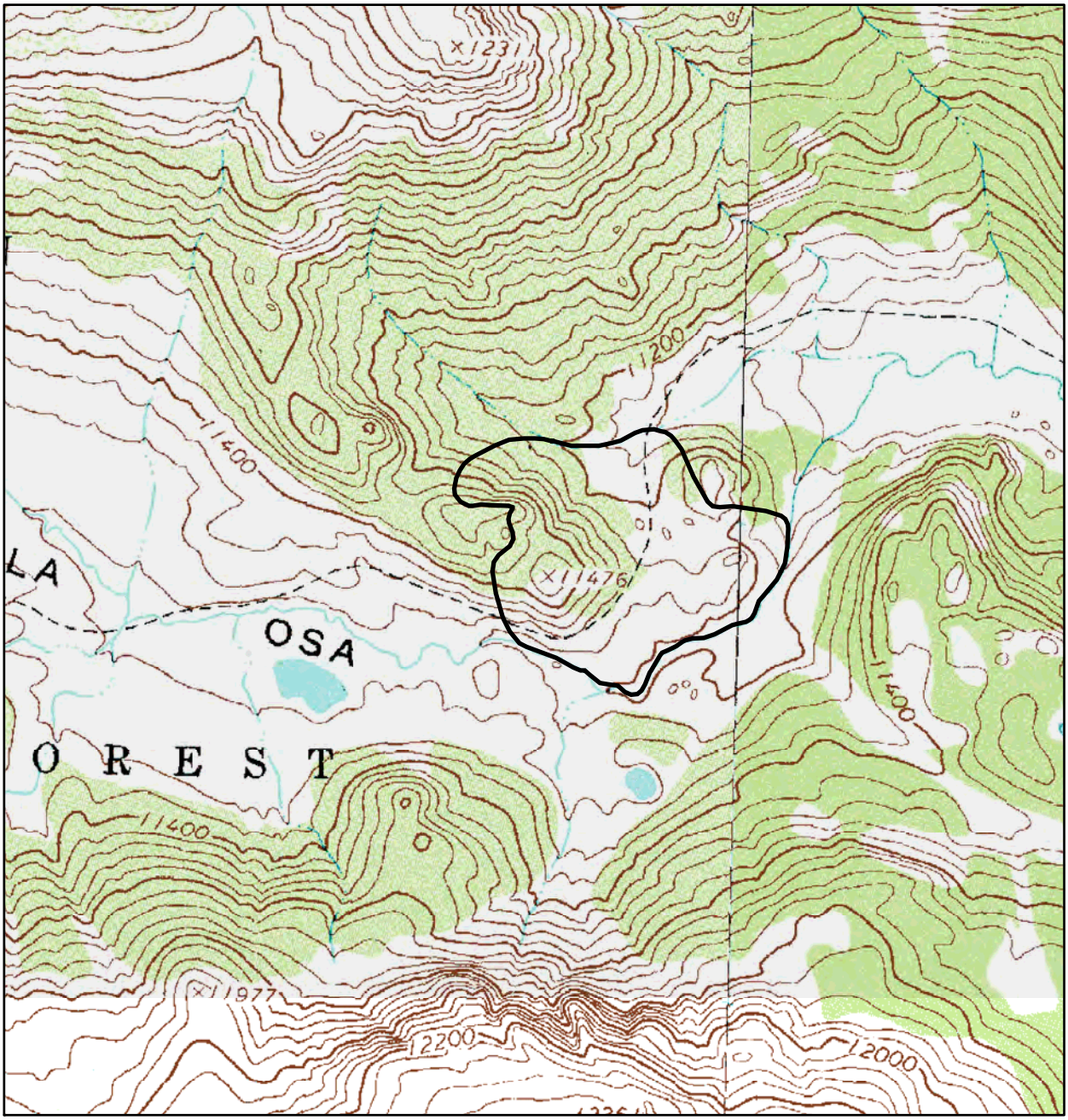

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Map Date: 12/11/2006

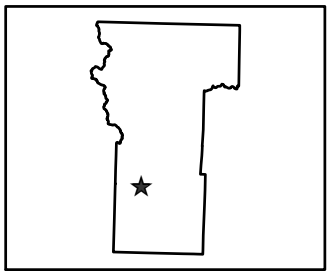
Legend

PCA Boundary

Weminuche Pass, 37107-F3
Rio Grande Pyramid, 37107-F4

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

Location in Hinsdale County



Rincon la Osa Potential Conservation Area, B2: Very High Biodiversity Significance

Slumgullion Creek

Biodiversity Rank - B2: Very 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: Lake San Cristobal, Slumgullion Pass

Size: 261 acres (106 ha) **Elevation:** 11,080 - 11,160 ft. (3,377 - 3,402 m)

General Description: This site is drawn for unique iron fen wetlands that occur in association with the Slumgullion Slide. The wetlands are situated along the upper reaches of Slumgullion Creek and continues down to a large, open, meadow wetland. Slumgullion Creek is a narrow stream channel with multiple seeps and springs adding mineral-rich, acidic water to the system. The lower meadow is a low gradient wetland with multiple old beaver ponds and large open flats. Soils are variable throughout with areas of deep histic epipedons over thick, gleyed clays. Soils are peat accumulating with extensive, iron-rich, mineral deposits throughout peat layers. Mineral-rich hydrology and mineral deposition appear to originate from springs coming in contact with highly fractured geology from the Slumgullion earth flow. General geology of the site and surrounding uplands consists of igneous rocks of the Tertiary Age (Steven 1974, Tweto 1979). Vegetation along Slumgullion Creek and lower meadow changes with geomorphic features, hydrologic variation, soils and mineral deposition. The occurrence of unique fen vegetation adheres to the small, spring-fed drainage along the upper reaches of Slumgullion Creek, opening into disjunct patches in the lower meadow. Iron fen vegetation is present in the drainage due to highly mineralized hydrology. Iron fens in the Southern Rocky Mountains are characterized by iron-rich, acidic hydrology, limonite deposits, and a unique assemblage of acid tolerant bryophytes and vascular plants. Groundwater feeding these wetlands filters through mineral-rich fractured rocks, which saturates peat layers and typically forms hardened sheets of oxidized iron (Cooper and Arp 1998). Although no limonite sheets were observed and no areas support extensive peat accumulations, patches of vegetation are diagnostic of iron fen hydrology. Indicators of iron fen hydrology present include Engelmann spruce (*Picea engelmannii*), resin birch (*Betula glandulosa*), sphagnum (*Sphagnum* sp.), and water sedge (*Carex aquatilis*). Bluejoint (*Calamagrostis canadensis*) and diamondleaf willow (*Salix planifolia*)also occur as codominants throughout the upper drainage. Engelmann spruce occurs in patches and along edges of the drainage as a canopy and subcanopy layer. It is absent in the lower, open meadow. Resin birch has variable cover throughout as sporadic patches along the upper drainage and as dense edge cover along the lower meadow. Sphagnum cover also varies with hydrology and is patchy throughout the site. Diamondleaf willow codominates the shrub layer in some areas increasing in cover as surface flows dilute iron-rich water

with distance from springs. Water sedge and bluejoint are both common throughout the herbaceous layer. Water sedge and Northwest Territory sedge (*Carex utriculata*) dominate the lower meadow. Adjacent uplands are highly variable throughout ranging from mixed Engelmann spruce, subalpine fir (*Abies lasiocarpa*), and quaking aspen (*Populus tremuloides*) forest to patches of shrubby cinquefoil (*Dasiphora fruticosa*) dominated shrublands, and subalpine meadows. The surrounding area is used for recreation including 4X4 travel, snowmobiling, and hunting. The site was formerly used for horse grazing, but shows very little disturbance at present. Anthropogenic disturbances include an OVH road running adjacent to the drainage and meadow, snowmobile travel across the meadow, and a staging area adjacent to the meadow. Small amounts of grazing were observed in the meadow.

Key Environmental Factors: The key environmental factors influencing species composition of the wetland are iron-rich, acidic, perennial hydrology, variable gradients, and soil composition.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B2): This site is drawn for an excellent (A-ranked) occurrence of the globally imperiled (G2/S2) iron fen wetland community *(Picea engelmannii) / Betula glandulosa / Carex aquatilis - Sphagnum angustifolium* woodland).

Natural Heritage element occurrences at the Slumgullion 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) / Betula glandulosa / Carex aquatilis - Sphagnum angustifolium Woodland	Iron Fen	G2	S2				A	2006-08-18

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all ecological processes necessary to the maintenance of the site and upstream activities such as deforestation, improper livestock grazing,

development, road maintenance, or water diversion could be detrimental to the site. Boundaries include portions of a nearby highway and an adjacent 4X4 road, which may be impacting site viability. These impacts will likely affect maintenance and planning for the site.

Protection Urgency Rank Comments (P3): The site may benefit from reducing recreation impact by limiting use of adjacent OHV road and parking area at lower meadow.

Management Urgency Rank Comments (M3): Current threats include exotic species invasion and alteration of hydrology and species composition by OHV use along an old road adjacent to drainage. Winter snowmobiling across the lower meadow may aid in artificially draining the wetland. Exotic species are not common within wetland, but are extensive along adjacent uplands. If usage changes or increases, components could be compromised.

Land Use Comments: Predominant land use is recreation.

Natural Hazard Comments: Natural hazards include spring flooding and land slides.

Exotic Species Comments: Exotics were observed in surrounding uplands and concentrated along old roadways and disturbed areas. Very few exotics were found within the wetland.

Off-Site Considerations: Off-site considerations include a 4X4 road and highway use and maintenance.

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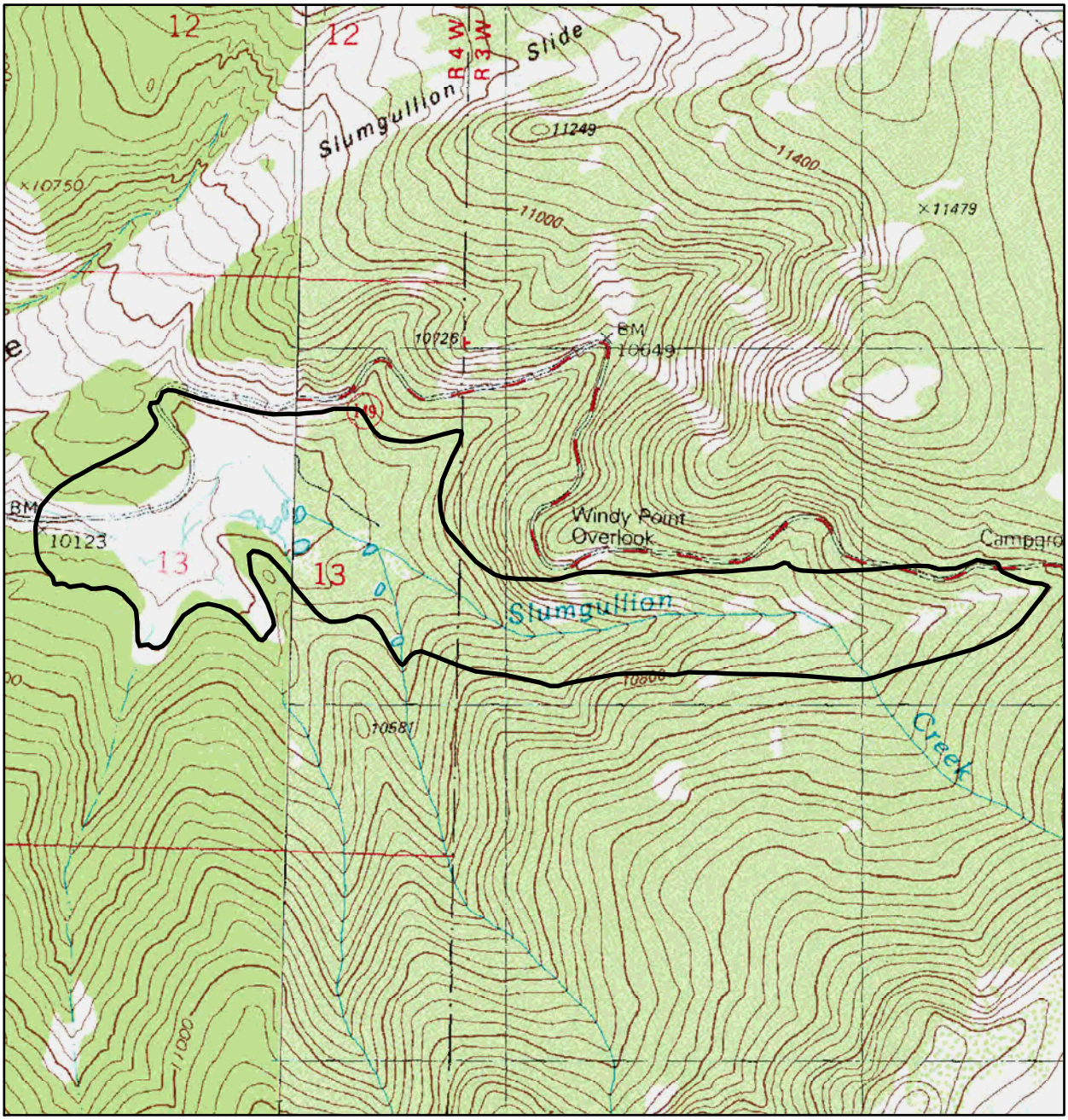
Version Date: 10/15/2006



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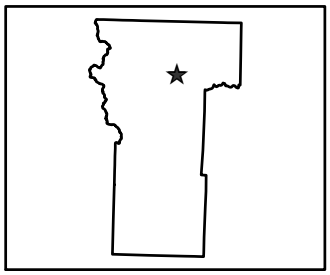
Legend

PCA Boundary

Slumgullion Pass, 37107-H2
Lake San Cristobal, 37107-H3

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

Location in Hinsdale County



Slumgullion Creek Potential Conservation Area, B2: Very High Biodiversity Significance

Upper Rough Creek

Biodiversity Rank - B2: Very High Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Baldy Cinco

Size: 49 acres (20 ha) **Elevation:** 11,645 - 12,080 ft. (3,549 - 3,682 m)

General Description: The wetland occurs just below treeline along the northern and western slopes of the headwaters of Rough Creek. Rough Creek, a second order tributary of Cebolla Creek, is situated in a wide valley of glacial drift and landslide debris of the Quaternary Age. Hydrology consists of a complex of iron-rich springs surfacing along a similar contour from waters originating at the base of Baldy Cinco. General geology consists of coarsely porphyritic quartz latite flows and breccias and a small area of intrusive rocks of the Oligocene epoch (Steven 1974, Tweto 1979). Soils are composed of fibric to hemic peat accumulations with a soil moisture gradient of moist to inundated. The wetland is classified as an iron fen, a specialized peatland type localized along the mineral belt of the Colorado Rockies. Peatlands are wetlands defined by having organic soils (histosols) with 40 cm peat accumulation in the upper 80 cm (USDA 2006). In this region, where precipitation inputs are minimal, peatlands are described as fens being dependent mainly on groundwater fed hydrology, with secondary inputs from other hydrologic sources (Cooper and Arp 1998). Iron fens in the southern Rocky Mountains are characterized by iron-rich, acidic hydrology, limonite deposits, and a unique assemblage of acid tolerant bryophytes and vascular plants. Groundwater feeding these wetlands filters through mineral-rich fractured rocks, saturating peat layers to form hardened sheets of oxidized iron (Cooper and Arp 1998). Acidic hydrology of iron fens is similar to true bogs and poor fens while ion concentration are comparable to rich fens (Cooper and Arp 1998). Fen vegetation forms a mosaic of shrub thickets and herbaceous openings around iron spring complex. Upper, southwestern reaches consist of a narrow corridor of fen vegetation and soils along the edge of adjacent drainage, opening to create a large slope wetland at lower, northeastern reaches. Diagnostic species include sphagnum (*Sphagnum* sp.), water sedge (*Carex aquatilis*), and Engelmann spruce (*Picea engelmannii*). Resin birch (*Betula glandulosa*), often a diagnostic species in iron fens, does not occur at this site which may be a factor of the elevation range of the species. Shrub thickets of diamondleaf willow (*Salix planifolia*), bluejoint (*Calamagrostis canadensis*), and sphagnum dominate hummocks and drier areas. Extensive cover of bluejoint indicates the extent of drying along edges of site. Sphagnum is scattered in some areas and forms dense carpets in other areas, extending into treed sections above active springs. Water sedge dominates saturated reaches and is common along inundated areas of open peat. Dispersed

microtopographic rises support low cover of Engelmann spruce with sphagnum and diamondleaf willow. Inundated areas of open peat and limonite deposition support low cover of vascular vegetation and extensive patches of liverworts. Other species present in low cover include mountain sedge (*Carex scopulorum*), silvery sedge (*Carex canescens*), and dwarf bilberry (*Vaccinium caespitosum*). Low to moderate species diversity is typical of this wetland type due to low pH. Wetland vegetation transitions to shortfruit willow (*Salix brachycarpa*) dominated carrs along drying edges of wetland. Surrounding uplands form a matrix of Engelmann spruce (*Picea engelmannii*), dwarf bilberry, and gooseberry currant (*Ribes montigenum*) woodlands and xeric alpine meadow vegetation. The site and surrounding uplands exhibit very little anthropogenic disturbance. The site is contained in the La Garita Wilderness and surrounding land use is limited to horse and foot travel. Rough Creek and Skyline Trails may be corridors for exotic species, but none were observed in the wetland. Extensive game trails along steep slopes may be the result of sheep grazing. Wildlife use, exhibited by scat and tracks, is located in areas of open peat.

Key Environmental Factors: Key environmental factors influencing species composition include upper subalpine elevation, iron-rich, acidic, perennial hydrology, and moderate slope.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B2): This site is drawn for an excellent (A-ranked) occurrence of the globally imperiled (G2/S2) (Engelmann spruce) / resin birch / water sedge - sphagnum iron fen ((*Picea engelmannii*) / *Betula glandulosa* / *Carex aquatilis - Sphagnum angustifolium* woodland).

Natural Heritage element occurrences at the Upper Rough 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) / Betula glandulosa / Carex aquatilis - Sphagnum angustifolium Woodland	Iron Fen	G2	S2				A	2006-09-13

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological

processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. The boundary does not include all ecological processes necessary to the maintenance of the site and activities such as improper livestock grazing or recreational uses, development, mining, or water diversion could be detrimental to the community.

Protection Urgency Rank Comments (P4): Site is managed by the USFS as part of the La Garita Wilderness within the Gunnison National Forest. There are no immediate threats to the occurrence as the area does not appear to be extensively used.

Management Urgency Rank Comments (M4): Skyline Trail appears to transect the wetland on maps. Trail is indistinct at this point before its intersection with the Rough Creek Trail. The trail could be reestablished and routed along uplands to avoid impacts to this area.

Natural Hazard Comments: Natural hazards include spring flooding and avalanche danger.

Off-Site Considerations: Predominant off-site uses include recreation and sheep grazing. Currently, these uses do not appear to impact the site.

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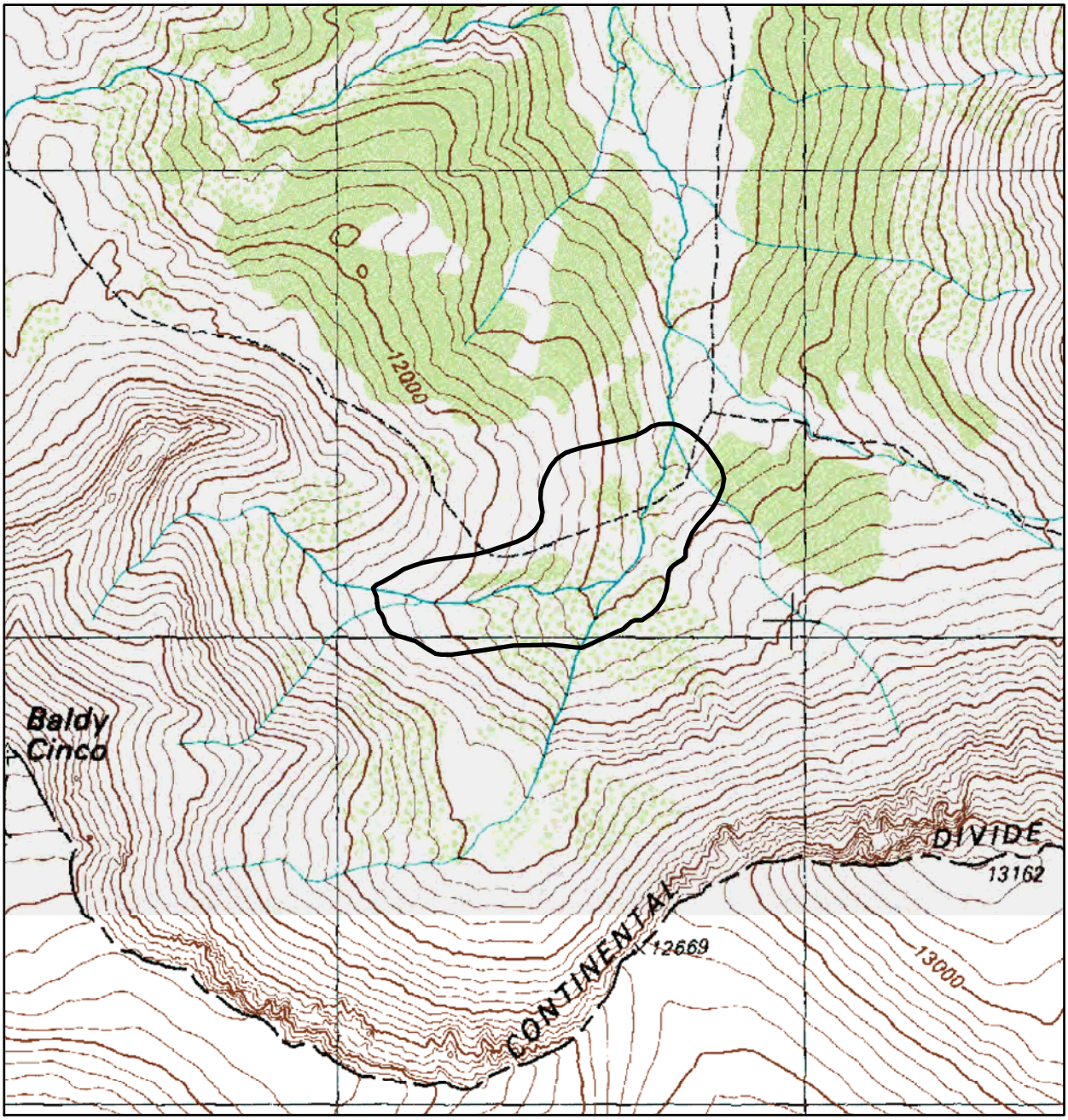
Version Date: 10/15/2006



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Map Date: 12/11/2006

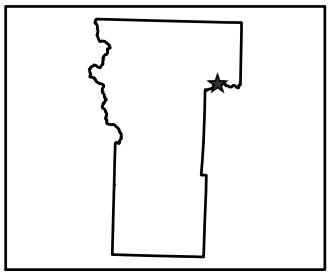
Legend

PCA Boundary

Baldy Cinco, 37107-H1

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

Location in Hinsdale County



Upper Rough Creek Potential Conservation Area, B2: Very High Biodiversity Significance

Wager Gulch

Biodiversity Rank - B2: Very High Biodiversity Significance

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

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Finger Mesa, Lake San Cristobal

Size: 137 acres (56 ha) **Elevation:** 10,920 - 11,360 ft. (3,328 - 3,463 m)

General Description: This site is drawn for a unique iron fen wetland occurring along subalpine reaches of Wager Gulch, a wide, glaciated tributary of the Lake Fork of the Gunnison River. Hydrology sustaining the wetlands appears to originate from the northeastern base of Bent Peak between the main fork and West Fork of Wager Gulch. Groundwater along the eastern reaches of the site is perennial, iron-rich, and acidic, maintaining a unique assemblage of vascular and non-vascular plants and has created an extensive sheet of limonite (hydrated iron-oxides). Iron fens in the southern Rocky Mountains are characterized by iron-rich, acidic hydrology, limonite deposits, and a unique assemblage of acid tolerant bryophytes and vascular plants. Groundwater feeding these wetlands filters through mineral-rich fractured rocks, saturating peat layers to form hardened sheets of oxidized iron (Cooper and Arp 1998). The vegetation structure and dynamics of the wetland are highly variable throughout the site. Variability in structure includes inundated areas of little vegetation and limonite sheets, deep water to shallow pools, shrub thickets, herbaceous vegetation, and tree dominated areas. Diagnostic species of the iron fen type include resin birch (*Betula glandulosa*), water birch (*Carex aquatilis*), sphagnum (*Sphagnum* sp.), and Engelmann spruce. Extensive limonite sheets have formed below the main spring and support little vascular vegetation with large patches of liverworts. Resin birch occurs in consistent cover throughout the site in dense thickets and dispersed patches. Sphagnum occurs as hummocks and dense carpets throughout the fen. Engelmann spruce is consistent along edges and microtopographic rises. Low species diversity is consistent with the type due to conductivity and pH of hydrology. Western seeps lack mineral rich water, supporting more common wetland vegetation. This area forms an open-basin, sloped shrubland with a matrix of dense diamondleaf willow interspersed with small patches of sedge dominated herbaceous communities. Northwest Territory sedge (*Carex utriculata*) tends to dominate inundated to saturated areas and is consistent throughout the stand forming dense herbaceous patches between and amongst shrub strata. Other graminoid species common in the wetland include water sedge and bluejoint which tends to dominate small rises and mesic areas. Forbs are consistent throughout and become a dominant herbaceous layer along lower reaches of the site, where the slope is more pronounced and soils are

well-drained. The shrub layer is broken along an old road grade, but the area is revegetating with dense shrub and herbaceous vegetation. Surrounding wetlands and uplands are variable. Shrublands are dominated by diamondleaf willow (*Salix planifolia*) and Wolf's willow (*Salix wolfii*). Forested areas consist of Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) with understories of bluejoint (*Calamagrostis canadensis*) and blueberry (*Vaccinium*) species. Openings in forested areas are dominated by xeric Thurber's fescue (*Festuca thurberi*) meadows. The site contains an iron fen which is a wetland unique to this area, whose occurrences are concentrated along the mineral belt of the Colorado Rockies. The site spans both sides of 4X4 road and extends along multiple contours, emptying into Wager Gulch and its west fork. It occurs along a popular access to the Continental Divide and Carson Mine which is used extensively by recreational OHV users. An old road crosses the wetlands above the main spring. It has been closed for restoration and is revegetating, but may still impact hydrology. Weeds occur along the road, but were not observed within the fen.

Key Environmental Factors: Key environmental factors influencing wetlands and species composition include subalpine elevation, perennial groundwater and iron-rich springs, gentle to moderate slopes, and peat accumulating soils.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B2): This site is drawn for an excellent (A-ranked) occurrence of the globally imperiled (G2/S2) iron fen wetland community, (*Picea engelmannii*) / *Betula glandulosa* / *Carex aquatilis* - *Sphagnum angustifolium* woodland) and an excellent (A-ranked) occurrence of the diamondleaf willow / Northwest Territory sedge wetland (*Salix planifolia* / *Carex utriculata* shrubland) whose global rank is unknown (GNR/S2).

Natural Heritage element occurrences at the Wager 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 glandulosa / Carex aquatilis - Sphagnum angustifolium Woodland	Iron Fen	G2	S2				A	2006-08-17
Natural Communities	Salix planifolia / Carex utriculata Shrubland	Diamondleaf Willow / Beaked Sedge	GNR	S2				A	2006-08-17

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all ecological processes necessary to the maintenance of the site and upstream activities such as mining, deforestation, improper livestock grazing or recreational use, development, or water diversion could be detrimental to the site. An intersecting road, which may have divided the site into its current two sections, is included. This disturbance, as well as past mining in the drainage and recreational use of the area, is very important to the health and viability of the site and may need to be addressed to protect the elements.

Protection Urgency Rank Comments (P3): The site is managed by the USFS within the Gunnison National Forest, but no special protection measures are in place. There is moderate urgency for site protection. It is threatened by adjacent road use and potential recreational uses. An old road transecting the site has been closed, but there is a large campsite between the road and the fen.

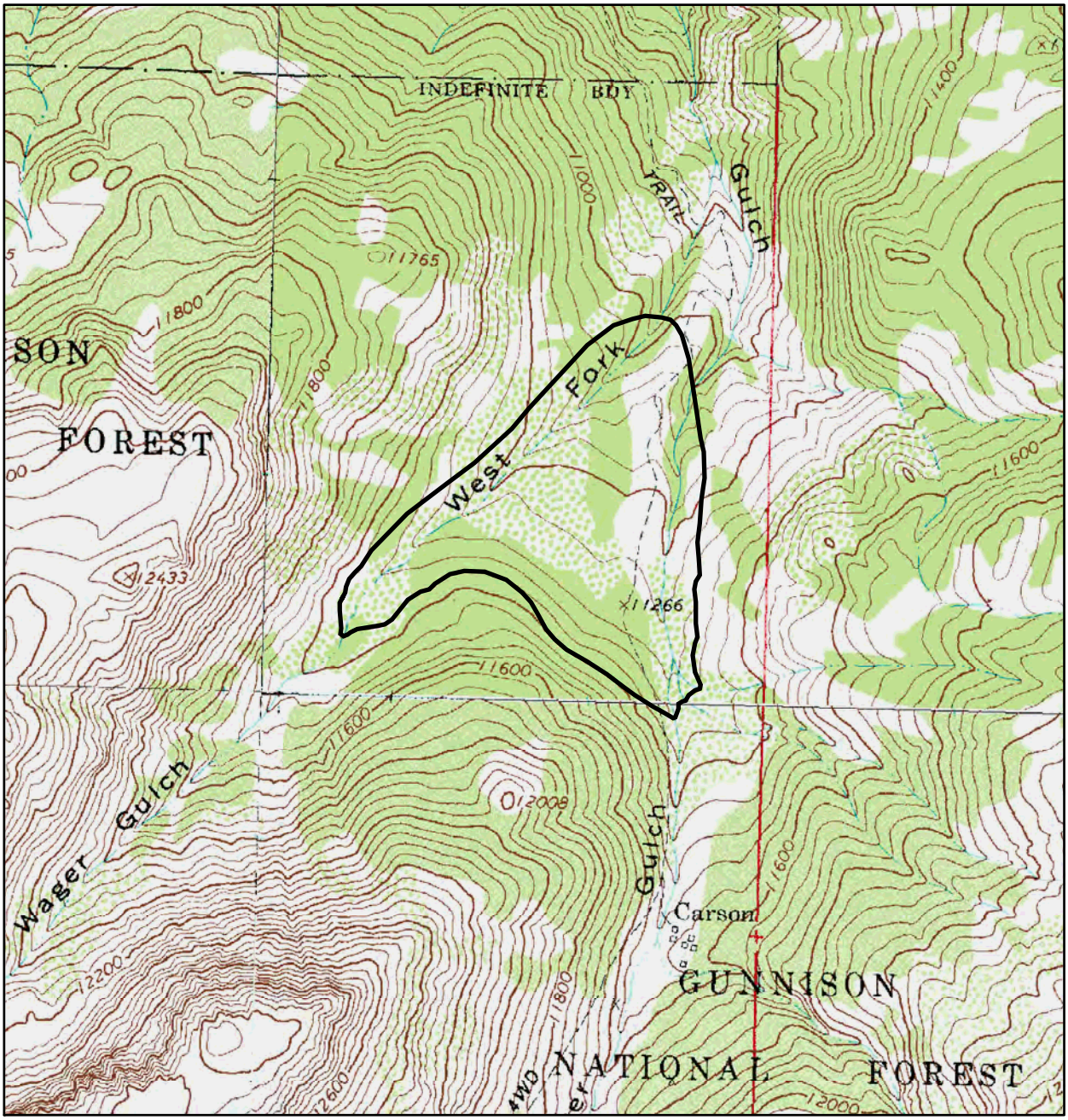
Management Urgency Rank Comments (M4): Management may be needed if usage along the road changes or increases. Site is currently intact and functioning, although fragmented.

Land Use Comments: Predominant land use is recreation.

Off-Site Considerations: Off-site land uses that may affect the site include mining at Carson Mine along upstream reaches and recreational uses along an adjacent road.

Version Author: Jones, J.R.

Version Date: 10/15/2006



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Map Date: 12/11/2006

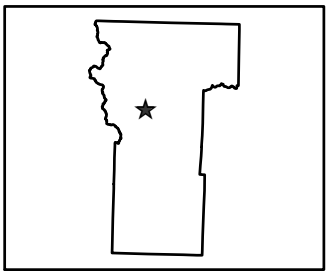
Legend

PCA Boundary

Lake San Cristobal, 37107-H3
Finger Mesa, 37107-G3

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

Location in Hinsdale County



Wager Gulch Potential Conservation Area, B2: Very High Biodiversity Significance

Antelope Park

Biodiversity Rank - B3: 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: Bristol Head, Creede, Hermit Lakes, Workman Creek

Size: 11,978 acres (4,847 ha) **Elevation:** 8,800 - 9,530 ft. (2,682 - 2,905 m)

General Description: This site encompasses the broad floodplain of Trout Creek and the Rio Grande River as they meander through Antelope Park. Antelope Park is approximately 10 miles long and over one mile wide in places. Geologists hypothesize that Antelope Park was not formed by the Rio Grande, but instead by the terminal moraine of the last glaciation some 20,000 thousand years ago (Chronic 1980; Steven et al. 1995). The vegetation reflects the geomorphology and is best characterized as a mosaic of large wet meadows with small patches of willow shrublands. The wet meadows are usually dominated by beaked sedge (*Carex utriculata*), while the willow shrublands are Geyer's willow (*Salix geyeriana*) or Rocky Mountain willow (*S. monticola*). The willow patches are usually restricted to the edge of the main channel. Adjacent to the wide and open floodplain are montane grasslands on rolling hills broken up by rhyolitic cliffs. Arizona fescue (*Festuca arizonica*) and slimstem muhly (*Muhlenbergia filiculmis*) dominate the extensive grasslands. Volcanic cliffs, primarily on the northern side of the valley, harbor the rock-loving and endemic Black Canyon gilia (*Gilia penstemenoides*) plant. The predominant uses of the site are ranching and recreation. Several ranches are operated as combined cattle ranch/fishing resorts. The Soward Ranch maintains small manmade ponds for rainbow trout fishing; these ponds are important habitat for the mossy valvata snail (*Valvata sincera*), a species that is rare in Colorado. The adjacent streams are not known to harbor the snail.

Key Environmental Factors: Upper montane elevation zone; glaciated valley

Land Use History: In 1875, more than 1,000 pronghorn antelope were counted in Antelope Park (Wason 1926 as cited in USDA Forest Service 1996). The herd in Antelope Park dwindled to a single specimen in 1883 (USDA 1936, as cited in USDA Forest Service 1996). Wolverines were shot in Antelope Park and were said to have been common in the 1880's (Cary 1911). Today there are no wolverines left in Mineral County. Many Rocky Mountain sheep were on Bristol Head in the early days, but in 1936 there were only three rams left there (USDA 1936 as cited in USDA 1996). Prior to the 1990's there are no reports of moose in Mineral County, but between 1990 and 1993, 100 moose were transplanted on the Creede Ranger District (USDA 1996).

Biodiversity Significance Rank Comments (B3): This site contains the wide riparian/wetland floodplain of the Rio Grande, the adjacent montane grasslands, and the rhyolitic cliffs that harbor the Colorado endemic Black Canyon gilia (*Gilia penstemonoides*). An excellent (A-ranked) occurrence of this globally vulnerable (G3/S3) plant resides here. There are six elements of concern at ten locations. The large population of Black Canyon gilia on the cliffs at the northern edge is the primary reason for the high biodiversity rank. Black Canyon gilia has been found in Gunnison, Montrose, Hinsdale and Mineral counties. Mineral County supports the largest known populations, of which the Antelope Park site is among the best, with over 100 individuals estimated for the area. In addition to the rare gilia, there are extensive montane grasslands (*Festuca arizonica - Muhlenbergia filiculmis* and *Festuca arizonica - Muhlenbergia montana*) in fair (C-ranked) and good (B-ranked) condition. These communities are important range land for both domestic livestock and wild large game. Within the winter range, Arizona fescue, blue grama (*Bouteloua gracilis*), fringed sage (*Artemisia frigida*), and mountain muhly (*Muhlenbergia montana*) are major components of the bighorn diets that occur in Arizona fescue stands (Shepherd 1975). Large and numerous stands of the globally common (G5/S4) beaked sedge wetlands (*Carex utriculata*) occur throughout the site and there are also good (B-ranked) occurrences of the state rare (G5/S3) Geyer's willow / beaked sedge community (*Salix geyeriana / Carex utriculata*).

Natural Heritage element occurrences at the Antelope 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	Festuca arizonica - Muhlenbergia montana Herbaceous Vegetation	Montane Grasslands	G3	S2				B	1998-07-27
Natural Communities	Carex utriculata Herbaceous Vegetation	Beaked Sedge Montane Wet Meadows	G5	S4				B	1998-08-12
Natural Communities	Salix geyeriana / Carex utriculata Shrubland	Geyer's Willow / Beaked Sedge	G5	S3				B	1998-07-25
Natural Communities	Salix geyeriana / Carex utriculata Shrubland	Geyer's Willow / Beaked Sedge	G5	S3				B	1998-08-12
Natural Communities	Festuca arizonica - Muhlenbergia filiculmis Herbaceous Vegetation	Montane Grasslands	GU	S3				C	1998-07-24
Vascular Plants	Gilia penstemonoides	Black Canyon gilia	G3	S3				A	1998-07-27

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

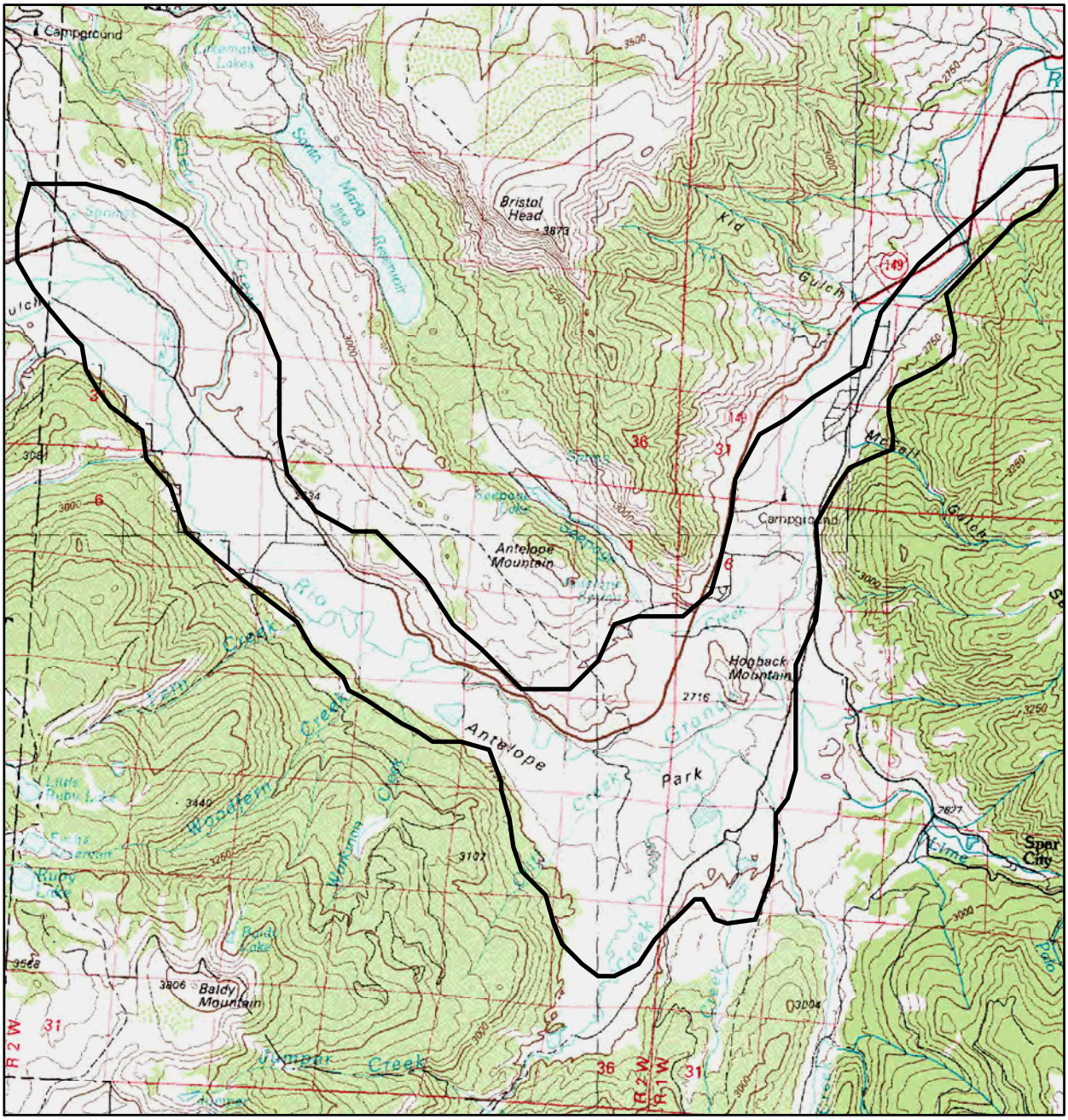
Boundary Justification: Includes the Rio Grande floodplain and the adjacent cliffs that harbor Black Canyon gilia (*Gilia penstemonoides*). The boundary is drawn to envelope the floodplain of the Rio Grande and Trout Creek at Antelope Park and include the adjacent montane grasslands, and volcanic cliffs. Although not contained in the present boundary, contributory watersheds should be managed to avoid downstream impacts in the Antelope Park site. Further research on the grasslands of Antelope Park may warrant a larger boundary.

Protection Urgency Rank Comments (P2): Multiple private ranches own over 90% of this site. The majority of the Black Canyon gilia population is on Rio Grande National Forest lands. The primary conservation concern is with the management of the private portions of this site.

Management Urgency Rank Comments (M3): Current management of the private lands is oriented towards working cattle ranches, including irrigation ditches, hay meadows, cattle grazing, and private fishing resorts. Although natural plant communities exist, they have an altered species composition that reduces its natural biodiversity significance. A more natural state would benefit the biological integrity of the Rio Grande floodplain, but of utmost importance is the continued limited

development along this wide valley.

Version Author: Rondeau, R.J.
Version Date: 12/10/1998



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Map Date: 05/28/2008

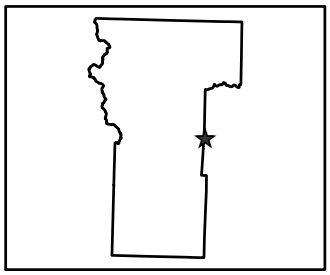
Legend

PCA Boundary

Del Norte, 37106-E1
Silverton, 37107-E1

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

Location in Hinsdale County



Antelope Park Potential Conservation Area, B3: High Biodiversity Significance

Brush Creek at Cannibal Point

Biodiversity Rank - B3: High 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: Cannibal Plateau

Size: 2,380 acres (963 ha) **Elevation:** 9,880 - 10,850 ft. (3,011 - 3,307 m)

General Description: The site is situated along the middle reaches of Brush Creek and the upper reaches of Mill Creek, both second order, headwater tributaries of Cebolla Creek. It encompasses highly variable ecosystems and hydrologic regimes along wide, glaciated valley bottoms, and narrow riparian corridors. Bedrock geology includes landslide deposits and glacial drifts of the Quaternary Age and igneous rocks of the Tertiary Age, specifically ash-flow tuffs of the main volcanic sequences and pre-ash-flow andesitic lavas, breccias, tuffs, and conglomerates (Steven 1974, Tweto 1979). Soils consist of organic accumulations over silty clay loams and unconsolidated materials with prominent silt and sand components and iron mottling. Forested uplands consist of Engelmann spruce (*Picea engelmannii*), Douglas-fir (*Pseudotsuga menziesii*), and quaking aspen (*Populus tremuloides*) along middle reaches and Engelmann spruce and subalpine fir (*Abies lasiocarpa*) along higher elevation reaches. Forest openings are dominated by large patches of shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*) shrublands with mixed xeric graminoids. Predominant land uses include recreational activities and livestock grazing. Hydrology along Mill Creek is compromised by upstream dams and adjacent roadways. Open, wide floodplains support a mosaic of dense tall shrublands and herbaceous wet meadows. Upper Mill Creek is dominated by a park willow (*Salix monticola*), mesic graminoid community. Riparian areas along Mill Creek are characterized by a series of old beaver dams with extensive willow regeneration interspersed with filling ponds and patches of dense herbaceous vegetation. Brush Creek supports a Geyer's willow (*Salix geyeriana*) and park willow shrubland with water sedge (*Carex aquatilis*) herbaceous understory. Other shrubs found along riparian reaches of the site include Drummond's willow (*Salix drummondiana*), shortfruit willow (*Salix brachycarpa*), and diamondleaf willow (*Salix planifolia*). Common graminoids in the herbaceous layer include smallwing sedge (*Carex microptera*), bluejoint (*Calamagrostis canadensis*), Northwest Territory sedge (*Carex utriculata*), water sedge, and bentgrass (*Agrostis* sp.). Common forbs include heartleaf bittercress (*Cardamine cordifolia*), fringed willowherb (*Epilobium ciliatum*), and largeleaf avens (*Geum macrophyllum*). Shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*), common yarrow (*Achillea millifolium*) and tufted hairgrass (*Deschampsia caespitosa*) are also common along edges indicating drying. Vegetation indicates past and present disturbances and hydrologic alterations with extensive shrub regeneration, presence of exotic and increaser species, and stable native vegetation

types in other areas. Mesic and inundated areas support the highest cover of native species, while drying edges and trampled areas support more increaser and exotic species.

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are subalpine elevation, gentle to moderate slope, groundwater recharge, and seasonal flooding.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B3): This site supports a good (B-ranked) occurrence of the globally vulnerable (G3/S3) park willow / mesic graminoid shrubland (*Salix monticola* / mesic graminoid shrubland), an excellent (A-ranked) occurrence of the Geyer's willow - park willow / water sedge shrubland (*Salix geyeriana - Salix monticola / Carex aquatilis* shrubland) whose global rank is unknown (GU/S3), a good to fair (BC-ranked) occurrence of a globally vulnerable (G3/S3) riparian willow carr (*Salix monticola* / mesic graminoids) and a good (B-ranked) occurrence of a globally apparently secure (G4/S4) alpine wetland (*Cardamine cordifolia - Mertensia ciliata*).

Natural Heritage element occurrences at the Brush Creek at Cannibal Point 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 / Mesic Graminoids Shrubland	Montane Riparian Willow Carr	G3	S3				B	2006-08-18
Natural Communities	Salix monticola / Mesic Graminoids Shrubland	Montane Riparian Willow Carr	G3	S3				BC	1994-07-02
Natural Communities	Cardamine cordifolia - Mertensia ciliata Herbaceous Vegetation	Alpine Wetlands	G4	S4				B	1994-07-02
Natural Communities	Salix geyeriana - Salix monticola / Carex aquatilis Shrubland	Montane Riparian Willow Carr	GU	S3				A	2006-08-28

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from

impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all ecological processes necessary to the maintenance of the site and upstream activities such as deforestation, improper livestock grazing or recreational use, development, road maintenance or water diversion could be detrimental to the site. Boundaries do not contain upper reaches of Cebolla drainage due to distance between contained elements, differences in hydrologic regime, ecological functions, and disturbances.

Protection Urgency Rank Comments (P4): The site is managed by the USFS as part of the Gunnison National Forest, but no special protection strategies are in place. The area exhibits some disturbances and threats from current use.

Management Urgency Rank Comments (M3): Land is managed for recreational use and livestock grazing. Livestock grazing along drainages and adjacent road may have deleterious effects on the elements. Disturbances observed at the site include reduced native graminoids and willow cover, extensive cover of exotic and increaser species in some areas, bank erosion and instability, trampling, and soil compaction. Reduction of current grazing along riparian areas could benefit the occurrences and help restore native vegetation.

Land Use Comments: Predominant land uses include livestock grazing and recreation.

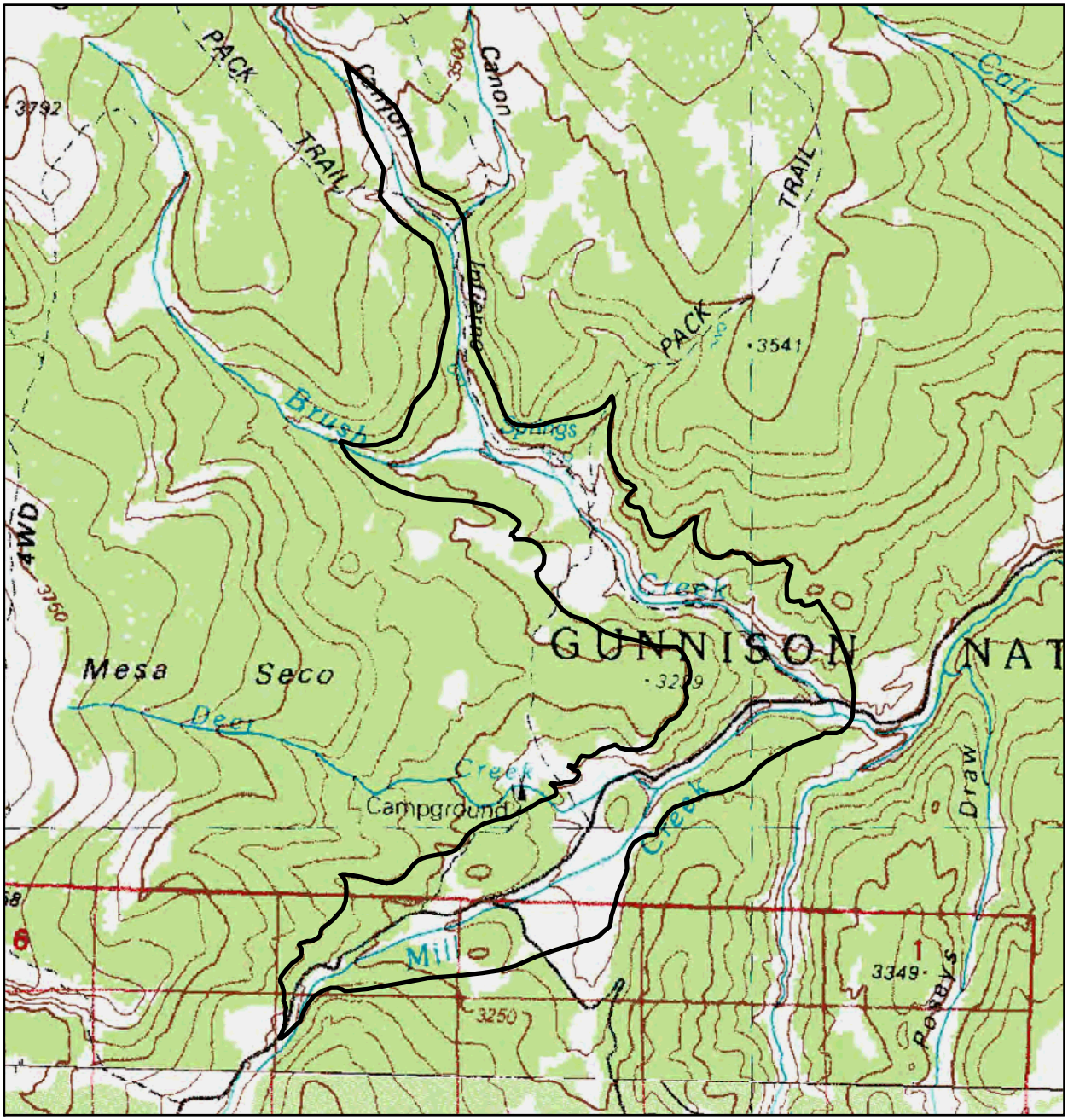
Natural Hazard Comments: Natural hazards include spring flooding.

Exotic Species Comments: Exotic species observed include common dandelion (*Taraxacum officinale*), white clover (*Trifolium repens*), timothy (*Phleum pratensis*), curly dock (*Rumex crispus*) and Kentucky bluegrass (*Poa pratensis*). All are present at low cover, but consistent along edges and in disturbed areas.

Off-Site Considerations: Off-site considerations include livestock grazing, road and road maintenance, watershed diversions, upstream dams, and recreational uses.

Information Needs: Need to determine status of cattle allotment and health of rangeland.

Version Author: Jones, J.R.
Version Date: 10/15/2006



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Map Date: 12/11/2006

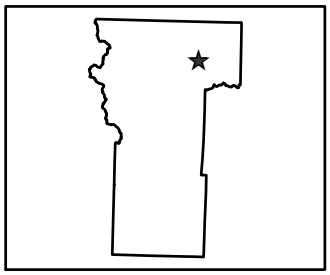
Legend

PCA Boundary

Montrose, 38107-A1

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

Location in Hinsdale County



Brush Creek at Cannibal Point Potential Conservation Area, B3: High Biodiversity Significance

Cebolla 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: Cannibal Plateau, Mineral Mountain

Size: 749 acres (303 ha) **Elevation:** 9,150 - 9,820 ft. (2,789 - 2,993 m)

General Description: The site spans approximately 3 miles along the middle reaches of Cebolla Creek, a third order tributary of the Gunnison River. It is characterized by a narrow riparian corridor confined in many places by canyon walls with a few reaches of open floodplain. General geology consists of igneous rocks of the Tertiary Age, specifically ash-flow tuffs of the main volcanic sequence and pre-ash-flow andesitic lavas, breccias, tuffs, and conglomerates (Steven 1974, Tweto 1979). Soils consist of organic accumulations over silty clay loams and unconsolidated materials with prominent silt and sand components. Surrounding uplands consist of blue spruce (*Picea pungens*), ponderosa pine (*Pinus ponderosa*), and bristlecone pine (*Pinus aristata*) woodlands at lower reaches and Engelmann spruce (*Picea engelmannii*), Douglas-fir (*Pseudotsuga menziesii*), and quaking aspen (*Populus tremuloides*) along middle reaches. Xeric graminoids and short shrubs inhabit woodland openings. Surrounding uplands are used predominantly for recreational activities and livestock grazing. Due to limited access, riparian areas are not extensively altered by grazing. Hydrology along Cebolla Creek is compromised by upstream dams and an adjacent road. Another section of blue spruce and thinleaf alder (*Alnus incana*) woodlands is present along lower reaches of Cebolla Creek on BLM land. The two sections are separated by cultivated hay fields and may have formerly been contiguous. Riparian vegetation is characterized by variable vegetation types and dominant strata throughout including areas of closed canopy layers, open canopy with consistent tall shrub cover, and open tall-shrublands. The narrow riparian zone is dominated by a blue spruce / thinleaf alder riparian community. Other tall shrubs found along the corridor include Drummond's willow (*Salix drummondiana*) and Bebb's willow (*Salix bebbiana*). Cover of herbaceous species is sparse with bluejoint (*Calamagrostis canadensis*), horsetail (*Equisetum arvense*), and common cowparsnip (*Heracleum maximum*) being most common. Exotic species are not common along the drainage, but occur along the road corridor and grazed uplands.

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are montane elevation, gentle to moderate slope, groundwater recharge, and seasonal flooding.

Climate Description: Climate and weather tend to follow typical patterns of the San

Juan mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B3): This site is drawn for a good (B-ranked) occurrence of the globally vulnerable (G3/S3) blue spruce / thinleaf alder woodland (*Picea pungens / Alnus incana* woodland).

Natural Heritage element occurrences at the Cebolla 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 pungens / Alnus incana Woodland	Montane Riparian Forests	G3	S3				B	2006-06-13

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

Boundary Justification: The site encompasses approximately 3 miles along the middle reaches of Cebolla Creek. Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. The boundary does not include all ecological processes necessary to the maintenance of the site and upstream activities such as deforestation, improper livestock grazing or recreational use, development, road maintenance or water diversion could be detrimental to the site. The lower reaches of Cebolla drainage are excluded due to distance, differences in hydrologic regime, ecological functions, and disturbances.

Protection Urgency Rank Comments (P3): The riparian area is contained in the Gunnison National Forest and bordered to the south by the La Garita Wilderness Area. There are definable threats, but not within 5 years.

Management Urgency Rank Comments (M3): Land is managed for recreational use and livestock grazing. Livestock grazing along drainages and adjacent road may have deleterious effects on the riparian community. Disturbances observed at the site include reduced native graminoids and willow cover, extensive cover of exotic and increaser species in some areas, bank erosion and instability, trampling, and soil compaction. Reduction or intensified management of current grazing along riparian areas could benefit the occurrence and help restore native vegetation.

Land Use Comments: Predominant land uses include livestock grazing and recreation.

Natural Hazard Comments: Natural hazards include spring flooding.

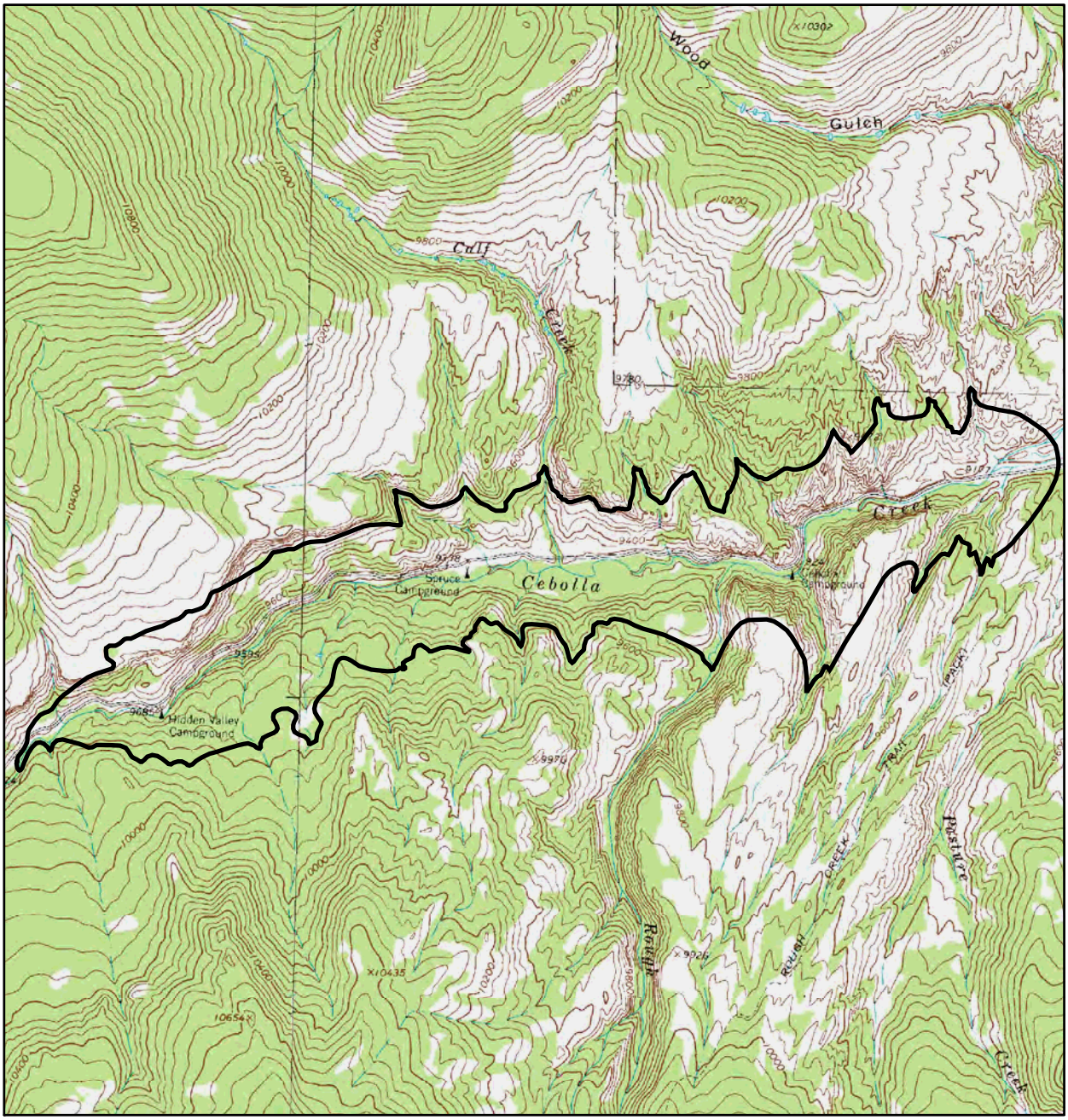
Exotic Species Comments: Exotic species are not common along this section of

Cebolla Creek, but are common along reaches above and below this section due to accessibility of riparian areas.

Off-Site Considerations: Off-site considerations include livestock grazing, road and road maintenance, watershed diversions, upstream dams, and recreational uses.

Information Needs: An occurrence of the globally rare Black Canyon gilia (*Gilia penstemonoides*) was documented in 1981. Further field surveys are needed to relocate this occurrence.

Version Author: Jones, J.R.
Version Date: 10/15/2006



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Map Date: 12/11/2006

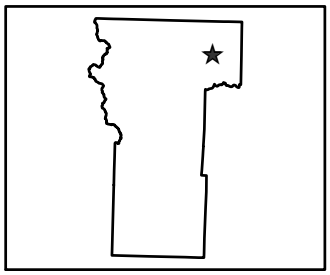
Legend

PCA Boundary

Mineral Mountain, 38107-A1
Cannibal Plateau, 38107-A2

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

Location in Hinsdale County



Cebolla Creek Potential Conservation Area, B3: High Biodiversity Significance

Cimarrona Creek

Biodiversity Rank - B3: High Biodiversity Significance

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

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Cimarrona Peak

Size: 870 acres (352 ha) **Elevation:** 8,380 - 10,400 ft. (2,554 - 3,170 m)

General Description: The Cimarrona Creek site encompasses a narrow canyon on the south end of Cimarrona Creek just prior to its confluence with Williams Creek. In the area of the confluence, the terrain opens into a broad valley that includes the very southern tip of the site. The canyon includes steep walls that drop as much as 500 feet to a narrow valley. Subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii)* dominate the overstory along the creek and thinleaf alder (*Alnus incana*) is the dominant shrub. Forbs dominate the ground cover. There are very few grasses and litter covers 57% of the ground. The riparian area is highly productive, healthy with little disturbance and the hydrology of the area is functioning properly. Although the creek is intermittent at this location, the riparian area is fed by a persistent seep. The upland communities surrounding the creek are little disturbed except for a trail leading into the Wilderness Area.

Biodiversity Significance Rank Comments (B3): This site supports a good (B-ranked) occurrence of a globally vulnerable (G3/S3) *Salix monticola* / mesic graminoid riparian willow carr, a good (B-ranked) occurrence of a globally vulnerable (G3/S3) *Populus angustifolia* / *Alnus incana* riparian forest, and an excellent (A-ranked) occurrence of a globally common (G5/S5) *Abies lasiocarpa* / *Alnus incana* riparian forest. There is also a poor (D-ranked) occurrence of a globally imperiled (G4T1T2/SNA) bird subspecies, Southwestern Willow Flycatcher (*Empidonax traillii extimus*).

Natural Heritage element occurrences at the Cimarrona 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
Birds	Empidonax traillii extimus	Southwestern Willow Flycatcher	G5T1T2	SNA	LE	SE		D	1995-07-07
Natural Communities	Populus angustifolia / Alnus incana Woodland	Montane Riparian Forest	G3	S3				B	1994-07-29
Natural Communities	Salix monticola / Mesic Graminoids Shrubland	Montane Riparian Willow Carr	G3	S3				B	1994-07-24
Natural Communities	Abies lasiocarpa / Alnus incana Forest	Montane Riparian Forests	G5	S5				A	1995-07-13

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

Boundary Justification: The boundary incorporates an area that will allow natural hydrological processes such as seasonal flooding and sediment deposition to maintain the riparian forest along Cimarrona Creek. The adjacent steep slopes that would most likely impact the riparian forest if altered are also included. It should be noted that the hydrological processes necessary to the riparian forest are not fully contained by the boundaries. Given that the riparian forest is dependent on natural hydrological processes associated with Cimarrona Creek, upstream activities such as water diversions, impoundments, improper livestock grazing, and development are detrimental to the hydrology of the riparian area. This boundary indicates the minimum area that should be considered for any conservation management plan. The boundary also includes an approximate 1,000 ft buffer. Eliminating disturbance within this buffer would aid in reducing impacts from sedimentation (Karr and Schlosser 1978), and assist in maintaining the integrity of the occurrences and its associated avian, macroinvertebrate and periphyton communities (Noel et al. 1986, Spackman and Hughes 1995).

Protection Urgency Rank Comments (P5): This site is entirely within the San Juan National Forest and the northern half of the boundary falls within the Weminuche Wilderness. Although this does not assure perpetual protection for the rare communities, no protection actions are currently needed. However, any changes in use of the land or ownership may necessitate action.

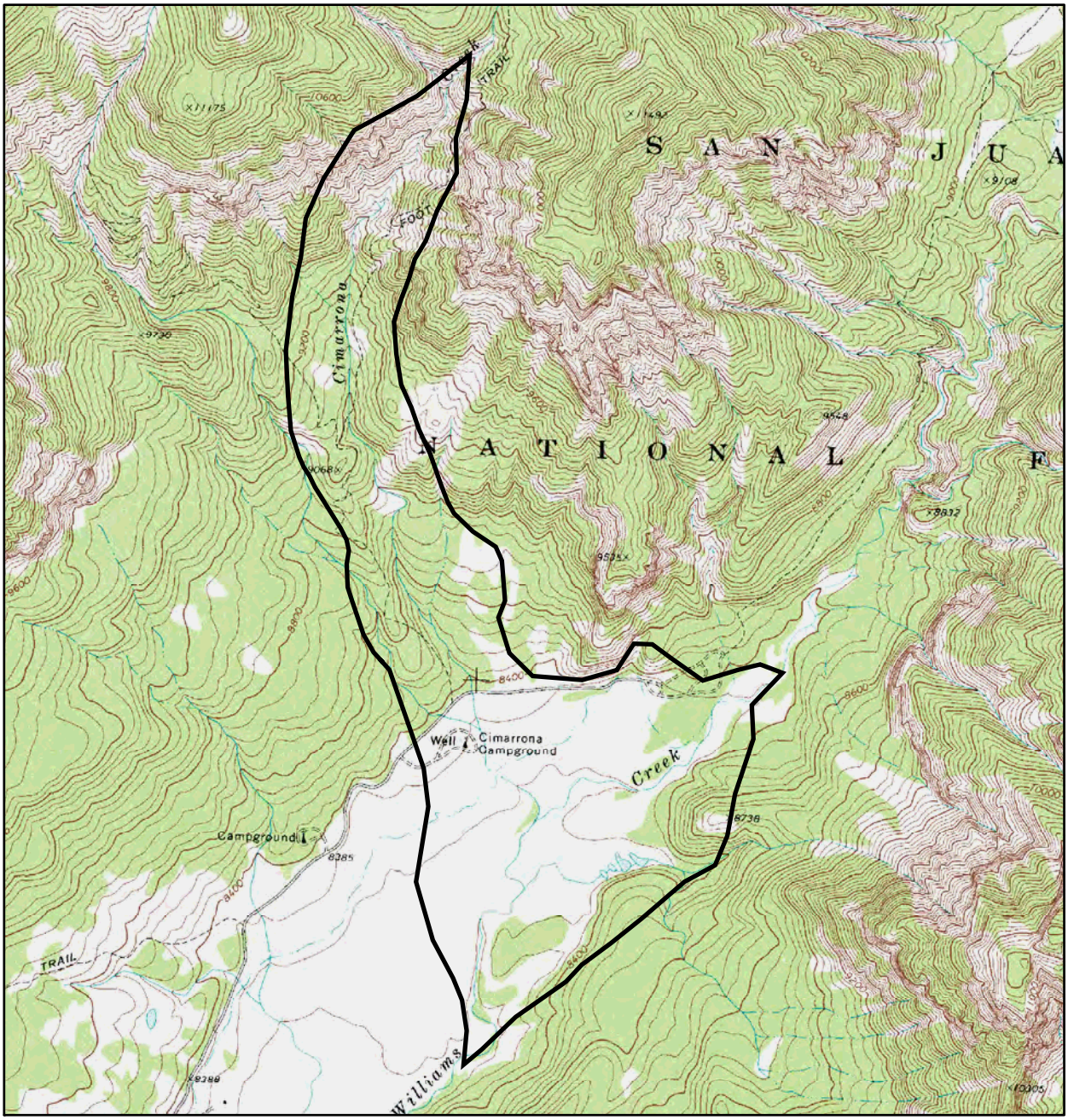
Management Urgency Rank Comments (M4): Current management seems to favor the persistence of the riparian forest, but management actions may be needed in the future to maintain the current quality of the riparian area. Increases in recreational use may require management actions to maintain the excellent quality of the site.

The campground and trail have the potential to adversely affect the riparian forest through the introduction of non-native plants. Monitoring to detect such introductions should be continuous.

Off-Site Considerations: Hydrological processes originating outside of the planning boundary, including water quality, quantity, timing and flow must be managed to maintain site viability.

Version Author: Kettler, S.M.

Version Date: 06/09/1997



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Map Date: 05/21/2008

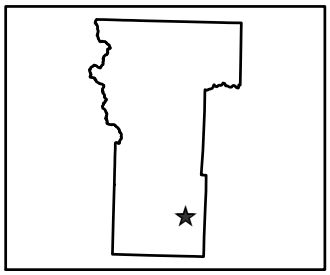
Legend

PCA Boundary

Cimarrona Peak, 37107-E2

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

Location in Hinsdale County



Cimarrona Creek Potential Conservation Area, B3: High Biodiversity Significance

Cinnamon Pass

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: Handies Peak

Size: 631 acres (255 ha) **Elevation:** 12,000 - 13,328 ft. (3,658 - 4,062 m)

General Description: This site contains most of the northeast-facing bowl below Cinnamon Mountain, on the jeep road that connects Animas Forks and Lake City. It is geologically situated on the San Juan volcanic ash flow tuff. High ridges define the site, forming a tight horseshoe-shaped alpine bowl, with Cinnamon Mountain (13,328 ft.) as the high point, in the southwest corner. The terrain is variable, with three or four obvious terraced benches distributed throughout the upper portions of the site. Talus fields and semi-permanent snow fields dominate the steep slopes which form the upper-most reaches of the site. Soil moisture is variable, with low-lying areas remaining moist to saturated from snow-melt and elevated areas being moist only in early summer. The headwaters of Cinnamon Creek contain some excellent quality wetlands. Drier upper slopes support typical alpine tundra with rock outcrops. The highest areas are dominated by snow willow (*Salix reticulata* ssp. *nivalis*), the host plant of the extremely rare Uncompahgre fritillary butterfly (*Boloria improba acrocnema*). More mesic slopes are dominated by alpine avens (*Geum rossii)*. Other species include Holm's ragwort (*Senecio holmii*), creeping sibbaldia (*Sibbaldia procumbens*), moss campion (*Silene acaulis*), thick-leaf whitlow-grass (*Draba crassa*) and fleabane (*Erigeron vagus*). The wetland areas have small areas of standing water and permanently saturated peat soils that support a variety of grasses and sedges, including tufted hairgrass (*Deschampsia cespitosa*), globe sedge (*Carex perglobosa*), black sedge (*Carex nova)*, smallwing sedge (*Carex microptera*), and native sedge (*Carex vernacula*), along with Altai cottongrass (*Eriophorum altaicum* var. *neogaeum*).

Biodiversity Significance Rank Comments (B3): Cinnamon Pass supports a good (B-ranked) occurrence of thick-leaf whitlow-grass (*Draba crassa*), a plant that is globally vulnerable (G3/S3). There is also an excellent (A-ranked) occurrence of alpine wetlands dominated by *Carex vernacula*, a community that is unranked (GU/S1) at present, and for which further research is needed to determine its rarity. The wetland areas contain excellent quality (A-ranked) patches of Altai cottongrass (*Eriophorum altaicum* var. *neogaeum*), a subspecies that is globally vulnerable (T3T4/S3).

Natural Heritage element occurrences at the Cinnamon Pass 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	Carex vernacula Herbaceous Vegetation	Alpine Wetlands	GU	S1				A	2002-07-23
Vascular Plants	Draba crassa	thick - leaf whitlow - grass	G3	S3				B	2002-07-23
Vascular Plants	Eriophorum altaicum var. neogaeum	Altai cottongrass	G4?T3T4	S3			USFS	A	2002-07-23

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

Boundary Justification: The boundary is drawn to encompass the occurrence of the alpine wetland community and areas upslope that provide moisture from snow melt that support the wetland. This area also includes the habitat of the Altai cottongrass and thick-leaf whitlow-grass. The boundary is not intended to include all of the area that would be required to sustain a population of the Uncompahgre fritillary (at this site, a total of five individuals were observed on August 8, 1995, and an even-year brood could not be confirmed). It does, however, contain appropriate habitat, including the snow willow upon which the butterflies depend.

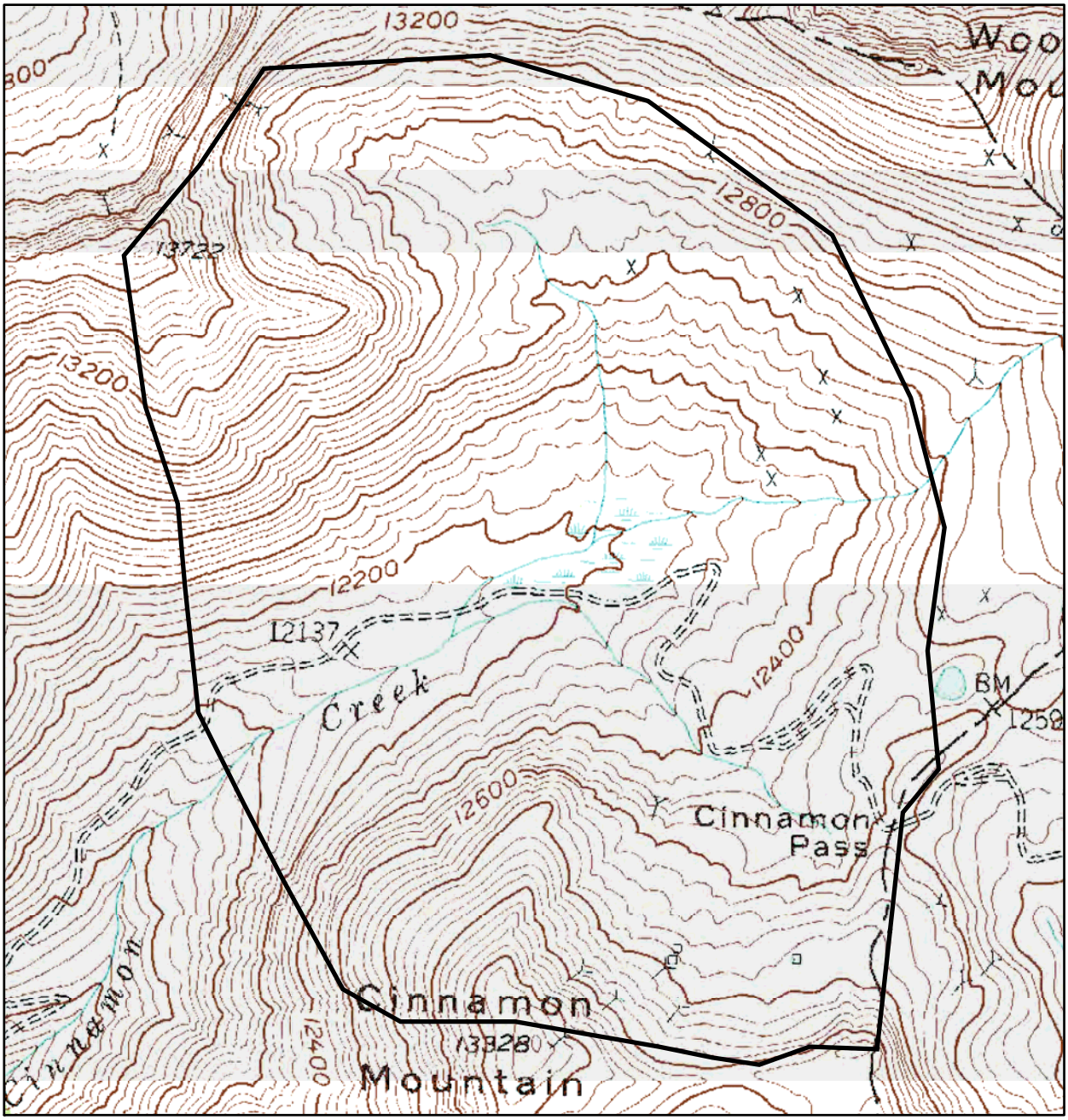
Protection Urgency Rank Comments (P3): The area is primarily BLM land, with a few private mining claims. There is no special protection in place.

Management Urgency Rank Comments (M3): No exotic species were observed. Some erosion resulting from sheep trailing was observed. The site has been subject to past mining activity and relatively intense domestic sheep grazing. Floral diversity appeared to be moderate to low. Sheep grazing may have already had negative effects on the Uncompahgre fritillary by reducing floral diversity for nectar sources and possible trampling of larvae.

Information Needs: Although *B. improba acrocnema* is known from this site, very few numbers have been observed; a total of 5 individuals were observed on August 8, 1995 (L.D. Beutler pers. comm.), and an even-year brood could not be confirmed. Further surveys are needed to relocate this butterfly. More research is needed to determine the rarity of the *Carex vernacula* wetland.

Version Author: Lyon, M.J.

Version Date: 12/13/2002



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Map Date: 05/21/2008

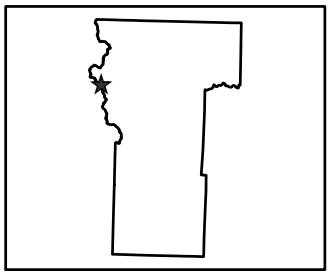
Legend

PCA Boundary

Handies Peak, 37107-H5

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

Location in Hinsdale County



Cinnamon Pass Potential Conservation Area, B3: High Biodiversity Significance

East Fork Powderhorn Creek

Biodiversity Rank - B3: High 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: Mineral Mountain, Rudolph Hill

Size: 2,156 acres (872 ha) **Elevation:** 9,300 - 10,900 ft. (2,835 - 3,322 m)

General Description: East Fork Powderhorn Creek runs through a moderately wide and moderately deep valley with gently sloping to steep sided slopes. Aspen (*Populus tremuloides*), buffalo berry (*Shepherdia canadensis*), Douglas-fir (*Pseudotsuga menziesii*), and Engelmann spruce (*Picea engelmannii*) dominate these slopes. The valley bottom consists of a complex of beaver ponds, both active and abandoned, along with large willow carrs, open wet meadows, and stands of alder (*Alnus incana*). Beaver dams are large and numerous causing the usual steep gradient stream to slow, forming pool-drops. Mountain willow (*Salix monticola)*, Geyer's willow (*S. geyeriana*), beaked sedge (*Carex utriculata*), Kentucky bluegrass (*Poa pratensis*), and numerous forbs dominate the riparian area forming a mosaic of sedge meadows and large willow carrs.

Biodiversity Significance Rank Comments (B3): This site supports a good (B-ranked) example of the globally vulnerable (G3/S3) Rocky Mountain willow / beaked sedge (*Salix monticola / Carex utriculata*) shrubland. This association is threatened by improper livestock grazing, inappropriate stream flow alterations, and heavy recreational use. The site also supports a good (B-ranked) example of the state vulnerable (G4/S3) Rocky Mountain willow (*Salix monticola*) / mesic forb shrubland. Many stands of this association may represent grazing induced shifts from other *Salix monticola* dominated plant associations. Stands with a complete native herbaceous understory intact are threatened by improper livestock grazing, inappropriate stream flow alterations, and heavy recreational use. Rocky Mountain willow appears to be the center of its distribution in Colorado, where it frequently forms large thickets with few other willow species present. Literature from Utah, Wyoming, Montana, Idaho, Nevada and Oregon indicate that Rocky Mountain willow loses importance north and west of Colorado, where Rocky Mountain willow mixes with other *Salix* species. For example, in central and eastern Utah, Rocky Mountain willow dominated stands are infrequent and due to structural and ecological similarities are included in Booth willow (*Salix boothii)* associations (Padgett et al. 1989), and in Idaho, Rocky Mountain willow also has a limited distribution and largely associates with other willow species (Brunsfeld and Johnson 1985).

Natural Heritage element occurrences at the East Fork Powderhorn 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 utriculata Shrubland	Montane Riparian Willow Carr	G3	S3				B	1994-07-03
Natural Communities	Salix monticola / Mesic Forbs Shrubland	Montane Riparian Willow Carr	G4	S3				B	1994-06-30

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

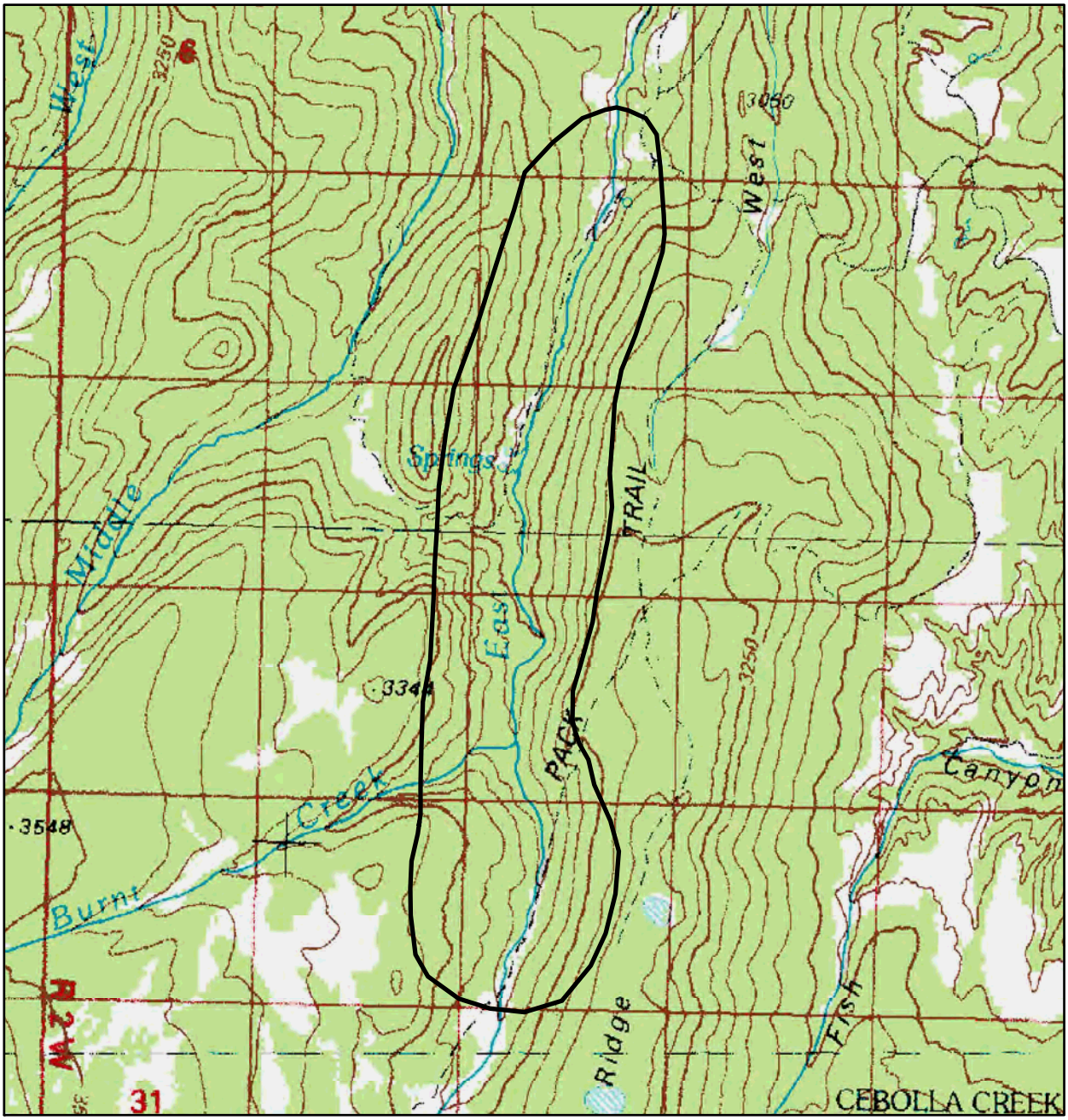
Boundary Justification: The boundaries incorporate an area that will allow natural hydrological processes such as seasonal flooding, sediment deposition, and new channel formation to maintain viable populations of the elements along East Fork Powderhorn Creek. The boundaries also provide a small buffer from nearby trails where surface runoff may contribute excess nutrients and sediment. It should be noted that the hydrological processes necessary to the elements are not fully contained by the site boundaries. Given that the communities are dependent on natural hydrological processes associated with East Fork Powderhorn Creek and its tributaries, upstream activities such as water diversions, impoundments, and improper livestock grazing are detrimental to the hydrology of the riparian area. This boundary indicates the minimum area that should be considered for any conservation management plan.

Protection Urgency Rank Comments (P5): Protection is adequate as almost the entire site is contained within the Powderhorn Primitive Area (BLM) while the Bureau of Land Management manages the remaining portion. However, water rights are not protected in the wilderness.

Management Urgency Rank Comments (M3): Management is needed within 5 years (or degrade). Grazing regimes should be altered to benefit riparian health. A pack trail exists in the area and may have allowed such non-natives as dandelion (*Taraxacum officinale*) and Kentucky bluegrass (*Poa pratensis*) to become prevalent.

Version Author: Rocchio, F.J.

Version Date: 12/19/2002



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Map Date: 05/27/2008

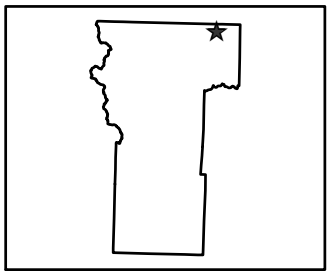
Legend

PCA Boundary

Montrose, 38107-A1

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

Location in Hinsdale County



East Fork Powderhorn Creek Potential Conservation Area, B3: High Biodiversity Significance

Henson 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: Lake City, Uncompahgre Peak

Size: 2,014 acres (815 ha) **Elevation:** 8,680 - 9,600 ft. (2,646 - 2,926 m)

General Description: The site is situated along middle and lower reaches of Henson Creek, a third order tributary of the Lake Fork of the Gunnison River. The wetland communities form a narrow riparian zone confined to a few meters along stream banks by the road and steep adjacent slopes. General geology of the drainage and surrounding uplands consists of igneous rocks of the Tertiary Age, specifically, ash-flow tuff of the main volcanic sequence and intra-ash flow andesitic lavas (Steven 1974, Tweto 1979). The site occurs in an active mining area of the mineral belt and upstream reaches of the drainage have been mined extensively. The BLM manages the largest portion of the Henson Creek watershed and is actively working toward reclamation of abandoned mines in the area. Two dams associated with mining operations along the drainage have been breached and no longer impact hydrology. Soils consist of alluviums of silt and clay over sandy clay loams. Stream bottoms consist of small to medium cobbles with intermittent boulders. Vegetation forms a dense layer of tall shrubs along narrow riparian areas and patches of open floodplain. The shrub layer is dominated by thinleaf alder (*Alnus incana*) and Drummond's willow (*Salix drummondiana*). Other tall shrubs interspersed throughout include greenleaf willow (*Salix lucida* ssp. *caudata*) and coyote willow (*Salix exigua*). Narrowleaf cottonwood (*Populus angustifolia*) and blue spruce (*Picea pungens*) form a consistent canopy layer along upper reaches of the drainage above the Henson Mine. Canopy cover is intermittent along lower reaches. Understory cover is sparse in most areas including low cover of short shrubs and mesic herbaceous species. Short shrubs include whitestem gooseberry (*Ribes inerme*) and Wood's rose (*Rosa woodsii*). California nettle (*Urtica dioica* ssp. *gracilis*), bluejoint (*Calamagrostis canadensis*), tall fringed bluebells (*Mertensia ciliata*), common cowparsnip (*Heracleum maximum*), and field horsetail (*Equisetum arvense*) are consistent in low cover throughout riparian reaches. Surrounding uplands are dominated by mixed forests and woodlands of Engelmann spruce (*Picea engelmannii*), blue spruce (*Picea pungens*), quaking aspen (*Populus tremuloides*), and Douglas-fir (*Pseudotsuga menziesii*). Disturbances in the drainage include past mining activity, adjacent road, development on private property, and recreational uses including OHV use, fishing, camping, hiking, and biking. Although there is extensive anthropogenic disturbance in the watershed, riparian vegetation is vigorous. Exotic species found in disturbed areas include Kentucky bluegrass (*Poa*

pratensis), common dandelion (*Taraxacum officinale*), and Canada thistle (*Cirsium arvense*).

Key Environmental Factors: Key environmental factors influencing species composition of the wetlands are montane elevation, seasonal flooding, free-flowing hydrology, and moderate gradient.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Land Use History: Watershed contains multiple town sites from past mining activity including Capitol City and Henson, both founded during the mining booms of the late 1800's as well as many old homesites from past settlers. The road along Henson Creek has been used and maintained since this time.

Biodiversity Significance Rank Comments (B3): This site is drawn for an excellent (A-ranked) occurrence of the globally vulnerable (G3/S3) thinleaf alder - Drummond's willow tall shrubland (*Alnus incana* - *Salix drummondiana* shrubland) and a good (B-ranked) occurrence of the globally vulnerable (G3/S3) narrowleaf cottonwood - blue spruce / thinleaf alder riparian woodland (*Populus angustifolia* - *Picea pungens* / *Alnus incana* woodland).

Natural Heritage element occurrences at the Henson 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 - Salix drummondiana Shrubland	Montane Riparian Shrubland	G3	S3				A	2006-09-11
Natural Communities	Populus angustifolia - Picea pungens / Alnus incana Woodland	Montane Riparian Forests	G3	S3				B	2006-09-11

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include entire watershed or all ecological processes necessary to the maintenance of the site and activities within the watershed such as deforestation, improper livestock grazing and recreational use, development, or

water diversion could be detrimental to the site.

Protection Urgency Rank Comments (P3): The site is managed by the BLM, Gunnison District. Threats include an adjacent road, recreational use, mining in the drainage, grazing, and private development.

Management Urgency Rank Comments (M3): The occurrences appears to be stable, but may need future management if recreational or private property use changes or increases.

Land Use Comments: Predominant land use is recreation. Other land uses include grazing along upper reaches and various private uses including development throughout the drainage.

Natural Hazard Comments: Natural hazards present in the drainage include avalanche danger, spring flooding, and falling rocks.

Exotic Species Comments: Exotic species are common along the drainage due to extensive use and an adjacent road. Exotics do not dominate or create large monocultures in any areas. Kentucky bluegrass (*Poa pratensis*), common dandelion (*Taraxacum officinale*), and Canada thistle (*Cirsium arvense*) were observed at the site in disturbed areas.

Off-Site Considerations: Off-site considerations include mining, roadway use and maintenance, and grazing.

Version Author: Jones, J.R.
Version Date: 10/15/2006

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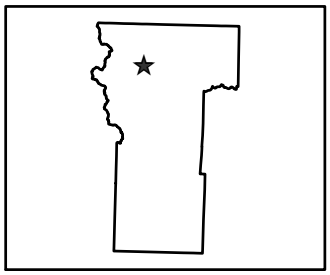
Legend

PCA Boundary

Montrose, 38107-A1

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

Location in Hinsdale County



Henson Creek Potential Conservation Area, B3: High Biodiversity Significance

Indian Creek at Tuckerville

Biodiversity Rank - B3: High Biodiversity Significance

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

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Granite Peak, Vallecito Reservoir

Size: 1,076 acres (436 ha) **Elevation:** 10,400 - 10,840 ft. (3,170 - 3,304 m)

General Description: This large area comprises a mosaic of spruce - fir forest, open Thurber fescue (*Festuca thurberi*) meadows, narrow stream beds dominated by willows, and more open wet meadows dominated by Colorado false hellebore (*Veratrum tenuipetalum*), green gentian (*Frasera speciosa*) and other tall forbs. Indian Creek runs through the site for about 1.5 miles. A large open park known as Runlett Park occupies the northern part of the site. Middle Mountain Road (FR 724) provides access to the area and is popular with four-wheel drive recreationist. It also leads to trails into the Weminuche and Rio Grande wilderness areas. Thurber fescue meadows occupy south and east-facing slopes. Wet meadows are interspersed with the drier grasslands. Both of these habitats support kittentails (*Besseya ritteriana*) and showy whitlow-grass (*Draba spectabilis* var. *oxyloba*). Other species here include Colorado false hellebore, green gentian, Parry's thistle (*Cirsium parryi*), smallwing sedge (*Carex microptera*), large mountain fleabane (*Erigeron coulteri*), nodding ragwort (*Ligularia bigelovii)*, monkshood (*Aconitum columbianum*), fowl managrass (*Glyceria striata*), Richardson's geranium (*Geranium richardsonii*), eltrot (*Heracleum sphondylium* ssp. *montanum*), strawberry (*Fragaria virginiana*), chiming bells (*Mertensia ciliata*), osha (*Ligusticum porteri*), blue wildrye (*Elymus glaucus*), orange sneezeweed (*Dugaldia hoopesii*), tall fleabane (*Erigeron elatior*), black-eyed susan (*Rudbeckia ampla*), Fendler's waterleaf (*Hydrophyllum fendleri*), and fewleaf thistle *(Cirsium centaureae*).

Biodiversity Significance Rank Comments (B3): The Indian Creek at Tuckerville site supports an excellent (A-ranked) occurrence of the globally vulnerable (G3/S3) *Festuca thurberi* subalpine grassland and good (B-ranked) occurrences of two globally apparently secure (G4/S4) natural communities: *Salix planifolia / Caltha leptosepala* and *Salix brachycarpa* / mesic forbs.

Natural Heritage element occurrences at the Indian Creek at Tuckerville 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	Festuca thurberi Subalpine Grassland Herbaceous Vegetation		G3	S3				A	2003-07-30
Natural Communities	Salix brachycarpa / Mesic Forbs Shrubland	Alpine Willow Scrub	G4	S4				AB	1994-07-15
Natural Communities	Salix planifolia / Caltha leptosepala Shrubland	Subalpine Riparian Willow Carr	G4	S4				B	2003-09-10

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

Boundary Justification: The boundary encompasses a mosaic of grasslands and wetlands. It includes the occurrence of Thurber fescue subalpine grassland.

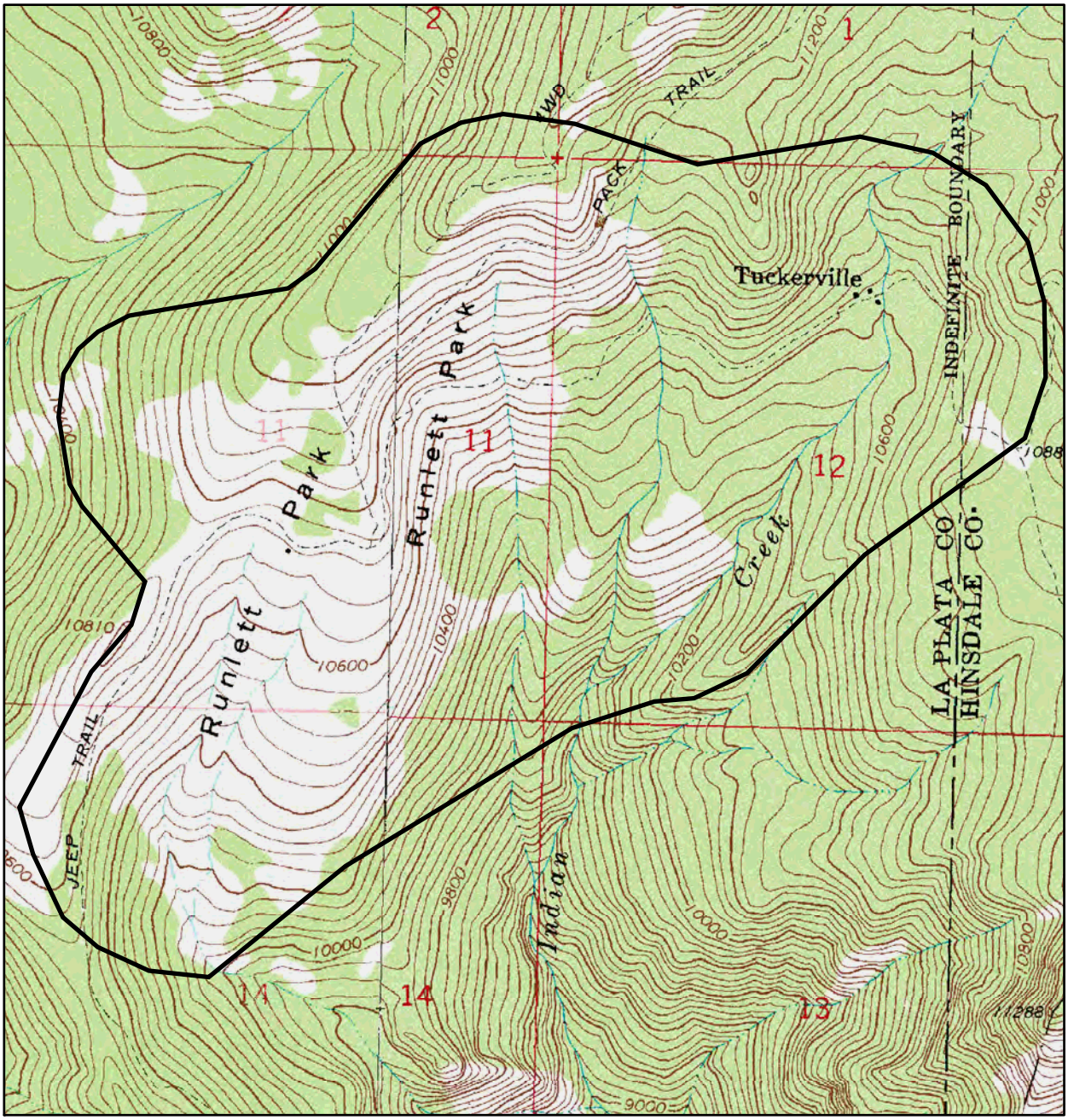
Protection Urgency Rank Comments (P5): The site is entirely within the San Juan National Forest.

Management Urgency Rank Comments (M4): Current management appears to be adequate. No exotic plant species or visible impacts of off-road vehicles were noted. Nearby areas along Middle Mountain Road in the Bear Creek drainage have abundant weeds, including Canada thistle (*Cirsium arvense*) and houndstongue (*Cynoglossum officinalle*), that could invade the site in the future. Continued monitoring for weeds may help to prevent this.

Off-Site Considerations: Hydrological processes originating outside of the planning boundary, including water quality, quantity, timing and flow must be managed to maintain site viability.

Version Author: Lyon, M.J.

Version Date: 01/30/2004



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Map Date: 05/27/2008

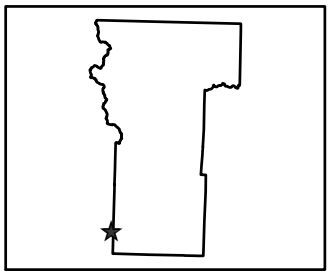
Legend

PCA Boundary

Granite Peak, 37107-D4
Vallecito Reservoir, 37107-D5

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

Location in Hinsdale County



Indian Creek at Tuckerville Potential Conservation Area, B3: High Biodiversity Significance

Jumper and Trout Creeks

Biodiversity Rank - B3: High Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Cimarrona Peak, Little Squaw Creek, Palomino Mountain, South River Peak, Spar City, Workman Creek

Size: 52,501 acres (21,246 ha) **Elevation:** 9,000 - 11,880 ft. (2,743 - 3,621 m)

General Description: The Jumper and Trout Creek site includes the watershed with the only known breeding population remaining for the boreal toad (*Bufo boreas* pop. 1) in the San Juan Range. There are two known active breeding ponds and many other recent toad sightings in the area. The site is within a montane spruce - fir forest, some of which is managed as a logging area by the Rio Grande National Forest. Below the Jumper-Trout Creek confluence, the stream widens and supports a riparian area with narrowleaf cottonwood (*Populus angustifolia*) and thinleaf alder (*Alnus incana*). At the lowest reach of Middle Creek there is a known population of Mossy Valvata (*Valvata sincera*), a state rare mollusk.

Biodiversity Significance Rank Comments (B3): This site supports the best and only remaining breeding population for the globally critically imperiled (G4T1Q/S1) boreal toad in the San Juan Range. This population is in good to fair (BC-ranked) condition. The toad was once common in many parts of Colorado, including the San Juans, but has been steadily declining for the past 20 years (Goettl 1997), with less than 20 high priority breeding sites remaining in Colorado (Steve Corn, pers. comm.; Lauren Livo, pers. comm., as cited in (Colorado Natural Heritage Program 1997). In addition, there are excellent (A-ranked) examples of a globally vulnerable (G3/S3) montane riparian forest (*Populus angustifolia - Picea pungens / Alnus incana*) and a globally vulnerable (G3/S3) montane riparian shrubland (*Alnus incana - Salix drummondiana*). Mossy Valvata (*Valvata sincera*), a state rare (G5/S3) invertebrate, occurs at the lower elevations. The Soward Ranch ponds harbor the only known Mineral County occurrence of the Mossy Valvata.

Natural Heritage element occurrences at the Jumper and Trout Creeks PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Amphibians	Bufo boreas pop. 1	Boreal Toad (Southern Rocky Mountain Population)	G4T1Q	S1		SE	USFS	BC	2007-99-99
Mollusks	Valvata sincera	Mossy Valvata	G5	S3				E	1988-09-17
Natural Communities	Alnus incana - Salix drummondiana Shrubland	Montane Riparian Shrubland	G3	S3				A	1995-06-19
Natural Communities	Populus angustifolia - Picea pungens / Alnus incana Woodland	Montane Riparian Forests	G3	S3				A	1995-06-19

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

Boundary Justification: The boundary drawn encompasses the existing boreal toad breeding population, boreal toad sightings, an occurrence of the Mossy Valvata, and the riparian community of Jumper Creek.

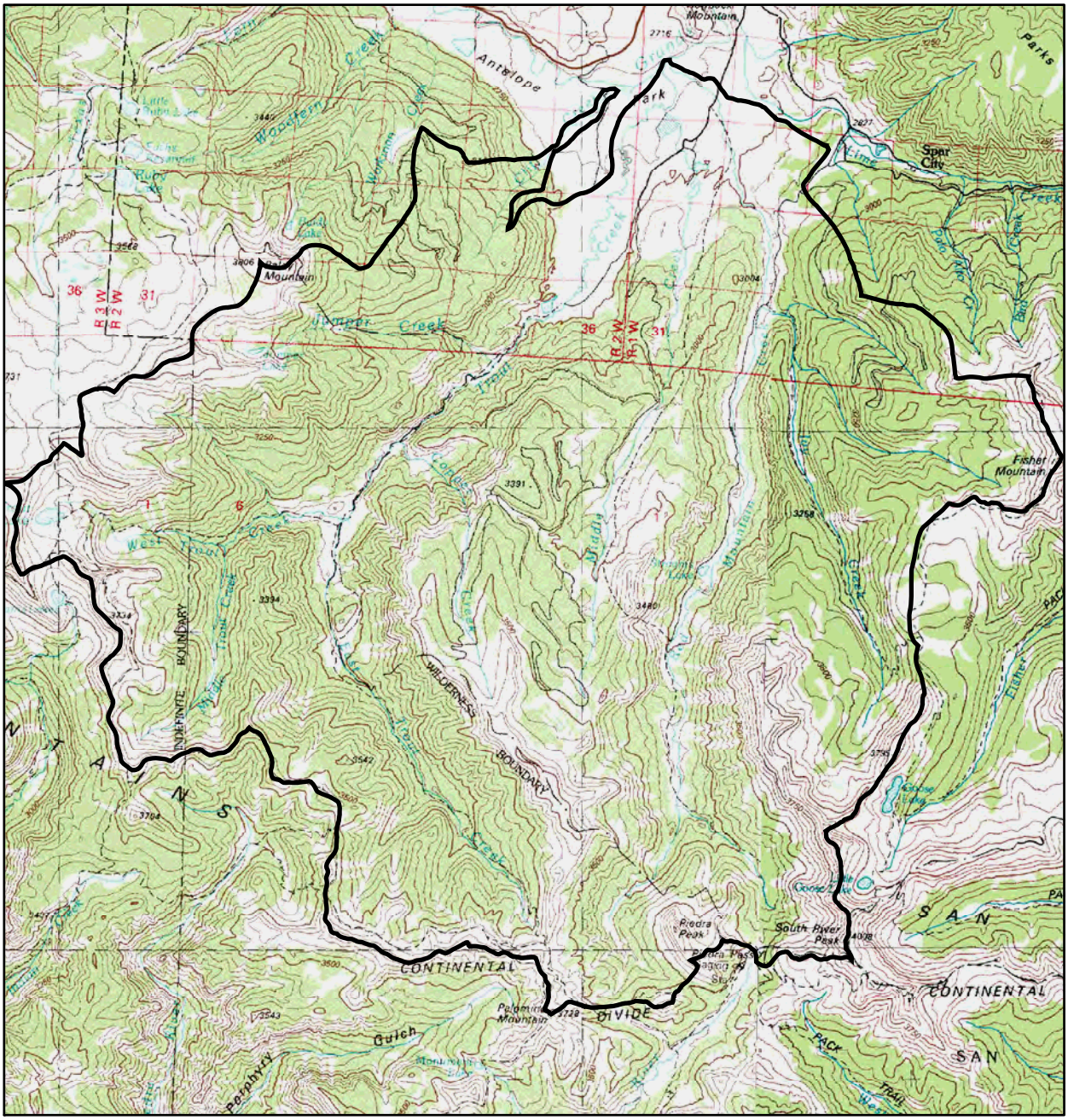
Protection Urgency Rank Comments (P4): As long as boreal toad individuals survive, this site should be designated as an SIA. Much of the site is owned and managed by Rio Grande National Forest, with the lower section along the riparian area privately owned. There is no special protection on either the private or federal lands, although USFS and CDOW pay special attention to the breeding sites.

Management Urgency Rank Comments (M4): The causes of boreal toad decline are unknown; however, USFS should review all management prescriptions for this site to ensure there are no conflicts. Management of this population requires fairly intensive human interaction. USFS and CDOW currently manage this boreal toad breeding area by closing off the logging road during the summer. The road puddle is spring fed through overflow from a blocked culvert. The forest has installed a spring box and a temporary fence. After the toadlets leave the area, the road is opened up during hunting season in order to maintain depth in the road ruts. Logging is very active here. The effects of logging on this population are unknown, although Husung and Alves (1998) presume the logging may be too close.

Information Needs: Additional inventory of this and adjacent areas warranted.

Version Author: Gaughan, C.R.

Version Date: 05/15/2008



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Map Date: 05/21/2008

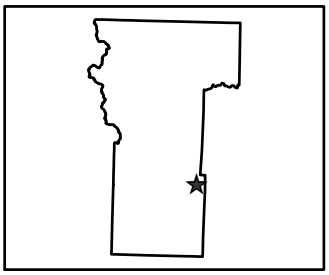
Legend

PCA Boundary

Del Norte, 37106-E1
Silverton, 37107-E1

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

Location in Hinsdale County



Jumper and Trout Creeks Potential Conservation Area, B3: High Biodiversity Significance

Lake Fork of the Gunnison River

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: Alpine Plateau, Lake City, Lake San Cristobal

Size: 6,470 acres (2,618 ha) **Elevation:** 7,950 - 9,220 ft. (2,423 - 2,810 m)

General Description: The Lake Fork of the Gunnison River is a third order tributary of the Gunnison River. The river is naturally dammed above the site by the Slumgullion Slide, creating Lake San Cristobal, the second largest natural lake in Colorado. The river flows free of extensive man-made obstructions from the outlet of the lake to Blue Mesa Reservoir. The site encompasses over 20 miles of the river corridor. General geology of the drainage is composed of landslide deposits, older gravels, and alluviums of the Quaternary Age and ash-flow tuff of main volcanic sequence of the Tertiary Age (Steven 1974). The watershed is mainly comprised of igneous rocks of the Tertiary Age, specifically ash-flow tuff of main volcanic sequence and pre-ash-flow andesitic lavas, breccias, tuff, and conglomerates (Tweto 1979). The basin forms a wide, open valley, with the Lake Fork as a narrow, riparian corridor. Soils are undeveloped with medium to large gravels, deposits of sands and silts interspersed with small to large cobbles. Riparian vegetation spans the length of the site as a narrow, riparian area of over 20 miles of the middle reaches of the Lake Fork. Being this extensive, vegetation is variable throughout, with areas of dense canopy, sparse canopy, tall shrublands, and mesic herbaceous vegetation. Canopy species cover is variable with blue spruce (*Picea pungens*) being consistent throughout in moderate to low cover and narrowleaf cottonwood (*Populus angustifolia*) being dense in some reaches and absent in others. Thinleaf alder (*Alnus incana*) is consistent in low to moderate cover along the entire reach. Other tall shrubs include Drummond's willow (*Salix drummondiana*), narrowleaf willow (*Salix exigua*), park willow (*Salix monticola*), and Bebb's willow (*Salix bebbiana*). Along a few areas, tall shrubs form dense, open shrublands. Short shrubs include American red raspberry (*Rubus idaeus*), skunkbush sumac (*Rhus trilobata*), and Wood's rose (*Rosa woodsii*). Mesic graminoids include bluejoint (*Calamagrostis canadensis*) and water sedge (*Carex aquatilis*). Mesic forbs present include starry false lily of the valley (*Maianthemum stellatum*) and field horsetail (*Equisetum arvense*). Some areas of the drainage are heavily impacted by disturbance and support high cover of exotic species including common dandelion (*Taraxacum officinale*), common plantain (*Plantago major*), white clover (*Trifolium repens*), Kentucky bluegrass (*Poa pratensis*), and smooth brome (*Bromus inermis*). Exotic species are concentrated in heavily disturbed areas near town, private property, and high use public lands. Surrounding uplands are dominated by ponderosa pine (*Pinus ponderosa*) woodlands with patches

of xeric shrubland grassland communities. Surrounding land uses are also highly variable including private property with residential development, hay fields and grazing, and ponds for fishing and public reaches with access for fishing and camping. Main disturbances include grazing, hydrologic alterations, exotic species invasion, road proximity, and recreational use.

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are montane elevation, low gradient, seasonal flooding, and floodplain development.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B3): This site is drawn for a good (B-ranked) occurrence of the globally vulnerable (G3/S3) narrowleaf cottonwood - blue spruce / thinleaf alder (*Populus angustifolia - Picea pungens / Alnus incana*) woodland. There is also a fair (C-ranked) occurrence of the state rare (G4/S3) Black Swift (*Cypseloides niger*).

Natural Heritage element occurrences at the Lake Fork of the Gunnison River PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Birds	Cypseloides niger	Black Swift	G4	S3B			USFS	C	2005-08-18
Natural Communities	Populus angustifolia - Picea pungens / Alnus incana Woodland	Montane Riparian Forests	G3	S3				B	1993-06-29

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. Boundaries also include small tributaries, floodplain and overflow channels. However, the boundary does not include all hydrological processes necessary to the maintenance of site hydrology and upstream activities such as deforestation, improper livestock grazing, development, or water diversion could be detrimental to the site.

Protection Urgency Rank Comments (P3): Predominant land uses are highly variable including private property with residential development, hay fields and

grazing, and ponds for fishing and public reaches with access for fishing and camping. Protection varies throughout the site.

Management Urgency Rank Comments (M3): River system is viable throughout, but impacted by anthropogenic disturbances. Exotic species control and limiting use along corridor could help native species recover in weedy, disturbed areas.

Land Use Comments: Land use varies along the corridor from public access to developed and private access.

Exotic Species Comments: Exotics are common in many areas and include common dandelion (*Taraxacum officinale*), common plantain (*Plantago major*), white clover (*Trifolium repens*), Kentucky bluegrass (*Poa pratensis*), and smooth brome (*Bromus inermis*). These species are concentrated along disturbed and accessible reaches.

Off-Site Considerations: Off-site considerations include road proximity and maintenance, development, and weedy species introductions from use of surrounding uplands.

Version Author: Jones, J.R.
Version Date: 10/15/2006

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Map Date: 12/11/2006

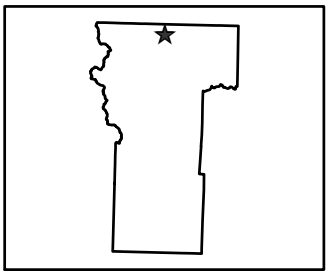
Legend

PCA Boundary

Durango, 37106-A1
Montrose, 38106-A1

1x2 Degree Digital Raster Graphic produced by the U.S. Geological Survey

Location in Hinsdale County



Lake Fork of the Gunnison River Potential Conservation Area, B3: High Biodiversity Significance

Los Pinos River

Biodiversity Rank - B3: High Biodiversity Significance

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

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Emerald Lake, Granite Lake, Granite Peak

Size: 3,992 acres (1,616 ha) **Elevation:** 7,950 - 10,400 ft. (2,423 - 3,170 m)

General Description: The site is situated along extensive reaches of the Pine River and Flint Creek, second and third order tributaries of the San Juan River. Both drainages are moderately sinuous with low to moderate gradient, and narrow, well-developed floodplains. Banks are stable and well-vegetated throughout. Surrounding uplands and mesic forests are dominated by variable cover of quaking aspen (*Populus tremuloides*), Engelmann spruce (*Picea engelmannii*), Douglas-fir (*Pseudotsuga menziesii*), and blue spruce (*Picea pungens*). Understory is mostly dominated by whortleberry (*Vaccinium myrtillus*), tall fringed bluebells (*Mertensia ciliata*), and Carolina bugbane (*Trautvetteria caroliniensis*). Surrounding land use is predominantly for recreation including hunting, camping, hiking and horseback riding. There is no evidence of recent or past extensive, anthropogenic disturbance. Natural disturbances include spring flooding, upstream beaver and avalanche activity, and wildlife use. Site encompasses multiple vegetation types including riparian woodlands, mesic forests, tall shrub wetlands, and small patches of herbaceous vegetation. Riparian areas consist of narrow floodplains dominated by tall shrubs with variable canopy and ground cover throughout. Tall shrub layers are dominated by thinleaf alder (*Alnus incana*) and Drummond's willow (*Salix drummondiana*). Other tall shrubs present include park willow (*Salix monticola*), strapleaf willow (*Salix ligulifolia*), Bebb's willow (*Salix bebbiana*), and greenleaf willow (*Salix lucida* ssp. *caudata*) which are more common along the Pine River reach. Variable canopy cover consists of blue spruce, quaking aspen, and a low cover of Engelmann spruce. Canopy cover is more dense and consistent along the Pine River reach. Short shrubs found along the drainage include twinberry honeysuckle (*Lonicera involucrata*) and American red raspberry (*Rubus idaeus*). Herbaceous species common along the riparian areas include tall fringed bluebells (*Mertensia ciliata*), Fendler's meadowrue (*Thalictrum fendleri*), common cowparsnip (*Heracleum maximum*), subalpine larkspur (*Delphinium barbeyi*), and bluejoint (*Calamagrostis canadensis*). Mesic forested elements cover extensive areas along the middle reaches of the Flint River with closed to moderately open canopy cover and a consistent forb layer. Canopy is dominated by Engelmann spruce with some subalpine fir (*Abies lasiocarpa*). In most areas the canopy layer is consistent creating a shaded, mesic forest floor. The herbaceous layer is dominated by Carolina

Tassel-rue (*Trautvetteria caroliniensis*) which forms extensive carpets in many areas. There are few exotic species including common dandelion (*Taraxacum officinale*), Kentucky bluegrass (*Poa pratensis*), and timothy (*Phleum pratense*) which are also more common along the Pine River reach.

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are gentle to moderate gradients, perennial surface hydrology, seasonal flooding, and groundwater discharge and recharge.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B3): This site is drawn for an excellent (A-ranked) occurrence of the globally vulnerable (G3/S3) thinleaf alder - Drummond's willow shrubland (*Alnus incana* - *Salix drummondiana* shrubland), an excellent (A-ranked) occurrence of the globally vulnerable (G3/S2?) subalpine fir / Carolina tasselrue forest (*Abies lasiocarpa / Trautvetteria caroliniensis* forest), and a good (B-ranked) occurrence of the globally vulnerable (G3/S3) narrowleaf cottonwood - blue spruce / thinleaf alder riparian woodland (*Populus angustifolia - Picea pungens / Alnus incana* woodland). Site also contains a good (B-ranked) occurrence of the globally apparently secure (G4/S4) community Drummond's willow / mesic forb tall shrubland (*Salix drummondiana* / mesic forb shrubland).

Natural Heritage element occurrences at the Los Pinos River 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 / Trautvetteria caroliniensis Forest	Subalpine Fir / Carolina Tasselrue	G3	S2?				A	2006-06-23
Natural Communities	Alnus incana - Salix drummondiana Shrubland	Montane Riparian Shrubland	G3	S3				A	2006-06-24
Natural Communities	Populus angustifolia - Picea pungens / Alnus incana Woodland	Montane Riparian Forests	G3	S3				B	2006-06-21
Natural Communities	Salix drummondiana / Mesic Forbs Shrubland	Drummonds Willow / Mesic Forb	G4	S4				B	2006-06-25

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

Boundary Justification: Site includes approximately 9 miles along the middle reaches of Pine River and Flint Creek, as well as surrounding areas important to the maintenance of site hydrology and 1,000 ft buffer (Keate 2004). This should account for natural hydrologic processes important to the maintenance of the elements such as seasonal flooding, groundwater recharge and discharge, surface flows, topography, and sediment deposition. However, activities such as deforestation, improper livestock grazing or recreational uses, development, or water diversion could be detrimental.

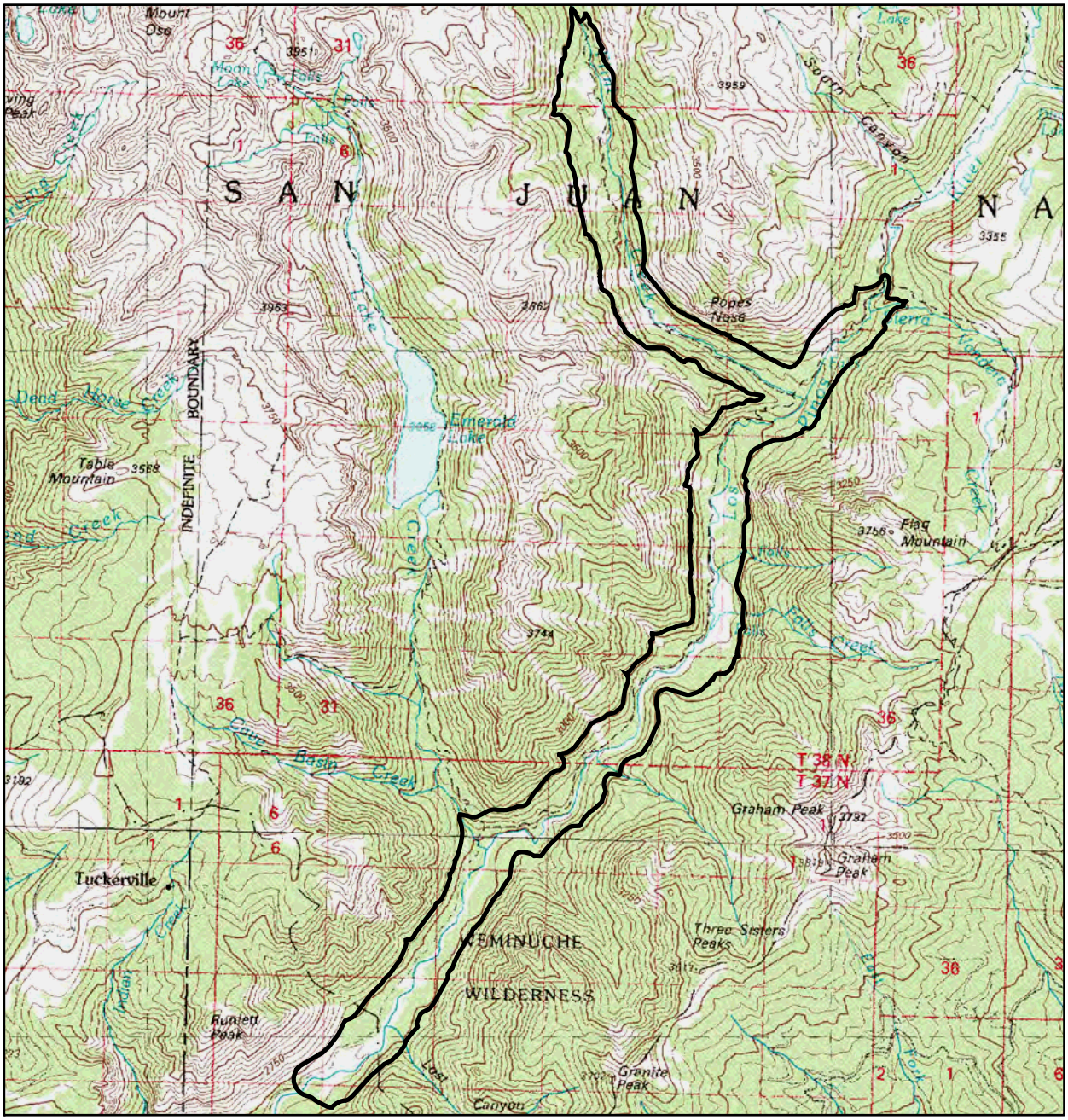
Protection Urgency Rank Comments (P3): Site is protected generally by the USFS as part of the Weminuche Wilderness within the San Juan National Forest, Columbine District. There are no current or immediate threats. Site may be impacted in the future due to proximity of trails to riparian areas.

Management Urgency Rank Comments (M4): Site exhibits no need of immediate management. Future management may be needed if use is increased or altered.

Exotic Species Comments: Exotics include Kentucky bluegrass (*Poa pratensis*), timothy (*Phleum pratense*), and dandelion (*Taraxacum officinale*). Exotics are more common along lower reaches of the Pine River, but do not cover extensive areas.

Version Author: Jones, J.R.

Version Date: 10/15/2006



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Map Date: 12/11/2006

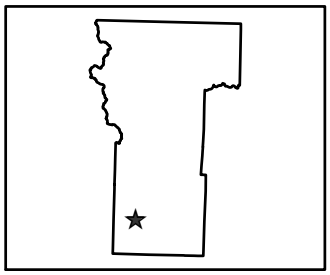
Legend

PCA Boundary

Durango, 37107-A1
Silverton, 37107-E1

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

Location in Hinsdale County



Los Pinos River Potential Conservation Area, B3: High Biodiversity Significance

Middle Fork Piedra River

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: Oakbrush Ridge

Size: 827 acres (335 ha) **Elevation:** 7,800 - 8,400 ft. (2,377 - 2,560 m)

General Description: The montane riparian forest occurrence is situated along approximately 4.5 km of the lower reaches of the Middle Fork of the Piedra River. The Middle Fork is a second order tributary of the Piedra River that flows through a wide valley, with glacial alluvium and drifts along upper reaches narrowing along lower reaches. The floodplain is variable throughout, with large backwater sloughs and narrow, sinuous sections. Banks are stable and vegetated throughout, with large boulders and cobbles along the streambed. The riparian community occurs consistently along the length of the river corridor for approximately 4.5 km. Blue spruce (*Picea pungens*) forms a consistent canopy throughout the occurrence. Other canopy species present include quaking aspen (*Populus tremuloides*) and ponderosa pine (*Pinus ponderosa*), both with low cover. A subcanopy is composed of a tall shrub layer and sapling blue spruce. The tall shrub layer is diverse with thinleaf alder (*Alnus incana*), park willow (*Salix monticola*), narrowleaf willow (*Salix exigua*), Drummond's willow (*Salix drummondiana*), and strapleaf willow (*Salix ligulifolia*) all being consistent. Sandbars support sapling blue spruce and dense willow communities. Short shrubs occurring along the banks of the river include twinberry honeysuckle (*Lonicera involucrata*) and Wood's rose (*Rosa woodsii*). Herbaceous vegetation is sparse, but the most common species include common cowparsnip (*Heracleum maximum*), Northwest Territory sedge (*Carex utriculata*), cutleaf coneflower (*Rudbeckia laciniata* var. *ampla*), and bluejoint (*Calamagrostis canadensis*). There are multiple backwater sloughs dominated by herbaceous graminoids. Adjacent uplands are dominated by xeric ponderosa pine woodlands. Quaking aspen forms a consistent component in the canopy and subcanopy layer with Gambel's oak (*Quercus gambelii*) and roundleaf snowberry (*Symphoricarpos rotundifolius*) dominating the shrub layer. Exotic species are not common along riparian areas but are present in adjacent uplands. Common dandelion (*Taraxacum officinale*), white clover (*Trifolium repens*), red clover (*Trifolium pratense*), cheatgrass (*Bromus tectorum*), and Kentucky bluegrass (*Poa pratensis*) are common. Disturbances in the area include livestock grazing, an adjacent road, camping and recreational uses, and upstream water diversion. Toner Taylor Ditch water diversion runs adjacent to the river for about 1.5 miles. Livestock use this, instead of the river, as a water source.

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are montane elevation, perennial surface flows, low gradient, and seasonal flooding.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B3): This site is drawn for a good (B-ranked) occurrence of the globally vulnerable (G3/S3) blue spruce / thinleaf alder riparian wetland (*Picea pungens* / *Alnus incana* woodland). This site also contains a good (B-ranked) occurrence of a state rare (G4/S3) park willow (*Salix monticola*) / mesic forbs shrubland.

Natural Heritage element occurrences at the Middle Fork Piedra River 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 pungens / Alnus incana Woodland	Montane Riparian Forests	G3	S3				B	2006-06-13
Natural Communities	Salix monticola / Mesic Forbs Shrubland	Montane Riparian Willow Carr	G4	S3				B	1994-08-01

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all hydrological processes necessary to the maintenance of site hydrology and upstream activities such as deforestation, improper livestock grazing, development, or water diversion could be detrimental to the site. Sections of an adjacent road and ditch, which may impact site hydrology and wetland functions, are also included. This may help to identify and manage for possible impacts from these disturbances.

Protection Urgency Rank Comments (P3): The site is managed by the USFS as part of the San Juan National Forest, but no special protection measures are in place. It is not immediately threatened.

Management Urgency Rank Comments (M3): Management may be needed to insure livestock grazing does not negatively impact the site and that exotic species do not become more common along the drainage.

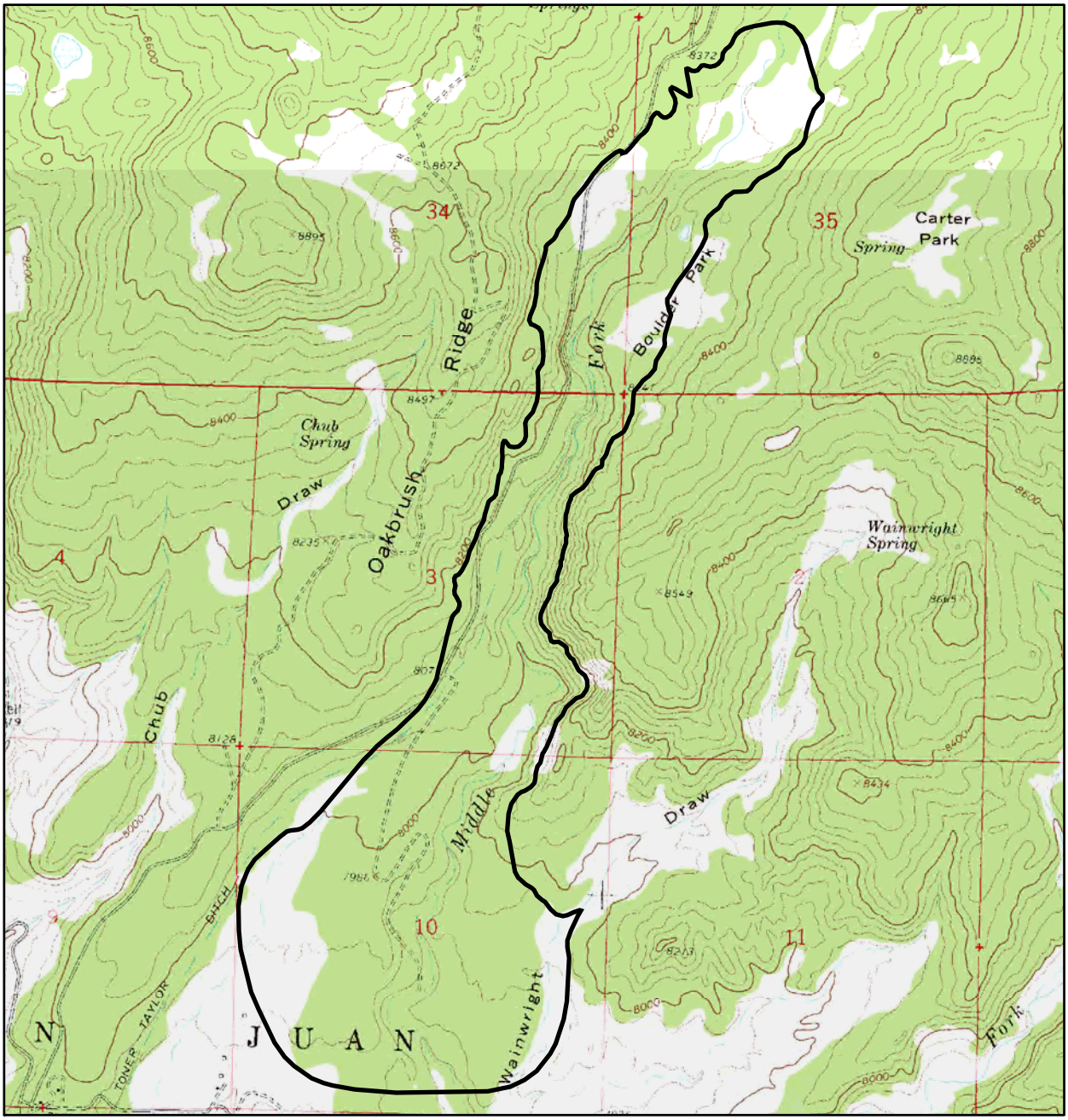
Land Use Comments: Predominant land uses include livestock grazing and recreation. Water diversion along the upper reaches of the drainage may impact the site.

Natural Hazard Comments: Spring flooding is the most evident natural hazard.

Exotic Species Comments: Exotic species are common in surrounding uplands due to roads, livestock grazing, and water diversion disturbances. Common dandelion (*Taraxacum officinale*), white clover (*Trifolium repens*), red clover (*Trifolium pratense*), cheatgrass (*Bromus tectorum*), and Kentucky bluegrass (*Poa pratensis*) are common. These species are not common along riparian reaches, but there is a possibility for invasion.

Off-Site Considerations: Off-site considerations include livestock impacts and recreational uses.

Version Author: Jones, J.R.
Version Date: 10/15/2006



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Map Date: 12/11/2006

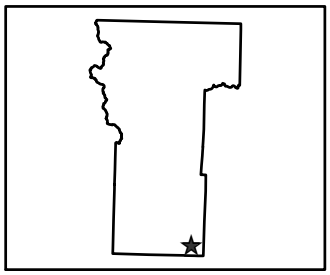
Legend

PCA Boundary

Oakbrush Ridge, 37107-D2

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

Location in Hinsdale County



Middle Fork Piedra River Potential Conservation Area, B3: High Biodiversity Significance

Pole Creek

Biodiversity Rank - B3: High 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: Pole Creek Mountain, Rio Grande Pyramid

Size: 1,177 acres (476 ha) **Elevation:** 10,400 - 11,200 ft. (3,170 - 3,414 m)

General Description: This site is drawn for a large subalpine willow carr along the upper reaches of Pole Creek. Pole Creek forms the boundary between San Juan and Hinsdale counties, and is a major tributary of the Rio Grande River, which flows through a glaciated U-shaped valley. The stream is low gradient with a relatively wide, well-defined floodplain. To the south, the slope is dominated by Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*). To the north, the slope is open, dominated by a community of mesic forbs. Two riparian willow communities were documented here by CNHP in 1995. The Wolf's willow (*Salix wolfii*) dominated community was located on Bear Creek at the confluence of the Rio Grande. Shrub cover in this community was 80%, with 60% Wolf's willow and 20% Booth's willow (*Salix boothii*). Associated species included water sedge (*Carex aquatilis*), Baltic rush (*Juncus balticus*), Virginia strawberry (*Fragaria virginiana*), and violet (*Viola* sp.). The Colorado Division of Wildlife stocked Rio Grande cutthroat trout (*Oncorhynchus clarkii virginialis*) from brood stock in the creek in 1996. The purity rank of these fish was A. The creek was surveyed in 1995 by Colorado Natural Heritage Program as part of the riparian survey. The area is a Forest Service Recreation Site used for hunting, fishing and hiking.

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are moderate gradient, groundwater discharge along southern slopes, seasonal flooding, and subalpine elevation.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B3): This site is drawn for good (B-ranked) occurrences of two globally vulnerable (G3/S3) riparian plant communities, Booth's willow (*Salix boothii*) / mesic forbs shrubland and Wolf's willow (*Salix wolfii*) / mesic forbs shrubland.

Natural Heritage element occurrences at the Pole 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 boothii / Mesic Forbs Shrubland	Booth's Willow / Mesic Forb	G3	S3				B	1995-08-26
Natural Communities	Salix wolfii / Mesic Forbs Shrubland	Subalpine Riparian Willow Carr	G3	S3				B	2006-08-31

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. The boundary does not include all hydrological processes necessary to the maintenance of site hydrology and upstream activities such as deforestation, improper livestock grazing, development, or water diversion could be detrimental to the site.

Protection Urgency Rank Comments (P4): The site is entirely within the Rio Grande National Forest.

Management Urgency Rank Comments (M3): Cattle were observed in the creek. Livestock use may be detrimental to natural vegetation communities, adding to the amount of increaser and non-native species.

Land Use Comments: Predominant land uses are recreation, including hunting, camping, and OHV use and livestock grazing.

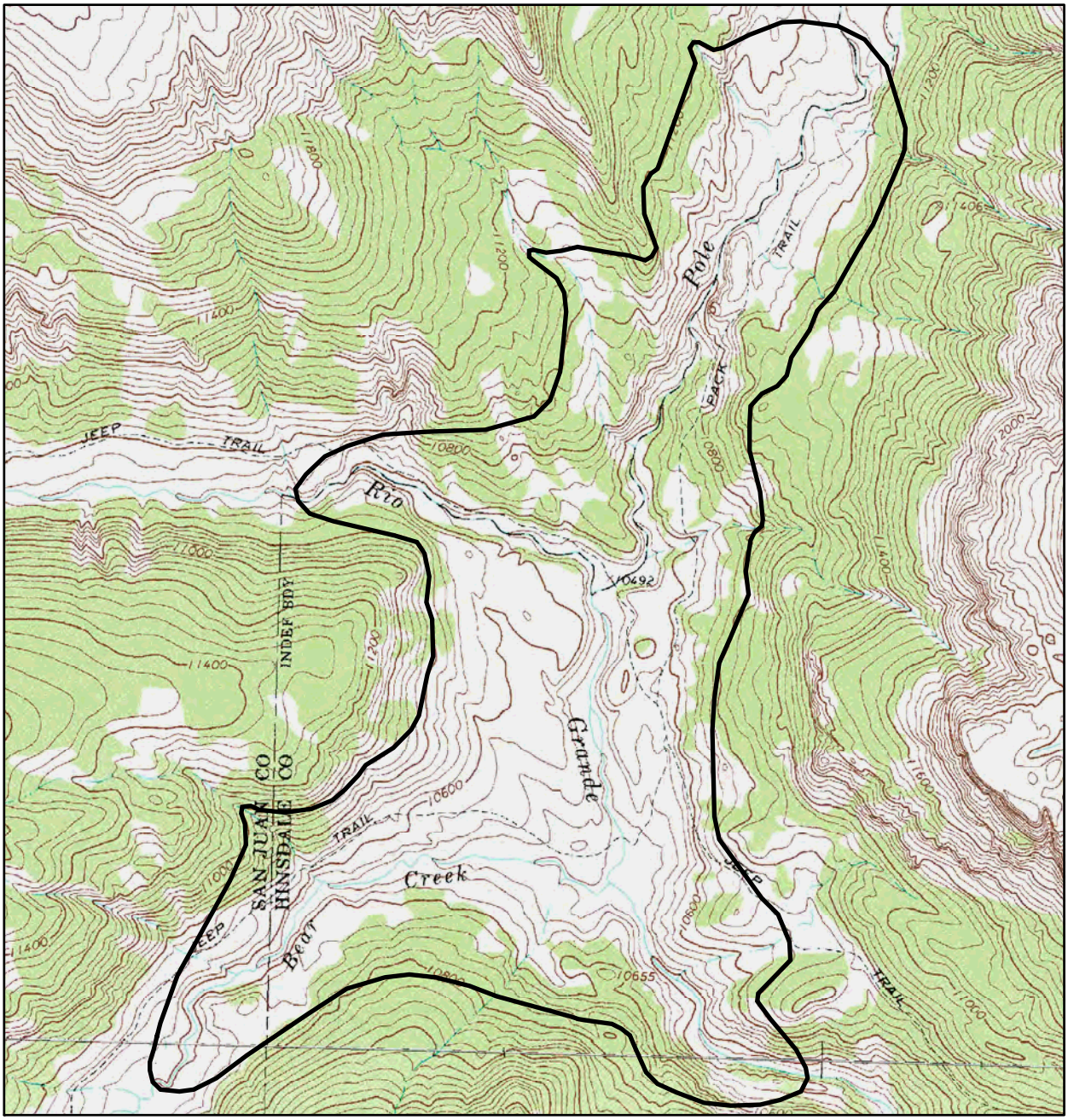
Natural Hazard Comments: Natural hazards are limited to spring flooding and possible avalanche activity on surrounding slopes.

Exotic Species Comments: Common dandelion (*Taraxacum officinale*) is the most common exotic in the area.

Off-Site Considerations: Off-site considerations include OHV use, livestock grazing, and road maintenance.

Version Author: Jones, J.R.

Version Date: 10/16/2006



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Map Date: 01/18/2007

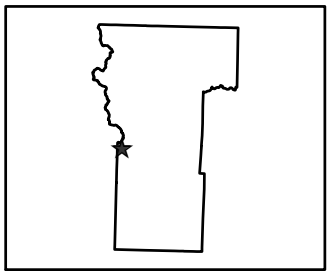
Legend

PCA Boundary

Rio Grande Pyramid, 37107-F4
Pole Creek Mountain, 37107-G4

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

Location in Hinsdale County



Pole Creek Potential Conservation Area, B3: High Biodiversity Significance

Rincon la Vaca

Biodiversity Rank - B3: High Biodiversity Significance

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

Management Urgency Rank - M5: Not Needed; No Threats Anticipated

U.S.G.S. 7.5-minute quadrangles: Weminuche Pass

Size: 149 acres (60 ha) **Elevation:** 11,000 - 11,600 ft. (3,353 - 3,536 m)

General Description: The site is located in the bottom of the Weminuche Valley on benches just up above the Los Pinos River on stream-deposited soils. The shrub carr is dominated by Wolf's willow (*Salix wolfii*) and diamondleaf willow (*S. planifolia*). Herbaceous cover is dominated by forbs, especially bluebells (*Mertensia ciliata*). There are exotic species present including dandelion (*Taraxacum officinale*). Adjacent uplands slope very steeply out of the riparian corridor and are comprised of spruce - fir forest.

Biodiversity Significance Rank Comments (B3): The biodiversity significance rank is based on a good (B-ranked) occurrence of a globally vulnerable (G3/S3) plant community, *Salix wolfii* / mesic forbs.

Natural Heritage element occurrences at the Rincon la Vaca 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	1995-07-26

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

Boundary Justification: The boundary encompasses the occurrence and an approximate 1,000 foot buffer. This boundary should protect the occurrence from direct disturbance, and is thought to protect the avian, macroinvertebrate and periphyton communities and limit impacts from sedimentation (see Noel et al. 1986, Spackman and Hughes 1995, Karr and Schlosser 1978).

Protection Urgency Rank Comments (P5): The site is contained in the Weminuche Wilderness Area in the San Juan National Forest.

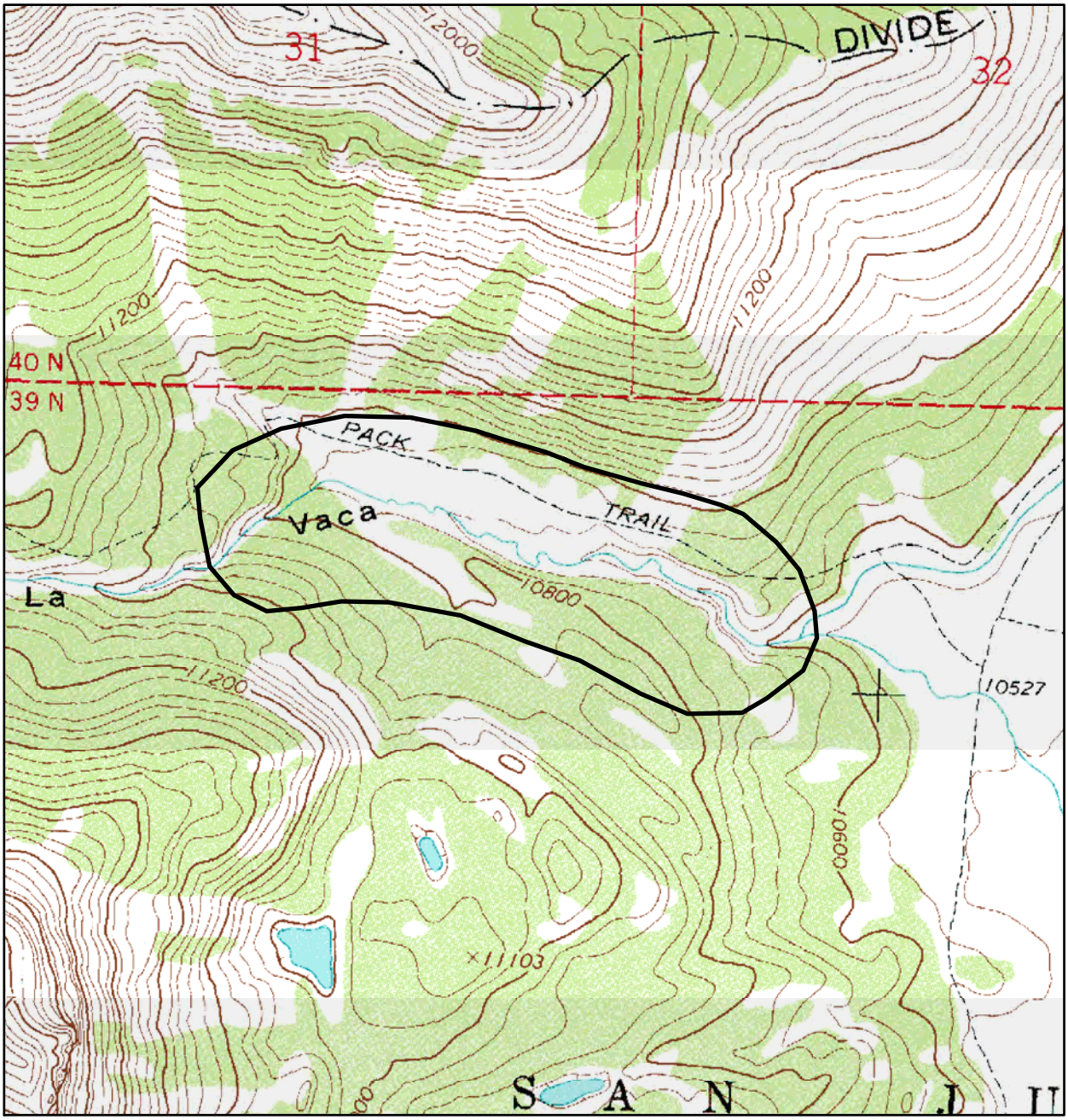
Management Urgency Rank Comments (M5): No serious management needs are known or anticipated at this site.

Exotic Species Comments: There are exotic species present including dandelion (*Taraxacum officinale*).

Off-Site Considerations: Hydrological processes originating outside of the planning boundary, including water quality, quantity, timing and flow must be managed to maintain site viability.

Version Author: Kettler, S.M.

Version Date: 06/09/1997



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Map Date: 05/27/2008

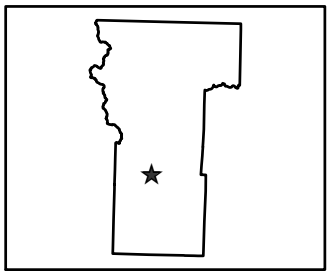
Legend

PCA Boundary

Weminuche Pass, 37107-F3

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

Location in Hinsdale County



Rincon la Vaca Potential Conservation Area, B3: High Biodiversity Significance

Squaw Creek at Chief Mountain

Biodiversity Rank - B3: High Biodiversity Significance

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

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Little Squaw Creek, Weminuche Pass

Size: 1,379 acres (558 ha) **Elevation:** 9,630 - 10,750 ft. (2,935 - 3,277 m)

General Description: The site is drawn for riparian plant communities along a third order stream. Drummond's willow (*Salix drummondiana*) is the predominant shrub along the cobbly shoreline, especially in the wider valley that is punctuated with beaver ponds. Certain reaches flow through a steep, narrow canyon with greater tree cover of Engelmann spruce (*Picea engelmannii*). The riparian community is a narrow strip and is likely in early to mid successional stages; it is expected that greater tree cover of Engelmann spruce will develop over time. The Colorado Division of Wildlife stocks Rio Grande cutthroat trout (*Oncorhynchus clarkii virginialis*) in Squaw Creek.

Biodiversity Significance Rank Comments (B3): The site supports a good (B-ranked) occurrence of a globally vulnerable (G3/S3) *Salix drummondiana / Calamagrostis canadensis* montane willow carr.

Natural Heritage element occurrences at the Squaw Creek at Chief Mountain 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 drummondiana / Calamagrostis canadensis Shrubland	Lower Montane Willow Carrs	G3	S3				B	1995-08-27

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

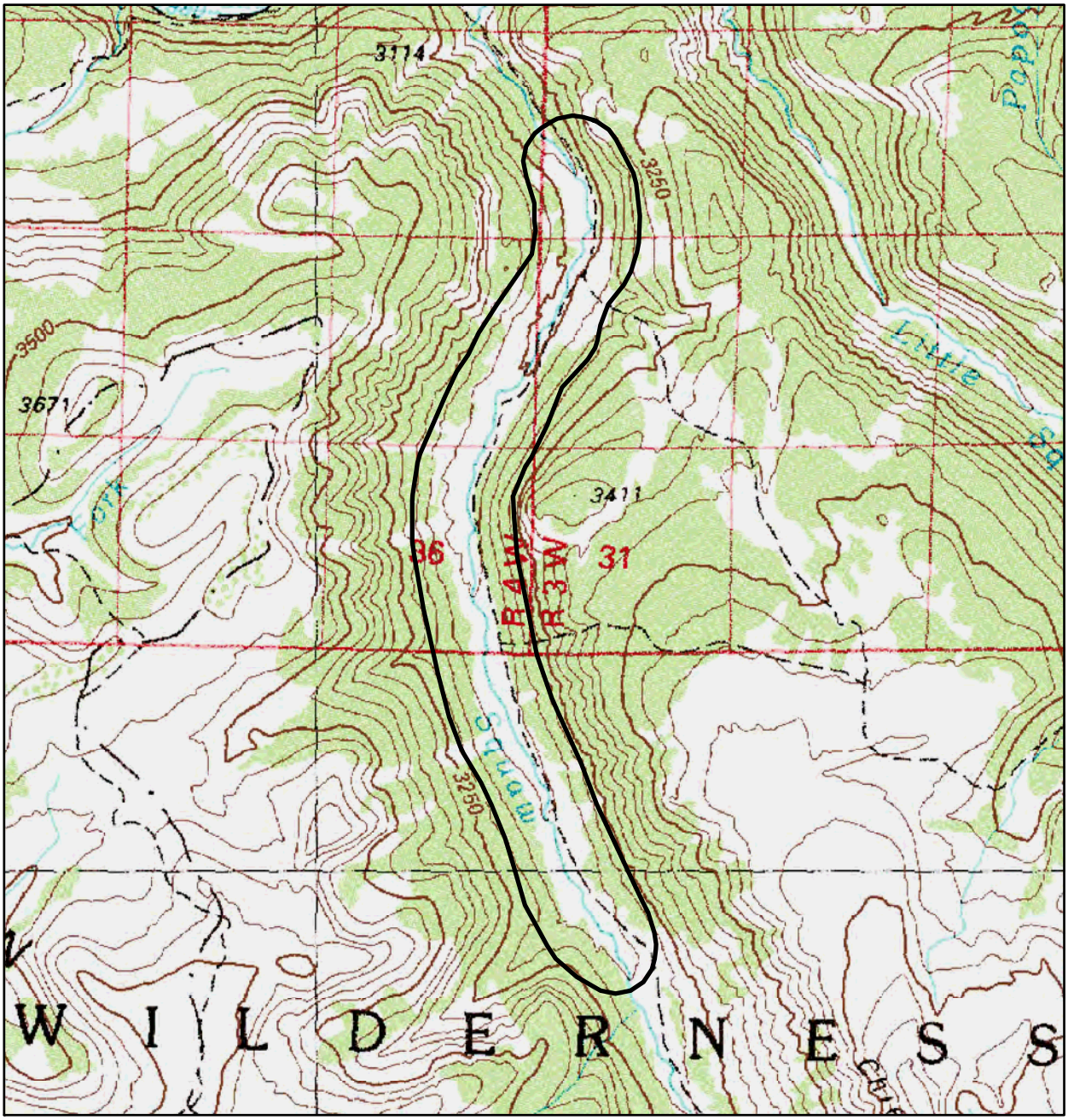
Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all ecological processes necessary to the maintenance of the site and activities such as mining, improper livestock grazing, recreational use, or water diversion could be detrimental to the site.

Protection Urgency Rank Comments (P5): This site is managed by USFS and is

within the Weminuche Wilderness.

Management Urgency Rank Comments (M4): This site receives significant recreational use from backpacking and horse packing; the Squaw Creek Trail parallels the drainage. No current grazing occurs in the area but signs of past grazing are evident such as the presence of exotics and grazing increasers like dandelion (*Taraxacum officinale*) and timothy (*Phleum pratense*).

Version Author: Neid, S.L.
Version Date: 05/05/2008



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Map Date: 05/21/2008

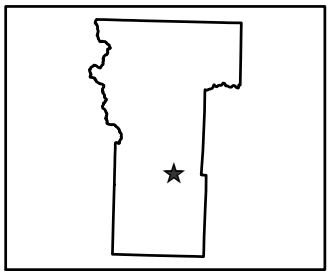
Legend

PCA Boundary

Silverton, 37107-E1

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

Location in Hinsdale County



Squaw Creek at Chief Mountain Potential Conservation Area, B3: High Biodiversity Significance

Upper Big Blue Creek

Biodiversity Rank - B3: High Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M5: Not Needed; No Threats Anticipated

U.S.G.S. 7.5-minute quadrangles: Uncompahgre Peak

Size: 209 acres (85 ha) **Elevation:** 11,920 - 12,580 ft. (3,633 - 3,834 m)

General Description: This site is drawn for wetlands in the wide, glaciated valley along the upper reaches of Big Blue Creek, a second order tributary of the Lake Fork of the Gunnison River. Riparian shrublands are positioned across the southeast-facing slopes above the main drainage along a series of small seeps and ephemeral streams. Bedrock geology consists of glacial drifts of the Quaternary Age and igneous rocks of the Tertiary Age, specifically, ash-flow tuff of main volcanic sequence and intra-ash flow andesitic lavas (Steven 1974, Tweto 1979). Soils consist of histic epipedons over silty to sandy clays, with inundated patches of well-developed fibric to hemic peats. The wetlands occur as a large mosaic of short willow shrubland and small patches of mesic herbaceous vegetation. Willow thickets are dominated by diamondleaf willow (*Salix planifolia*) with some shortfruit willow along drying edges. Mesic graminoids dominate the herbaceous layer throughout, with water sedge (*Carex aquatilis*) along saturated to inundated areas and bluejoint (*Calamagrostis canadensis*) along topographical rises and drier soils. Other herbaceous species include Northwest Territory sedge (*Carex utriculata*), redpod stonecrop (*Rhodiola rhodantha*), white marsh marigold (*Caltha leptosepala*), and sheep sedge (*Carex illota*). The riparian shrublands are interspersed with openings of water sedge dominated small-patch fens. Mesic shrublands grade into xeric, rocky uplands dominated by large expanses of shortfruit willow (*Salix brachycarpa*) and alpine meadows of mixed tufted hairgrass (*Deschampsia caespitosa*), creeping sibbaldia (*Sibbaldia procumbens*), Drummond's rush (*Juncus drummondii*), and Ross' avens (*Geum rossii*). Drainage exhibits little anthropogenic disturbance aside from an old homesite foundation. Evidence of sheep grazing was observed in adjacent drainages, but there was no evidence of current grazing in this area. Natural disturbances include avalanche activity, spring flooding, elk and deer grazing.

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are gentle to moderate gradient, groundwater recharge and discharge, alpine elevation, and peat accumulating soils.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B3): This site is drawn for an excellent (A-ranked) occurrence of the globally rare (G2Q/S2S3) diamondleaf willow / bluejoint - water sedge shrubland (*Salix planifolia / Calamagrostis canadensis - Carex aquatilis* shrubland).

Natural Heritage element occurrences at the Upper Big Blue 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 planifolia / Calamagrostis canadensis - Carex aquatilis Shrubland	Subalpine Riparian Willow Carr	G2Q	S2S3				A	2006-09-29

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all ecological processes necessary to the maintenance of site hydrology and upstream activities such as deforestation, improper livestock grazing, development, or water diversion could be detrimental to the site.

Protection Urgency Rank Comments (P4): Site is managed within the Uncompahgre Wilderness. There are no evident threats to the area.

Management Urgency Rank Comments (M5): No management is needed at this time but management may be needed if usage changes.

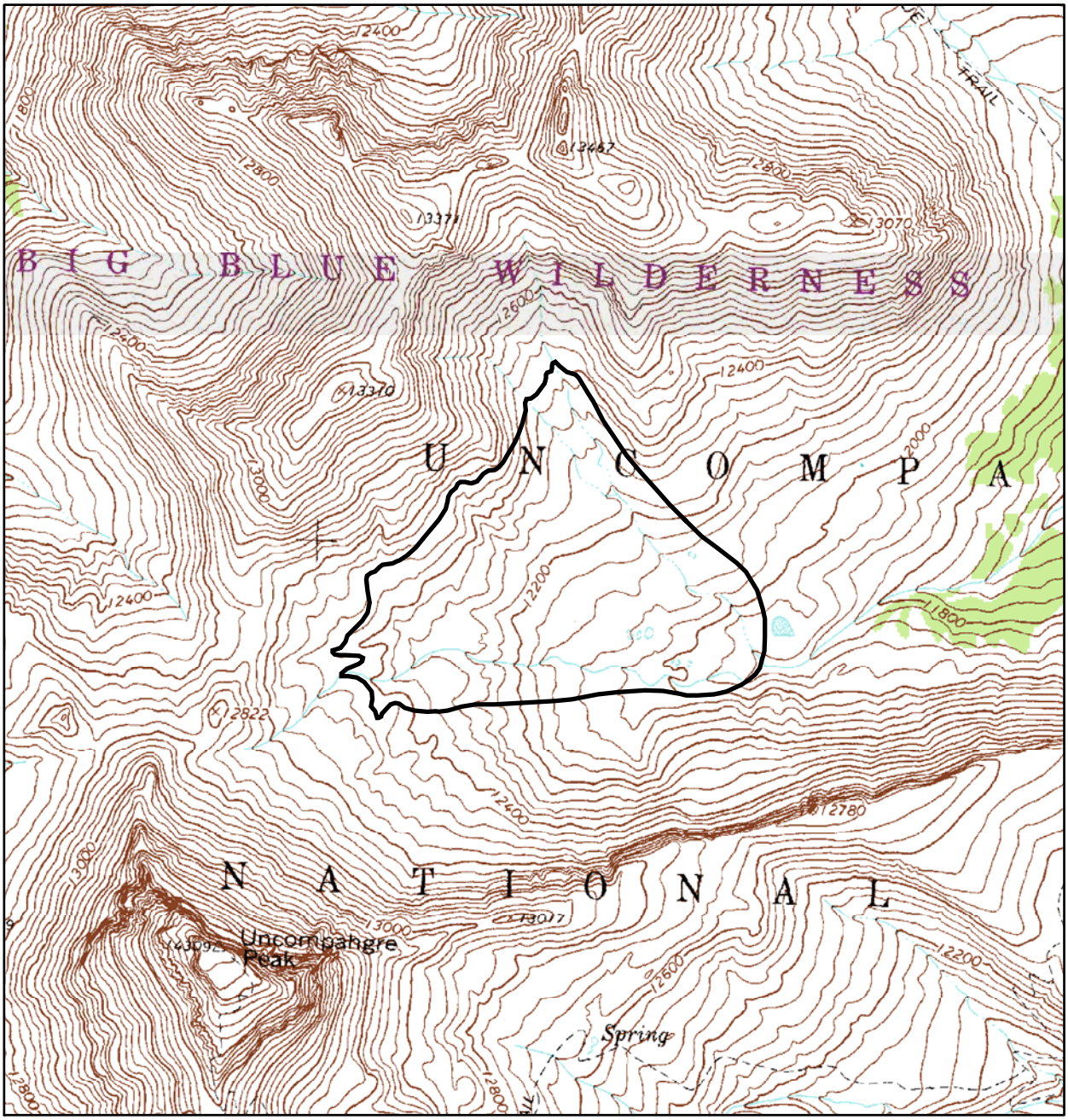
Land Use Comments: Predominant land uses include recreational use and sheep grazing during summer season.

Natural Hazard Comments: Avalanche activity during fall, winter, and spring is the primary natural hazard. Caution should be taken if traveling in the drainage during these times.

Exotic Species Comments: There were no exotics observed at the site and very few in the surrounding area.

Version Author: Jones, J.R.

Version Date: 10/15/2006



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Map Date: 12/11/2006

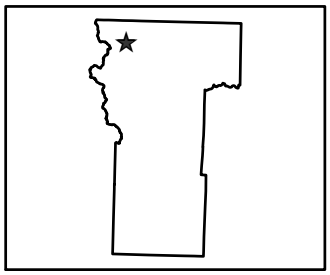
Legend

PCA Boundary

Uncompahgre Peak, 38107-A4

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

Location in Hinsdale County



Upper Big Blue Creek Potential Conservation Area, B3: High Biodiversity Significance

American Flats

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Handies Peak

Size: 743 acres (301 ha) **Elevation:** 12,000 - 13,000 ft. (3,658 - 3,962 m)

General Description: The site is situated along open, rolling, alpine reaches of the American Flats just northeast of Engineer Pass. The area is part of a large alpine expanse within the western slope of the volcanic San Juan Mountains that contains multiple springs forming the headwaters of Henson Creek. Bedrock geology consists of intermediate lavas and pyroclastic rocks of the Oligocene epoch (Steven 1974, Tweto 1979). The wetland occurs across a large, variable slope as small patches in late snow melt areas, small swales and mesic contours. Soils are dry to mesic in most areas with variable organic content. Dominant vegetation is composed of xeric alpine meadow species, with Ross' avens (*Geum rossii*), creeping sibbaldia (*Sibbaldia procumbens*), Parry's clover (*Trifolium parryi*), and tufted hairgrass (*Deschampsia caespitosa*). There are multiple seeps with perennial hydrology and hydric soils. Black alpine sedge (*Carex nigricans*) and Drummond's rush (*Juncus drummondii*) form small-patch communities along mesic contours, depressions, and late snow melt areas embedded throughout a predominantly dry alpine meadow . In multiple areas, black alpine sedge occurs as a near monoculture with small patches of Drummond's rush. Other graminoids common along mesic areas include tufted hairgrass, alpine timothy (*Phleum alpinum*), and native sedge (*Carex vernacula*). Forb species found in mesic areas include white marsh marigold (*Caltha leptosepala*), American alpine speedwell (*Veronica wormskjoldii*), and Eastwood's podistera (*Podistera eastwoodiae*). Upland species found in mesic areas include Ross' avens, Parry's clover, and creeping sibbaldia. No exotic species were observed . Anthropogenic disturbances include sheep grazing and recreational use (the Alpine Loop Road runs adjacent to the site). Old roads and mining use are evident along the flats, but no recent vehicular use was observed off of maintained roads. Natural disturbances include extreme alpine environment and wildlife use.

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are groundwater hydrology, alpine elevation, exposed, open aspects, and low gradient.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer

"monsoon" season.

Biodiversity Significance Rank Comments (B4): This site is drawn for an excellent (A-ranked) occurrence of the globally unranked (GU/S2) black alpine sedge - Drummond's rush (*Carex nigricans* - *Juncus drummondii*) alpine herbaceous wetland community.

Natural Heritage element occurrences at the American Flats 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	Carex nigricans - Juncus drummondii Herbaceous Vegetation	Alpine Wetlands	GU	S2				A	2006-08-19

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all ecological processes necessary to the maintenance of the site and activities such as mining, improper livestock grazing, recreational use, or water diversion could be detrimental to the site.

Protection Urgency Rank Comments (P4): The site is managed by the BLM, but no specific protection strategies are in place. Predominant land use is recreation and some late summer sheep grazing.

Management Urgency Rank Comments (M4): There is currently no change in management needed. Future management may be needed if grazing or recreational uses increase or change.

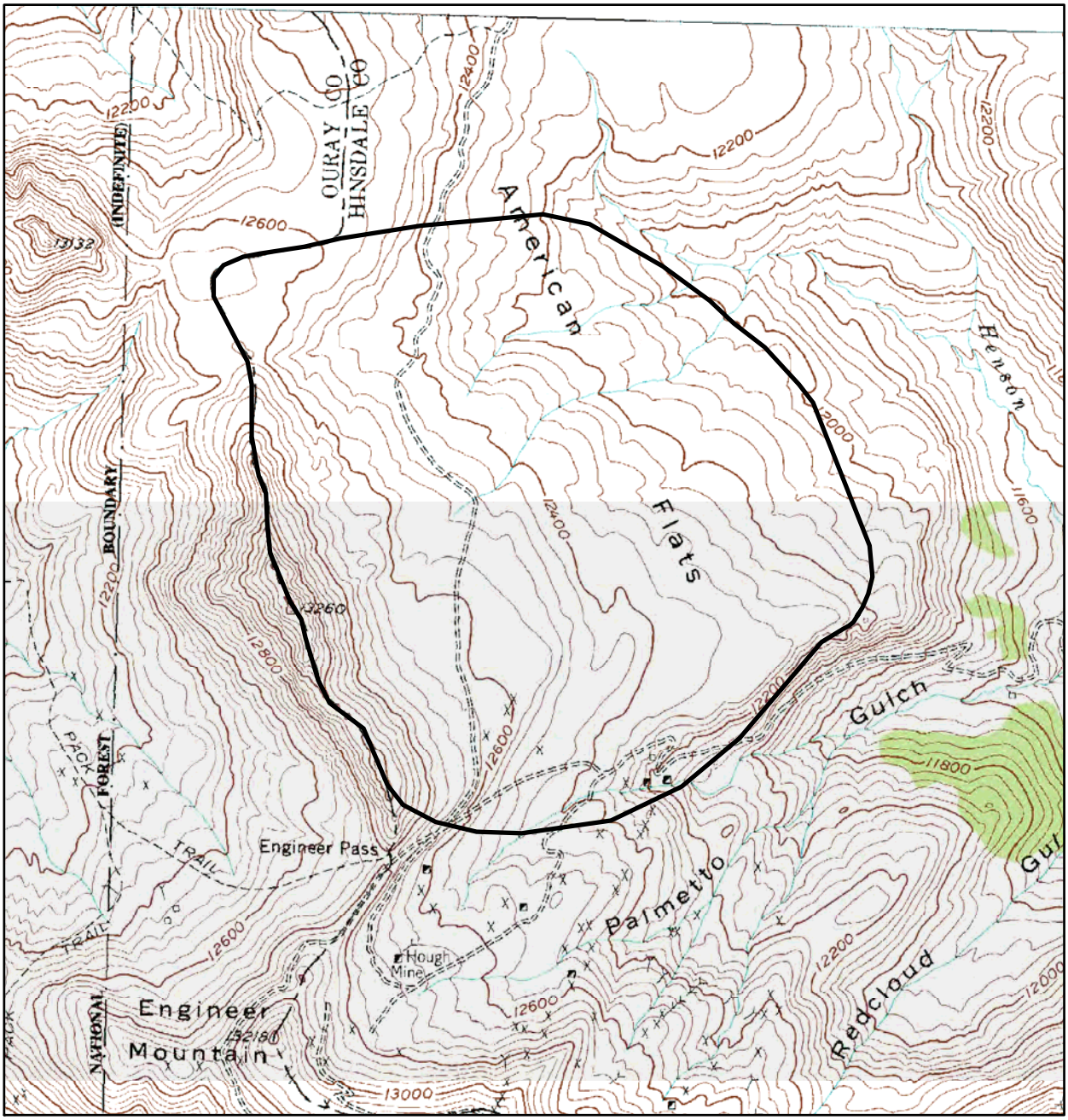
Land Use Comments: Predominant land uses include recreation and sheep grazing.

Natural Hazard Comments: Natural hazards include avalanches from steep western slopes and quickly changing weather.

Exotic Species Comments: No exotics were observed. Road may act as a conduit for exotic species.

Version Author: Jones, J.R.

Version Date: 10/15/2006



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Map Date: 01/18/2007

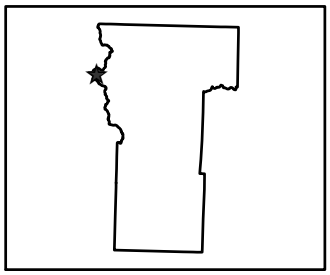
Legend

PCA Boundary

Handies Peak, 37107-H5

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

Location in Hinsdale County



American Flats Potential Conservation Area, B4: Moderate Biodiversity Significance

Cleveland Gulch

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Handies Peak

Size: 467 acres (189 ha) **Elevation:** 12,200 - 12,280 ft. (3,719 - 3,743 m)

General Description: The community occurrence is situated along the basin floor at the upper reaches of a large, open valley at the headwaters of Cleveland Gulch, a first order tributary of the Lake Fork of the Gunnison River. Surrounding mountains formed during the volcanic sequences of the western San Juans creating steep, scree slopes interspersed with seasonally saturated topographic rises. The wetland occurs along multiple seeps of similar contours at the base of surrounding scree fields. Seeps flood to the gently sloping basin floor, creating a complex of wetlands with mesic soils to shallow, open water pools. Soils vary from shallow histic epipedons over unconsolidated rock to histosols. Black alpine sedge (*Carex nigricans*) and Drummond's rush (*Juncus drummondii*) occur as small-patch communities in some areas and as minimal components of the larger wetland complex in other areas. Black alpine sedge forms near monocultures in multiple areas and is a consistent component throughout the upper reaches of the basin. Drummond's rush cover is patchy, but it is a consistent component throughout the wetland complex. Other graminoids common within the wetland include tufted hairgrass (*Deschampsia caespitosa*), sheep sedge (*Carex illota*), Tracy's rush (*Juncus tracyi*), and alpine timothy (*Phleum alpinum*). Water sedge (*Carex aquatilis*) is common in saturated areas and Altai cottongrass (*Eriophorum altaicum* var. *neogaeum*) is present at low cover. Common mesic forbs include white marsh marigold (*Caltha leptosepala*), American alpine speedwell (*Veronica wormskjoldii*), splitleaf groundsel (*Packera dimorphophylla*), and Parry's clover (*Trifolium parryi*). Drier species found along rises include Ross' avens (*Geum rossii*), pussytoes (*Antennaria* sp.), and creeping sibbaldia (*Sibbaldia procumbens*). No exotic species were observed. Surrounding uplands support very little vegetation and are dominated by unconsolidated rocks, with little soil development. Disturbances in the drainage are from past mining, with an old road grade still evident along side slopes and extensive mining along upper slopes. A stream running out of the upper basin shows evidence of aluminum precipitation along the stream bottom. These deposits are likely from draining from old mine sites upstream.

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are alpine elevation, low gradient, and perennial groundwater discharge.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B4): This site is drawn for an excellent (A-ranked) occurrence of the globally vulnerable (G4?T3T4/S3) Altai cottongrass (*Eriophorum altaicum* var. *neogaeum*) and a good (B-ranked) occurrence of the globally unranked (GU/S2) black alpine sedge - Drummond's rush (*Carex nigricans - Juncus drummondii*) alpine herbaceous wetland community.

Natural Heritage element occurrences at the Cleveland 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	Carex nigricans - Juncus drummondii Herbaceous Vegetation	Alpine Wetlands	GU	S2				B	2006-07-28
Vascular Plants	Eriophorum altaicum var. neogaeum	Altai cottongrass	G4?T3T4	S3			USFS	A	2006-07-28

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all hydrological processes necessary to the maintenance of site hydrology and upstream activities such as mining, improper recreational use, development, or water diversion could be detrimental to the site.

Protection Urgency Rank Comments (P4): There are no immediate threats. Predominant land uses include mining and minimal recreational uses.

Management Urgency Rank Comments (M4): Future management may be needed if tailings from surrounding mines add additional precipitates to the site.

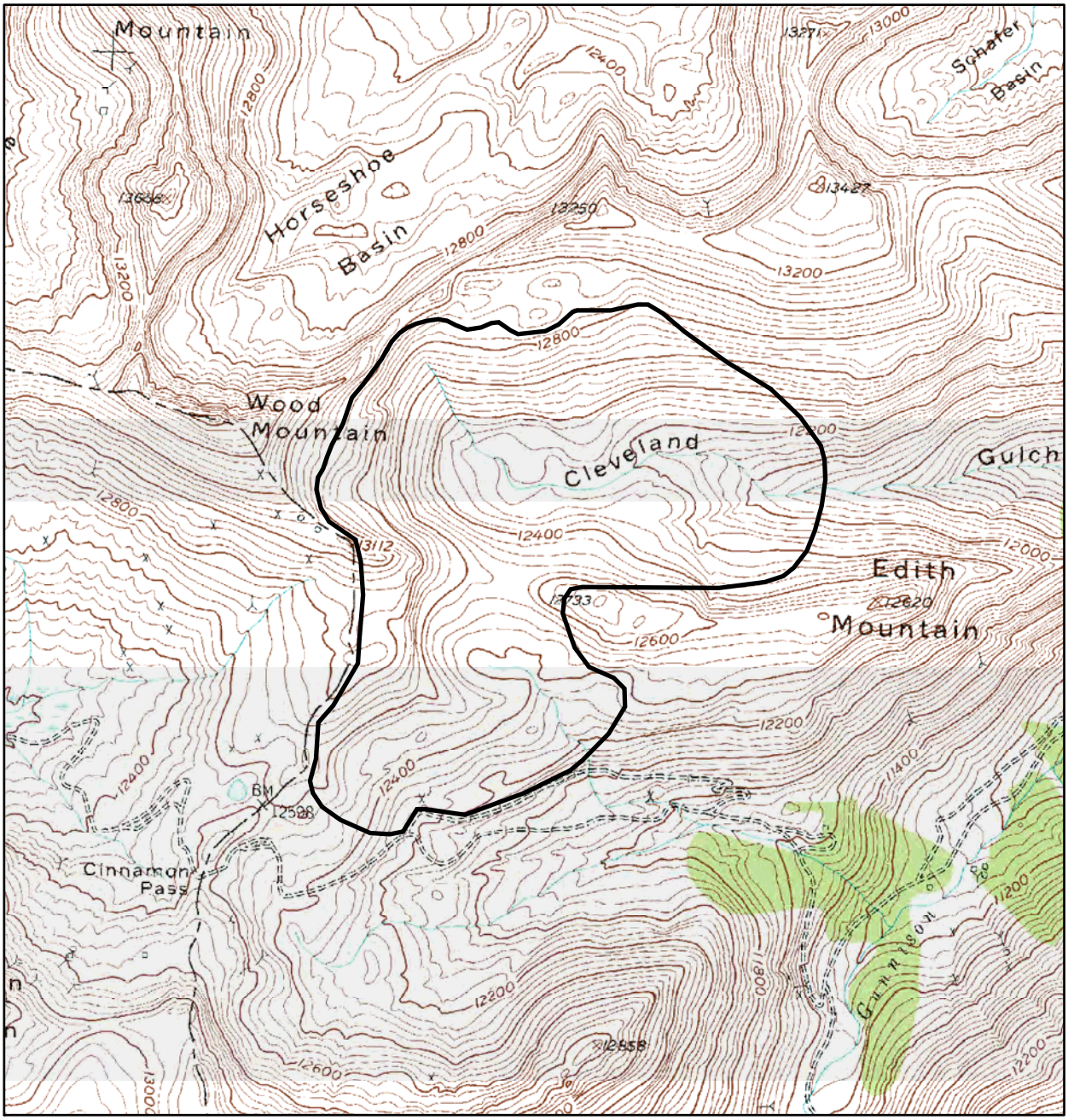
Land Use Comments: Predominant land use is recreation. There are multiple mining sites along adjacent uplands, however none appear active.

Natural Hazard Comments: Natural hazards in the drainage include avalanches and falling rock.

Exotic Species Comments: No exotics were observed.

Off-Site Considerations: Past mining in the drainage is the principal off-site concern.

Version Author: Jones, J.R.
Version Date: 10/15/2006



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Fax (970) 491-3349
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Map Date: 01/18/2007

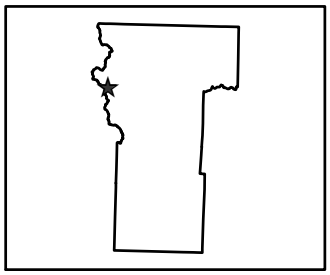
Legend

PCA Boundary

Handies Peak, 37107-H5

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

Location in Hinsdale County



Cleveland Gulch Potential Conservation Area, B4: Moderate Biodiversity Significance

Granite Lake

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M5: Not Needed; No Threats Anticipated

U.S.G.S. 7.5-minute quadrangles: Granite Lake

Size: 63 acres (25 ha) **Elevation:** 10,600 - 10,800 ft. (3,231 - 3,292 m)

General Description: The wetland is situated along an open basin at the convergence of two small draws creating an ephemeral tributary of Granite Lake. The wetland contains a few narrow, deep channels, with no apparent disturbances. The northwestern edge contains a small fen wetland with perennial, groundwater-fed hydrology. Soils are composed of histosols which are predominantly dry along surfaces with saturated patches and small rivulets throughout. General geology varies throughout the area with predominant geology consisting of igneous rocks of the Tertiary Age (Stevens 1974, Tweto 1979). Surrounding uplands consist of an open canopy of Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) woodlands with rocky, xeric understory. The main anthropogenic disturbance is an adjacent pack trail. This trail may act as a vector for the introduction of exotic species. Natural disturbances include spring flooding and wildlife use. The wetland occurs as a dense short shrubland dominated by diamondleaf willow (*Salix planifolia*) thickets. The herbaceous understory is dominated by bluejoint (*Calamagrostis canadensis*) which is most common along microtopographic rises and drier areas. Other common graminoids include tufted hairgrass (*Deschampsia caespitosa*) and water sedge (*Carex aquatilis*). Common forbs include Rocky Mountain hemlockparsley (*Conioselinum scopulorum*), redpod stonecrop (*Rhodiola rhodantha*), white marsh marigold (*Caltha leptosepala*), and American alpine speedwell (*Veronica wormskjoldii*). Edges of the wetland consist of a mosaic of dense shrubs with openings dominated by mesic herbaceous vegetation. A small, inundated fen wetland located along the northwestern edge of site is dominated by fewflower spikerush (*Eleocharis quinqueflora*) and a water sedge community. No exotic species were observed in the wetland. *Poa* sp. found in the wetland was identified as the native Kentucky bluegrass (*Poa agassizensis*).

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are moderate gradient, subalpine elevation, groundwater discharge, and seasonal flooding.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer

"monsoon" season.

Biodiversity Significance Rank Comments (B4): This site is drawn for an excellent (A-ranked) occurrence of the globally apparently secure (G4/S2S3) diamondleaf willow / bluejoint (*Salix planifolia / Calamagrostis canadensis*) shrubland.

Natural Heritage element occurrences at the Granite 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 planifolia / Calamagrostis canadensis Shrubland	Subalpine Riparian Willow Carr	G4	S2S3				A	2006-08-03

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all hydrological processes necessary to the maintenance of site hydrology and upstream activities such as deforestation, improper livestock grazing, development, or water diversion could be detrimental to the site.

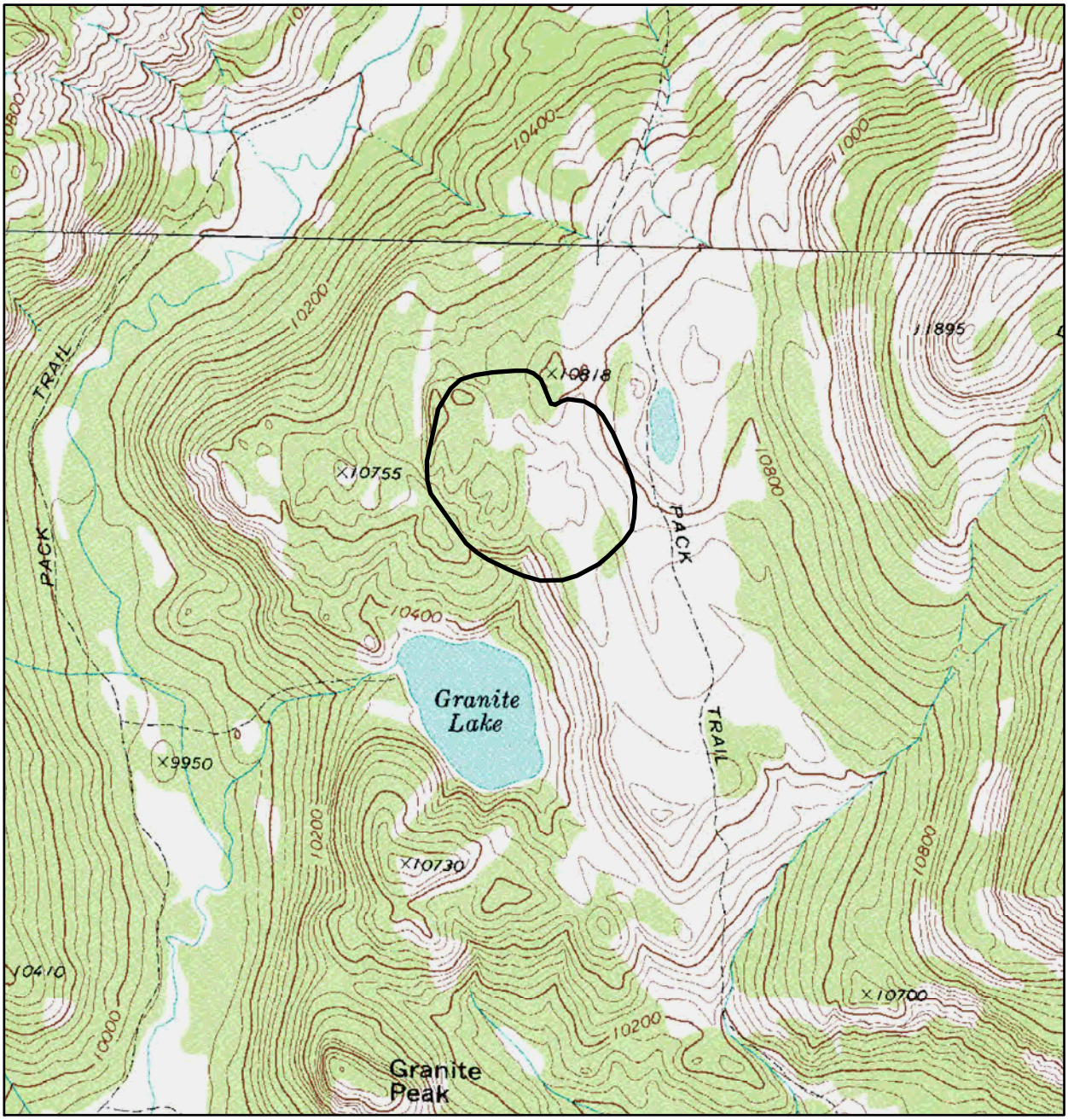
Protection Urgency Rank Comments (P4): The site is contained within the Weminuche Wilderness with no immediate threats.

Management Urgency Rank Comments (M5): There are no immediate threats. Adjacent pack trail does not appear to be impacting the wetland.

Land Use Comments: Predominant land use is recreation.

Exotic Species Comments: No exotics were observed.

Version Author: Jones, J.R.
Version Date: 10/15/2006



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Map Date: 01/18/2007

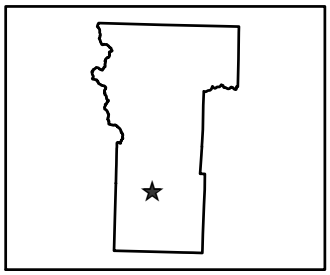
Legend

PCA Boundary

Granite Lake, 37107-E3

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

Location in Hinsdale County



Granite Lake Potential Conservation Area, B4: Moderate Biodiversity Significance

Indian Creek at Williams Creek Reservoir

Biodiversity Rank - B4: Moderate Biodiversity Significance

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

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Cimarrona Peak

Size: 64 acres (26 ha) **Elevation:** 9,200 - 10,000 ft. (2,804 - 3,048 m)

General Description: The Indian Creek at Williams Creek Reservoir site encompasses a riparian area along Indian Creek at 9,500 feet in the San Juan Mountains of Hinsdale County. The narrow valley runs north - south and drains Palisade Meadow into Williams Creek. The area is characterized by a steep canyon with slopes of over 50% and there are numerous slides forming pockets of open riparian areas along Indian Creek that are dominated by willow (*Salix* sp.). Drummond's willow (*Salix drummondiana*) / mesic forb riparian shrublands dominate these willow areas. Willows, including Rocky Mountain willow (*Salix monticola*), cover 100% of these areas and forbs, including woodreed (*Cinna latifolia*), cow parsnip (*Heracleum lanatum*), waterleaf (*Hydrophyllum capitatum*) and Franciscan bluebells (*Mertensia franciscana*), cover 70% of the ground. In more forested areas outside of the slides, thinleaf alder (*Alnus incana*) dominates. The upland areas of the hillside contain a mix of spruce (*Picea* sp.), fir (*Abies* sp.) and aspen (*Populus tremuloides*). Although the site is quite pristine, a trail runs directly through it and there are a few exotic plant species present that were probably introduced through activities on the trail.

Biodiversity Significance Rank Comments (B4): This site contains an excellent (A-ranked) occurrence of Drummond's willow (*Salix drummondiana*) / mesic forb, a plant community that is apparently secure on a global scale (G4/S4). This riparian shrubland occurs in the Wyoming Basin and the Southern Rocky Mountain ecoregions and is most commonly found on relatively steep streams, rarely forming more than a narrow, 5 to 25 feet wide band along streambanks. The closed to partially open canopy of Drummond's willow and a thick carpet of many forb species characterize this plant association.

Natural Heritage element occurrences at the Indian Creek at Williams Creek Reservoir 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 drummondiana / Mesic Forbs Shrubland	Drummonds Willow / Mesic Forb	G4	S4				A	1994-07-31

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

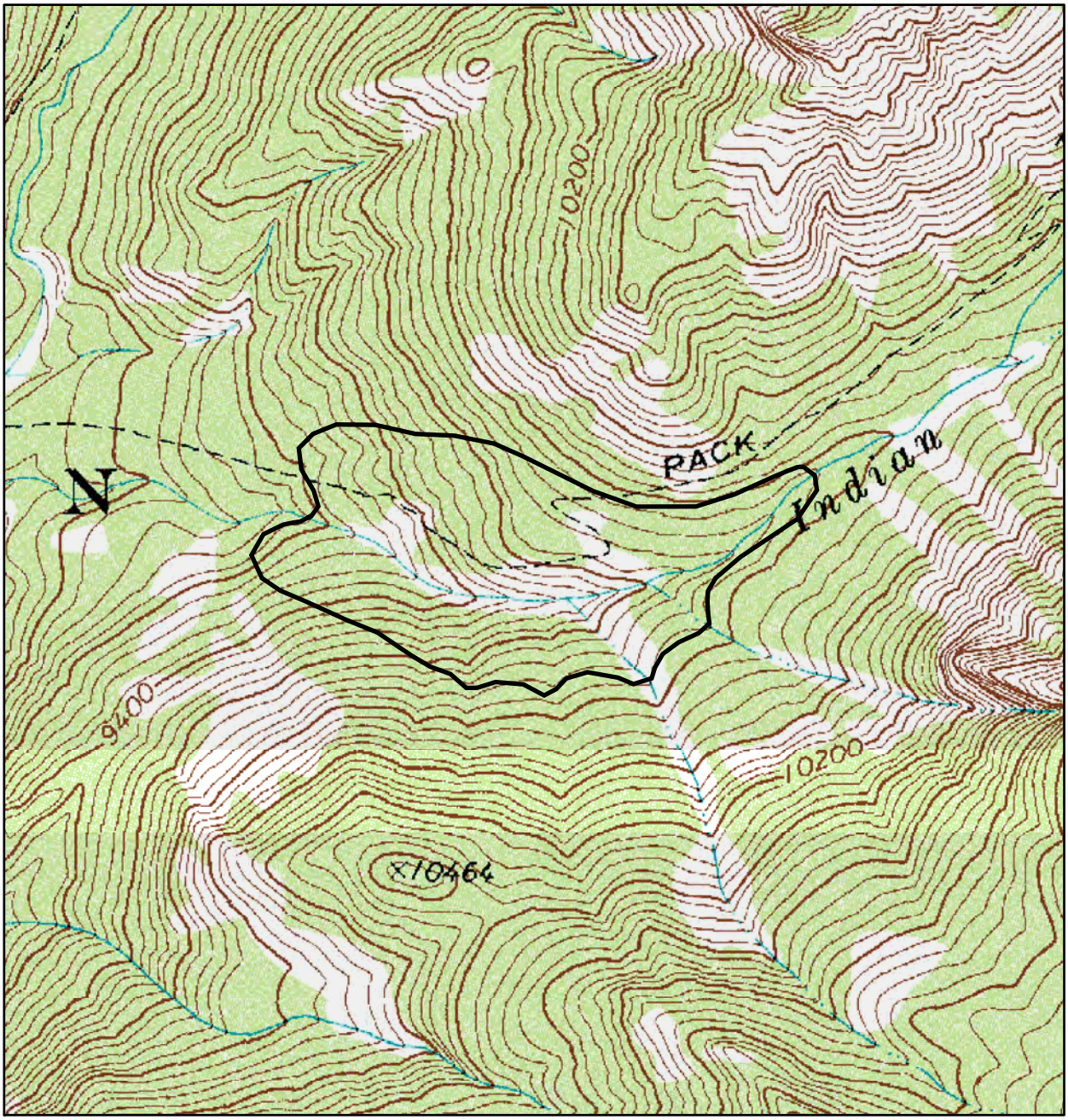
Boundary Justification: The boundary includes the occurrence and a small buffer up and downstream, and uphill of the creek. This buffer is intended to prevent impacts from trampling and to provide suitable habitat where additional individuals can become established over time. Eliminating disturbance within this 1,000-foot buffer would also aid in reducing impacts from sedimentation (Karr and Schlosser 1978), and assist in maintaining the integrity of the occurrence and its associated avian, macroinvertebrate and periphyton communities (Noel et al. 1986, Spackman and Hughes 1995). It should be noted that the hydrological processes necessary to the willow - forb community are not fully contained by the site boundaries. Given that the community is dependent on natural hydrological processes associated with Indian Creek, upstream activities such as water diversions, impoundments, and improper livestock grazing are detrimental to the hydrology of the riparian area. This boundary indicates the minimum area that should be considered for any conservation management plan.

Protection Urgency Rank Comments (P5): The site is contained entirely within the Weminuche Wilderness in the San Juan National Forest and present land protection is adequate. However, future changes in status or use of the land may warrant action.

Management Urgency Rank Comments (M4): Current management seems to favor the persistence of the willow / forb plant community, but management actions may be needed in the future to maintain its current quality. A trail running through the area is creating disturbance and could potentially lead to trampling and the introduction of exotic plant species. A monitoring program would aid in the detection of introduced exotic plants and identify necessary management actions to maintain the current quality of the site.

Version Author: Fayette, K.K.

Version Date: 04/11/1997



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Map Date: 05/27/2008

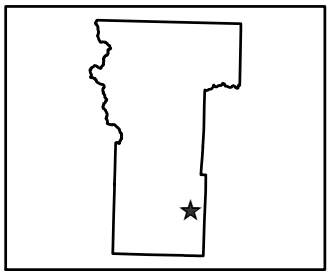
Legend

PCA Boundary

Cimarrona Peak, 37107-E2

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

Location in Hinsdale County



Indian Creek at Williams Creek Reservoir Potential Conservation Area, B4: Moderate Biodiversity Significance

Los Pinos River at Rincon la Osa

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: Weminuche Pass

Size: 66 acres (27 ha) **Elevation:** 10,160 - 10,240 ft. (3,097 - 3,121 m)

General Description: This site is a sedge meadow in wide valley at the base of Los Pinos River that receives indirect moisture from seeps upslope. It is dominated by sedges, especially smallwing sedge (*Carex microptera*). Thick willow carrs dominated by diamondleaf willow (*Salix planifolia*) line the riparian corridor. The willow carrs and sedge meadow transition to open meadows and subalpine spruce / fir forest in the adjacent uplands. Meadow vegetation is dominated by cinquefoil (*Pentaphylloides floribunda*), Thurber fescue (*Festuca thurberi*), bluegrass (*Poa* sp.) and mixed forbs. Dense stands of subalpine spruce / fir forest with some aspen thickets occur on south-facing toe slopes. The area is grazed by livestock, although not enough to alter the riparian community to a great extent as seen in other park areas nearby. To the north of the wet meadow is a large outfitters camp. Some upland meadow sites have a high percentage of dandelion (*Taraxacum officinale*) and pasture species are present (e.g. *Phleum alpinum, Poa pratensis*).

Biodiversity Significance Rank Comments (B4): The site supports a good (B-ranked) occurrence of a state rare (G4/S2?) smallwing sedge (*Carex microptera*) montane wetland.

Natural Heritage element occurrences at the Los Pinos River at Rincon la Osa 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	Carex microptera Herbaceous Vegetation	Montane Wetland	G4	S2?				B	1995-07-26

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

Boundary Justification: The boundary encompasses the occurrence and an approximate 1,000 foot buffer. This boundary should protect the occurrence from direct disturbance, and is thought to protect the avian, macroinvertebrate and periphyton communities and limit impacts from sedimentation (see Noel et al. 1986, Spackman and Hughes 1995, Karr and Schlosser 1978).

Protection Urgency Rank Comments (P5): The site is contained in the Weminuche

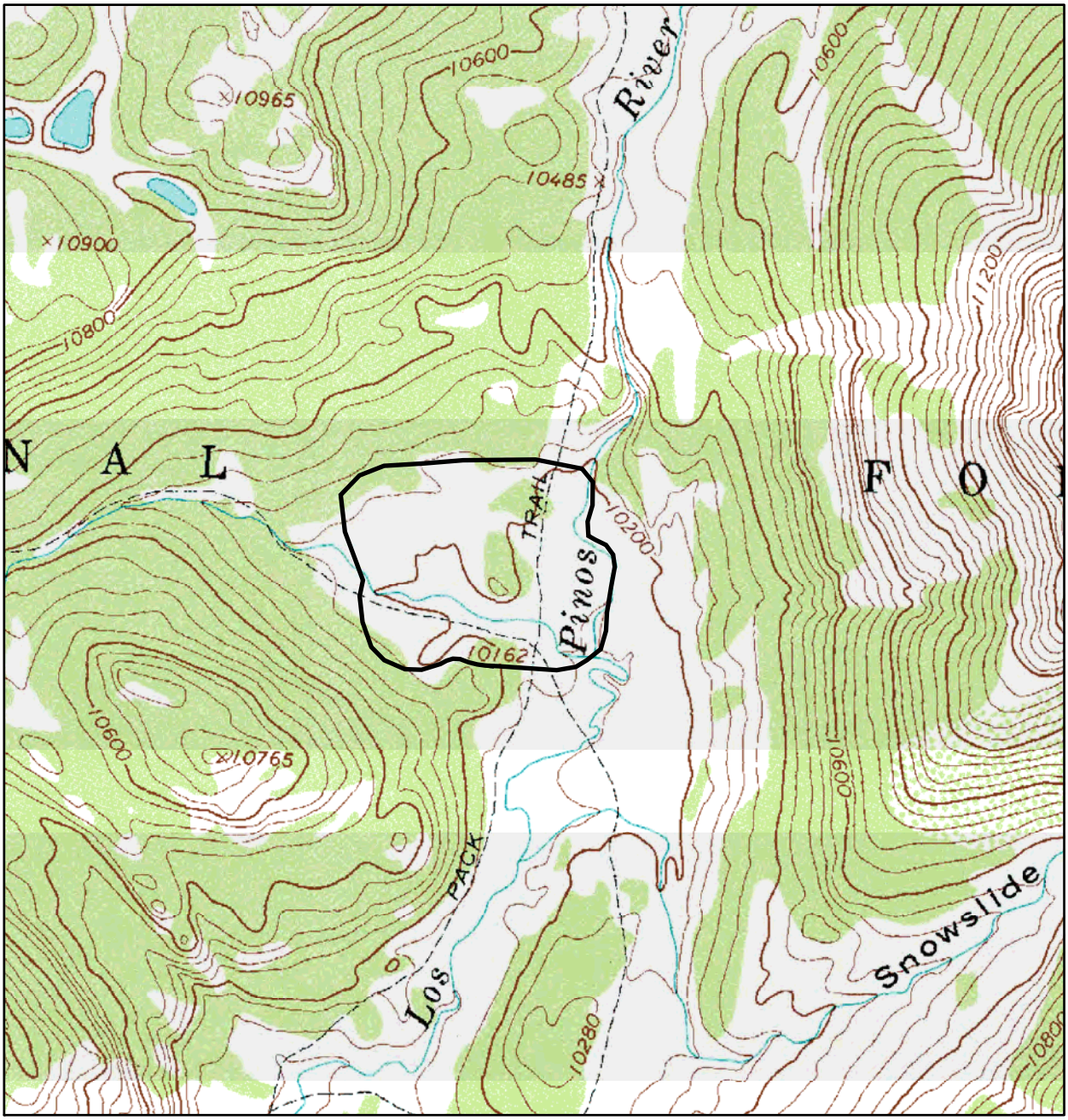
Wilderness in San Juan National Forest.

Management Urgency Rank Comments (M3): Management may be needed within 5 years to reduce non-native species introduction impacts from use of pack trail and grazing.

Exotic Species Comments: Some upland meadow sites have a high percentage of dandelion (*Taraxacum officinale*) and pasture species are present (e.g. *Phleum alpinum, Poa pratensis*).

Off-Site Considerations: Hydrological processes originating outside of the planning boundary, including water quality, quantity, timing and flow must be managed to maintain site viability.

Version Author: Kettler, S.M.
Version Date: 06/09/1997



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Map Date: 12/11/2006

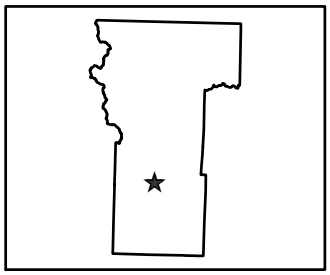
Legend

PCA Boundary

Weminuche Pass, 37107-F3

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

Location in Hinsdale County



Los Pinos River at Rincon la Osa Potential Conservation Area, B4: Moderate Biodiversity Significance

North Fork of Sand Creek

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Granite Lake

Size: 1,934 acres (783 ha) **Elevation:** 10,600 - 12,000 ft. (3,231 - 3,658 m)

General Description: This site is drawn for a large wetland complex situated along the upper reaches of multiple tributaries of Weminuche Creek and the Los Pinos River. The wetland complex is a mosaic of fens, wet meadows and patches of mesic forest. Bedrock geology consists of metamorphic and igneous rocks of the Precambrian Age, specifically, Eolus Granite (Steven 1974, Tweto 1979). The majority of wetlands are gently to moderately sloped, open-basin peatlands. Peatlands are wetlands characterized by organic soils (histosols) with 40 cm peat accumulation in the upper 80 cm (USDA 2006). In this region, peatlands are fens and dependent on groundwater with minimal secondary inputs from other hydrologic sources. Peat in most surveyed fens in the wetland complex are well-developed throughout and fibric to hemic in decomposition. Many inundated sites exhibit patterning with strings (raised areas) separated by flarks, which are linear pools, small rivulets, and areas of shallow, open water (Chadde et al. 1998). Meadow openings vary from mesic to inundated herbaceous communities as well as tree dominated wetlands. The majority of meadow openings are dominated by a continuous, rhizomatous mat of fewflower spikerush (*Eleocharis quinqueflora*) often forming a near monoculture of low-stature, low species diversity, low cover, inundated peat flats. Water sedge (*Carex aquatilis*) is the next most common species being found at low to moderate cover in all stands. Strings support higher species diversity than flarks including bluejoint (*Calamagrostis canadensis*), tufted hairgrass (*Deschampsia caespitosa*), and splitleaf groundsel (*Packera dimorphophylla*). Patches of mesic forest dot the open wetlands and support a consistent canopy strata dominated by Engelmann spruce with water sedge in the understory. Drier meadow openings and drying edges of inundated areas support much higher species diversity and some of these openings are dominated by sheep sedge (*Carex illota*) herbaceous communities. Other common species in the wetlands include elephanthead lousewort (*Pedicularis groenlandica*), redpod stonecrop (*Rhodiola rhodantha*), silvery sedge (*Carex canescens*), and white marsh marigold (*Caltha leptosepala*). Surrounding uplands are dominated by mesic Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) forests. Understory varies between drier areas of extensive whortleberry (*Vaccinium myrtillus*) cover and patches of mesic forbs along small seeps with dense cover of tall fringed bluebells (*Mertensia ciliata*), starry false lily-of-the-valley (*Maianthemum stellatum*), and arrowleaf ragwort

(*Senecio triangularis*). This site contains the headwaters for a conservation population of Colorado River Cutthroat Trout (*Oncorhynchus clarkii pleuriticus*).

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are gentle to moderate gradient, subalpine elevation, formation of microtopographic rises, and perennial, groundwater-fed hydrology.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer "monsoon" season.

Biodiversity Significance Rank Comments (B4): This site supports an excellent (A-ranked) occurrence of the globally apparently secure (G4/S3) subalpine fir / Engelmann spruce - water sedge subalpine, riparian wetland forest (*Abies lasiocarpa - Picea engelmannii / Carex aquatilis* forest) and a good (B-ranked) occurrence of the sheep sedge herbaceous wetland (*Carex illota* herbaceous vegetation) whose global rank is unknown (GUQ/S2). Site also contains an excellent (A-ranked) occurrence of the globally apparently secure (G4/S3S4) fewflower spikerush herbaceous wetland (*Eleocharis quinqueflora* herbaceous vegetation), and an excellent (A-ranked) occurrence of the globally demonstrably secure (G5/S4) water sedge (*Carex aquatilis*) herbaceous vegetation.

Natural Heritage element occurrences at the North Fork of Sand 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	Abies lasiocarpa - Picea engelmannii / Carex aquatilis Forest	Subalpine Riparian / wetland Forest	G4	S3				A	2006-07-16
Natural Communities	Eleocharis quinqueflora Herbaceous Vegetation	Alpine Wetlands	G4	S3S4				A	2006-07-17
Natural Communities	Carex aquatilis Herbaceous Vegetation	Montane Wet Meadows	G5	S4				A	1994-07-30
Natural Communities	Carex illota Herbaceous Vegetation	Alpine Wetlands	GUQ	S2				B	2006-07-14

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological

processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all ecological processes necessary to the maintenance of the site and upstream activities such as deforestation, improper livestock grazing, development, or water diversion could be detrimental to the communities.

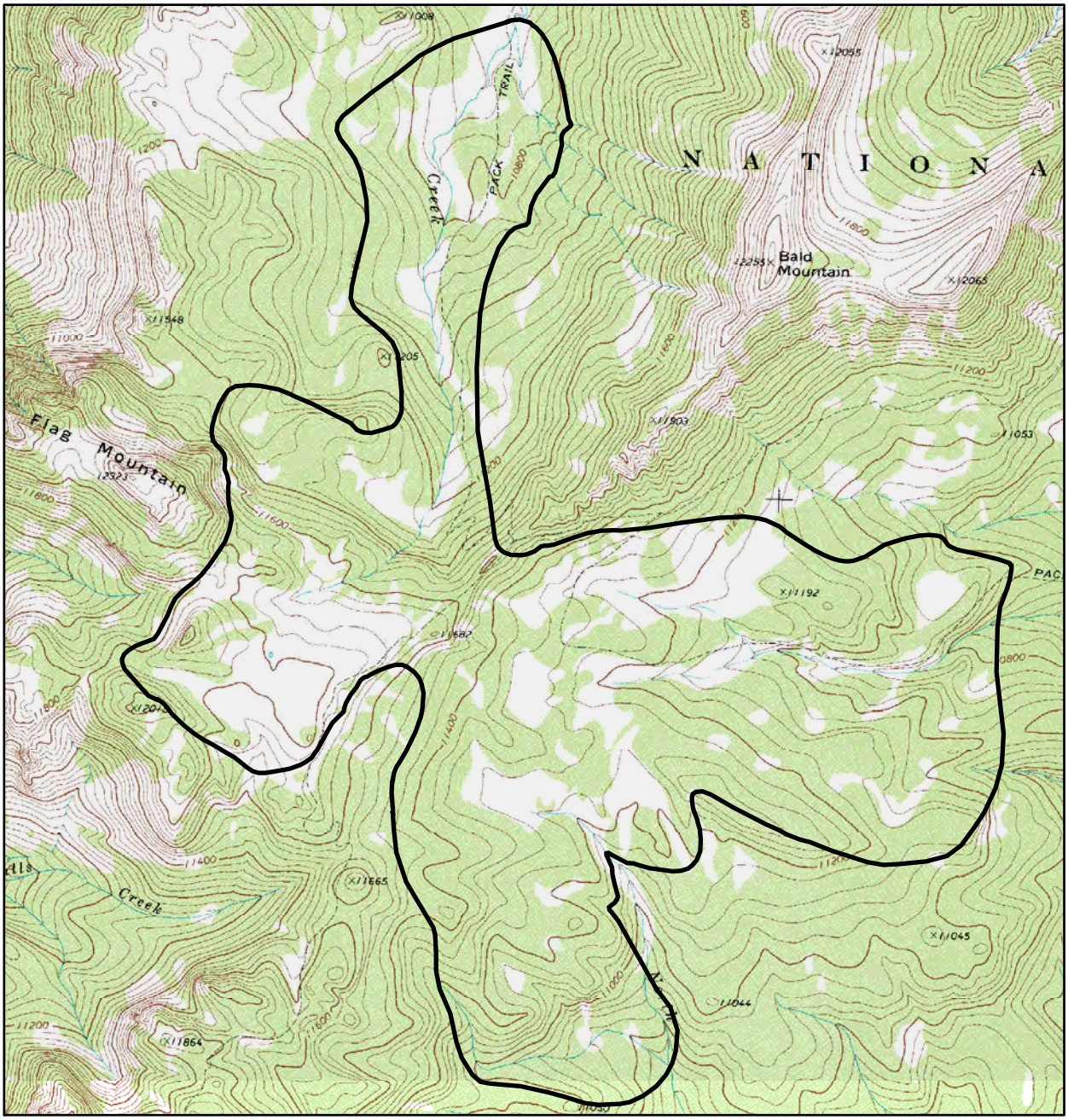
Protection Urgency Rank Comments (P4): The site is managed by the USFS within the San Juan National Forest and Weminuche Wilderness. Currently there are no threats to the occurrences.

Management Urgency Rank Comments (M4): Currently no management actions are needed. It is not apparent whether areas of bare peat along inundated wetlands are the result of natural disturbances from surface flows or hydrologic heave or the result of negative impacts from game use.

Land Use Comments: Predominant use of the surrounding areas is recreation, including hiking, horseback-riding and hunting. Vehicle use is limited.

Exotic Species Comments: There are few exotics. When present, exotics are concentrated along trails and roads.

Version Author: Jones, J.R.
Version Date: 10/15/2006



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Map Date: 12/11/2006

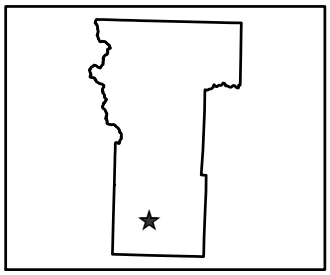
Legend

PCA Boundary

Granite Lake, 37107-E3

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

Location in Hinsdale County



North Fork of Sand Creek Potential Conservation Area, B4: Moderate Biodiversity Significance

Rio Grande at Pole Creek Mountain

Biodiversity Rank - B4: Moderate Biodiversity Significance

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

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Pole Creek Mountain, Rio Grande Pyramid

Size: 623 acres (252 ha) **Elevation:** 9,900 - 10,000 ft. (3,018 - 3,048 m)

General Description: The site is drawn along the upper reaches of the Rio Grande River, a third order drainage. This section of the river flows through a wide, open glaciated valley bottom with several beaver ponds. The shrub dominated wetland is concentrated along floodplains and beaver ponds. Bedrock geology consists of patches of glacial deposits of the Quaternary Age surrounded by various igneous rocks of the Tertiary Age (Steven 1974, Tweto 1979). Soils vary from inundated to dry with varying amounts of organic material. Upper reaches of the site are characterized by a willow carr are dominated by a consistent, dense tall shrub layer of Geyer's willow (*Salix geyeriana*) and park willow (*Salix monticola*) concentrated around large, open deep-water beaver ponds. The understory is dominated by a dense layer of mesic graminoids in inundated to saturated areas. Middle to lower reaches of site with more openings and drier patches are dominated by mesic forbs in the understory. Species composition varies along the moisture gradient with saturated areas being healthier, dominated by native graminoids. Drier areas exhibit impacts from present and past grazing supporting many increaser species and exotics. Predominant uses of surrounding uplands include livestock grazing and recreation. A single cow moose was observed in the wetland. The site appears to be recovering from past grazing with more native species cover and less trampling and livestock use than the last survey in 1995.

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are montane elevation, low gradient, and seasonal flooding.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer monsoon season.

Biodiversity Significance Rank Comments (B4): This site is drawn for a good (B-ranked) occurrence of Geyer's willow - park willow / mesic graminoid montane riparian willow carr (*Salix geyeriana* - *Salix monticola* / mesic graminoid shrubland).

The global imperilment rank is unknown for this community type, but it is rare in Colorado (GU/S3).

Natural Heritage element occurrences at the Rio Grande at Pole Creek Mountain 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 geyeriana - Salix monticola / Mesic Graminoid Shrubland	Montane Riparian Willow Carr	GU	S3				B	2006-08-31

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all hydrological processes necessary to the maintenance of site hydrology and upstream activities such as deforestation, improper livestock grazing, development, or water diversion could be detrimental to the site.

Protection Urgency Rank Comments (P3): The site is managed by the USFS as part of the Rio Grande National Forest. Possible threats include livestock grazing and exotic species, but it appears to be recovering from past uses.

Management Urgency Rank Comments (M4): Exclusion of livestock grazing from floodplain reaches may encourage the growth of native species, bank stabilization, and general floodplain health.

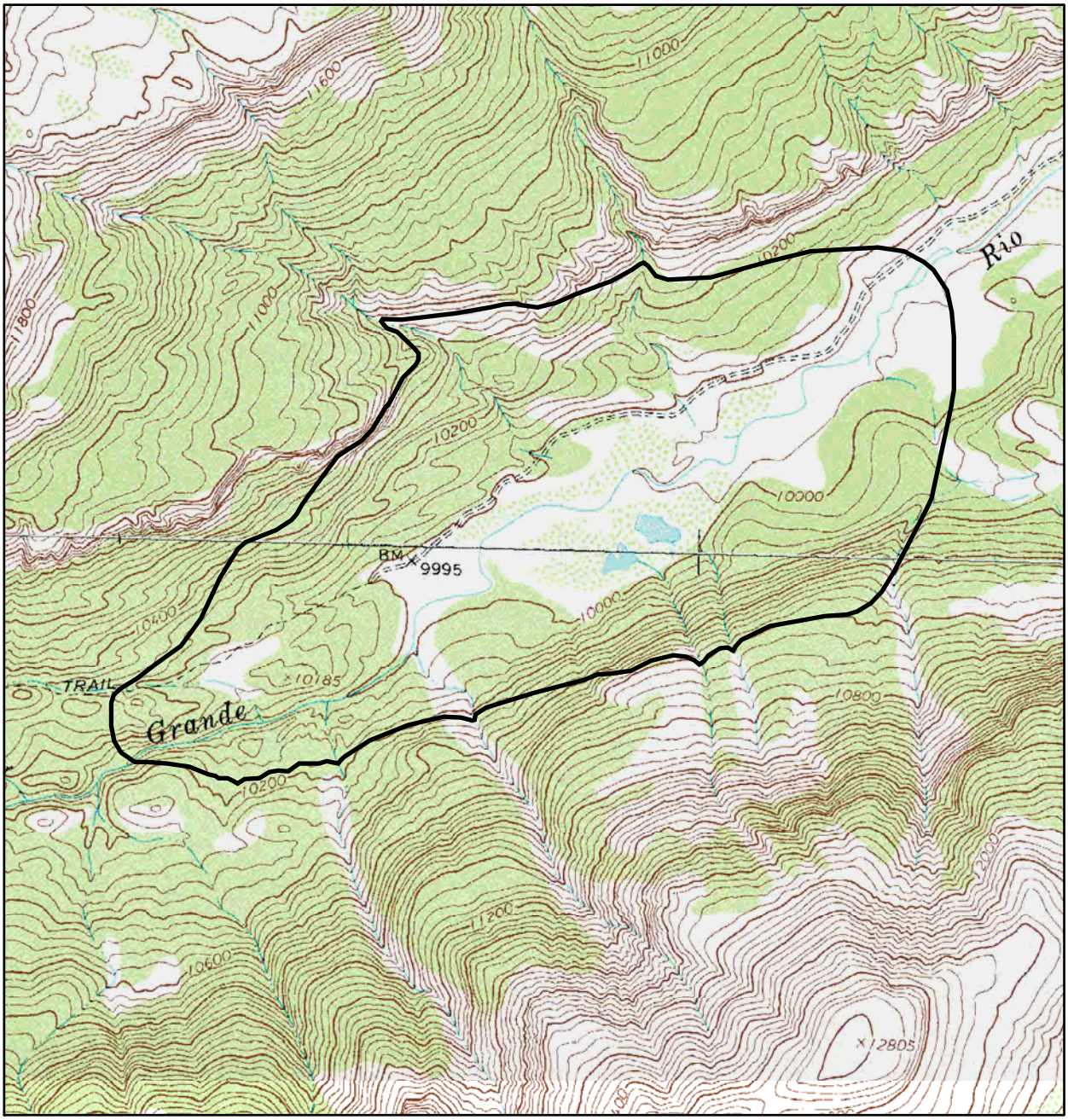
Land Use Comments: Predominant land uses include recreation and livestock grazing.

Exotic Species Comments: Common exotics include Kentucky bluegrass (*Poa pratensis*), common dandelion (*Taraxacum officinale*), and white clover (*Trifolium repens*). These species are concentrated in drying areas and are absent within the active floodplain.

Off-Site Considerations: Off-site considerations include an adjacent road, recreation, and livestock grazing.

Version Author: Jones, J.R.

Version Date: 10/15/2006



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Map Date: 12/11/2006

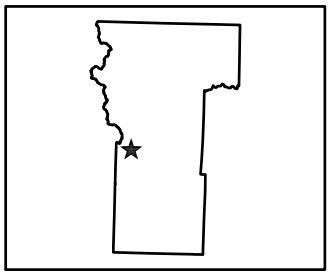
Legend

PCA Boundary

Rio Grande Pyramid, 37107-F4
Pole Creek Mountain, 37107-G4

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

Location in Hinsdale County



Rio Grande at Pole Creek Mountain Potential Conservation Area, B4: Moderate Biodiversity Significance

South Canyon

Biodiversity Rank - B4: Moderate Biodiversity Significance

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

Management Urgency Rank - M5: Not Needed; No Threats Anticipated

U.S.G.S. 7.5-minute quadrangles: Emerald Lake, Granite Lake

Size: 183 acres (74 ha) **Elevation:** 10,000 - 11,400 ft. (3,048 - 3,475 m)

General Description: Along the narrow floodplain, on benches along the stream in South Canyon, Engelmann spruce (*Picea engelmannii)* dominates the overstory with mixed willows (*Salix* species) in the understory. Stream banks are densely vegetated and trees and shrubs are regenerating successfully. The uplands are a mix of subalpine meadow, aspen (*Populus tremuloides*) and spruce (*Picea* species) - fir (*Abies* species) forests. An outfitters cabin occurs at the lower end of the canyon and a steep trail leads up the canyon; however, the trail appears to be seldom used.

Biodiversity Significance Rank Comments (B4): The South Canyon site contains an excellent (A-ranked) occurrence of a montane riparian forest (*Abies lasiocarpa / Salix drummondiana*) which is demonstrably secure on a global scale (G5/S4).

Natural Heritage element occurrences at the South Canyon 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 / Salix drummondiana Forest	Montane Riparian Forest	G5	S4				A	1995-07-23

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

Boundary Justification: The boundary includes the montane riparian forest occurrence and 1,000 ft buffer. This buffer should protect the occurrence from direct disturbance, and is thought to protect the avian, macroinvertebrate and periphyton communities and limit impacts from sedimentation (Noel et al. 1986, Spackman and Hughes 1995, Karr and Schlosser 1978).

Protection Urgency Rank Comments (P5): The site is contained in the Weminuche Wilderness Area in San Juan National Forest. Very little foot and horse traffic occurs in the area, probably due to the rugged terrain.

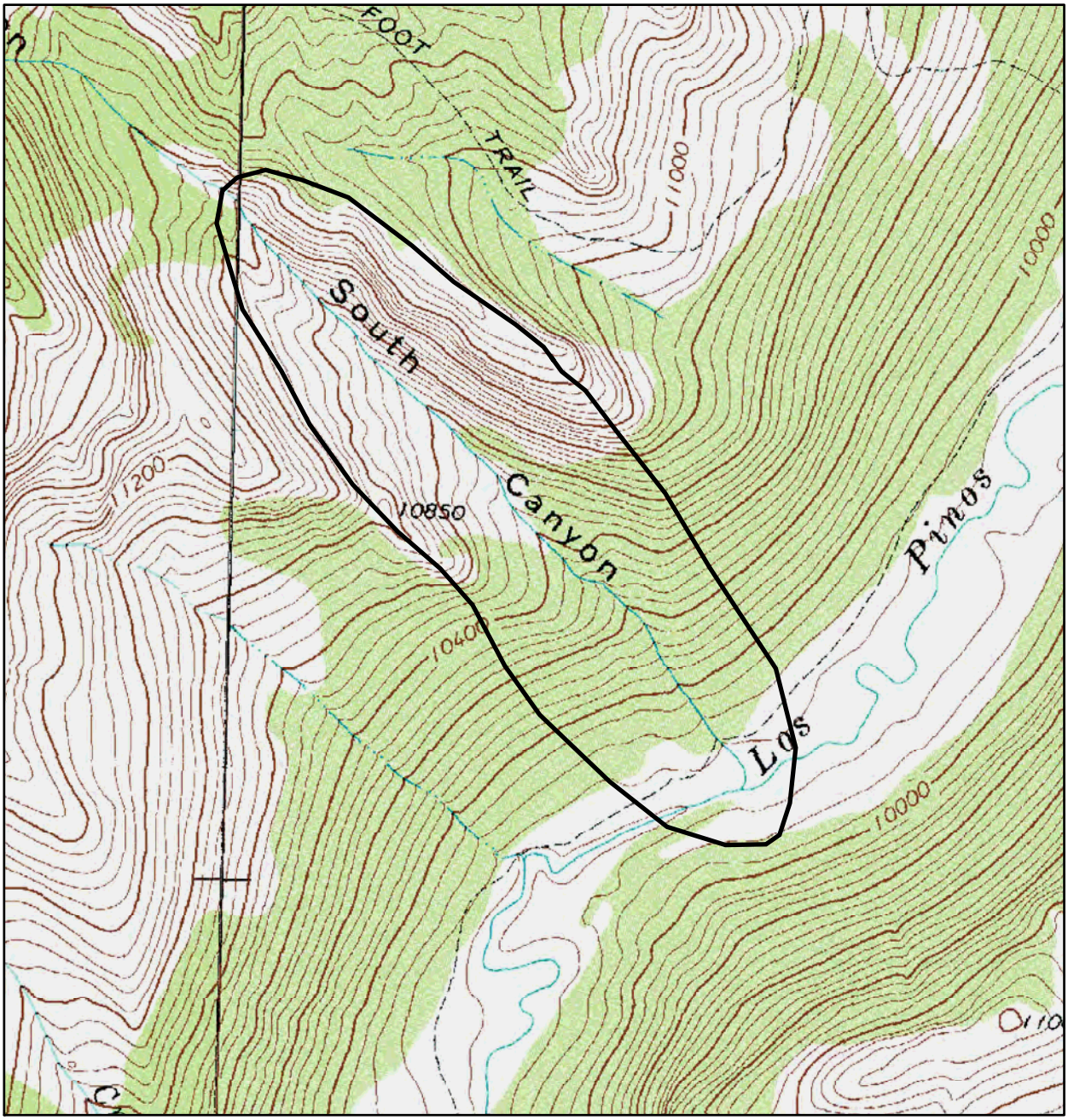
Management Urgency Rank Comments (M5): No serious management needs known or anticipated at this site.

Exotic Species Comments: Several white clovers (*Trifolium repens*) and dandelions (*Taraxacum officinale*) were seen downstream.

Off-Site Considerations: Hydrological processes originating outside of the planning boundary, including water quality, quantity, timing and flow must be managed to maintain the viability of the site.

Version Author: Kettler, S.M.

Version Date: 06/09/1997



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Map Date: 12/11/2006

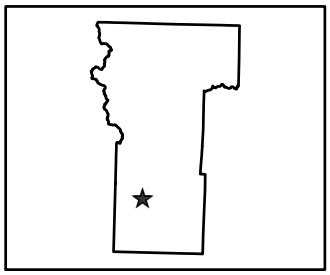
Legend

PCA Boundary

Granite Lake, 37107-E3
Emerald Lake, 37107-E4

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

Location in Hinsdale County



South Canyon Potential Conservation Area, B4: Moderate Biodiversity Significance

Upper Mosca Creek

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Bear Mountain, Granite Peak

Size: 783 acres (317 ha) **Elevation:** 7,860 - 9,400 ft. (2,396 - 2,865 m)

General Description: The site is comprised of the riparian area along Upper Mosca Creek. Forested uplands have spruce (*Picea engelmannii*) and fir (*Abies lasiocarpa*), while the upper watershed has been logged. There are many open meadows along the drainage.

Biodiversity Significance Rank Comments (B4): The Upper Mosca Creek site contains an excellent (A-ranked) occurrence of an subalpine fir (*Abies lasiocarpa*) / mixed currant coniferous wetland forest. This plant community is globally common (G5) but vulnerable (S3) in the state. In Colorado, the wetland forest is a facultative riparian forest with a wide elevation range, 8,200 to 12,000 feet. Stands occur along very steep streams where the riparian area is narrow and dominated by species of the surrounding forest. These forests are heavily shaded with a very open shrub layer of just a few individuals. Subalpine fir dominates the dense tree canopy, while any of the following currant species may be present in the shrub layer: gooseberry (*Ribes inerme*), prickly currant (*Ribes lacustre*) and alpine prickly currant (*Ribes montigenum*).

Natural Heritage element occurrences at the Upper Mosca 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	Abies lasiocarpa / Ribes (montigenum, lacustre, inerme) Forest	Coniferous Wetland Forests	G5	S3				A	1995-07-12

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

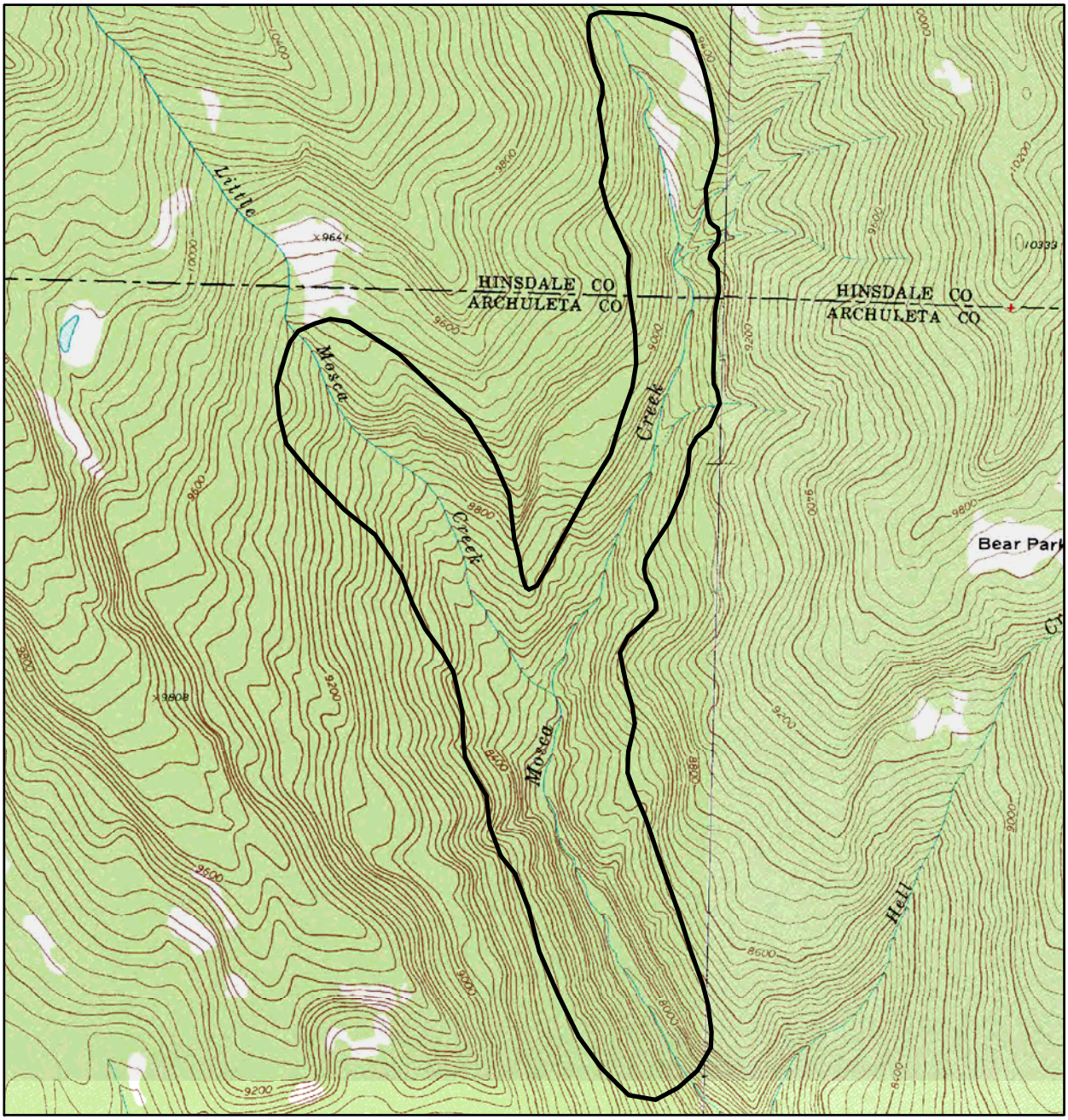
Boundary Justification: The boundary encompasses the occurrence and an approximate 1,000 foot buffer. Eliminating disturbance within this 1,000 foot buffer would aid in reducing impacts from sedimentation (Karr and Schlosser 1978), and assist in maintaining the integrity of the occurrence and its associated avian, macroinvertebrate and periphyton communities (Noel et al. 1986, Spackman and Hughes 1995).

Protection Urgency Rank Comments (P4): The site is located in the Bear Park Potential Research Natural Area of the San Juan National Forest. The RNA has not yet been designated but has been highly recommended. Designation would change this rank to P5.

Management Urgency Rank Comments (M4): Current management seems to favor the persistence of the community, but management actions may be needed in the future to maintain its current quality. There is evidence of impacts from logging, but it appears to be recovering. Access roads to timber sale areas may provide a potential avenue for non-native species invasion.

Off-Site Considerations: Hydrological processes originating outside of the site boundaries, including water quality, quantity, timing and flow must be managed to maintain the current quality of the coniferous wetland forest.

Version Author: Lyon, M.J.
Version Date: 02/15/2002



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Map Date: 12/11/2006

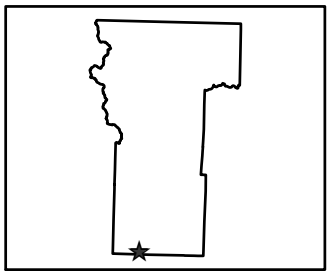
Legend

PCA Boundary

Bear Mountain, 37107-D3
Granite Peak, 37107-D4

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

Location in Hinsdale County



Upper Mosca Creek Potential Conservation Area, B4: Moderate Biodiversity Significance

Upper Rambouillet Park

Biodiversity Rank - B4: Moderate Biodiversity Significance

Protection Urgency Rank - P4: No Threat or Special Opportunity

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Slumgullion Pass

Size: 191 acres (77 ha) **Elevation:** 11,750 - 11,950 ft. (3,581 - 3,642 m)

General Description: The site is drawn for a spring-fed wetland complex along the upper, northeastern reaches of Rambouillet Park. Rambouillet Park is a large, high elevation plateau with multiple spring-fed wetlands that flow southwest feeding the West Fork of Cebolla Creek. Bedrock geology is composed of quartz latite of Rambouillet Park, predominantly coarsely porphyritic quartz latite flows and breccias of the Oligocene epoch (Steven 1974, Tweto 1979). Soils are inundated to saturated throughout consisting of fibric to hemic peats up to 40+cm, grading into dry, rocky substrates. This wetland is a fen type of peatland. Peatlands are peat accumulating wetlands characterized by organic soils (histosols) with 40 cm peat accumulation in the upper 80 cm (USDA 2006). In this region where precipitation inputs are minimal, peatlands are fens dependent on groundwater with secondary inputs from other hydrologic sources (Cooper et al. 1999). The wetland varies throughout with multiple areas of shallow, open water that are interspersed with inundated soils and densely vegetated hummocks. Sheep sedge (*Carex illota*) is the dominant species throughout the gently sloping wetland creating dense patches on saturated soils and a near monoculture on hummocked areas. Lower reaches are composed of inundated soils, shallow, open water, and floating mats of water sedge (*Carex aquatilis*). Other graminoid species include tufted hairgrass (*Deschampsia caespitosa*), Northwest Territory sedge (*Carex utriculata*), and mountain timothy (*Phleum alpinum*). Mesic forbs present include redpod stonecrop (*Rhodiola rhodantha*), American bistort (*Polygonum bistortoides*), Eastwood's podistera (*Podistera eastwoodiae*), and splitleaf groundsel (*Packera dimorphophylla*). Diamondleaf willow (*Salix planifolia*) is present in very low cover. No exotic species were observed within the wetland. A rough 4X4 road runs adjacent to the wetland along its western edge. It does not appear to be heavily used or impacting hydrology. Predominant use is recreation including hunting, skiing, and hiking. There is evidence of elk and deer use within the wetland, with scat and tracks throughout. Adjacent uplands are dominated by xeric, alpine meadows with large expanses of shortfruit willow (*Salix brachycarpa*) shrublands, and small patches of Engelmann spruce (*Picea engelmannii*).

Key Environmental Factors: Key environmental factors influencing species composition of the wetland are upper subalpine elevation, low gradient, perennial, groundwater-fed hydrology, and peat-accumulating soils.

Climate Description: Climate and weather tend to follow typical patterns of the San Juan Mountains of Colorado being generally xeric throughout the year with warm spring weather causing snowmelt flooding, wet summers, and a late summer monsoon season.

Biodiversity Significance Rank Comments (B4): This site is drawn for a good (B-ranked) occurrence of the globally unranked, but state imperiled (GUQ/S2) sheep sedge (*Carex illota*) herbaceous vegetation.

Natural Heritage element occurrences at the Upper Rambouillet 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	Carex illota Herbaceous Vegetation	Alpine Wetlands	GUQ	S2				B	2006-07-18

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

Boundary Justification: Boundaries include 1,000 ft of uplands to buffer from impacts to site condition (Keate 2004). This buffer accounts for natural ecological processes important for the maintenance of wetland elements such as seasonal flooding, groundwater recharge, surface flows, and sediment deposition. However, the boundary does not include all hydrological processes necessary to the maintenance of site hydrology and upstream activities such as improper livestock grazing or recreational use, development, or water diversion could be detrimental to the site.

Protection Urgency Rank Comments (P4): There are no specific protection strategies in place. Predominant land uses include recreation such as OHV use, skiing, snowmobiling, hunting, and snow pack monitoring.

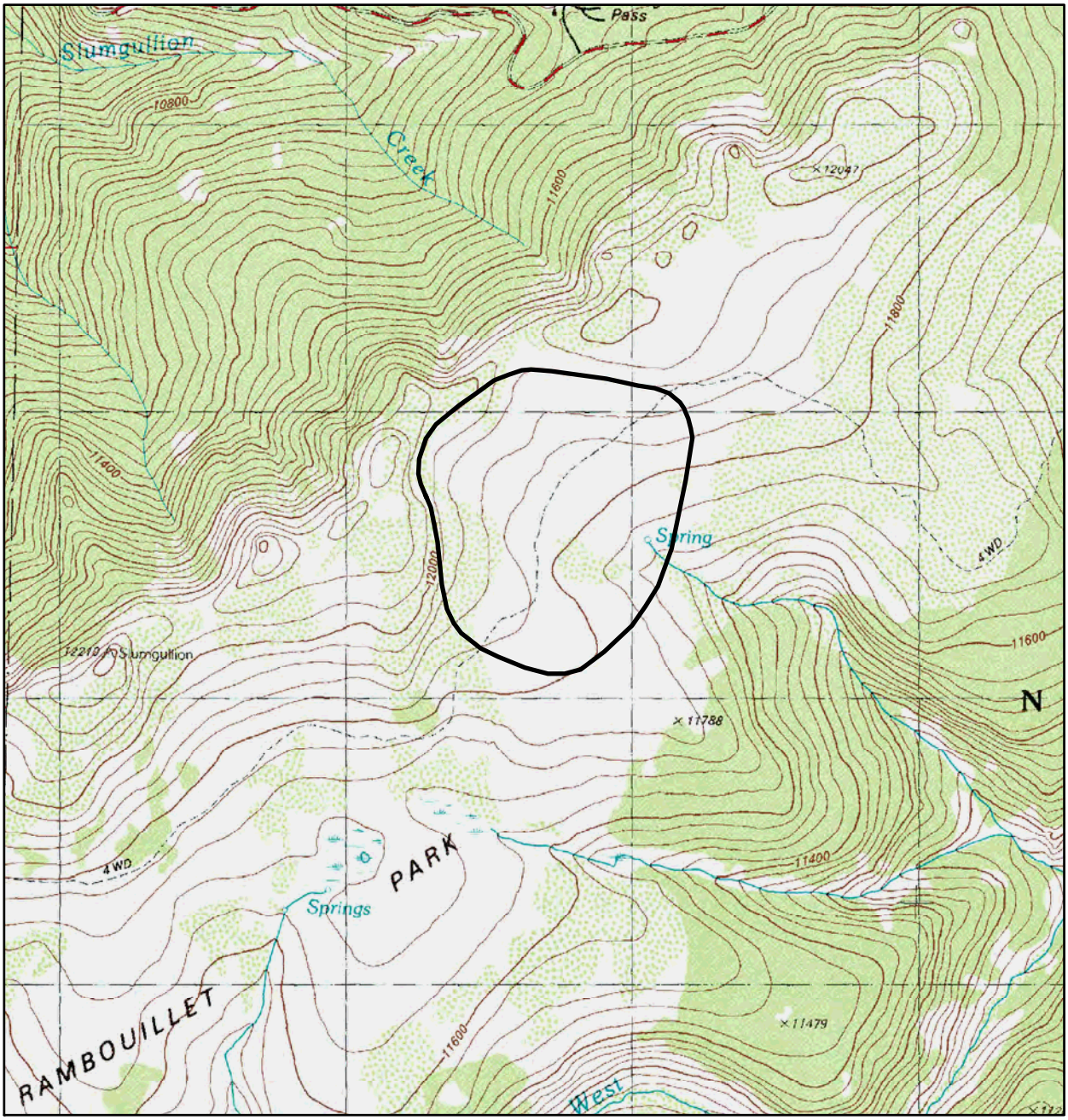
Management Urgency Rank Comments (M4): There are no immediate threats. Markers for a winter snowpack measurement trail were found along the lower reaches of the site which are traveled by snowmobiles in the winter and OHV's in summer. Compression of soils and trails may increase drainage and dewater the wetland.

Land Use Comments: Predominant land use is recreation. Local USFS and BLM field offices use this area for snow pack measurement during winter.

Exotic Species Comments: No exotics were observed.

Version Author: Jones, J.R.

Version Date: 10/15/2006



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Map Date: 12/11/2006

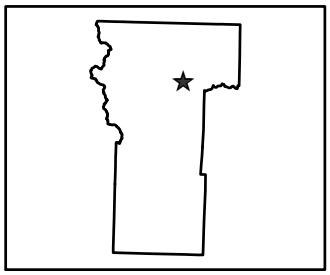
Legend

PCA Boundary

Slumgullion Pass, 37107-H2

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

Location in Hinsdale County



Upper Rambouillet Park Potential Conservation Area, B4: Moderate Biodiversity Significance

Upper Weminuche Creek

Biodiversity Rank - B4: Moderate Biodiversity Significance

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

Management Urgency Rank - M4: Not Needed Now; No Current Threats; May Need in Future

U.S.G.S. 7.5-minute quadrangles: Granite Lake

Size: 60 acres (24 ha) **Elevation:** 9,760 - 10,000 ft. (2,975 - 3,048 m)

General Description: The site is located where an un-named tributary meets Weminuche Creek. Most of the riparian area is dominated by Drummond's willow (*Salix drummondiana*). The north end is a sedge meadow. Inactive beaver ponds are present in the area. The vegetation on the adjacent uplands is dominated by spruce - fir on north-facing slopes and aspen (*Populus tremuloides*) on south-facing slopes.

Biodiversity Significance Rank Comments (B4): The site supports a good (B-ranked) occurrence of a state rare (G4/S2?) smallwing sedge (*Carex microptera*) montane wetland.

Natural Heritage element occurrences at the Upper Weminuche 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	Carex microptera Herbaceous Vegetation	Montane Wetland	G4	S2?				B	1995-07-24

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

Boundary Justification: The boundary encompasses the wetland occurrence and an approximate 1,000 foot buffer. This boundary should protect the occurrence from direct disturbance, and is thought to protect the avian, macroinvertebrate and periphyton communities and limit impacts from sedimentation (see Noel et al. 1986, Spackman and Hughes 1995, Karr and Schlosser 1978).

Protection Urgency Rank Comments (P5): The site is contained in the Weminuche Wilderness Area in San Juan National Forest.

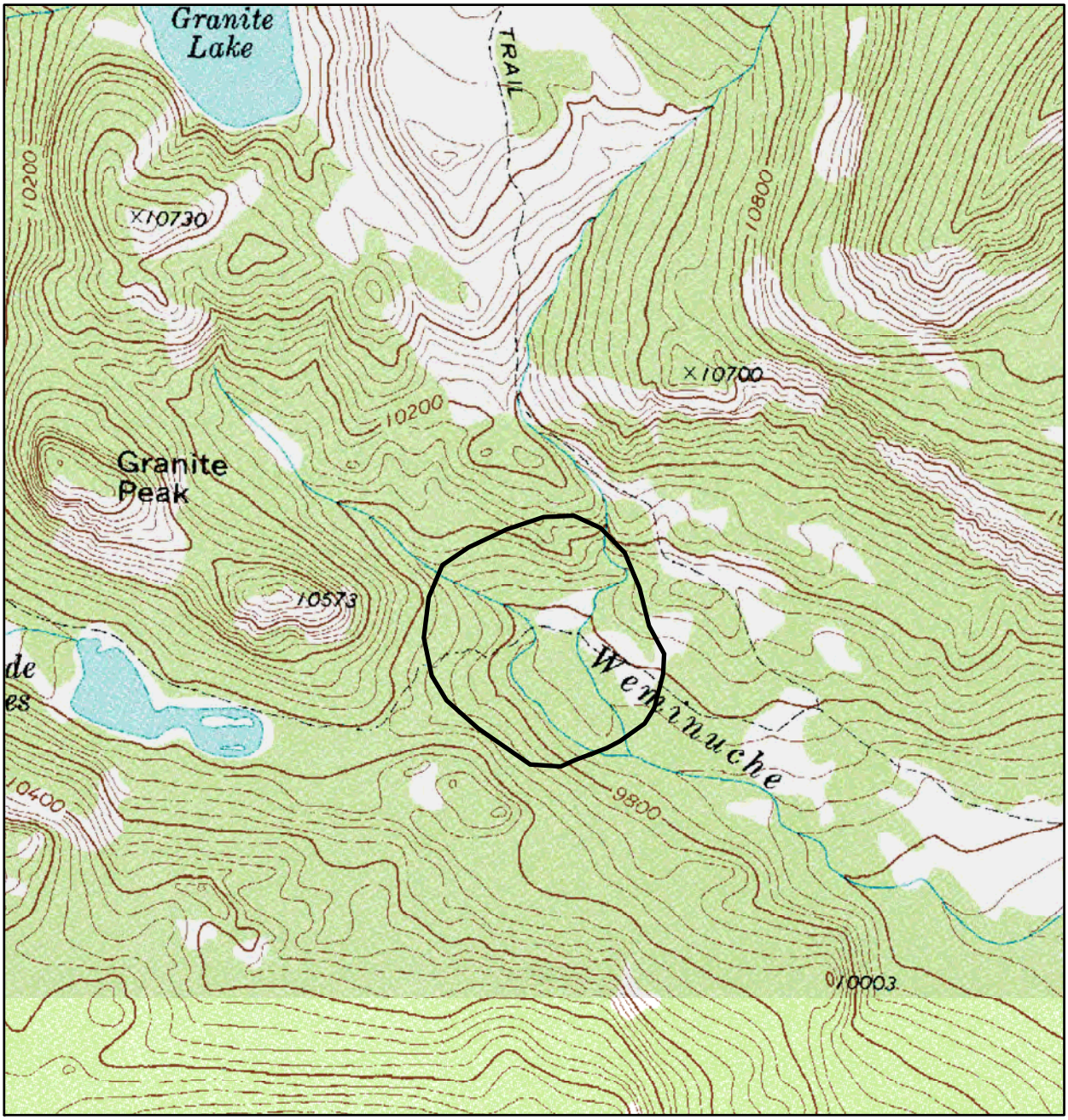
Management Urgency Rank Comments (M4): Management of horse packing and associated non-native plant species may be needed to maintain current quality. Horse packing seems to be increasing in the area.

Exotic Species Comments: Dandelions (*Taraxacum officinale*) are sparse in the sedge meadow, but denser along the trail.

Off-Site Considerations: Hydrological processes originating outside of the planning boundary, including water quality, quantity, timing and flow must be managed to maintain site viability.

Version Author: Kettler, S.M.

Version Date: 06/09/1997



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Map Date: 05/27/2008

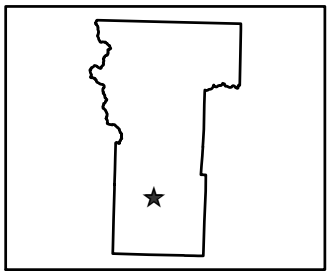
Legend

PCA Boundary

Granite Lake, 37107-E3

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

Location in Hinsdale County



Upper Weminuche Creek Potential Conservation Area, B4: Moderate Biodiversity Significance

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Appendix B. Sites of Local Significance

Sites of Local Significance (SLS) are sites that include good examples of species or natural communities that may be too small or whose biological or ecological significance is not great enough to be considered exemplary in a statewide context. Therefore, these sites do not meet the minimum criteria for a PCA. However, they do contribute to the character of the local area and the overall local diversity of plants and communities present, and therefore warrant consideration at some planning level. SLS typically include sites that were surveyed but do not contain tracked species or communities. In some cases they are based on plot data where the full extent of a community is not known and the surveyed areas do not meet the minimum size requirement for an occurrence.

After PCAs and NCAs have been delimited, the remaining data collected is evaluated for inclusion as Sites of Local Significance (SLS). These are sites that include good condition but small size or of species or natural communities that are common and already documented in the study area. However, they do contribute to the character of the local area and the overall local diversity of plants and communities present, and therefore warrant consideration at some planning level.

APPENDIX B TABLE OF CONTENTS

Lake San Cristobal 219
Los Pinos River at Weminuche Pass 221

Site of Local Significance

Name:

Lake San Cristobal

Location: Site is located at the southern end of Lake San Cristobal forming a large delta where the Lake Fork of the Gunnison River empties into the lake.

USGS 7.5 minute quadrangle: Lake San Cristobal

Legal Description: T 43N R 4W Section 27, 28, 33, 34

Land status: Joint ownership by Mrs. Emma Plauche and the BLM, Gunnison Field Office

General Description: Wetland is situated at the southern end of Lake San Cristobal. Lake San Cristobal is the second largest natural lake in Colorado. The lake was formed by the Slumgullion Slide a mass wasting event that slid volcanic material several miles from the flank of Meso Seca blocking the Lake Fork of the Gunnison River. Although the earthflow is still active, it no longer impacts water levels in the lake. Site occurs as a large delta wetland formed at the junction of the Lake Fork of the Gunnison River and Lake San Cristobal.

Vegetation along the delta varies from graminoid dominated herbaceous communities to tall shrublands. Areas along the lake edge with fluctuating water levels are dominated by a Northwest Territory sedge (*Carex utriculata*) herbaceous community. These areas are characterized by small, open channels of bare sandy soils interspersed with raised densely vegetated islands. Further south in the delta, the tall shrubs, park willow (*Salix monticola*) and Drummond's willow (*Salix drummondii*) are dominant with the mesic graminoids water sedge (*Carex aquatilis*) and Northwest Territory sedge (*Carex utriculata*) forming a dense understory layer. Shrubs in this area are variable in size, with extensive vegetative growth and dead branches, percent cover and stature appears to vary along the hydrologic gradient. Areas near the road and drying reaches near the inlet of the Lake Fork supports a tall, mature willow shrubland. This area is mostly dry with a few small wet depressions and channels. The understory layer in this section supports extensive cover of non-native species including Kentucky bluegrass (*Poa pratensis*) and Canada thistle (*Cirsium arvense*) (which are dominant in some areas), white clover (*Trifolium repens*), and red clover (*Trifolium pratense*), and common dandelion (*Taraxacum officinale*). Exotic species are concentrated along disturbed, drying areas. Site also supports a variety of wildlife species including moose, beaver, waterfowl, and amphibians including the Northern Leopard Frog.

CNHP Vegetation Classification Type: *Carex utriculata* Herbaceous Vegetation (G5S4), *Salix drummondiana/Carex utriculata* Shrubland (G4S3)

Protection Comments: Site is owned jointly by a private party and the Bureau of Land Management, Gunnison Field Office. The private owner is interested in keeping the site natural with no plans to alter or develop the area.

Management Comments: Upper reaches are used heavily as fishing access to the Lake Fork. The entire area is surrounded by a maintained county road. Natural hydrologic regime has likely been altered by road proximity and past uses. Kentucky bluegrass is one of the dominant species along upper reaches with moderate patches of invasive Cirsium sp. taking hold in willow openings.

Soils Description: Soils consist of a small organic layer over silty clay loams and clay loams and exhibit seasonal drying in the form of extensive Fe mottling.

Site of Local Significance

Name:

Los Pinos River at Weminuche Pass

Location: Site is located along the upper reaches of the Pine River, in a large, open valley, below Weminuche Pass.

USGS 7.5 minute quadrangle: Weminuche Pass

Legal Description: T 39N, 40N R 4W

General Description: Wetland occurs at the upper reaches of Los Pinos River in a large, open, glaciated valley. The Los Pinos is a tributary of the Pine River, which is the principal drainage in the area. The Pine River spills into the Vallecito Reservoir north of Durango and continues on as a third order tributary of the San Juan River.

The site is situated just below Weminuche Pass along an open basin formed by a large valley glacier during the Bull Lake and Pinedale glaciations. Site contains a series of moist to inundated meadows fed by perennial seeps and springs concentrated along the toe of the eastern slope. Perennial hydrology and gentle to moderate slopes have created a large wetland complex of terraced, patterned, and sloping fens amongst small stream corridors and elevated mesic meadows.

The majority of inundated areas support hydric, fen soils and common fen wetland plant communities. Large areas of the site are dominated by a water sedge (*Carex aquatilis*) herbaceous community. Fewflower spikerush (*Eleocharis quinqueflora*) and Northwest Territory sedge (*Carex utriculata*) also have consistent cover and co-dominate in many saturated areas of the wetland complex. Other mesic graminoids with consistent, low cover include silvery sedge (*Carex canescens*), smallwing sedge (*Carex microptera*), and bluejoint (*Calamagrostis canadensis*). Common mesic forbs presnt along saturated reaches include redpod stonecrop (*Rhodiola rhodantha*), largeleaf avens (*Geum macrophyllum*), white marsh marigold (*Caltha leptosepala*), splitleaf groundsel (*Packera dimorphophylla*), and small white violet (*Viola macloskeyi*). Purple marshlocks (*Comarum palustre*) are locally abundant along seep areas of eastern slopes. Tufted hairgrass (Deeschampsia caespitosa) dominates drier meadow areas, forming a large mesic graminoid dominated community at southern reaches of the wetland.

CNHP Vegetation Classification Type: *Carex aquatilis* Herbaceous Vegetation (G5S4), *Eleocharis quinqueflora* Herbaceous Vegetation (G4S3S4), *Carex aquatilis – Carex utriculata* Herbaceous Vegetation (G4S4)

Protection Comments: Area is managed as part of the Weminuche Wilderness within the San Juan National Forest predominantly for recreational use. No mechanized vehicles are allowed in the area. Recreational uses in the area include hiking, camping, hunting, and horseback riding. There are multiple permitted hunting outfitters in the area.

Management Comments: Adjacent Pine River trail is extensively used in the summer hiking season and fall hunting seasons and may act as a conduit for exotic species introduction. Exotic species appear to be mostly concentrated along the main trail and were not observed in saturated areas of the wetland. Hydrology is compromised by the Raber Lohr Ditch and the Fuchs Ditch which run along each side of the valley. Despite water removal from the system, the wetland appears to be healthy and stable, but may be reduced from its former size.

Soils Description: Soils along saturated reaches of the wetland consist of fibric to hemic peats up to 40cm+. Drier areas of the basin support a prominent organic component over sandy clay soils.

Appendix C. Characterization Abstracts

This appendix contains fact sheets or characterization abstracts for most of the elements highlighted in this report. Other elements and additional information can be found at www.natureserve.org/explorer/.

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AMPHIBIANS

Boreal Toad (Bufo boreas boreas)

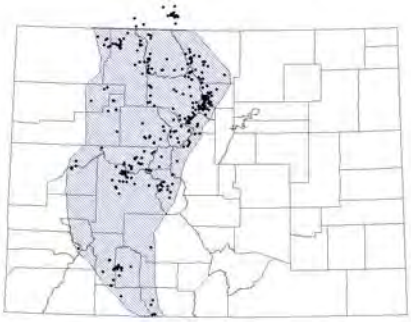
Taxonomy:
Class:
.0 Amphibia
Order: Anura
Family: Bufonidae
Genus: *Bufo*

Taxonomic Comments: Prior to the 1990s, morphological, biogeochemical, and vocal differences were noted between toads of the *Bufo boreas* complex in the southern Rocky Mountains and those in the Pacific Northwest (Burger and Bragg 1947, Hubbard 1972). Goebel (1996) described *Bufo boreas* in the southern Rocky Mountains as genetically distinct from those in the Pacific Northwest. These differences may warrant recognition as one or more distinct species. Until this change is formally accepted, Hammerson (1999) has offered the common name of Mountain Toad for the interim, and suggests that the Latin name may become *Bufo pictus*. For the purposes of this report, we are referring all naming to boreal toad (*Bufo boreas boreas*).

CNHP Ranking: G4T1Q, S1

State/Federal Status: State Endangered/USFWS candidate for listing (warranted but precluded)/USFS Sensitive

Habitat Comments: The boreal toad breeds in still or slowly moving water such as can be found in marshes, ponds, and lakes. Successful breeding generally requires permanent or semipermanent water sources. Post breeding, one may find the boreal toad in more terrestrial environments. Though they still tend to linger near water in damp environments, some females will use drier, more densely vegetated areas. Rocks, logs and rodent burrows provide cover while away from water during periods of inactivity (Hammerson 1999).



Distribution: The southern Rocky Mountain population of boreal toads is likely distinct from other populations (A. Goebel, unpbl. data). Although relationships among populations of this toad are not resolved, recent genetic evaluations suggest that the southern Rocky Mountain population ranges from southern Idaho to New Mexico (Goettl 1997; Steve Corn pers. comm.; A. Goebel unpbl. data). In Colorado, this species occurs throughout the mountains above approximately 8,000 feet in elevation. There are

approximately 206 historical localities for the boreal toad in Colorado, while currently there are just 35 known active breeding sites.

Important Life History Characteristics: Boreal toads are long-lived, reaching ages of nine years or more (Campbell 1976). Reproductive maturity does not occur until age four in males and six in females (Carey 1976). Other important considerations include sensitivity to toxicants, relatively short breeding season (starting as the winter snowpack begins to thaw), and slow metabolic rates of the larvae (Hammerson 1999).

Known Threats and Management Issues: The boreal toad is currently found in 67 known Colorado breeding locations comprising 32 populations, only two of which are considered viable (T. Jackson, CDOW, pers. comm.). This species has disappeared from 83 percent of its historic locations in Colorado, 94 percent in Wyoming, and is believed to be extirpated from New Mexico (USFWS 2004). The boreal toad was once known from 25 counties in Colorado, including Grand County, where it was considered common. Its distribution in Colorado is now restricted to 14 counties. Available information suggests that boreal toad populations continue to decline (Keinath and McGee 2005). Reasons for the declining toad population are still being investigated. Proposed causes include chytrid fungus (*Batrachochytrium dendrobatidis*), acid rain, drought, pollution, increased UV radiation, natural population flux, or some synergistic combination of these and/or other factors (USFWS 2004). The major source of decline is believed to be chytrid fungus, which has been linked to major declines in proximate areas such as Rocky Mountain National Park (Muths et al. 2003, USFWS 2004). Examinations of infected toads show that chytrid fungus suppresses the immune system to a point that a secondary infection (e.g. red-leg disease) is usually the ultimate cause of death (USFWS 2004). Researchers hypothesize that one or a combination of environmental stressors is reducing the toads' ability to survive this pathogen (Loeffler 2001a). At this time, researchers do not know whether or not populations can persist in the presence of chytrid fungus. Research is on-going, but it may be several more years before this question can be answered (T. Jackson, CDOW, pers. comm.).

Grand County contracted with the Colorado Natural Heritage Program (CNHP) to evaluate boreal toad habitat within the proposed road corridor, and to identify impacts that could result from implementation of Fraser Valley Parkway project. CNHP conducted surveys for the boreal toad within and adjacent to the proposed Fraser Valley Parkway alignment during the spring and summer breeding season of 2005 . No toads, tadpoles, egg masses, or metamorphs in any of the surveyed areas along the road alignment. CNHP biologists estimated about 2.3 ha of summer habitat and no breeding habitat would be directly affected by the road. About 3 ha of possible breeding habitat and about 14 ha of possible summer habitat within and/or adjacent to the proposed parkway would be affected (Gaughn and Grunau 2005).

References: Burger and Bragg 1947, Hubbard 1972, Goebel (1996), A. Goebel, unpbl. data, Hammerson (1999), Goettl 1997; Steve Corn pers. comm.; Campbell 1976, Carey 1976, T. Jackson, CDOW, pers. comm., USFWS 2004, Keinath and McGee 2005, Muths et al. 2003, Loeffler 2001a, Gaughan and Grunau 2005

Version date: March 2006

BIRDS

Black Swift (Cypseloides niger)

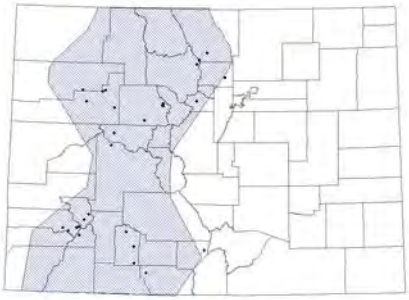
Taxonomy:
Class: Aves
Order: Apodiformes
Family: Apodidae
Genus: *Cypseloides*

Taxonomic Comments: Subfamily Cypseloidinae

CNHP Ranking: G4 S3B

State/Federal Status: USFS Sensitive

Habitat Comments: Black Swifts nest on vertical rock faces, near waterfalls or in dripping caves (Lack 1956). Beyond that requirement, they inhabit a variety of landscapes, from seacoasts to the high elevations of the Rocky Mountains (CBBA 1998).



Distribution: Black swifts breed in scattered colonies in western North America, from southeast Alaska to central Mexico, and migrate to the Neotropics in the winter (Stiles and Negret 1994). In Colorado, black swifts breed most commonly in the San Juan mountains, with scattered colonies in four other mountain ranges -- Sangre de Cristo, Flat Tops, Gore, and Front (CBBA 1998).

Important Life History Characteristics: After arriving in Colorado in June, black swifts take all summer to raise a single nestling (CBBA 1998). The cool microclimates they select for nesting presumably slows the developmental metabolism of the nestlings. Since nestlings are typically fed only once per day after the adults return from a day of foraging, slower development rates would help the survival.

Known Threats and Management Issues: There are few obvious threats to this species, except where development alters nesting habitat. The Colorado Breeding Bird Atlas (1998) hypothesizes that at least 20% of all black swifts breed in Colorado.

Potential Conservation Areas supporting *Cypseloides niger*:
Pitkin/Booth Creeks

Southwestern Willow Flycatcher
(Empidonax traillii extimus)

(text from NatureServe www.natureserve.org Accessed 2002)

Taxonomy:
Class: Aves
Order: Passeriformes
Family: Tyrannidae
Genus: *Empidonax*

Taxonomic Comments:

CNHP Ranking: G5T1T2

State/Federal Status: LE, FS, E

Photo from Finch and Stoleson 2000

Habitat Comments: The Southwestern Willow Flycatcher nests in thickets, scrubby and brushy areas, open second growth, swamps, and open woodland (AOU 1983). This flycatcher is restricted to riparian habitat in Arizona (Brown 1988) and nests primarily in swampy thickets, especially of willow, sometimes buttonbush (Phillips et al. 1964, AOU 1983), tamarisk (Brown 1988), vines, or other plants, where vegetation is 4-7 m or more in height. Tamarisk is commonly used in the eastern part of the range. Habitat patches as small as 0.5 ha can support one or two nesting pairs (see USFWS 1993).

Thy nest in forks or on horizontal limbs of small trees, shrubs, or vines, at height of 0.6-6.4 m (mean usually about 2-3 m) (Harris 1991), with dense vegetation above and around the nest. Eats mainly insects caught in flight, sometimes gleans insects from foliage; occasionally eats berries. In breeding range, forages within and occasionally above dense riparian vegetation.

Distribution: Developing current population estimate is challenging --as of the 2001 breeding season, there was a minimum of 986 breeding territores; a few more are believed to exist on Tribal and private lands (USFWS 2002). Though much suitable habitat remains to be surveyed, the rate of discovery of new nesting pairs has leveled off (Sogge et al. 2001, 2002). A rough estimate is that 200 to 300 pairs may remain undiscovered, yielding an estimated population of 1200 to 1300 pairs (USFWS 2002). The largest remaining population documented in California (and one of the largest rangewide) is along the South Fork of the Kern River, just east of Lake Isabella, Kern County (Unitt 1987, Harris 1991). The largest population in Arizona occurs along the Colorado River in upper Grand Canyon, and the largest population in New Mexico is along the upper Gila River in the southwestern part of

the state. See Biosystems Analysis (1989) and Unitt (1987) for additional recent breeding localities. Seventy-five per cent of the approximately 100 pairs in New Mexico are confined to one local area (New Mexico Dept. Game and Fish 1995). Marshall (2000) found that 53% of the individuals were in just 10 sites (breeding groups) rangewide, while the other 47% were distributed among 99 small sites of ten or fewer territories. The actual number of NatureServe "occurrences" described by these sites will undoubtedly be fewer than 100.

Important Life History Characteristics: This flycatcher exists in small, fragmented populations, with only ten or so populations having greater than 10 nesting pairs. The persistence of the smaller populations is dependent on immmigration from nearby populations and their isolated nature increases the risk of local extirpation (USFWS 2002). The vulnerability of the few relatively large opulations (e.g. to fire, inundation) makes the above threats particularly acute (USFWS 2002).

Known Threats and Management Issues: Decline is due primarily to destruction and degradation of cottonwood-willow and structurally similar riparian habitats. The causes of habitat loss and change are water impoundment, water diversion and groundwater pumping, channelization and bank stabilization, riparian vegetation control, livestock grazing, off-road vehicle and other recreational uses, increased fires, urban and agricultural development, and hydrological changes resulting from these and other land uses. Tamarisk has relaced native riparian vegetation in many areas, with varying effects on flycatcher populations. Native riparian plant communities probably have a greater recovery value for flycatchers, but currently occupied and suitable tamarisk habitat should be maintained (USFWS 2002). Increased irrigated agriculture and livestock grazing have also resulted in increased range and abundance of Brown-headed Cowbirds; and, in some areas, heavy brood parasitism by cowbirds has contributed to the decline (Harris 1991, Brown 1988). Proposed reservoirs threaten the habitat of some populations. Wintering habitat limitations are unknown, but the amount of lowland wet habitat within its wintering range has declined substantially in the last centurey (Koronkiewicz et al. 1998). See USFWS (1993, 2002) for further details on threats. Also of concern is the intensive use of pesticides both in agricultural areas adjacent to nesting grounds and on the migrating and wintering grounds (USFWS 2002).

FISH

Colorado River Cutthroat Trout (Oncorhynchus clarki pleuriticus)

Taxonomy:
Class: Actinopterygii
Order: Salmoniformes
Family: Salmonidae
Genus: *Oncorhynchus*

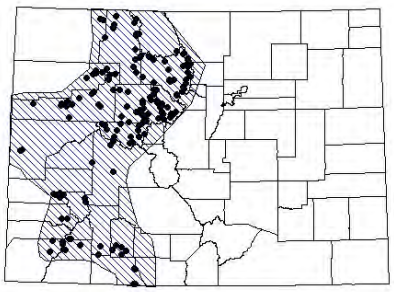
Taxonomic Comments: Subclass – Neopterygii. The only trout species native to Colorado is the cutthroat (Sealing et al. 1992). Drainage histories have isolated four distinct subspecies of cutthroat trout in Colorado; the Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*), the Greenback cutthroat trout (*O. clarki stomias*), the Yellowfin cutthroat trout (*O. clarki macdonaldi*), and the Rio Grande cutthroat trout (*O. clarki virginalis*). Of these four, the Yellowfin cutthroat trout is extinct, and the distributions of the remaining three have been reduced to a fraction of their respective historic ranges (Behnke 1988; Sealing et al. 1992).

CNHP Ranking: G4T3, S3

State/Federal Status: State Species of Special Concern/FS Sensitive/BLM Sensitive

Habitat Comments: The historical habitat included most clearwater streams and rivers of western Colorado (Behnke 1992). Good stream conditions for Colorado River cutthroat trout include cold, clear-running water with high oxygen content, rocky substrates, fairly high stream gradients, and a pH ranging from 6 to 9 (Binns 1977; Sealing et al. 1992).

Distribution: Historic distributions of the Colorado River cutthroat trout extended from the headwaters of the Colorado River basin downstream to the Dirty Devil River in Utah and to the San Juan River drainage in Colorado, New Mexico, and Arizona (Sealing et al. 1992). Refer to the following page for current distributions. The introduction of non-native trout species, dating to 1872 in Colorado, is considered a primary cause for the decline in numbers and genetic purity of Colorado River cutthroat trout (Sealing et al. 1992; Wiltzius 1985). Wernsman (1973) reported only three populations of relatively pure Colorado River cutthroat trout in Colorado. These were in Cunningham Creek (Pitkin County), Northwater Creek (Garfield County), and the headwater area of the Colorado River in Rocky Mountain National Park (Grand County).



Most of the remaining Colorado River cutthroat trout are found in small headwater streams or alpine lakes that have resisted colonization of non-native trout (Proebstel 1994).

Important Life History Characteristics: Competition and hybridization with non-native salmonids occurs. This trait has contributed to the current preferences of this native trout for

lakes, beaver ponds, and small streams. Clean, cold water running over a boulder-cobble substrate marks the preferred habitat of this trout (Trotter 1987).

Spawning occurs from late spring through early summer (Behnke and Zarn 1976; Sealing et al. 1992). Sexual maturity is usually reached between the ages of 2 and 4 years (Martinez 1988; Sealing et al. 1992).

Known Threats and Management Issues: The Colorado River cutthroat trout is heavily managed and studied. Presently, there are 42 populations in Colorado judged to be genetically pure (Proebstel 1994). However, the primary reasons for conservation concern at the global and state levels are long-term trend prognoses and threats. Populations continue to decline in many streams (Young et al. 1996); hybridization between this species and non-native trout species (Rainbow trout *Onchorhynchus mykiss*) poses the greatest threat to the elimination of pure populations. Competition with non-native trout species and exotic fish diseases also pose threats, and declines have been hastened by loss of habitat to grazing, clearcutting, water diversions, and stream channelization (Trotter 1987).

The Colorado River cutthroat trout population in Northwater Creek is still intact. We also found this fish in Trapper Creek and East Fork Parachute Creek on NOSR-1 (see Figure 6 and Appendix A), though the population in Trapper Creek was apparently impacted from degraded stream conditions. The lack of shrub cover along the stream likely causes increased water temperatures that are detrimental to the fish. This lack of cover apparently stems from a long history of grazing by domestic livestock.

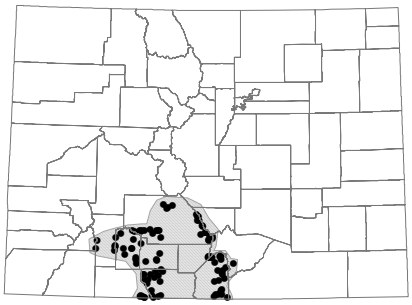
Version date: March 2006

Rio Grande cutthroat trout (Oncorhynchus clarki virginalis)

Taxonomy
Class: Osteichthyes
Order: Salmoniformes
Family: Salmonidae
Genus: *Oncorhynchus*

Taxonomic Comments: Rio Grande cutthroat trout are closely related to Greenback River cutthroat trout (*Oncorhynchus clarki stomias*) and Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*). Rio Grande cutthroat trout hybridize with various species and subspecies of the genus *Oncorhynchus* and therefore local cutthroat populations can range in appearance from "pure-looking" to obvious hybrids (U.S. Fish and Wildlife Service 1998). Genetic variation is under study by D. Shiozawa and R. Evans at BYU (Starnes 1995).

CNHP Ranking: G4T3 S3



Colorado Distribution

State/Federal Status: BLM and Forest Service Sensitive Species; State of Colorado Species of Concern.

Phenology: *Oncorhynchus clarki virginalis* spawn from March through July, depending on water temperature (Sublette et al. 1990). In colder waters, growth is slow, and age at maturity may be 4 years (Rinne 1995).

Global Range: The historic range of *Oncorhynchus clarki virginalis* is not definitely known, but it probably encompassed all the colder headwaters in the Rio Grande drainage, including the Chama, Jemez, and Rio San Jose drainages along with those of the Pecos and Canadian drainages (Sublette et al. 1990, Behnke 1992). *Oncorhynchus clarki pleuriticus* may also have occurred in Texas and Mexico (see Behnke 1992). The present range includes New Mexico and Colorado. The southernmost distribution is at Indian Creek in the Lincoln National Forest and Animas Creek in the Gila National Forest, southern New Mexico (Rinne 1995).

State Range: In Colorado, *Oncorhynchus clarki virginalis* is at present limited to a few small headwater tributary streams in the Rio Grande and San Juan national forests in southwestern Colorado. There are also few lake and introduced populations within the forests.

Habitat Comments: Inhabits clear, cold, well-oxygenated mountain streams with moderate gradients, rocky to gravelly substrates, and abundant riparian vegetation; also is found in ponds and lakes (Trotter 1987).

Distribution/Abundance: The total abundance of the Rio Grande cutthroat trout is unknown. Currently they occupy 480 miles of stream and 1,120 acres of lake habitats in Colorado, and 260 miles of stream habitat in New Mexico (USFWS 1998). Approximately 106 populations currently exist in New Mexico, and 161 in Colorado (see USFWS 2002). Some of these populations are hybridized, small, and/or include non-native competing salmonids. At least 30 genetically pure remnant populations are distributed rangewide (USFWS 2002); including transplanted populations, there are about 100 pure populations (USFWS 2002). The United States Fish and Wildlife Service (2002) identified 13 populations that are pure (confirmed by appropriate genetic testing), that have over 2,500 fish, are secured by a barrier, and do not coexist with non-natives. Because of the habitat conditions and tubifex worm scarcity, these 13 populations are not threatened by whirling disease (USFWS 2002).

The Colorado Division of Wildlife has reintroduced the Rio Grande cutthroat trout at many sites in the Rio Grande and San Juan national forests in southwestern Colorado.

Known Threats and Management Issues: The decline in Rio Grande cutthroat trout populations was caused by several factors related to human activities. The major factor was the introduction of non-native salmonid species (rainbow trout, brook trout, brown trout, and Yellowstone cutthroat trout) into their historic range. Rainbow trout and various cutthroat subspecies readily hybridize with Rio Grande cutthroat trout (Everhart and Seaman 1971, U.S. Fish and Wildlife Service 1998). Introduced brook trout (Behnke and Zarn 1976, Behnke 1979) and brown trout (Wang 1989) tend to outcompete and ultimately displace Rio Grande cutthroat trout. Finally, because cutthroat trout are more easily caught than other salmonid species, harvest by anglers may have played an important role in reducing Rio Grande cutthroat populations, particularly in waters where non-native species were present with Rio Grande cutthroat trout (U.S. Fish and Wildlife Service 1998).

Other factors that contributed to the decline of Rio Grande cutthroat trout populations also were associated with the human settlement and development of the Southern Rockies. Exploitation of land, water, minerals, timber resources, and fisheries adversely affected Rio Grande cutthroat trout and their habitat (U.S. Fish and Wildlife Service 1998). The diversion of streams and the removal of water for irrigation of agricultural lands had major impacts on the ecology and hydrology of waters occupied by Rio Grande cutthroat trout.

Whirling disease (caused by a microscopic, water-borne parasite *Myxobolus cerebralis*), which causes skeletal deformities and ultimately death in trout species is also a concern within the current range of the Rio Grande cutthroat trout.

Potential Conservation Areas supporting *Oncorhynchus clarki virginalis*:

Adams Fork of Conejos River	on page 192
Nabor Creek	on page 169

Version date: June 2003

Source: Upper San Juan Basin, Sovell et al., 2003

NATURAL COMMUNITIES

Subalpine fir - Engelmann spruce / Water sedge Forest

Abies lasiocarpa - Picea engelmannii / Carex aquatilis

Global rank/State rank:
G4 / S3
HGM subclass: S1/2, R2, R3/4?
Colorado elevation range:
7,600-10,100 ft (2,300-3,080 m)

General Description

This association is a shaded forest with few to no shrubs and a thick to open carpet of *Carex aquatilis* (water sedge) along the stream banks. It occurs below 10,000 ft (3,000 m) on saturated soils along narrow streams and adjacent to willow carrs and sedge fens. The undergrowth of this association is dominated by *Carex aquatilis* (water sedge) with *Calamagrostis canadensis* (bluejoint reedgrass) as an occasional a co-dominant.

In Colorado, this association occurs on the margins of subalpine willow carrs and sedge fens and adjacent to moderate gradient, narrow streams. Soils are organic or sandy clay loams.

Vegetation Description

Picea engelmannii (Engelmann spruce) is usually the dominant overstory species in this plant association with 13-35% cover. *Abies lasiocarpa* (subalpine fir) can also be present with 7-70% cover. At lower elevations, *Populus angustifolia* (narrowleaf cottonwood), *Populus tremuloides* (quaking aspen) and even *Populus* x *acuminata* (lanceleaf cottonwood) may be present and mixed with the conifer overstory. The shrub cover is minor but diverse, with *Lonicera involucrata* (twinberry honeysuckle), *Juniperus communis* (common juniper), *Salix bebbiana* (Bebb willow), *Salix monticola* (mountain willow), *Salix planifolia* (planeleaf willow), and *Betula occidentalis* (river birch).The herbaceous understory dominated by 10-80% cover of *Carex*
aquatilis (water sedge) is the diagnostic indicator vegetation layer for this association. No
other single herbaceous species exceeds it in abundance. Forbs can be abundant or sparse.

Ecological Processes

The *Abies lasiocarpa-Picea engelmannii/Carex aquatilis* plant association is considered to be a climax community when it occurs along the edges of wet willow carrs and sedge fens. One theory of succession suggests that as ponds begin to dry, a fibrous mat forms, allowing terrestrial species such as sedges to become established. As ponds continue to fill in and the water level lowers, *Carex aquatilis* becomes the dominant sedge. As the area dries more and the water table lowers, conifers such as *Abies lasiocarpa* and *Picea engelmannii* become established.

Subalpine fir - Engelmann spruce / Tall fringed bluebells Forest

Abies lasiocarpa - Picea engelmannii / Mertensia ciliata

Global rank/State rank:
G5 / S5
HGM subclass: S1/2?, R2,
R3/4
Colorado elevation range:
8,200-11,500 ft (2,500-3,500 m)

General Description

This association is a heavily shaded forest with no shrubs and a thick line of wildflowers lining the stream edge. It is a common community in the subalpine zone along first- and second-order streams. *Mertensia ciliata* (tall fringed bluebells) is nearly always present but can be absent. Other forbs consistently present include *Cardamine cordifolia* (heartleaf bittercress), *Saxifraga odontoloma* (brook saxifrage) and *Senecio triangularis* (arrowleaf ragwort). *Salix drummondiana* (Drummond willow), *Lonicera involucrata* (twinberry honeysuckle), and *Ribes* (currant) species can be present, but with less than 10% cover. At high elevations, *Vaccinium myrtillus* (whortleberry), typically an upland species, can intergrade with this riparian plant association on the stream banks. This is a common plant association throughout the southern Rocky Mountains of Colorado and occurs in all mountain ranges and National Forests in Colorado, comprising approximately 2,000+ miles of stream habitat in Colorado alone.

This association occurs in narrow to wide valleys, 35-350 feet (10-100 m) wide, and is limited to the immediate stream channel edge and overflow areas. It usually establishes within 15 feet (5 m) of the channel and within 2 feet (0.5 m) of channel bankfull height. Typically this association occurs along steep (2-15% gradient), narrow streams, but can also be found along moderate gradient stretches. Soils range from a thin layer of skeletal sandy loams to somewhat deep, mottled loamy sands over colluvial boulders. Total soil depth is never more than 7 feet (2 m), and is typically less than 3 feet (1 m). Consistent to all profiles is a deep, dark brown color and high organic content.

Vegetation Description

Either *Picea engelmannii* (Engelmann spruce) or *Abies lasiocarpa* (subalpine fir) is present, although they are not always present together. The tree canopy can be very thick, completely overhanging the stream, or it can be quite open, with a wide gap over the stream. There is generally very little shrub cover. *Vaccinium myrtillus* (whortleberry), can be abundant, but it was present in only a third of the stands sampled. Other shrub species that may be present include *Salix drummondiana* (Drummond willow), *S. planifolia* (planeleaf willow), *S. monticola* (mountain willow), *Alnus incana* ssp. *tenuifolia* (thinleaf alder), *Lonicera involucrata* (twinberry honeysuckle), and several *Ribes* (currant) species.

The dense, mossy forb layer is the diagnostic part of this vegetation type. The forb layer is usually very narrow, often well under 3 ft (1 m) wide, clinging to and undulating with the side of the narrow stream channel. It is species-rich with 20-80%

total combined forb cover. No single forb species is consistently present in every stand, however, a distinct suite of species is present in varying combinations.

Ecological Processes

Many first- and second-order streams run through subalpine spruce-fir forests providing habitats for obligate riparian shrubs, forbs, and grasses, forming a number of riparian *Abies lasiocarpa - Picea engelmannii* (subalpine fir-Engelmann spruce) plant associations. Although *Abies lasiocarpa* and *Picea engelmannii* are not obligate riparian species, the two species strongly influence subalpine riparian ecosystems.

Subalpine fir - Engelmann spruce / Currant spp. Forest

Abies lasiocarpa - Picea engelmannii / Ribes spp.

Global rank/State rank:
G5 / S3
HGM subclass: R2, R3/4?
Colorado elevation range:
8,300-12,200 ft (2,500-3,700 m)

General Description

The *Abies lasiocarpa-Picea engelmannii/Ribes* spp. (subalpine fir-Engelmann spruce/Currant spp.) association forms a heavily shaded forest with a very open shrub layer of just a few individual shrubs. This association has a wide elevational range, and is a common and facultative riparian community. It occurs along steep or moderate gradient streams where the riparian area is narrow and dominated by species of the surrounding forest. *Abies lasiocarpa* (subalpine fir) and *Picea engelmannii* (Engelmann spruce) dominate the tree canopy, while *Ribes* (currant) species dominate the shrub layer.

This is a small community in Colorado, occuring throughout mountainous regions of the state. It has been documented from the Flat Tops Plateau in the White and Colorado River Basins and in the San Juan, Rio Grande, Gunnison, White River, Routt, San Isabel and Pike National Forests. In Colorado, this plant association occurs along narrow to moderately wide streams in steep ravines and valleys. Stream channels are narrow and steep or moderately wide and sinuous with a moderate gradient. Soils are sands or loam over sand, gravel, and cobbles.

Vegetation Description

This community is very similar to the *Abies lasiocarpa-Picea engelmannii/Mertensia ciliata* plant association, with a similar overstory and herbaceous characteristics. The difference lies in the consistent presence of a shrub layer with *Ribes* spp. often as the dominant species. *Abies lasiocarpa* (subalpine fir) and *Picea engelmannii* (Engelmann spruce) dominate the tree canopy. The shrub layer is dominated by 1-50% cover of usually one and occasionally a mix of any of the following *Ribes* (currant) species: *Ribes inerme* (whitestem gooseberry), *R. lacustre* (prickly currant), *R. montigenum* (gooseberry currant), or *R. wolfii* (Wolf currant). Other shrubs that may be present include *Lonicera involucrata* (twinberry honeysuckle) and *Sorbus scopulina* (mountain ash). Willows may be present along the stream edge (usually less abundant than the *Ribes)*, and can include *Salix drummondiana* (Drummond willow), *S. monticola*, (mountain willow) *S. bebbiana* (Bebb willow), or *S. boothii* (Booth willow). A variable forb layer is present.

Ecological Processes

Many first- and second-order streams run through subalpine spruce-fir forests providing habitats for obligate riparian shrubs, forbs, and grasses, forming a number of riparian *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) plant associations. Although *Abies lasiocarpa* and *Picea engelmannii* are not obligate riparian species, the two species strongly influence subalpine riparian ecosystems.

Subalpine fir - Engelmann spruce / Drummond willow Forest

Abies lasiocarpa - Picea engelmannii / Salix drummondiana

Global rank/State rank:
G5 / S4
HGM subclass: R2, R3/4
Colorado elevation range:
8,400-10,900 ft (2,600-3,300 m)

General Description

This association is a heavily forested type found along second and third-order streams above 8,400 ft (2,600 m) where *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests also occur on adjacent hillslopes. Tall *Alnus incana* ssp. *tenuifolia* (thinleaf alder) and *Salix drummondiana* (Drummond willow) grow in a thick band along the edge of the stream. At lower elevations, *Alnus incana* is more abundant than *Salix drummondiana*. At mid-elevations, the two shrubs can be codominant.

At higher elevations, *Salix drummondiana* becomes dominant and *Alnus incana* drops out, forming the *Abies lasiocarpa-Picea engelmannii/Salix drummondiana* plant association. *Picea pungens* (blue spruce) is occasionally present at the stream edge and represents a variation of this type.

This common and well-documented plant association occurs in the San Juan Mountains and the Colorado, Gunnison, Arkansas, and South Platte River Basins. It is commonly found on steep (2-25% gradient), narrow (<35 ft, 10 m), first-order streams in moderate to deep V-shaped valleys. The thick shrub canopy is restricted to a narrow band along the rocky stream bank. It can also occur in wider valleys along moderate gradient reaches with channel bottoms that range from bedrock to gravel and one site in the Gunnison River Basin occurs along a braided stream channel. Soils are typically shallow (<3 ft, 1 m) sandy loams to sandy clay loams packed between large angular boulders and cobbles with a thin layer of partially decomposed organic matter under the litter layer.

Vegetation Description

This association does not generally form a mosaic and is often the only riparian association along a stream reach. It typically has a dense canopy of 20-90% cover of

Abies lasiocarpa (subalpine fir) and/or *Picea engelmannii* (Engelmann spruce). *Picea contorta* (lodgepole pine) may be present in drier, early-seral stands. *Salix drummondiana* (Drummond willow) is always present as part of a narrow but dense strip of shrubs. Other shrubs that occur with less frequency include *Salix monticola* (mountain willow), *Salix brachycarpa* (barrenground willow), *Salix planifolia* (planeleaf willow), *Lonicera involucrata* (twinberry honeysuckle), *Alnus incana* ssp. *tenuifolia* (thinleaf alder) and *Cornus sericea* (red-osier dogwood). The dense herbaceous undergrowth is formed by a variety of species.

Ecological Processes

The dense overstory, thick shrub canopy, and thick forb undergrowth of this association indicate that it is late-seral. High forb cover suggests that with time, further upper canopy closure, and a continued high water table, this association may shift to an *Abies lasiocarpa-Picea engelmannii/Mertensia ciliata* (subalpine fir/bluebells) plant association. With a more open forest canopy, shrubs such as *Alnus incana* ssp. *tenuifolia* (thinleaf alder) or *Salix drummondiana* (Drummond willow) may have higher abundance. Stands with high cover of both *Salix drummondiana* and *Alnus incana* in the understory may be transitional as *Salix drummondiana* replaces *Alnus incana* at higher elevations.

Thinleaf alder-Drummond willow Shrubland

Alnus incana ssp. tenuifolia - Salix drummondiana

Global rank/State rank:
G3 / S3
HGM subclass: R2, R3/4
Colorado elevation range:
7,300-9,700 ft (2,200-3,000m)

General Description

Alnus incana ssp. *tenuifolia-Salix drummondiana* (thinleaf alder-Drummond willow) is a relatively common plant association on the Western Slope. The association is generally found along steep-gradient streams with stable, shaded stream banks. This association occurs in the Gunnison, Arkansas, and St. Vrain River Basins and the San Juan and Rio Grande National Forests.

This association occurs along very steep, fast-moving streams in sheer-walled, confined canyons. It also occurs along or within the active channel of moderately to slightly entrenched channels in wider valleys. Stream channels are steep and rocky, less steep with limited floodplains and gravel and cobble bottoms, or wide and sinuous. Soils of this association are highly variable, but most are stratified alluvium with buried A horizons. Stands with a rich, herbaceous undergrowth have a thick layer, 5-10 inches (10-30 cm), of fine sandy loam and sandy clay loam over a coarse alluvial deposit. Stands with little shrub cover and herbaceous growth have coarse, skeletal soils without an accumulated fine layer at the surface.

Vegetation Description

This plant association is characterized by a dense, closed canopy of *Alnus incana* ssp. *tenuifolia* (thinleaf alder) and *Salix drummondiana* (Drummond willow) bordering the stream. Other willows that may be present include *Salix monticola* (mountain willow), *S. boothii* (Booth willow), *S. exigua* (sandbar willow), *S. lucida* (ssp. *caudata* or ssp. *lasiandra*) (shining willow), and *S. geyeriana* (Geyer willow). Other shrubs occasionally present include *Lonicera involucrata* (twinberry honeysuckle), *Ribes inerme* (whitestem gooseberry), *Cornus sericea* (red-osier dogwood), *Rosa woodsii* (Woods rose), *Amelanchier utahensis* (Utah serviceberry), *Acer glabrum* (Rocky Mountain maple), *Symphoricarpos oreophilus* (mountain snowberry), and *Ribes montigenum* (gooseberry currant). Some stands have a rich herbaceous understory that includes *Oxypolis fendler* (Fendler cowbane), *Heracleum maximum* (common cowparsnip), *Equisetum pratense* (field horsetail), *Mertensia ciliata* (tall fringed bluebells) *Rudbeckia laciniata* var. *ampla* (cutleaf coneflower), and *Angelica ampla* (giant angelica). In some stands, the herbaceous undergrowth is sparse (less than 10% cover) due to shading and floodscouring.

Ecological Processes

The *Alnus incana* ssp. *tenuifolia-Salix drummondiana* (thinleaf alder-Drummond willow) plant association is an early to midseral community restricted to stream margins, rarely forming large, extensive stands. Both species are prolific seed producers and are the first to colonize coarse-textured cobble bars and recently scoured alluvial surfaces. When young, these shrubs are flexible, can tolerate most flood events, and readily resprout. With time, *Salix drummondiana* may become more abundant by taking advantage of the nitrogen-rich soils associated with *Alnus incana* ssp. *tenuifolia.*

Water sedge Herbaceous Vegetation

Carex aquatilis

Global rank/State rank:
G5 / S4
HGM subclass: S1/2
Colorado elevation range:
7,600-11,800 ft (2,300-3,600 m)

General Description

Carex aquatilis (water sedge) is a common, widespread plant association that can occur as large meadows in high montane valleys or as narrow strips bordering ponds and streams at lower elevations. It occurs in a variety of environmental settings in the montane and subalpine zones. A clear dominance by *Carex aquatilis* and low cover of *C. utriculata* (beaked sedge) or *Pedicularis groenlandica* (elephanthead lousewort) set this plant association apart from closely related types.

This plant association occurs in a variety of valley types, but the largest expanses occur in broad, low-gradient valleys where large snow-melt fed swales and slopes dominate the landscape. It can also grow in fine sediments at the margins of lakes and beaver ponds. The largest occurrences are found adjacent to narrow, deep, sinuous streams. Some stands occur along steep streams, others along wide, shallow streams,

as well as where beaver dams and ponds have altered the channel morphology. Soils are mostly deep, dark colored heavy clays, silts or organic layers over more skeletal layers. Soils are often saturated to the surface, and if not, mottling is commonly present within 10 cm of the surface.

Vegetation Description

This plant association is characterized by a dense rhizomatous meadow of *Carex aquatilis* (water sedge), usually accompanied by a few other graminoids species such as *Calamagrostis canadensis* (bluejoint reedgrass) or *Deschampsia caespitosa* (tufted hairgrass). *Eleocharis quinqueflora* (fewflower spikerush) can be abundant on organic substrates. *Carex utriculata* (beaked sedge) may be present. When present, *Carex utriculata* (beaked sedge) is usually not more than one third the cover of *C. aquatilis* (water sedge) cover. If it is more than that, the stand may be a *Carex aquatilis - Carex utriculata* (water sedge- beaked sedge) or *Carex utriculata* (beaked sedge) plant association. Forbs are often present, although sometimes inconspicuously. Species include *Epilobium* spp. (willowweed), *Pedicularis groenlandica* (elephanthead bittercress), and *Mertensia ciliata* (tall fringed bluebells).

Ecological Processes

Presence of *Carex utriculata* (beaked sedge) may indicate the site has progressed from the more wet *Carex utriculata* community to the current less mesic conditions, and may become dominated by *Salix planifolia* (planeleaf willow) or *Salix wolfii* (Wolf willow). *Carex aquatilis* (water sedge) associations trap sediment from overbank flows which forms a clay pan, eventually raising the water table. This process drives retrogressive succession and a plant association dominated by *Carex utriculata* takes over on these sites.

Small-head sedge Herbaceous Vegetation

Carex illota

Global rank/State rank:
GUQ / S2
HGM subclass: S1/2
Colorado elevation range:
10,900-12,300 ft (3,320-3,750 m)

General Description

This association is found on lake shores, near springs, and below snow patches in a narrow altitudinal range in the lower alpine. It is characterized by a near monoculture of *Carex illota* (small-head sedge), low cover of other graminoids and forbs, and bare ground over at least one-third of the stand. Surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years.

Sites are flat to gently sloping, stable and snow-covered in winter. Soils from stands in Colorado are loess, with accumulations of organic matter. The average pH of the surface horizon is 5.2. The pH increases with depth; clay and organic matter, moisture retention capacity and available water decrease sharply with depth.

Vegetation Description

The *Carex illota* (small-head sedge) association is a seasonally flooded subpolar grassland. *Carex illota* (small-head sedge) often forms a near monoculture, usually with over 50% cover. Other forb and graminoid species that may be present, usually with less than 1% cover include *Carex scopulorum* (mountain sedge), *Juncus drummondii* (Drummond rush), *Carex nigricans* (black alpine sedge), *Caltha leptosepala* (marsh marigold), *Rhodiola rhodantha* (redpod stonecrop), and *Pedicularis groenlandica* (elephanthead lousewort). The shrub *Salix planifolia* (planeleaf willow) may also be present with less than 1% cover. The non-vascular layer is highly developed and almost equally as abundant as the vascular cover.

Ecological Processes

This plant association usually occurs under high quality undisturbed conditions with no introduced species, no advanced soil erosion or signs of trampling or soil compaction. Chronic disturbance from overgrazing or recreational use can result in plant trampling, damage or death, and increasing bare ground.

Smallwing sedge Herbaceous Vegetation

Carex microptera

Global rank/State rank:
G4 / S2?
HGM subclass: S1/2
Colorado elevation range:
8,900-11,700 ft (2,700-3,570 m)

General Description

The *Carex microptera* (smallwing sedge) association probably has a wide distribution throughout the state, but is overlooked due to its relatively small patch size. It has been documented from north-central Colorado and the San Juan National Forest in southwestern Colorado. This plant association typically forms small meadows on fine-textured, mesic soils. Its relationship with past heavy grazing may explain the relatively small occurrences. *Carex microptera* (smallwing sedge) typically dominates the association, but other graminoids are usually present and forb cover is minor.

This community is usually associated with meadows and stream terraces in wide, 350-500 ft (100-150 m), low-gradient valleys with narrow and sinuous stream channels. It also occurs near beaver dams and marshes. Soil textures range from fine, stratified alluvial material to clay with a thin organic layer on the surface.

Vegetation Description

Carex microptera (smallwing sedge) forms a dense graminoid layer with 10-85% cover. Other graminoid species typically have less than 1% cover and include *Juncus triglumis* (threehulled rush), *Juncus castaneus* (chestnut rush), *Juncus longistylis* (longstyle rush), *Deschampsia caespitosa* (tufted hairgrass), *Carex capillaris* (hairlike sedge), *Carex saxatilis* (rock sedge) and other sedge species. Forb cover is usually not more than 20%, and is more commonly less than 5%. Common forb species include

Rhodiola integrifolia (ledge stonecrop), *Polygonum viviparum* (alpine bistort), *Gentiana algida* (whitish gentian), *Artemisia scopulorum* (alpine sagebrush), *Pedicularis groenlandica* (elephanthead lousewort), *Achillea millefolium* var. *occidentalis* (western yarrow), *Epilobium hornemannii* (Hornemann willowherb), and *Potentilla diversifolia* (varileaf cinquefoil).

Ecological Processes

Little is known about the successional status of this plant association, but it appears to be a stable community on moist to wet sites along streams.

Black alpine sedge - Drummond rush Herbaceous Vegetation

Carex nigricans - Juncus drummondii

Global rank/State rank:
GU / S2
HGM subclass: S1/2
Colorado elevation range:
10,400-11,800 ft (3,170-3,500 m)

General Description

The *Carex nigricans-Juncus drummondii* (black alpine sedge-Drummond rush) association is found in small depressions below late-melting snow patches and at the edges of wet sedge fens at high elevations, often at or above treeline. It has primarily been reported from the Indian Peaks area but may be common in other alpine areas of the state. It is not continually flooded, but has a high water table throughout the summer. The association often consists of hummocks of peat with *Carex nigricans* (black alpine sedge) above wetter areas with *Carex aquatilis* (water sedge).

This association occurs in meadows and on streambanks in alpine and subalpine areas. Soils are thin peats overlying gravels and other glacial deposits.

Vegetation Description

Carex nigricans (black alpine sedge) forms a low mat with high average cover and frequency. Cover is variable, but usually is greater than 50%. *Juncus drummondii* (Drummond rush) is usually present, but with less than 5% cover. Other graminoids, including *Deschampsia caespitosa* (tufted hairgrass), *Phleum alpinum* (alpine timothy), *Festuca brachyphylla* (Colorado fescue), and other *Carex* (sedge) spp. may be present with low cover. Forbs are typically more abundant than associated graminoids. Typical forbs include *Caltha leptosepala* (marsh marigold), *Pedicularis groenlandica* (elephanthead lousewort), *Antennaria media* (Rocky Mountain pussytoes), *Polygonum viviparum* (alpine bistort), *Ligusticum tenuifolium* (Idaho licoriceroot), *Stellaria umbellata* (umbrella starwort) and *Sibbaldia procumbens* (creeping sibbaldia).

Ecological Processes

This is a stable association. Soils are saturated during the entire growing season, but are not continually flooded.

Woolly sedge Herbaceous Vegetation

Carex pellita (=lanuginosa)

Global rank/State rank:
G3 / S3
HGM subclass: D2/3, S3/4, R5
Colorado elevation range:
4,600-9,300 ft (1,400-2,830 m)

General Description

Carex pellita is the name currently used by the USDA Plants Database for both *Carex lanuginosa* and *Carex lasiocarpa*. These species are recognized separately in Colorado, where *C. lasiocarpa* is much less common than *C. lanuginosa*. The *Carex lasiocarpa* association is ranked as S1 in Colorado and is currently known only from the subalpine fens on the east side of the Park Range.

Carex pellita (=C. lanuginosa) (woolly sedge) is a distinctive wetland-indicator sedge that forms small- to medium sized meadows. It occurs in depressions and swales at the saturated edge of stream channels or in standing water. On the eastern plains of Colorado, it can occur under the canopy of cottonwood trees, forming the *Populus deltoides/Carex pellita* (plains cottonwood/wooly sedge) plant association.

This plant association occurs in very wet conditions, generally at the saturated edge of the stream channel or in standing water. Stream channels are sinuous with a moderate gradient. Soils are deep silt loams to clays. Mottling often occurs throughout the profile.

Vegetation Description

This plant association is characterized by a nearly monotypic stand of *Carex lanuginosa* (woolly sedge). Other graminoid cover is minor, but includes *Phalaris arundinacea* (reed canarygrass), *Carex nebrascensis* (Nebraska sedge), *Schoenoplectus pungens* (threesquare bulrush), and *Poa pratensis* (Kentucky bluegrass). Scattered forbs include *Mentha arvensis* (wild mint), and *Cirsium arvense* (Canada thistle). *Equisetum arvense* (field horsetail) and *Equisetum hyemale* (scouringrush horsetail) may also be present.

Ecological Processes

The *Carex pellita* (woolly sedge) plant association appears to be a fairly stable community because of its strongly rhizomatous roots and well developed soils. In Montana, the *Carex pellita* plant association can be associated with large amounts of *Carex lasiocarpa* (slender sedge). With season-long grazing, *Carex pellita* decreases in abundance, shifting dominance towards *Poa pratensis* (Kentucky bluegrass). In Colorado, stands of *Carex pellita* that occur on stream banks with a consistent water table depth and heavy, cohesive clay soils, appear stable and long-lived as long as the water table level remains consistent.

Beaked sedge Herbaceous Vegetation

Carex utriculata

Global rank/State rank:
G5 / S5
HGM subclass: D1, D2/3, R2, S1/2?, S3/4
Colorado elevation range:
5,600-11,000 ft (1,700-3,350 m)

General Description

The *Carex utriculata* (beaked sedge) plant association is a common wet meadow community that occurs around the edges of montane lakes and beaver ponds, along the margins of slow-moving reaches of streams and rivers, and in marshy swales and overflow channels on broad floodplains. The water table is usually near the surface for most of the growing season. This association is well documented throughout the western states. A clear dominance of *Carex utriculata* over other *Carex* species including *C. aquatilis* (water sedge), sets this association apart from closely related types.

Carex utriculata (beaked sedge) grows in standing water or saturated soils. It also occurs along the margins of lakes and beaver ponds. Stream channels are wide and slightly sinuous, to wide and more sinuous. Soils are saturated organics or fine silty clays to clays over cobbles and alluvium. Mottling often occurs within a few centimeters of the surface.

Vegetation Description

This plant association is characterized by stands dominated by *Carex utriculata* (beaked sedge). Stands often appear to be nearly pure *Carex utriculata* (beaked sedge), but a variety of other graminoid species may be present as well. *Carex aquatilis* can be abundant, but if equal in cover to *C. utriculata*, see the *Carex aquatilis-Carex utriculata* association on page 336. Other *Carex* (sedge) species present include *Carex lenticularis* (shore sedge) and *C. microptera* (small-wing sedge), but usually with low cover relative to the amount of *C. utriculata* (beaked sedge) present. Other graminoid species that may be present include *Glyceria striata* (fowl mannagrass), *Calamagrostis canadensis* (bluejoint reedgrass), and *Juncus balticus* var. *montanus* (mountain rush). Forb cover is very inconspicuous and can include *Mentha arvensis* (wild mint), *Mimulus guttatus* (seep monkeyflower), and *Geum macrophyllum* (largeleaf avens). Willow carrs (i.e., shrubland thickets) are often adjacent and a few scattered willows will occur within the *Carex utriculata* limiting growth conditions (extremely cold and/or extremely wet), or because of heavy browsing by wildlife or livestock. The elevation of the site determines which willow species are in and adjacent to *Carex utriculata* (beaked sedge) stands. Willow species that are present may include *Salix monticola* (mountain willow), *S. drummondiana* (Drummond willow), *S. geyeriana* (Geyer willow), *S. planifolia* (planeleaf willow), and *S. exigua* (sandbar willow).

Ecological Processes

The *Carex utriculata* (beaked sedge) plant association occurs on the wettest sites of the riparian or wetland area, such as low-lying swales, and shallow margins of lakes and ponds, often in standing water. It is an early-seral community and is known to invade margins of newly formed beaver ponds, as well as the freshly exposed silt beds of drained beaver ponds. With time, the *Carex utriculata* plant association will grade into *Carex aquatilis* (water sedge) and *Calamagrostis canadensis* (bluejoint reedgrass) associations.

Successional shifts in species composition can be initiated by a change in the physical environment of the riparian area. Flooding events can result in sediments deposited on the floodplain, raising the surface higher above the water table. As aggradation, or build up, of the floodplain proceeds, the site can become drier and the dominant graminoid cover changes.

Abandoned beaver ponds also go through a similar succession. With time, ponds become silted-in and *Carex utriculata* establishes on the new, saturated substrate. As the site becomes firm and raised above the old pond level, *Carex aquatilis* and willows may become established. With further aggradation and time *Calamagrostis canadensis* may become established in the undergrowth. Depending on site characteristics, various willow species may become established in the overstory as well, creating the *Salix monticola/Carex utriculata* (mountain willow/beaked sedge) plant association or the *Salix geyeriana/Calamagrostis canadensis* (Geyer willow/bluejoint reedgrass) plant association, for example.

Distance from the stream channel can also differentiate the graminoid dominance spatially within the riparian mosaic. *Carex utriculata* commonly occurs at the stream channel or pond edge where the water table is close to or at the ground surface. As the floodplain surface becomes higher with increased distance from the channel edge, the ground becomes slightly less saturated and shifts to mesic meadows of *Carex aquatilis*, or on higher surfaces, to slightly drier meadows of *Calamagrostis canadensis*.

Few-flower spikerush Herbaceous Vegetation

Eleocharis quinqueflora

Global rank/State rank:
G4 / S3S4
HGM subclass: S1/2
Colorado elevation range:
8,700-12,300 ft (2,650-3,800 m)

General Description

The *Eleocharis quinqueflora* (fewflower spikerush) plant association is a uniform peatland community found in upper subalpine and lower alpine wetlands. It is easily recognized by its homogeneity, the presence of usually little more than *Eleocharis quinqueflora* and *Carex aquatilis* (water sedge), and the sparse nature of the vegetation growth. This is a common association of upper subalpine elevations. It is widespread and is well documented throughout the western states.

The *Eleocharis quinqueflora* (fewflower spikerush) plant association occurs in high elevation, marshy meadows associated with seeps where the water table is at the soil surface. Valley bottoms are moderately wide to wide and usually have a gentle to moderate gradient (0.4-6%). Adjacent stream channels are narrow and sinuous headwater rivulets with lateral seepage from surrounding toeslopes. This association occurs on peat occasionally as deep as 7 ft (2 m). The soils remain saturated throughout the growing season and may not be very rich in nutrients.

Vegetation Description

This plant association is characterized by widely-spaced *Eleocharis quinqueflora* (fewflower spikerush) with *Pedicularis groenlandica* (elephanthead lousewort) often present. *Carex aquatilis* (water sedge) is present in 85% of stands. Other forb and graminoid species present are variable. Some of the more frequently encountered species include *Caltha leptosepala* (marsh marigold), *Carex scopulorum* (mountain sedge), *Carex utriculata* (beaked sedge), *Carex illota* (small-headed sedge), and *Carex jonesii* (Jones sedge).

Ecological Processes

Eleocharis quinqueflora (fewflower spikerush) is an early colonizer and persists under wet conditions. *Carex aquatilis* (water sedge) can be a co-dominant in this plant association. Grazing can increase the cover of increaser and invader species such as *Agrostis stolonifera* (creeping bentgrass) and *Juncus balticus* var. *montanus* (mountain rush), and will damage the wet soils.

Blue spruce / Thinleaf alder Woodland

Picea pungens / Alnus incana ssp. tenuifolia

Global rank/State rank:
G3 / S3
HGM subclass:
R2, R3/4
Colorado elevation range:
6,100-10,650 ft (1,900-3,200 m)

General Description

The *Picea pungens/Alnus incana* ssp. *tenuifolia* (blue spruce/thinleaf alder) plant association occurs in montane riparian areas in Colorado. It occurs in deep, shaded canyons and narrow valleys along relatively straight stream reaches. It generally forms small patches, but can be continuous for several river miles.

This plant association occurs along narrow to moderately wide floodplains and stream benches in canyons subject to cold air drainage and limited sunlight. Stream channels are steep and narrow, moderately broad and slightly sinuous, or broad and highly sinuous. Soils are generally shallow and range from loamy sand to silty clay loams with heavy organic matter content over gravel, cobbles, and boulders.

Vegetation Description

Picea pungens (blue spruce) dominates the overstory with 1-70% cover. There are typically many seedling and saplings as well as mature trees. *Abies lasiocarpa* (subalpine fir) is usually present with up to 50% cover. Other tree species that occurred in half or fewer of the stands sampled include *Picea engelmannii* (Engelmann spruce), *Populus tremuloides* (quaking aspen), *Pinus contorta* (lodgepole pine) and *Pinus ponderosa* (ponderosa pine).

The thick shrub understory is confined to a narrow band lining the stream channel. *Alnus incana* ssp. *tenuifolia* (thinleaf alder) was present in all stands sampled, and ranged in cover from 1 to 80%. Other shrub species present were highly variable, with constancy of less then 40%, but often appearing with abundant cover when present. These shrubs include *Salix drummondiana* (Drummond willow), *Cornus sericea* (redosier dogwood), *Ribes lacustre* (current), *Acer glabrum* (Rocky Mountain maple), *Vaccinium* spp. (whortleberry), *Salix boothii* (Booth willow), and *Salix wolfii* (Wolf willow).

The forb canopy layer is thick, up to 50% total cover and species-rich, often with more than 40 species represented in one stand. Species include *Actaea rubra* (red baneberry), *Conioselinum scopulorum* (Rocky Mountain hemlockparsley), *Oxypolis fendleri* (cowbane), *Geranium richardsonii* (Richardson geranium), *Heracleum maximum* (common cowparsnip), *Maianthemum stellatum* (starry false Solomon seal), *Mertensia ciliata* (tall fringed bluebells), *Rudbeckia laciniata* var. *ampla* (cutleaf cornflower), and *Equisetum arvense* (field horsetail).

Ecological Processes

In deep, narrow canyons with swift-moving streams and narrow floodplains and benches, *Picea pungens* (blue spruce) appears to be a climax riparian species, and will remain until removed or damaged by a catastrophic flood. In Colorado, the closely related *Picea pungens/Equisetum arvense* (blue spruce/field horsetail) plant association is considered an indicator of frequent flooding. With less frequent flooding, this association may gradually change to a *Picea pungens/Alnus incana* ssp. *tenuifolia* (blue spruce/thinleaf alder) plant association.

Narrowleaf cottonwood - Blue spruce / Thinleaf alder Woodland

Populus angustifolia - Picea pungens / Alnus incana ssp. tenuifolia

Global rank/State rank:
G4 / S4
HGM subclass: R2?, R3/4
Colorado elevation range:
6,800-9,600 ft (2,070-2,925 m)

General Description

This is a common mixed deciduous-evergreen community of montane valleys, where *Populus angustifolia* (narrowleaf cottonwood) and *Picea pungens* (blue spruce) are co-dominant along a stream reach. Frequently, other conifer trees are present, but not as abundant as *Picea pungens* (blue spruce). The shrub understory is typically dense and diverse. *Alnus incana* ssp. *tenuifolia* (thinleaf alder) is almost always present.

Only a handful of good condition stands are known, and the community is highly threatened by improper livestock grazing, heavy recreational use, and stream flow alterations.

This association occurs in valleys with narrow to moderately wide floodplains, 30-600 ft (10-200 m), and in deep canyons. This association is commonly found on slightly meandering to meandering floodplains of broad reaches. Occasionally, stands occur along steep reaches. Soils range from shallow sandy loams to silty clay loams and clays over cobbles and boulders. Profiles are generally highly stratified, with layers of fine soils over layers of coarser sediments.

Vegetation Description

The upper canopy is dominated by *Populus angustifolia* (narrowleaf cottonwood) and either *Picea pungens* (blue spruce) or *Picea engelmannii* (Engelmann spruce). Other less frequently encountered tree species may also be present and include *Pseudotsuga menziesii* (Douglas-fir), *Abies concolor* (white fir), *Populus tremuloides* (quaking aspen), and *Abies lasiocarpa* (subalpine fir). *Alnus incana* ssp. *tenuifolia* (thinleaf alder) is almost always present in the shrub canopy layer, although cover amounts vary and other shrub species may be more abundant. *Lonicera involucrata* (twinberry honeysuckle) is the most frequently encountered species after *Alnus*. Many other shrub species can occur within this association, including *Amelanchier alnifolia* (Saskatoon serviceberry), *Acer glabrum* (Rocky Mountain maple), *Salix drummondiana* (Drummond willow), *S. exigua* (sandbar willow), *S. lucida* ssp. *caudata* (shining willow), *S. geyeriana* (Geyer willow), *S. boothii* (Booth willow), *Prunus virginiana* (chokecherry), and *Symphoricarpos oreophilus* (mountain snowberry).

The undergrowth is diverse and can be sparse or dense, depending on local conditions. Total herbaceous cover rarely exceeds 40%. *Maianthemum stellatum* (starry false Solomon seal) and *Geranium richardsonii* (Richardson geranium) are frequently found. Graminoid cover is less diverse than forb cover.

Ecological Processes

This mixed deciduous-evergreen plant association is a mid-seral community. With continued fluvial activity, such as flooding, channel migration, sediment deposition, and scouring, narrowleaf cottonwood and blue spruce will continue to co-occur along the reach. Gradual and slightly sinuous stream channels that have overbank flow and sediment deposition favor establishment of *Populus angustifolia*. *Picea pungens* is favored along reaches in deep valleys with steep canyon walls that provide conditions for strong cold-air drainage. If the floodplain is no longer active, i.e., is no longer flooded because the stream channel has become lower (surface becomes a terrace) or upstream dams control floods, then cottonwoods will eventually die and the conifers may persist.

Narrowleaf cottonwood / Thinleaf alder Woodland

Populus angustifolia / Alnus incana ssp. tenuifolia

Global rank/State rank:
G3 / S3
HGM subclass: R3/4
Colorado elevation range:
6,000-9,600 ft (1,830-2,930 m)

General Description

The *Populus angustifolia/Alnus incana* ssp. *tenuifolia* (narrowleaf cottonwood/thinleaf alder) plant association is characterized by a dense stand of *Alnus incana* lining the stream bank and an open to nearly closed canopy of *Populus angustifolia*. Other shrubs may occur but *Alnus incana* ssp. *tenuifolia* (thinleaf alder) usually has at least 10-20% cover and is the most abundant of all other shrubs within the stand. It occurs along narrow, fast-moving stream reaches in montane areas.

This plant association occurs on active floodplains in narrow to broad valleys. It forms a narrow, dense band along stream banks and benches. Some of the stands have signs of recent flooding. Stream gradient and channel width are highly variable. Some sites occur along steep, narrow reaches with little sinuosity. Other sites occur along low gradient, moderately sinuous, broad channel reaches, low gradient, highly sinuous reaches, or very narrow and highly sinuous stream sections. Soils are mostly coarse textured ranging from deep sands to shallow sandy loams. Some profiles show stratification with loams to clay loams alternating with sands. Most profiles become skeletal at an average depth of 12 inches (30 cm).

Vegetation Description

The dominance of *Populus angustifolia* (narrowleaf cottonwood) and *Alnus incana* ssp. *tenuifolia* (thinleaf alder) are the key diagnostic characteristics of this association. Several other tree and shrub species may be present, but they rarely equal the abundance of the diagnostic species. The overstory is an open to dense canopy of *Populus angustifolia*, which is always present, if sometimes only as sapling-sized individuals. Other tree species that may be present include *Pseudotsuga menziesii* (Douglas-fir), *Juniperus scopulorum* (Rocky Mountain juniper), *Populus tremuloides* (quaking aspen), *Pinus ponderosa* (ponderosa pine), *Populus* x *acuminata* (lanceleaf cottonwood), *Abies concolor* (white fir), or *Picea pungens* (blue spruce). The shrub understory is dominated by a dense band of *Alnus incana* ssp. *tenuifolia* (thinleaf alder) lining the stream bank. A variety of other shrubs may be present, intermingling with the alder but usually providing less than the total alder cover. Other shrub species include *Salix bebbiana* (Bebb willow), *Salix monticola* (mountain willow), *Salix drummondiana* (Drummond willow), *Salix ligulifolia* (strapleaf willow), *Salix lucida* ssp. *caudata* (shining willow), *Salix exigua* (sandbar willow), *Cornus sericea* (red-osier dogwood), *Rosa woodsii* (Woods rose), *Acer glabrum* (Rocky Mountain maple), and *Betula occidentalis* (river birch).

The herbaceous undergrowth is generally sparse. Herbaceous species include *Poa pratensis* (Kentucky bluegrass), *Taraxacum officinale* (dandelion), *Equisetum arvense* (field horsetail), *Rudbeckia laciniata* var. *ampla* (cutleaf coneflower), *Heracleum*

maximum (common cowparsnip), *Maianthemum stellatum* (starry false Solomon seal), *Trifolium repens* (white clover), *Calamagrostis canadensis* (bluejoint reedgrass), *Oxypolis fendleri* (Fendler cowbane), and *Cardamine cordifolia* (heartleaf bittercress).

Ecological Processes

The *Populus angustifolia/Alnus incana* ssp. *tenuifolia* (narrowleaf cottonwood/thinleaf alder) plant association is considered a mid-seral community (not the youngest and not the oldest stands of cottonwoods within a reach). With time and without flooding disturbance, stands may become dominated by invading conifers from adjacent upland communities such as *Pseudotsuga menziesii* (Douglas-fir), *Juniperus* spp. (juniper), or *Picea engelmannii* (Engelmann spruce).

Booth willow / Mesic forb Shrubland

Salix boothii / Mesic forb

Global rank/State rank:
G3 / S3
HGM subclass: S1/2, R2
Colorado elevation range:
7,000-9,500 ft (2,130-2,900 m)

General Description

The *Salix boothii*/mesic forb (Booth willow/mesic forb) plant association is a tall (4-5 ft, 1-2 m) shrubland that often forms extensive thickets (willow carrs) on broad montane floodplains. This association is common in the northern half of Colorado. This association occurs on wetter sites within the floodplain environment. It is usually found within 2.5 ft (0.75 m) of the water table, but is occasionally located above the channel on low terraces of straighter sections of river. The ground surface is often uneven and hummocky due to past flooding and beaver activity. A narrow to broad, low-gradient floodplain is common along all of the river reaches. Stream channels are steep and narrow, broad and sinuous, narrow and meandering, or recently eroding. Soils are highly stratified with alternating layers of sandy loams and clay loams and mottled within the top 4 inches (10 cm). Others are finely textured, dark-colored, highly organic soils with silty clay loam mottling. Lower profiles contain a gravel or cobble layer which may indicate that the soil section is a silted-in beaver pond.

Vegetation Description

Salix boothii (Booth willow) forms large stands with a canopy ranging from 20-80% cover. Other shrub species can be as abundant but do not exceed that of *Salix boothii* nor are they consistently present. Other shrub species include *Salix drummondiana* (Drummond willow), *Salix geyeriana* (Geyer willow), *Salix monticola* (mountain willow), *Dasiphora floribunda* (shrubby cinquefoil), *Betula nana (=glandulosa)* (bog birch), and *Alnus incana* ssp. *tenuifolia* (thinleaf alder).

The undergrowth is characterized by a sparse to lush forb layer growing on raised hummocks. No one forb species is dominant, instead several abundant species have a combined cover of 40-60%. Forb species include *Swertia perennis* (star gentian), *Pedicularis groenlandica* (elephanthead lousewort), *Polygonum bistortoides* (American bistort), *Heracleum maximum* (common cowparsnip), and *Achillea millefolium* var. *occidentalis* (western yarrow). Graminoid cover is typically low (< 20%), but it can be as high as 80%. Graminoid species include *Carex aquatilis* (water sedge), *Carex utriculata* (beaked sedge), and *Calamagrostis canadensis* (bluejoint reedgrass).

Ecological Processes

The *Salix boothii* (Booth willow)/mesic forb plant association appears to be a stable and long-lived community on sites that are neither completely saturated nor dry throughout the growing season. The undergrowth of *Salix boothii* dominated associations varies according to the substrate and water regime. Wetter stands have an understory of *Carex utriculata* (beaked sedge), while drier stands may have *Calamagrostis canadensis* (bluejoint reedgrass) and various forb species. It is unclear whether grazing increases the dominance of either mesic forbs or graminoids or if there are subtle environmental differences between sites that contribute to this. With excessive grazing, this community may be replaced by a *Salix boothii/Poa pratensis* (Booth willow/Kentucky bluegrass) type with native forbs once dominant in the *Salix boothii*/mesic forb plant association growing under the protection of shrub bases.

Drummond willow / Bluejoint reedgrass Shrubland

Salix drummondiana / Calamagrostis canadensis

Global rank/State rank:
G3 / S3
HGM subclass: S1/2, R2
Colorado elevation range:
8,000-9,800 ft (2,400-3,000 m)

General Description

The *Salix drummondiana*/*Calamagrostis canadensis* (Drummond willow/bluejoint reedgrass) plant association is characterized by a dense canopy of *Salix drummondiana* and a thick undergrowth of *Calamagrostis canadensis*. This association is often associated with beaver activity along streams and can also occur within the riparian mosaic with *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests. This plant association occurs in scattered locations on the West Slope in the Yampa, Colorado and Gunnison River Basins and in the Routt National Forest.

This plant association occurs as small, isolated patches in forest and shrubland openings along channels in narrow valley bottoms. *Salix drummondiana* (Drummond willow) usually occurs along steep, narrow stream margins. It is often associated with beaver activity and can occasionally occur along low-gradient streams.

Vegetation Description

Salix drummondiana (Drummond willow) dominates the shrub overstory. Other shrubs can be present and abundant, such as *Salix planifolia* (planeleaf willow) and *Alnus incana* ssp. *tenuifolia* (thinleaf alder). The graminoid layer is dominated by *Calamagrostis canadensis* (bluejoint reedgrass). Other abundant graminoids include *Carex aquatilis* (water sedge), *Carex utriculata* (beaked sedge), and *Glyceria striata*

(fowl mannagrass). Forb cover is typically low and includes *Galium boreale* (northern bedstraw), *Geranium richardsonii* (Richardson geranium), and *Mertensia ciliata* (tall fringed bluebells).

Ecological Processes

The *Salix drummondiana*/*Calamagrostis canadensis* (Drummond willow/bluejoint reedgrass) plant association is often an early colonizer of first-order, boulder-strewn, steep streams. Only a few stands representing the *Salix drummondiana*/*Calamagrostis canadensis* (Drummond willow/bluejoint reedgrass) plant association have been found in Colorado, and livestock grazing has probably altered the species composition of these stands. This association appears to be limited to saturated wetland environments and therefore may be dependent on beaver populations that maintain a high water table. In addition, near beaver activity, this association may be a mid-successional community that will eventually become a *Salix planifolia* (planeleaf willow) or *Salix monticola* (mountain willow) type as the area dries slightly and accumulates sediment.

Geyer willow - Mountain willow / Bluejoint reedgrass Shrubland

Salix geyeriana - Salix monticola / Calamagrostis canadensis

Global rank/State rank:
G3 /S3
HGM subclass: R2
Colorado elevation range:
8,200-9,200 ft (2,500-2,800 m)

General Description

The *Salix geyeriana-Salix monticola/Calamagrostis canadensis* (Geyer willowmountain
willow/bluejoint reedgrass) plant association is a tall (4-8 ft, 1.5-2.5 m), deciduous shrubland that occurs in small and large stands interspersed with wet meadows, open stream channels, and beaver ponds. The willow canopy is nearly a homogeneous mix of the two willow species.

This plant association occurs on wide floodplains that are flat or hummocky and occurs within 2 ft (0.5 m) of the channel high water mark. Stream channels are narrow and highly sinuous or braided by beaver activity. Soil textures range from sandy loam to silty clay, with up to 50% organic matter in the upper layers. Water table depths range from 8-25 inches (20-60 cm).

Vegetation Description

The shrub canopy is dominated by 22-40% cover of *Salix geyeriana* (Geyer willow) and 15-50% cover of *Salix monticola* (mountain willow). Other shrubs that may be present include *Salix planifolia* (planeleaf willow), *Salix drummondiana* (Drummond willow), *Lonicera involucrata* (twinberry honeysuckle), and *Ribes inerme* (whitestem gooseberry). The undergrowth can be patchy, but generally dominated by *Calamagrostis canadensis* (bluejoint reedgrass). Other herbaceous species that may be present include *Carex aquatilis* (water sedge), *Geum macrophyllum* (largeleaf avens), and *Heracleum maximum* (common cowparsnip).

Ecological Processes

Stands dominated by *Salix geyeriana* (Geyer willow) appear to be stable, long-lived communities. *Salix geyeriana* is most stable where the water table does not drop below 3 ft (1 m) of the surface. It appears to be limited to cold, wet environments of broad valley bottoms at high elevations. Due to the colder environments, organic matter builds up in the soils and succession to other associations is likely to be slow. Beaver activity is also important in maintaining this association since it may be the last successional community to establish on naturally silted-in beaver ponds.

Mountain willow / Beaked sedge Shrubland

Salix monticola / Carex utriculata

Global rank/State rank:
G3 / S3
HGM subclass: S1/2, R2
Colorado elevation range:
6,600-10,300 ft (2,000-3,100 m)

General Description

The *Salix monticola*/*Carex utriculata* (mountain willow/beaked sedge) plant association is a tall (5-8 ft, or 1.5-2.5 m), deciduous shrubland with an open canopy of willows and a thick understory of grasses and sedges. It occurs on open floodplains and often occupies the entire valley floor. The undergrowth is dominated by patches of *Carex utriculata* (beaked sedge). This association often includes *Carex aquatilis* (water sedge) and *Calamagrostis canadensis* (bluejoint reedgrass), but is distinguished from the *Salix monticola*/*Carex aquatilis* (mountain willow/water sedge) and *Salix monticola*/*Calamagrostis canadensis* (mountain willow/bluejoint reedgrass) associations because *Carex utriculata* is either the clear dominant or most consistently present of the three throughout the stand.

This plant association commonly occurs near beaver ponds. Willows establish on hummocks of higher ground and *Carex utriculata* (beaked sedge) establishes at the pond margins. This association also occurs along wet stream banks and terraces of low gradient (<3%), broad valley bottoms. Stream reaches can be moderately wide with a gentle gradient, wide and meandering, or altered by beaver activity, creating multiple channels. Soils are clay loam, sandy clay loam and heavy silty clay textures with occasional mottling. Some profiles have a buried organic layer. Others have up to 40% organic matter in the top 20 inches (50 cm).

Vegetation Description

This association is characterized by a thick canopy dominated by *Salix monticola* (mountain willow) as the matrix species. The matrix species is the willow with the highest abundance, even though other willow species combined may have greater canopy cover. Other shrub species that may be present include *Salix geyeriana* (Geyer willow), *Salix brachycarpa* (barrenground willow), *Salix drummondiana* (Drummond willow), *Salix. ligulifolia* (strapleaf willow), and *Salix boothii* (Booth willow). *Carex utriculata* (beaked sedge) is the most abundant graminoid. Other graminoid

cover is minor and includes *Carex aquatilis* (water sedge), *Poa pratensis* (Kentucky bluegrass), and *Deschampsia caespitosa* (tufted hairgrass). Total forb cover is generally less than 10%. Forb species include *Cardamine cordifolia* (heartleaf bittercress), *Mertensia ciliata* (tall fringed bluebells), and *Heracleum maximum* (common cowparsnip).

Ecological Processes

This plant association requires a high water table and saturated soils for much of the growing season and may be an early successional stage of the *Salix monticola/Carex aquatilis* and the *Salix monticola/Calamagrostis canadensis* associations.

Carex utriculata (beaked sedge), *Carex aquatilis* (water sedge), and *Calamagrostis canadensis* (bluejoint reedgrass) are common dominant undergrowth of several *Salix* plant associations. These three graminoids indicate different micro-environments, generally separating out along a moisture gradient related to the depth of the water table, and can represent different stages of succession of the floodplain. *Carex utriculata* (beaked sedge) occurs on the wettest sites, such as shallow pond margins, low-lying swales, and overflow channel with the shallowest water tables. *Carex aquatilis* (water sedge) occurs on intermediate sites that have saturated but not inundated soils. *Calamagrostis canadensis* (bluejoint reedgrass) dominates the drier sites with lower water tables.

Mountain willow / Mesic forb Shrubland

Salix monticola / Mesic forb

Global rank/State rank:
G4 / S3
HGM subclass: S1/2, R2, R3/4
Colorado elevation range:
6,800-10,700 ft (2,070-3,260 m)

General Description

The *Salix monticola/*mesic forb (mountain willow/mesic forb) plant association is a tall (5-8 ft, 1.5-2.5 m), deciduous shrubland with a dense or open canopy and an herbaceous layer dominated by a variety of forbs and grasses. While no single herbaceous species is a clear dominant, total forb cover is generally greater than 30% and exceeds total graminoid cover.

This association occurs along broad, swift-moving streams and active floodplains in narrow to moderately wide valleys. The ground surface is usually undulating, from past flooding or beaver activity. Stands form narrow bands at the stream edge, ranging from 1-6 ft (0.1-2 m) above the channel elevation. In wider valley bottoms, stands occur further from the bank, but never more than 2.5 ft (0.75 m) above the annual high water mark. Most stands occur adjacent to straight, wide, and shallow channels ranging from bedrock to silty-bottomed reaches. A few stands occur on meandering, cobble-bottomed reaches or streams braided by beaver activity. Soils are fine textured sandy clays to silty and sandy clay loams.

Vegetation Description

Salix monticola (mountain willow) forms a dense to open canopy, and if not the clear dominant, then it is the matrix willow. The matrix species is the willow with the highest abundance, even though other willow species combined may have greater canopy cover. Other shrub species that may be present include *Ribes inerme* (whitestem gooseberry), *Salix drummondiana* (Drummond willow), *S. planifolia* (planeleaf willow), *S. bebbiana* (Bebb willow), *S. geyeriana* (Geyer willow), *S. brachycarpa* (barrenground willow), *S. wolfii* (Wolf willow), *S. lucida* ssp. *caudata* or *lasiandra* (shining willow), *Alnus incana* ssp. *tenuifolia* (thinleaf alder) and *Lonicera involucrata* (twinberry honeysuckle).

Total forb cover ranges from 10-70%. No one forb species is noticeably more abundant than any other, nor is any species consistently present in all stands. Forb species that may be present include *Heracleum maximum* (common cowparsnip), *Rudbeckia laciniata* var. *ampla* (cutleaf coneflower), *Mertensia ciliata* (tall fringed bluebells), and *Fragaria virginiana* (strawberry). Graminoid cover may be absent or up to 50% cover; in general it does not exceed the total forb cover. Graminoid species that may be present include *Calamagrostis canadensis* (bluejoint reedgrass) and *Carex utriculata* (beaked sedge). Generally, forbs are dominant under shrubs on hummocks and ridges while graminoids dominate the undergrowth in low-lying, wetter swales. Exotic graminoid and forb species include *Poa pratensis* (Kentucky bluegrass), *Trifolium repens* (white clover), and *Taraxacum officinale* (dandelion).

Ecological Processes

Salix monticola (mountain willow) dominated plant associations appear to be longlived and stable. They occur on mesic sites that support a diversity of graminoids and forbs. *Salix monticola* appears to grow only where the water table does not drop below 3 ft (1 m) of the surface. It appears to be limited to cold, wet environments in broad valley bottoms at high elevations. Due to the colder environments, organic matter builds up in the soils, and it is likely that succession to other associations is slow. This plant association occurs on mesic sites and supports a rich diversity of forbs. On broad, hummocky floodplains stands can form extensive willow carrs. Sites with a higher abundance of exotic forbs and graminoids may be grazing-induced. At higher elevations, this association grades into the *Salix planifolia*/mesic forb (planeleaf willow/mesic forb) association.

Mountain willow / Mesic graminoid Shrubland

Salix monticola / Mesic graminoid

Global rank/State rank:
G3 / S3
HGM subclass: S1/2, S3/4, R2
Colorado elevation range:
6,600-11,000 ft (2,000-3,350 m)

General Description

The *Salix monticola*/mesic graminoid (mountain willow/mesic graminoid) plant

association is a tall (5-8 ft, 1.5-2.5 m), deciduous shrubland, with an open to closed canopy of willows on broad, gentle floodplains, or in narrow canyon bottoms. The herbaceous undergrowth is diverse, with a variety of graminoid and forb species. This association is distinguished from the *Salix monticola*/mesic forb association by having a higher cover of graminoid species. Stands with predominantly non-native graminoid species in the undergrowth are considered grazing-induced. Stands are considered high quality when their undergrowth is predominantly native graminoid species.
The *Salix monticola*/mesic graminoid (mountain willow/mesic graminoid) plant association dominates stream reaches in narrow to wide valleys, 65-400 ft (20-120 m) wide, with active floodplains and broad, swift-moving streams. Stands usually occur > 2 ft (0.5 m) above the bankfull channel along the stream edge or away from the channel up to 50 ft (15 m). The ground surface is usually undulating due to past flooding or beaver activity. Stream channels can be fairly steep and narrow with cobble beds, moderately wide and sinuous with cobble beds or broad, meandering rivers with a developed floodplain. Some stands also occur along channels that are braided due to beaver activity. Soils are fine textured clay loams and sandy clay loams of varying depths, 4-18 inches (10-45 cm). Mottling and gleyed layers often occur within 5 inches (12 cm) of the ground surface.

Vegetation Description

Salix monticola (mountain willow) forms a dense to open canopy. If it is not the clear dominant, then it is the matrix willow. The matrix species is the willow with the highest abundance, even though other willow species combined may have greater canopy cover. Other shrubs that may be present at higher elevations include *Salix planifolia* (planeleaf willow), *S. geyeriana* (Geyer willow), and *S. brachycarpa* (barrenground willow). At lower elevations, other shrubs that may be present include *Salix irrorata* (bluestem willow), *S. lucida* ssp. *caudata* (shining willow), *Alnus incana* ssp. *tenuifolia* (thinleaf alder) and *Dasiphora floribunda* (shrubby cinquefoil). Total graminoid cover ranges from 10-55% and exceeds that of total forb cover. No single species is particularly dominant over the others, and no one species is present in every stand. Graminoid species that may be present include *Poa pratensis* (Kentucky bluegrass), *Juncus balticus* var. *montanus* (mountain rush), *Carex aquatilis* (water sedge), and *Equisetum arvense* (field horsetail). Forb cover ranges from 5-20% and forbs generally are not as abundant as graminoids. Forb species that may be present include *Heracleum maximum* (common cowparsnip), *Fragaria virginiana* (strawberry) and *Achillea millefolium* var. *occidentalis* (western yarrow). In stands with pronounced hummock micro-topography underneath the willow canopy, graminoids will typically dominate the low-lying swales, while forbs will dominate the better drained hummocks and ridge tops.

Ecological Processes

The *Salix monticola*/mesic graminoid (mountain willow/mesic graminoid) plant association appears to be a stable, long-lived community. Stands with an abundance of *Poa pratensis* (Kentucky bluegrass) or *Agrostis stolonifera* (creeping bentgrass) may be a grazing-induced disclimax. Stands with abundant *Salix planifolia* (planeleaf willow) may indicate a transition between higher elevational sites dominated by *Salix planifolia* and lower elevational sites where *Salix monticola* is more abundant.

Planeleaf willow / Bluejoint reedgrass Shrubland

Salix planifolia / Calamagrostis canadensis

Global rank/State rank:
G4 / S3
HGM subclass: S1/2, R1
Colorado elevation range:
8,900-11,800 ft (2,700-3,600 m)

General Description

The *Salix planifolia/Calamagrostis canadensis* (planeleaf willow/bluejoint reedgrass) plant association is the least common of the *Salix planifolia* plant associations. It is frequently grazed to the point of shifting the dominant undergrowth grasses. It may have been more abundant historically.
This is a high elevation wetland plant association, usually occurring in broad, glacial valleys and swales where direct snow melt is the primary moisture source throughout the growing season. Stream channels are wide and moderately sinuous, often associated with beaver ponds. This association also occurs in narrow valleys with sinuous streams and wet floodplains. *Salix planifolia* shrublands occur on peat or mineral soils, deep clay loams and sandy clay loams, derived from glacial till. The mineral soils can have a high organic content.

Vegetation Description

Salix planifolia (planeleaf willow) forms a dense shrub layer with 30-100% cover. Other willow species that may be present include *Salix brachycarpa* (barrenground willow), and *Salix wolfii* (Wolf willow). *Calamagrostis canadensis* (bluejoint reedgrass) dominates the dense and sometimes rich herbaceous layer. Several *Carex* (sedge) species can also be present including *Carex utriculata* (beaked sedge), *Carex microptera* (smallwing sedge), and *Carex aquatilis* (water sedge). The forb layer can be diverse, but often has less than 20% total cover. Forb species can include *Caltha leptosepala* (marsh marigold), *Cardamine cordifolia* (heartleaf bittercress), *Pedicularis groenlandica* (elephanthead lousewort), and *Mertensia ciliata* (tall fringed bluebells).
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Ecological Processes

Salix planifolia (planeleaf willow), *Salix brachycarpa* (barrenground willow) and *Salix wolfii* (Wolf willow) are abundant low-stature willows of first- and second-order streams of subalpine elevations of Colorado. *Salix planifolia* and *Salix brachycarpa* can form extensive stands, often creating intricate mosaics in broad, subalpine valleys. In general, *Salix planifolia* occupies the wettest micro-habitats on peat soils, although it can grow well on mineral soils. *Salix brachycarpa* is more often found on slightly drier and more welldrained micro-habitats than *Salix planifolia*. *Salix wolfii* grows on deep, undecomposed peat, while *Salix planifolia* tends to grow on more decomposed (humified) organic soils. *Salix planifolia* also grows at elevations below the subalpine and becomes a much taller willow due to a longer growing season. In montane elevations, *Salix planifolia* is often a codominant in *Salix monticola* plant associations. The *Salix planifolia/Calamagrostis canadensis* association may represent an ecotonal

community to the conifer/*Calamagrostis canadensis* community type. In Colorado, *Salix planifolia/Calamagrostis canadensis* stands have been observed at the ecotone to the conifer/*Calamagrostis canadensis* plant association.

Planeleaf willow / Marsh-marigold Shrubland

Salix planifolia / Caltha leptosepala

Global rank/State rank:
G4 / S4
HGM subclass: S1/2, R1
Colorado elevation range:
8,900-11,800 ft (2,700-3,600 m)

General Description

The *Salix planifolia/Caltha leptosepala* (planeleaf willow/marsh marigold) plant association is a common and abundant upper montane and subalpine community occurring on very wet to saturated soils. This association is characterized by lowstature shrubs, less than 2 ft (0.5 m) tall, and a thick carpet of forbs in the undergrowth. There may be scattered patches of other willows present. This is a major subalpine wetland plant association that occurs throughout the Rocky Mountains of Colorado.

This plant association typically occurs in wide, glaciated valleys adjacent to streams. It occurs in swales, depressions, and on slopes where snowmelt runoff saturates soils for much of the growing season. The ground may be flat or uneven with raised hummocks. Stream gradients range from <1% in broad floodplains to 14% in steep snowmelt basins. Stream channels vary. Channels may be steep and narrow, firstorder streams in snow melt basins, relatively wide and straight, narrow, relatively deep, and meandering in broad, glaciated valleys or braided, multiple channels below beaver dams. Soil textures are highly variable. Mineral soils vary along a moisture gradient. Wet sites have soil textures of silty clays and silt loams, while slightly drier sites have loamy sands and sandy loams overlying gravelly alluvium. Some stands occur on well-drained, mineral soils with well-oxygenated water and no mottled or gleyed layers. Other sites have a shallow organic layer overlying a gravel or cobble layer within 10-20 inches (20-50 cm) of the surface. The water table at these sites is usually near the surface throughout the growing season and may be perched by a clay horizon. Still other stands occur on deep, dark clay loams with high organic content or a fibrous layer on top.

Vegetation Description

Salix planifolia (planeleaf willow) may form nearly pure stands with 10-100% cover. Other willows that may be present at lower elevations include *Salix geyeriana* (Geyer willow) and *S. monticola* (mountain willow). At higher elevations, other shrubs that may be present include *Salix brachycarpa* (barrenground willow) on drier sites, or *Betula nana (=glandulosa)* (bog birch) and *Salix wolfii* (Wolf willow) on wetter sites. *Picea engelmannii* (Engelmann spruce) is occasionally scattered throughout the stand. Typically, the willow canopy is nearly closed and an herbaceous undergrowth occurs only in openings between willow patches. The undergrowth is characterized by an abundance of forbs with few graminoids. *Caltha leptosepala* (marsh marigold) is usually present. Other wet species such as *Trollius laxus* (American globeflower), *Cardamine cordifolia* (heartleaf bittercress), *Senecio triangularis* (arrowleaf ragwort), *Mertensia ciliata* (tall fringed bluebells), *Pedicularis groenlandica* (elephanthead lousewort) and *Rhodiola rhodantha* (redpod stonecrop) are also indicators of this type. Graminoid species that may be present include *Calamagrostis canadensis* (bluejoint reedgrass) and *Carex aquatilis* (water sedge).

Ecological Processes

Salix planifolia (planeleaf willow), *S. brachycarpa* (barrenground willow) and *S. wolfii* (Wolf willow) are abundant low-stature willows of first- and second-order streams of subalpine elevations of Colorado. *Salix planifolia* and *Salix brachycarpa* can form extensive stands, often creating intricate mosaics in broad, subalpine valleys. In general, *Salix planifolia* occupies the wettest micro-habitats on peat soils, although it can grow well on mineral soils. *Salix brachycarpa* is more often found on slightly drier and more well-drained micro-habitats than *Salix planifolia*. *Salix wolfii* grows on deep, undecomposed peat, while *Salix planifolia* tends to grow on more decomposed (humified) organic soils. *Salix planifolia* also grows at elevations below the subalpine, and becomes a much taller willow due to a longer growing season. In montane elevations, *Salix planifolia* is often a co-dominant in *Salix monticola* plant associations. This association occurs in wet swales that are saturated throughout most or all of the growing season. It is a long-lived, stable association that changes with fluctuations in the water table and degree of soil saturation.

Planeleaf willow / Water sedge Shrubland

Salix planifolia / Carex aquatilis

Global rank/State rank:
G5 / S4
HGM subclass: S1/2
Colorado elevation range:
8,300-11,700 ft (2,530-3,560 m)

General Description

The *Salix planifolia/Carex aquatilis* (planeleaf willow/water sedge) plant association is a low-stature willow shrubland that grows in wet to saturated soils, ususally above 9,000 ft (2,800 m). It is a common plant association of subalpine glacial valleys. *Salix planifolia* occasionally mixes with *Salix brachycarpa* (barrenground willow) or *Salix wolfii* (Wolf willow) at higher elevations and grades into taller willow carrs with *Salix monticola* (mountain willow) at lower elevations. This plant association is a common type and occurs throughout the Rocky Mountains of Colorado.

This plant association occurs in wide, wet valleys on snow-melt fed swales. It also occurs in narrow valleys with sinuous streams and wet floodplains associated with

beaver ponds. Stream channels are wide and moderately sinuous, narrow and sinuous, or highly braided by beaver activity. Soils have an organic peat top layer over mineral silty clays, heavy silty clay loams, silty loams, sandy loams, or loamy sands. Mottling is often evident.

Vegetation Description

This plant association is characterized by low-stature (1.5-5 ft; 0.5-1.5 m) *Salix planifolia* (planeleaf willow). Other willows that may be present include *Salix monticola* (mountain willow), *Salix wolfii* (Wolf willow), *Salix boothii* (Booth willow), *Salix geyeriana* (Geyer willow), and *Salix drummondiana* (Drummond willow)

The herbaceous undergrowth is dominated by *Carex aquatilis* (water sedge). Other graminoid species that may be present include *Carex utriculata* (beaked sedge), *Calamagrostis canadensis* (bluejoint reedgrass), and *Deschampsia caespitosa* (tufted hairgrass). Total forb cover is often less than 30%. Species that may be present include *Caltha leptosepala* (marsh marigold), *Cardamine cordifolia* (heartleaf bittercress), *Pedicularis groenlandica* (elephanthead lousewort), and *Conioselinum scopulorum* (Rocky Mountain hemlockparsley).

Ecological Processes

Salix planifolia (planeleaf willow), *Salix brachycarpa* (barrenground willow) and *Salix wolfii* (Wolf willow) are abundant low-stature willows of first- and second-order streams of subalpine elevations of Colorado. *Salix planifolia* and *Salix brachycarpa* can form extensive stands, often creating intricate mosaics in broad, subalpine valleys. In general, *Salix planifolia* occupies the wettest micro-habitats on peat soils, although it can grow well on mineral soils. *Salix brachycarpa* is often found on slightly drier and more well-drained micro-habitats than *Salix planifolia*. *Salix wolfii* grows on deep, undecomposed peat, while *Salix planifolia* tends to grow on more decomposed (humified) organic soils. *Salix planifolia* also grows at elevations below the subalpine, and becomes a much taller willow due to a longer growing season. At montane elevations, *Salix planifolia* is often a co-dominant in *Salix monticola* plant associations.

The *Salix planifolia/Carex aquatilis* (planeleaf willow/water sedge) plant association occurs in wet swales that are saturated throughout the growing season. The dense canopy layers and thick undergrowth indicate stable conditions. Both *Carex aquatilis* (water sedge) and *Caltha leptosepala* (marsh marigold) can tolerate saturated soils, and occasionally they co-dominate the undergrowth.

Planeleaf willow / Mesic forb Shrubland

Salix planifolia / Mesic forb

Global rank/State rank:
G4 / S4
HGM subclass: S1/2, R2
Colorado elevation range:
8,900-12,100 ft (2,700-3,700 m)

General Description

The *Salix planifolia/*mesic forb (planeleaf willow/mesic forb) plant association is a low stature (<2 ft, 0.5 m) shrubland with abundant and diverse forbs under the willow canopy. It is a common community of the sublapine and lower alpine areas. It occurs on mesic soils. This plant association typically occurs in wide, glaciated valleys adjacent to streams. It occurs in swales, depressions and on slopes where snow melt runoff saturates soils for much of the growing season. The ground may be flat or uneven with raised hummocks. Stream gradients range from <1% in broad floodplains to 14% in steep snowmelt basins. Stream channels vary. Channels may be steep and narrow, first-order streams in snow melt basins, relatively wide and straight, narrow, relatively deep, and meandering in broad, glaciated valleys or braided, multiple channels below beaver dams.

Soil textures are highly variable. Mineral soils vary along a moisture gradient. Wet sites have soil textures of silty clays and silt loams, while slightly drier sites have loamy sands and sandy loams overlying gravelly alluvium. Some stands occur on well-drained, mineral soils with well-oxygenated water and no mottled or gleyed layers. Other sites have a shallow organic layer overlying a gravel or cobble layer within 10-20 inches (20-50 cm) of the surface. The water table at these sites is usually near the surface throughout the growing season and may be perched by a clay horizon. Still other stands occur on deep, dark clay loams with high organic content or a fibric or hemic layer on top.

Vegetation Description

Salix planifolia (planeleaf willow) often forms nearly pure stands. Other willows that may be present include *Salix monticola* (mountain willow), *S. brachycarpa* (barrenground willow), *S. boothii* (Booth willow), *S. drummondiana* (Drummond willow), and *S. wolfii* (Wolf willow). *Picea engelmannii* (Engelmann spruce) can occur along the outer edges of the stand.

Typically, the willow canopy is nearly closed and an herbaceous undergrowth occurs only in openings between willow patches. The undergrowth is characterized by an abundance of forbs with few graminoids. Forb species include *Achillea millefolium* var. *occidentalis* (western yarrow), *Mertensia ciliata* (tall fringed bluebells), and *Senecio triangularis* (arrowleaf ragwort).

Ecological Processes

Salix planifolia (planeleaf willow), *Salix brachycarpa* (barrenground willow) and *Salix wolfii* (Wolf willow) are abundant low-stature willows of first- and second-order streams of subalpine elevations of Colorado. In general, *Salix planifolia* occupies the wettest micro-habitats on peat soils, although it can grow well on mineral soils. *Salix brachycarpa* is more often found on slightly drier and more well-drained microhabitats than *Salix planifolia*. *Salix wolfii* grows on deep, undecomposed peat, while *Salix planifolia* tends to grow on more decomposed (humified) organic soils. *Salix planifolia* also grows at elevations below the subalpine, and becomes a much taller willow due to a longer growing season. In montane elevations, *Salix planifolia* is often a co-dominant in *Salix monticola* plant associations.

The *Salix planifolia*/mesic forb (planeleaf willow/mesic forb) plant association occurs in wet swales that are saturated throughout most or all of the growing season. It is a

long-lived, stable association that changes with fluctuations in the water table and degree of soil saturation. The *Salix planifolia*/mesic forb association may be a grazing-induced phase of the *Salix planifolia/Caltha leptosepala* (planeleaf willow/marsh marigold) association. Many stands in the Routt National Forest are heavily grazed and contain a high number of exotic and increaser species such as *Taraxacum officinale* (dandelion) and *Fragaria virginiana* (strawberry). Other stands in Colorado, however, do not show an increase in non-native species.

Wolf willow / Mesic forb Shrubland

Salix wolfii / Mesic forb

Global rank/State rank:
G3 / S3
HGM subclass: S1/2, R1
Colorado elevation range:
7,900-11,000 ft (2,400-3,400 m)

General Description

The *Salix wolfii*/mesic forb (Wolf willow/mesic forb) plant association occurs at mid to upper montane and lower subalpine elevations. It frequently covers wide, open, gently sloping areas near first- and second-order streams. It can be recognized by the generally dense layer of low-growing, silvery *Salix wolfii* (Wolf willow) dominating the overstory with a variety of mesic forbs and some graminoids in the undergrowth. In Colorado, *Salix wolfii* (Wolf willow) grows in small patches and does not form aslarge, expansive willow carrs (i.e., shrubland thickets) like *Salix planifolia* (planeleaf willow). *Salix wolfii* often forms a mosaic with stands of *S. planifolia*, *S. brachycarpa* (barrenground willow) and open *Carex* spp. (sedge) meadows.
This association occurs in wide mountain valleys, along first- or second-order streams on well-drained slopes and hummocks on the valley floor. The water table is usually within the top 3 ft (1 m) of soil and groundwater slowly seeps to the surface. Stream channels are narrow, relatively deep and sinuous. The soils may be saturated in the spring and early summer, but dry somewhat during the summer as the water table drops. Soil textures often have a high organic content and are silty clays, silty clay loams, silty loams, or deep sandy clays, clay loams, and sandy clay loams over gravels and rocks. Some stands have a loamy horizon underlain by a clay horizon.

Vegetation Description

Salix wolfii (Wolf willow) dominates the shrub layer with 10-90% cover. Other willow species that may be present include *Salix planifolia* (planeleaf willow), *Salix boothii* (Booth willow), and *Salix geyeriana* (Geyer willow). Total forb cover exceeds that of total graminoid cover. No single forb species is particularly more abundant than any other, and no one species is present in every stand. Forb species that may be present include *Caltha leptosepala* (marsh marigold), *Mertensia ciliata* (tall fringed bluebells), *Senecio triangularis* (arrowleaf ragwort), *Ligusticum porteri* (Porter licoriceroot), *Fragaria virginiana* (strawberry), *Cardamine cordifolia* (heartleaf bittercress), *Geum macrophyllum* (large-leaved avens), and *Heracleum maximum* (common cowparsnip). Graminoid species present are diverse, yet generally have a low cover relative to the amount of total forb cover. Graminoid species may include *Deschampsia caespitosa* (tufted hairgrass), *Calamagrostis canadensis* (bluejoint reedgrass), and various *Carex* (sedge) species.

Ecological Processes

Salix planifolia (planeleaf willow), *Salix brachycarpa* (barrenground willow) and *Salix wolfii* (Wolf willow) are abundant low-stature willows of first- and second-order streams of subalpine elevations of Colorado. Stands of *Salix wolfii* are less frequently encountered, and are usually limited in size. *Salix wolfii* grows on deep, undecomposed peat, while *Salix planifolia* tends to grow on more decomposed (humified) organic soils.
When non-native and increaser species are abundant, the *Salix wolfii*/mesic forb association may be a grazing-induced phase of the *Salix wolfii/Carex aquatilis* (Wolf willow/water sedge) association. Many stands in the Routt National Forest are heavily grazed and contain a high number of exotic and increaser species such as *Taraxacum officinale* (dandelion) and *Fragaria virginiana* (strawberry). However, other stands in Colorado without abundant increaser or non-native species do not appear to be grazing induced.

PLANTS

Eriophorum altaicum ssp. neogaeum (Altai cottongrass)

Eriophorum altaicum var. *neogaena*. Photograph copyright© CNHP by P. Lyon

Taxonomy
Class: *Monocotyledoneae*
Order: *Cyperales*
Family: *Cyperaceae*
Genus: *Eriophorum*

Taxonomic Comments: A more common, closely related plant, the narrowleaf cottongrass (*E. angustifolia*), has multiple heads and leaf blades nearly as long as the stems. It is closely related to plants found in Siberia (Weber and Wittman 1986).

CNHP Ranking: G4?T3? S3

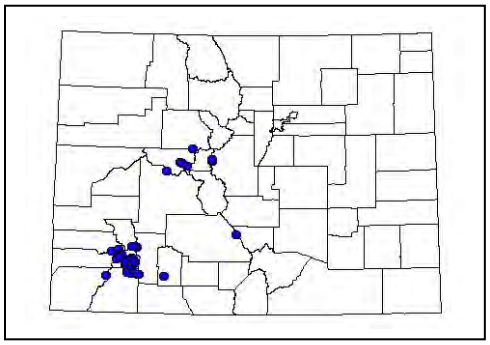
State/Federal Status: Forest Service Sensitive

Description: The plants are rhizomatous, with solitary white fleecy heads on the tops of the stems, and lacking well-developed leaf blades (Weber 1996).

Habitat Comments: Altai cottongrass grows in wet meadows, fens, and around ponds, usually above or at treeline. It is often associated with elephant-head Pedicularis (*Pedicularis groenlandica*), tufted hairgrass (*Deschampsia cespitosa*), marsh marigold (*Caltha leptosepala*), mosses and sedges. It grows in patches in wetlands at high elevations, often associated with water sedge (*Carex aquatilis*), marsh marigold (*Caltha leptosepala*), elephant head (*Pedicularis groenlandica*) and tufted hairgrass (*Deschampsia cespitosa*). In San Juan County, it is sometimes associated with iron fens.

Global Range: *Eriophorum altaicum* var. *neogaeum* is the New World variety of a circumpolar species. In North America, it occurs in Colorado, Montana, Utah, Wyoming and British Columbia.

State Range: Altai cottongrass occurs in 10 counties: Eagle, Gunnison, La Plata, Mineral, Park, Pitkin, Saguache, San Juan and San Miguel.



Distribution in Colorado

Distribution/Abundance: There are 38 known occurrences in Colorado, in ten counties. Several locations have over a thousand individuals.

Known Threats and Management Issues: Threats appear to be limited for this species; however, local

trampling may affect easily accessed occurrences. The primary management issue is maintaining the natural hydrologic regime of the wetlands in which it occurs.

Version date: May 2004

Weber, W.A. and Ronald Wittmann. 1996. Colorado Flora: Western Slope. University Press of Colorado.