Survey of Critical Wetlands and Riparian Areas in Southern Alamosa and Costilla Counties, San Luis Valley, Colorado

Colorado Natural Heritage Program
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Natural Heritage Program COLORADO

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June 29, 2004

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Cover photograph: Rio Grande near San Luis Hills

Photo taken by Joe Rocchio.

ACKNOWLEDGEMENTS

Financial support for this study was provided by the Colorado Department of Natural Resources (CDNR) through a grant from the Environmental Protection Agency (EPA), Region 8. We greatly appreciate the support and assistance of Alex Chappell (retired) of the Colorado Division of Wildlife, Kimberly Seymour of the Colorado Department of Natural Resources, and Sarah Fowler, Glenn Rodriguez, Brent Truskowski, and Ed Sterns (retired) of the EPA, Region 8.

We are very grateful to the Colorado Division of Wildlife's Wetlands Program, The Nature Conservancy, and Ducks Unlimited for their in-kind contribution to this project. Their collaboration made this project possible.

The U.S. Fish and Wildlife Service staff at the Alamosa/Monte Vista National Wildlife Refuge provided much help with maps, relevant documents, landowner access information, and most appreciatively, a place to rest, eat, and sleep after a long day in the field. Thanks so much! Chandra Pettie of the Natural Resources Conservation Service graciously provided her time in suggesting wetland sites to visit. The City of Alamosa provided access to their properties along the Rio Grande. John Alves of the Colorado Division of Wildlife provided much data and assistance with Rio Grande cutthroat trout information. We also thank Rich Levad, of Rocky Mountain Bird Observatory, for providing updated data on waterbirds at Adams Lake. Many thanks to Cindy Villa who volunteered her botanical skills and arranged for CNHP to visit the Dos Hermanos Ranch in Costilla County. The Rio Grande Headwaters Land Trust provided a very helpful set of GIS layers. Also, many thanks to Milagro's Coffee House and Café for jump starting many mornings and KRZA for keeping me entertained during the many hours spent in my vehicle roaming the backroads of southern Alamosa and Costilla counties.

We are also grateful to the landowners who gave us permission to survey their property. We enjoyed meeting them, and in some cases hiking with them on their property.

Our staff in Fort Collins, including Jodie Bell, Jill Handwerk, Jeremy Siemers, Amy Lavender, and Barbara Brayfield all worked with us patiently.

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EXECUTIVE SUMMARY

Although the rate of wetland loss in Southern Alamosa and Costilla counties is difficult to quantify, it is clear that many wetlands have been lost or profoundly altered from their pre-settlement state. Agriculture, grazing, development, construction of reservoirs, water diversions, and groundwater withdrawal have had many impacts on wetlands throughout the study area. Fertile soils and available water for irrigation make floodplains productive areas for agriculture. Since the nineteenth century, hydrological diversions have been developed for irrigation and drinking water supplies. Groundwater withdrawal supplies irrigation water and has resulted in lowering water tables in many areas with a subsequent loss of wetlands. Such activities have eliminated or altered some wetlands, and created other wetlands very different from those in existence prior to European settlement.

It is clear that with the current rate of land use conversion and the lack of comprehensive wetland protection programs, wetlands will continue to be lost or dramatically altered. However, the likelihood for human conflicts with biologically important wetlands is minimized if there is the opportunity to proactively plan for managing human activity or managing for the species or habitat of interest. The purpose of this project is to provide a data resource for the Colorado Division of Wildlife and the San Luis Valley Wetland Focus Area Committee in conducting proactive planning. This document should be considered a tool for managing lands that support rare wetland species and plant associations within Southern Alamosa and Costilla counties.

In 2003, 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 Southern Alamosa and Costilla counties. 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.

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

(1) The Colorado Wetlands Partnership, a wetlands protection partnership that includes the Colorado Division of Wildlife, the Colorado Office of The Nature Conservancy, Colorado State Parks, Partners for Wildlife, Ducks Unlimited, and Great Outdoors Colorado;
(2) The San Luis Valley Wetland Focus Area Committee's effort to identify protection and restoration priorities;
(3) CNHP's Comprehensive Statewide Wetland Classification and Characterization Project;
(4) The Nature Conservancy's Priority Conservation sites in the San Luis Valley;
(5) The hydrogeomorphic (HGM) wetland functional assessment program; and
(6) CNHP's Vegetation Index of Biotic Integrity (VIBI) for Wetlands project.

This project supports the VIBI and HGM development process by identifying potential reference wetlands and the range of variation and potential subclasses within Southern Alamosa and Costilla counties, and by performing a qualitative wetland functional assessment to guide future quantitative efforts in assessing the range of variation within a subclass. The identification of reference wetlands also assists CNHP's Vegetation Index of Biotic Integrity for Wetlands project by providing a list of potential reference sites which can be utilized in the development of VIBI models. CNHP's wetland work provides input to the Colorado Wetlands Initiative Partners by

identifying potential sites for protection and restoration. Finally, the results of this survey will be incorporated into CNHP's Comprehensive Statewide Wetlands Classification.

Field surveys began in June 2003 and continued through September 2003. High quality examples of wetlands and riparian areas and those supporting populations of rare wetland-dependent species were given highest priority. Such locations were identified by: (1) examining existing biological data for rare or imperiled plant and animal species and significant plant communities (collectively called **elements**) from the Colorado Natural Heritage Program's database, (2) accumulating additional existing information on these elements, (3) input from local citizens of Southern Alamosa and Costilla counties and more specifically, the San Luis Valley Wetland Focus Area Committee, and, (4) conducting extensive field surveys. Areas that were found to contain significant elements were delineated as Potential Conservation Areas (PCA). These areas were prioritized by their biological urgency (the most rare or imperiled) and their ability to maintain viable populations of the elements (degree of threat). A qualitative functional assessment was conducted at most of the wetland and riparian areas visited. The restoration potential of each PCA was also noted.

Results of this project confirm that Southern Alamosa and Costilla counties contain areas with high biological significance and a diverse array of wetlands that support a wide variety of plants, animals, and plant associations. At least 26 major wetland/riparian plant communities, six birds, one fish, and one plant from CNHP's Tracking List of plants, animals, and plant communities are known to occur in, or are associated with, wetlands in Southern Alamosa and Costilla counties. Fifteen of the wetland/riparian plant communities and two of the bird species documented were not incorporated into CNHP's BIOTIC database due to either a lack of necessary information, or because the quality, size and landscape context of these elements was too poor to incorporate into the database. However, they are included in Table 10 to indicate their presence in the study area.

Seventeen wetland and riparian sites of biodiversity significance are profiled in this report as Potential Conservation Areas (PCAs). These PCAs represent the best examples of 11 wetland and riparian communities observed on the private and public lands visited. CNHP believes these PCAs include those wetlands that most merit conservation efforts, while emphasizing that protecting only these PCAs will, in no way, adequately protect all the functions and values associated with wetlands in Southern Alamosa and Costilla counties. Despite the best efforts during one field season, it is likely that some elements that are present were not documented during the survey due to either lack of access, phenology (reproductive timing) of species, or time constraints. Future surveys will likely identify additional areas of biological significance that have not been identified in this report. The delineation of PCA boundaries in this report does not confer any regulatory protection on recommended areas, rather are intended to support wise planning and decision making for the conservation of these significant areas. Additional information may be requested from Colorado Natural Heritage Program, Colorado State University, 8002 Campus Delivery, Fort Collins, CO 80523-8002.

Protection and/or proper management of the PCAs would help to conserve the biological integrity of Southern Alamosa and Costilla counties, and Colorado. Of these PCAs, several stand out as very significant such as the Rio Grande at Alamosa National Wildlife Refuge (B2) and Hanse Bluffs Seeps (B3) Potential Conservation Areas. The Rio Grande at Alamosa National Wildlife Refuge supports populations of the Federally Endangered Southwestern Willow Flycatcher while the Hansen Bluffs Seeps Potential Conservation Area (B3) supports a fen occurring at an uncharacteristically low elevation.

Of the 17 wetland and riparian PCAs, we identified four as being **nearly irreplaceable biodiversity significance** (B2), 11 of **high biodiversity significance** (B3), one of **moderate biodiversity significance** (B4), and one of **general biodiversity significance** (B5). The highest ranking PCAs are the highest priorities for conservation action. Overall, the concentration and quality of imperiled elements and habitats attest to the fact that wetland conservation efforts in Southern Alamosa and Costilla counties will have both state and global significance.

The results of the survey will be provided to the Colorado Division of Wildlife's Wetlands Program, Colorado Department of Natural Resources, U.S. Environmental Protection Agency Region 8, The Nature Conservancy, Colorado State University library, and the San Luis Valley Wetland Focus Area Committee and will be available to the public on CNHP's website (http:\\www.cnhp.colostate.edu).

CONSERVATION STRATEGIES

Conservation strategies can be classified as three major types:

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

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

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

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

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

3. Recognize the importance of all natural communities and lands at all elevations. Although much effort in the past has been directed at protecting the most scenic, high elevation areas, the lower elevations have received less attention. While the specific PCAs identified here

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

4. Develop and implement comprehensive programs to address loss of wetlands. In conjunction with the information contained in this report, information regarding the degree and trend of loss for all wetland types (e.g., fens, emergent marshes, riparian forests, seeps/springs, etc.) should be sought and utilized to design and implement a comprehensive approach to the management and protection of Southern Alamosa and Costilla counties wetlands. Such an effort could provide a blueprint for wetland conservation in the County. Encourage and support statewide wetland protection efforts such as CDOW's Wetlands Partnership. County governments are encouraged to support research efforts on wetlands to aid in their conservation. Countywide education on the importance of wetlands could be implemented through the county extension service or other local agencies. Encourage communication and cooperation with landowners regarding protection of wetlands in Southern Alamosa and Costilla counties. Utilize the expertise and breadth of experience within the San Luis Valley Wetland Focus Area Committee.

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

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

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

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

8. Continue inventories where necessary, including inventories for species that cannot be surveyed adequately in one field season and inventories on lands that CNHP could not access in 2003. Not all targeted inventory areas can be field surveyed in one year due to either lack of access, phenology of species, or time constraints. Because some species are ephemeral or migratory, completing an inventory in one field season is often difficult. Despite the best efforts during one field season, it is likely that some elements that are present were not documented during the survey and other important sites have not been identified in this report.

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

10. Encourage public education. One of the greatest tools in conserving land for biodiversity is to explain the value of such areas to the public. As described in this report, Southern Alamosa and Costilla counties are rich in wetland animal and plant diversity. 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 Southern Alamosa and Costilla counties should increase awareness of the uniqueness of the habitats within the counties. Similarly, providing educational pamphlets or newsletters that explain why these areas are so valuable can increase public interest and support for biodiversity conservation.

INTRODUCTION

Wetlands are places where soils are inundated or saturated with water long enough and frequently enough to significantly affect the plants and animals that live and grow there. Until recently, most people viewed wetlands as a hindrance to productive land use. Consequently, many wetlands across North America were purposefully drained. Since 1986, wetlands have been lost at a rate of 58,500 acres/year (Dahl 2000). In Colorado an estimated 1 million acres of wetlands (50% of the total for the state) were lost prior to 1980 (Dahl 1990).

Although the rate of wetland loss in Southern Alamosa and Costilla counties is difficult to quantify, it is clear that many wetlands have been lost or profoundly altered from their pre-settlement state. Agriculture, grazing, development, construction of reservoirs, water diversions, and groundwater withdrawal have had many impacts on wetlands throughout the study area. Fertile soils and available water for irrigation make floodplains productive areas for agriculture. Since the nineteenth century, hydrological diversions have been developed for irrigation and drinking water supplies. Groundwater withdrawal supplies irrigation water and has resulted in lowering water tables in many areas with a subsequent loss of wetlands. Such activities have eliminated or altered some wetlands, and created other wetlands very different from those in existence prior to European settlement. For example, the development of an extensive network of canals and irrigation agriculture has created irrigation-induced wetlands where none previously existed. This same activity has altered many natural wetlands by changing hydrological patterns across the landscape. It is clear that with the current rate of land use conversion and the lack of comprehensive wetland protection programs, wetlands will continue to be lost or dramatically altered.

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

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

The Survey of Critical Wetlands and Riparian Areas in Southern Alamosa and Costilla counties, conducted by the Colorado Natural Heritage Program (CNHP), is a part of ongoing wetland surveys of Colorado counties by CNHP. To date, similar surveys have been conducted in all or parts of over 20 counties. CNHP has also completed the Comprehensive Statewide Wetland Characterization and Classification Project (Carsey et al. 2003). This project compiled data from multiple sources, including CNHP's Riparian Classification (Kittel et al. 1999), to produce a comprehensive wetland classification for the State of Colorado.

The purpose of this project is to provide a data resource for the San Luis Valley Wetland Focus Area Committee and federal, state, and local agencies in conducting proactive planning for wetland conservation in Southern Alamosa and Costilla counties. This document should be considered a tool for managing lands that support rare wetland species and plant associations within Southern Alamosa and Costilla counties. There are limitations to the information, in particular, the survey work was conducted for one growing season. 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 additional information. Also, all areas of Southern Alamosa and Costilla counties were not surveyed. Due to limitations of time and land access, this report only includes information from readily observed species or from areas that biologists received permission to visit. Finally, this report does not include all wetland species or associations found within Southern Alamosa and Costilla counties. This project specifically targeted the organisms that are tracked by CNHP (see the Methods section of this document). The primary focus was to identify the locations of the wetland plant and animal populations, and plant associations on CNHP's list of rare and imperiled elements of biodiversity, assess their conservation value, and to systematically prioritize these for conservation action. Wetland functions and restoration potential for each site visited was also assessed.

The locations of biologically significant wetlands were identified by:

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

Locations in the counties with natural heritage significance (those places where elements have been documented) are presented in this report as Potential Conservation Areas (PCAs). The goal is to identify a land area that can provide the habitat and ecological needs upon which a particular element or suite of elements depends for their continued existence. The best available knowledge of each species' life history is used in conjunction with information about topographic, geomorphic, and hydrologic features, vegetative cover, as well as current and potential land uses to delineate PCA boundaries.

The PCA boundaries delineated in this report do not confer any regulatory protection of the PCA, nor do they recommend automatic exclusion of all activity. It is hypothesized that some activities will prove degrading to the element(s) or the ecological processes on which they depend, while others will not. The boundaries represent the best professional estimate of the primary area supporting the long-term survival of the targeted species or plant associations and are presented for planning purposes. They delineate ecologically sensitive areas where land-use practices should be carefully planned and managed to ensure that they are compatible with protection of natural heritage resources and sensitive species. Please note that these boundaries are based primarily on our understanding of the ecological systems. A thorough analysis of the human context and potential stresses was not conducted. All land within the PCA planning boundary should be considered an integral part of a complex economic, social, and ecological landscape that requires wise land-use planning at all levels.

CNHP uses the Heritage Ranking Methodology to prioritize conservation actions by identifying those areas that have the greatest chance of conservation success for the most imperiled elements. The PCAs are prioritized according to their **biodiversity significance rank**, or B-rank, which

ranges from B1 (irreplaceable) to B5 (general or statewide biodiversity significance). These ranks are based on the conservation (imperilment or rarity) ranks for each element and the element occurrence ranks (quality rank) for that particular location. Therefore, the highest quality occurrences (those with the greatest likelihood of long-term survival) of the most imperiled elements are the highest priority (receive the highest B-rank). See the section on Natural Heritage Ranking System in this document for more details. The B1-B3 PCAs are the highest priorities for conservation actions. The sum of all the PCAs in this report represents the area CNHP recommends for protection in order to preserve the natural heritage of Southern Alamosa and Costilla counties's wetlands.

WETLAND DEFINITIONS, REGULATIONS, AND FUNCTIONAL ASSESSMENTS

WETLAND DEFINITIONS

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

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

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

WETLAND REGULATION IN COLORADO

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

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

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

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

WETLAND FUNCTIONS AND VALUES

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

- Groundwater recharge--the replenishing of below ground aquifers.
- Groundwater discharge--the movement of ground water to the surface (e.g., springs).
- Floodflow alteration--the temporary storage of potential flood waters.
- Sediment stabilization--the protection of stream banks and lake shores from erosion.
- Sediment/toxicant retention--the removal of suspended soil particles from the water, along with toxic substances that may be adsorbed to these particles.
- Nutrient removal/transformation--the removal of excess nutrients from the water, in particular nitrogen and phosphorous. Phosphorous is often removed via sedimentation; transformation includes converting inorganic forms of nutrients to organic forms and/or the conversion of one inorganic form to another inorganic form (e.g., NO_3^- converted to N_2O or N_2 via denitrification).
- Production export--supply organic material (dead leaves, soluble organic carbon, etc.) to the base of the food chain.
- Aquatic diversity/abundance--wetlands support fisheries and aquatic invertebrates.
- Wildlife diversity/abundance--wetlands provide habitat for wildlife.

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

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

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

WETLAND FUNCTIONAL ASSESSMENT

For this project, CNHP utilized a qualitative, descriptive functional assessment based on the best professional judgment of CNHP ecologists while incorporating some of the principles of the hydrogeomorphic (HGM) assessment method. Each wetland was classified according to both the Cowardin et al. (1979) and hydrogeomorphic (HGM) (Brinson 1993) classification systems and twelve categories (listed below) were used to assess each wetland. Using the HGM method, wetland functions are evaluated or compared only with respect to other wetlands in the same subclass, because different subclasses often perform very different functions. For example, a montane kettle pond may provide habitat for rare plant associations never found on a large river but provides little in the way of flood control, while wetlands along a major river perform important flood control functions but may not harbor rare plant species. Thus, the category, **Overall Functional Integrity**, was included in the functional assessment to provide the user of some indication of how a particular wetland is functioning in comparison to its natural capacity, as opposed to comparing it to different wetland types.

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

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

Overall Functional Integrity

The overall functional integrity of each wetland is a rating indicating how a particular wetland is functioning in comparison to wetlands in its same hydrogeomorphic class and/or subclass. For example, mineral soil flats (salt meadows) do not typically function as high wildlife habitat but do have high capacity for storing surface/groundwater. Thus, a mineral soil flat that is given a low rating for General Wildlife Habitat, General Fish Habitat, and Production Export/Food Chain Support does not necessarily indicate that the wetland is not functioning to its capacity. These ratings may just reflect that mineral soil flats, because of their landscape position and soil chemistry, naturally perform fewer functions than a depressional wetland. However, this

particular wetland may be functioning the 'best' that could be expected from a mineral soil flat. The Overall Functional Integrity rating would reflect this by giving this particular wetland an "At Potential" rating based on the best professional judgment of CNHP ecologists. In summary, a mineral soil flat wetland having more low ratings than a depressional wetland does not necessarily mean that it is functioning improperly. However, if this particular mineral soil flat was given an Overall Functional Integrity rating of "Below Potential," then it could be assumed that the wetland is not functioning to the capacity that it should (relative to other mineral soil flat wetlands).

Flood Attenuation and Storage

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

Sediment/Shoreline Stabilization

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

Groundwater Discharge/Recharge

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

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

Dynamic Surface Water Storage

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

Elemental Cycling
The cycling of nutrients, or the abiotic and biotic processes that convert elements from one form to another, is a fundamental ecosystem process, which maintains a balance between living biomass and detrital stocks (Brinson et al. 1985). Disrupting nutrient cycles could cause an imbalance between the two resulting in one factor 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.

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

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

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

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

Production Export/Food Chain Support
Production export refers to the flushing of organic material (both particulate and dissolved organic carbon and detritus) from the wetland to downstream ecosystems. Production export

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

Uniqueness

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

HYDROGEOMORPHIC (HGM) APPROACH TO WETLAND FUNCTIONAL ASSESSMENT

In an effort to provide a more consistent and logical basis for regulatory decisions about wetlands, a new approach to assessing wetland functions--the *hydrogeomorphic* approach is being developed. In Colorado, the hydrogeomorphic, or HGM, approach to wetland function assessment is being developed by the Colorado Geological Survey, with help from the U.S. Army Corps of Engineers, other government agencies, academic institutions, the Colorado Natural Heritage Program, and representatives from private consulting firms (Colorado Geological Survey et al. 1998). HGM assessment and classifications have also been conducted specifically for Summit County, CO (SAIC 2000; Johnson 2002).

This approach is based on a classification of wetlands according to their hydrology (water source and direction of flow) and geomorphology (landscape position and shape of the wetland) called "hydrogeomorphic" classification (Brinson 1993). There are four hydrogeomorphic classes present in Colorado: riverine, slope, depression, and mineral soil flats (Table 1). Within a geographic region, HGM wetland classes are further subdivided into subclasses. A subclass includes all those wetlands that have essentially the same characteristics and perform the same functions.

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

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

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

Class	Geomorphic setting	Water Source	Water Movement	Subclass	Plant community examples
Riverine	In riparian areas along rivers and streams	Overbank flow from channel	One-directional and horizontal (downstream)	R1-steep gradient, low order streams	Herbaceous plant community in subalpine
				R2-moderate gradient, low to middle order	*Populus angustifolia/Alnus incana* ssp. *tenuifolia* along North Fork Trinchera Creek
				R3-middle elevation, moderate gradient along small/mid-order stream	The *Populus angustifolia/ Salix exigua* community found along the Rio Grande
				R4-low elevation canyons or plateaus	The *Picea pungens/Alnus incana* ssp. *tenuifolia* community found in the upper montane zone.
				R5-low elev. Floodplains	Colorado River
Slope	At the base of slopes, e.g., along the base of the foothills; also, places where porous bedrock overlying a 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.	Herbaceous and shrubland plant communities
				S2-subalpine and montane fens on calcareous substrates	Extreme rich fens in South Park.
				S3-wet meadows at middle elev.	Hansen Bluffs seeps dominated by sedges.

Class	Geomorphic setting	Water Source	Water Movement	Subclass	Plant community examples
				S4-low elevation meadows	Wet meadows dominated by pasture grasses and sedges
Depressional	In depressions cause by glacial action (in the mountains) and oxbow ponds within floodplains. Lake, reservoir, and pond margins are also included.	Shallow ground water	Generally two-directional, vertical: flowing into and out of the wetland in the bottom and sides of the depression	D1-mid to high elevation basins with peat soils or lake fringe without peat	Elk Meadows fen.
				D2-low elevation basins that are permanently or semi-permanently flooded	Depressional wetlands in Rio Grande River floodplain
				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	Playa lakes on Colorado's eastern plains.
Mineral Soil Flat	Topographically flat wetland	Precipitation and groundwater	Two directional	F1-low elevation with seasonal high water table	Salt flats in San Luis Valley

PROJECT BACKGROUND

LOCATION AND PHYSICAL CHARACTERISTICS OF STUDY AREA

Southern Alamosa and Costilla counties are located in the San Luis Valley, in south-central Colorado (Figure 1). The San Luis Valley is Colorado's largest and driest mountain park and is bounded on all sides by imposing mountain ranges. The Sangre de Cristo Mountains line the east and northeast sides of the basin, rising abruptly from the level valley floor to over 14,000 feet above sea level. Alluvial fans are common all along the west slopes of the Sangre de Cristos Mountains. The San Juan Mountains, which form the western perimeter, are a less striking feature as viewed from the valley floor. Unlike the narrow, jagged profile of the Sangre de Cristo Mountains, the San Juan Mountains rise gradually over 40 miles from the valley to the Continental Divide, which forms the western boundary of the study area. The Cochetopa Hills, which form the northwest boundary of the basin, bridge the San Juan and Sangre de Cristo highlands. Significant watercourses in Southern Alamosa and Costilla counties include the Rio Grande, Sangre de Cristo, Trinchera, and Culebra creeks. The floodplain of the Rio Grande contains a significant portion of the wetlands found in the study area.

Almost all of the study area consists of private lands. The U.S. Fish and Wildlife Service manages the Alamosa and Monte Vista National Wildlife Refuges. The Alamosa National Wildlife Refuge occurs entirely within the study area while only a small portion of the Monte Vista National Wildlife Refuge occurs in the project area. The Bureau of Land Management manages a parcel east of the Alamosa National Wildlife Refuge and the Colorado State Land Board and the Colorado Division of Wildlife manage small parcels within Alamosa County. All of Costilla County is in private ownership.

CLIMATE

The study area is characterized by cold winters and cool summers. At Alamosa, the average January temperature is 18^{o} F and the average July temperature is 65^{o} F (U.S. Department of Agriculture 1973). Local microclimates are strongly influenced by topography. The higher elevations are decidedly cooler and moister, except during winter thermal inversions, which trap the coldest air at the valley floor. The valley bottom lies in a double rain shadow. The San Juan Mountains block westerly winter storms and the Sangre de Cristo Mountains block spring moisture from the east, creating a very dry landscape. Alamosa is, in fact, the driest weather station in Colorado. In late summer, southerly "monsoon" flows commence, and provide the only respite from drought. In general, precipitation increases with altitude, from Alamosa, where yearly precipitation averages just over seven inches, to the crests of the surrounding mountain ranges, where estimated precipitation approaches 40 inches annually (Figure 2; Colorado Climate Center, 1998). Runoff and groundwater recharge from higher elevations of the watershed, which receive abundant snowfall and summer rain, are crucial to the persistence of riparian and wetland communities, as well as the economic well-being of the San Luis Valley.

Precipitation in 2002 was the 7th lowest on record for Alamosa at 4.42 inches (http://www.crh.noaa.gov/pub/climate/alspcpn.htm). Precipitation totals for 2003 through December are slightly below average (7.08 inches).

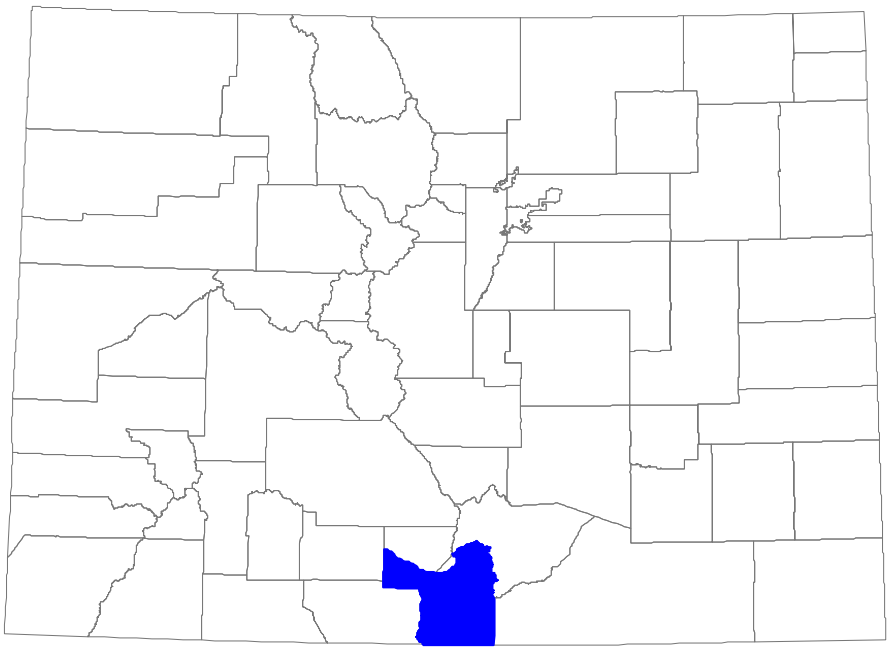


Figure 1. Location of Southern Alamosa and Costilla counties in Colorado

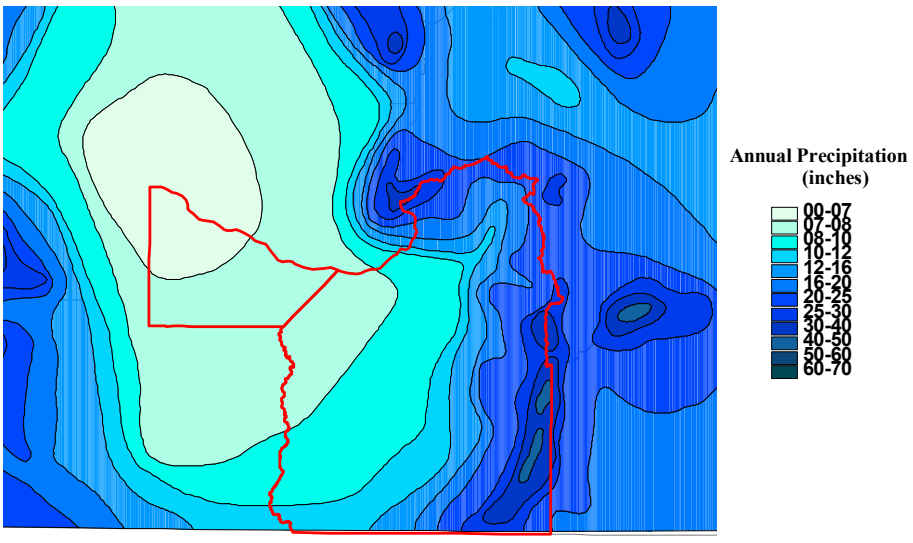


Figure 2. Precipitation in Southern Alamosa and Costilla counties.

GEOLOGY AND HYDROLOGY

The San Luis Valley is a broad structural depression that was created by Cenozoic faulting of the Rio Grande Rift Zone. The San Luis valley is geologically composed of Precambrian plutonic and metamorphic rocks overlain by valley-fill deposits from surrounding mountains (Leonard and Watts 1989) (Figure 3). These deposits are interbedded fine- to coarse-grained alluvial and lacustrine deposits, volcanic flows, and volcaniclastic rocks that are estimated to range in thickness from 5,000 ft. to 10,000 ft. within the study area (Leonard and Watts 1989). These deposits contain both confined and unconfined aquifers.

The geology of the eastern and western sides of the study area is quite different. Generally, the Sangre de Cristo range is composed of Precambrian granites and schists with some conglomerates, sandstones, and limestones. Pleistocene glaciation dramatically sculpted areas above 10,000 feet, particularly on the northeast side of the range (Peterson 1971). The San Juan Mountains are generally older lava and ash flow deposits of Tertiary origin, with basalts and tuffs of Pliocene/Miocene origin found throughout (Tweto 1979). Alluvial fans line both sides of the valley and contain sedimentary-type cobbles.

Much of the study area lies on the valley floor, which is relatively flat, with a topographic depression on the eastern side. The valley floor is composed of sediments of up to 30,000 feet thick. Several layers of lava flows are embedded within these sediments. In addition, a layer of largely impermeable clay, 10 to 80 feet thick, underlies the superficial sediments (U.S. Department of Agriculture 1984). The clay layer, at depths of 50 to 130 feet, inhibits the vertical movement of water, and creates two separate aquifers, both containing large quantities of water. The lower aquifer is **confined** while the uppermost aquifer is **unconfined** and lies above the clay lens. The locations and degree of contact between these two reservoirs are presently unknown. This hydro-geologic structure results in a relatively high water table in many areas. Soils in both the confined and the unconfined aquifers are composed of unconsolidated clay, silt, sand, and gravel, with particle sizes decreasing towards the center of the valley (Leonard and Watts 1989). Recharge areas for both aquifers are believed to be along the alluvial fans at the base of the planning area's mountain ranges (U.S. Department of Agriculture 1984; Colorado Geological Survey 2003). Along the eastern side, the valley was down faulted along the base of the Sangre de Cristo Mountains and hinged at the base of the San Juan Mountains in the west (Jodry and Stanford 1996). This activity left zones on either side of the valley where water from mountain drainages and/or groundwater flow moving toward the valley is able to infiltrate and recharge both confined and unconfined aquifers. The unconfined aquifer lies above the uppermost impermeable layer and is the hydrological source for many of the wetlands found on the valley floor (Figure 3). Wetlands are often found in areas where groundwater, from the unconfined aquifer, moves toward low-lying areas and surfaces on the landscape. Wetlands in the study area are also associated with major river drainages such as the Rio Grande, Sangre de Cristo and Trincher creeks and smaller tributaries of these stream systems. Along these reaches, beavers, as in the higher elevations, play an important role creating and maintaining wetlands. The San Luis Valley is estimated to contain over 2 billion acre-feet of ground water (Pearl 1974).

As was discussed above, precipitation is much higher at higher elevations than in the lower San Luis Valley. Snowmelt percolates through the shallow mountain soils to emerge as springs that feed riverine, slope, and depressional wetland types that support riparian and wetland plant communities. In addition to precipitation, beavers play an important role creating and maintaining montane wetlands by building dams that impound and store water. The creation of beaver ponds raises local groundwater tables and supports many different wetland plant communities.

Steep mountain streams and rivers deliver huge peak flows in high snowmelt years, rolling large rocks and gravel down their river beds and carrying large volumes of suspended sediment. Flooding rivers are constantly reworking their banks, then rebuilding them with material deposited as turbulent waters subside. Where a river's gradient moderates and the valley widens, coarse bedload is dropped and the river begins to create a new channel, meandering across the floodplain creating a mosaic of wetland and riparian plant communities. As water moves toward the valley floor, either via major river drainages or groundwater flow, it quickly infiltrates into the coarse and fine sediments of the valley floor, thereby recharging the confined and unconfined aquifer of the San Luis Valley floor.

SOILS

Soils in the basin vary widely, ranging from rocky shallow soils in the Sangre de Cristo mountains, to cobbly, loamy well drained soils in the foothills and alluvial fans, to clayey, sandy, silty and highly alkaline soils in the valley bottom (U.S. Department of Agriculture 1973; U.S. Department of Agriculture 1980; U.S. Department of Agriculture 1984). Along drainages, both in the mountains and on the valley floor, wetland plant communities occur on alluvium soils. Soils on the valley floor vary but are often characterized by high alkalinity. Although many of the soil patterns in the high elevations are common in Colorado, the extremely alkaline nature of valley bottom soils is unusual and is a significant determinant of the vegetation pattern in low elevations (U.S. Department of Agriculture 1972; U.S. Department of Agriculture 1984; Galatowitsch 1988; Dick-Peddie 1993).

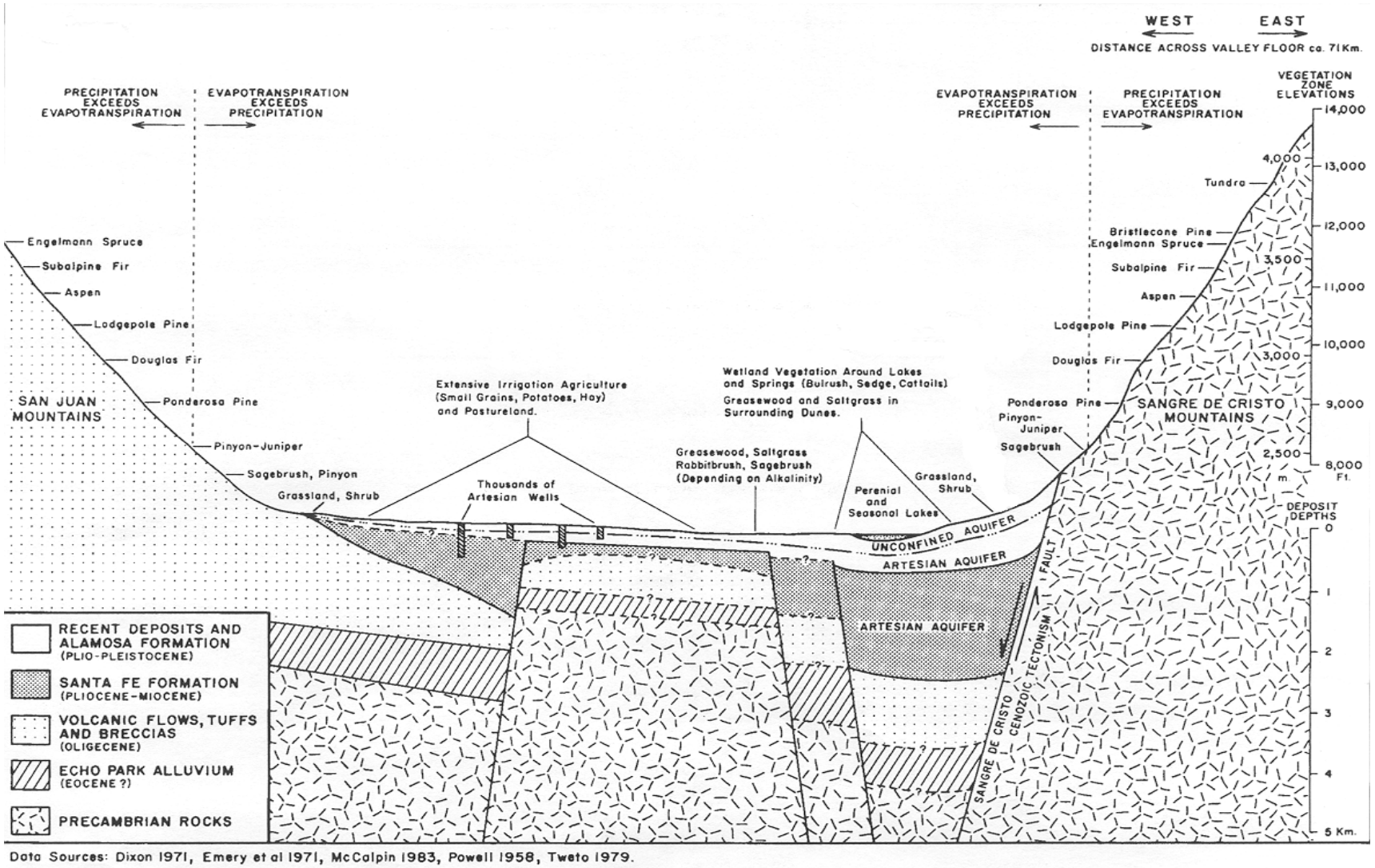


Figure 3. Generalized geologic cross-section of the San Luis Valley (from Jodry and Stanford 1996

VEGETATION

The project area contains an exceptional array of terrestrial and aquatic habitats. Elements of Great Basin, Short Grass Steppe, Rio Grande Valley, and southern Rocky Mountain floras, with steep gradients in elevation, moisture, and soil characteristics produce a landscape unique in Colorado. Valley bottom vegetation is typified by greasewood (*Sarcobatus vermiculatus*) and halophytic (salt-loving) grasses such as alkali sacaton (*Sporobolus airoides*) and saltgrass (*Distichlis spicata*) in the extensive alkali basins. Rubber rabbitbrush (*Chrysothamnus nauseosus*) and xeric grasses, such as indian rice grass (*Oryzopsis hymenoides*), occur on sandy soils where summer rains leach salts below the rooting zone. Valley bottom wetlands support a flora adapted to seasonal soil saturation and saline conditions. The marshes, lakes, and playas vary greatly in depth, salinity, and period of inundation. Regularly flooded basins support well developed aquatic and shoreline emergent vegetation, such as pondweeds (*Potamogeton* spp.), spikerush (*Eleocharis palustris*), hardstem bulrush (*Schoenoplectus acutus*), cattail (*Typha latifolia*), and American three-square (*Scirpus pungens*). Basins with irregular or short duration flooding contain saltgrass and/or western wheatgrass (*Pascopyrum smithii*) meadows, or barren salt flats. Basins which dry by mid-summer often support seasonal stands of salt tolerant annuals which complete their life cycles after surface water evaporates and the late summer rains begin. The most saline areas are dominated by salt crusts and species such as sea-blite (*Suaeda calceoliformis*), seaside heliotropium (*Heliotropium curassavicum*), and red glasswort (*Salicornia rubra*).

The alluvial fans, which line the valley bottom have their own characteristic vegetation. Extensive stands of pinyon pine (*Pinus edulis*), Gambel oak (*Quercus gambelii*), needle and thread grass (*Stipa comata*) and short grass steppe vegetation indicate the greater precipitation and milder winter temperatures of this zone, compared to the valley bottom. Many of the streams in these alluvial fans, particularly at the base of the Sangre de Cristo Range, support excellent riparian forests of narrowleaf cottonwood (*Populus angustifolia*), with dense shrub understories of willows (*Salix* spp.) western birch, (*Betula occidentalis*), ocean spray (*Holodiscus discolor*), and wild rose (*Rosa woodsii*).

The Sangre de Cristo Mountains contain typical southern Rocky Mountain vegetation including mixed forests of Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*), and occasional stands of white fir (*Abies concolor*) at lower elevations, and Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) at higher elevations. Dry south-facing slopes at high elevations support open woodlands of bristle-cone pine (*Pinus aristata*). Aspen (*Populus tremuloides*) stands are abundant throughout the study area at elevations over 8,500 feet. Sub-alpine and alpine wetlands are largely vegetated with willows (e.g., *Salix planifolia, S. drummondiana, S. wolfii, S. geyeriana, S. bebbiana*), sedges (e.g., *Carex aquatilis, C. scopulorum, C. utriculata, C. simulata*), wetland grasses (e.g., *Calamagrostis canadensis*, *Deschampsia cespitosa*), and forbs such as marsh marigold (*Caltha leptosepala*) and bittercress (*Cardamine cordifolia*). Narrowleaf cottonwood (*Populus angustifolia*), Colorado blue spruce (*Picea pungens*), mountain alder (*Alnus incana*), and chokecherry (*Prunus virginiana*) are common along large montane streams in the foothills while narrowleaf cottonwood (*Populus angustifolia*), coyote willow (*Salix exigua*), and mountain willow (*Salix monticola*) are common along riparian areas in the valley floor.

OBSERVATIONS ON MAJOR THREATS TO WETLAND BIODIVERSITY

The following table lists only those threats that were observed at or near the Potential Conservation Areas (see Results section of this document) and were thought to potentially impact the elements of concern.

Table 2. Threats observed at the potential conservation areas.

Potential Conservation Area	B –rank	Hydrologic Modification	Residential Development	Mining	Incompatible Grazing	Logging	Recreation	Roads	Non-native Species
Rio Grande	B2	X	X		X			X	X
Rio Grande at Alamosa National Wildlife Refuge	B2	X			X		X		X
Blanca Greasewood Flats	B3	X			X				X
Bowen Ditch Playas	B3	X			X				
Cuates Creek	B3								
Elk Meadows Fen	B3								
Hansen Bluffs Seeps	B3	X							X
Jaroso Creek	B3								
Little Ute Creek	B3								
North Fork Trinchera Creek	B3						X	X	
Playa Blanca	B3	X						X	X
Rio Grande at Trinchera Creek	B3	X			X				
Sangre de Cristo Creek	B3		X				X	X	X
Torcido Creek	B3								
Trinchera Creek Below Smith Reservoir	B3	X							X
Rio Grande at State Line	B4	X							X
Adams Lake	B5	X			X				X

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

Hydrological Modifications

Groundwater pumping is one of the greatest threats to the San Luis Valley's biodiversity. Surface water impoundments and diversions present an equally widespread, and allied threat. The playa lake ecosystems of the San Luis Valley floor depend upon a complex interaction of surface and groundwater sources that undergo characteristic seasonal and inter-annual fluctuations. Where sources of fresh surface water, such as creeks or springs build on the shallow water table to create seasonal groundwater mounds, extensive wetlands have developed. Preliminary work has shown that not only are hydrologic dynamics in the valley complex, but that the differing water sources vary widely in water quality (Cooper and Severn 1992). Wetland vegetation is strongly affected by water salinity, and valley wetlands have developed unique floristic patterns based on the quantity and quality of water they receive. Water uses that perturb the timing or magnitude of surface flows, or affect the water table, have the potential to detrimentally affect valley bottom wetlands. Even minor changes in the water depth or duration of inundation in the wetland basins can have profound effects on soil salinity, and consequently, wetland vegetation. Cooper and Severn (1992) observed that the entire range of soil moisture and salinity, and associated plant communities, from permanently saturated wetland to saline flat to rain rinsed upland, occurred

over an elevation gradient of only 5 to 8 feet. Wetland dependent fauna, such as nesting waterbirds, amphibians, or vertebrates may be affected by even brief fluctuations in wetland hydrology.

The Bureau of Reclamation's Closed Basin Project has pumped shallow groundwater to supplement Rio Grande flows, in order to meet Colorado's commitments to New Mexico, Texas, and Mexico under the Rio Grande Compact. Impacts from this project are purported by land owners and researchers (Cooper and Severn 1992), but not yet quantitatively described. The recent increases in groundwater development are superimposed on an a extensive background of surface water diversion. Nearly all the streams in the watershed are diverted for irrigated agriculture or hay meadows, or affected by unintentional impoundments, such as roads or ditches. The effects of such extensive hydrologic alterations are varied, from waterlogging in some areas to drying of wetlands in others. A solid understanding of the interactions between groundwater and surface water developments is presently lacking. Plans to pump confined aquifer water for trans-basin use are a serious concern given such scientific uncertainty.

Despite considerable debate, the hydrologic connections between surface, as well as shallow and deep groundwater resources and valley bottom wetlands remain poorly understood. The confusing array of past, present, and anticipated hydrologic disturbances, make it exceedingly difficult to accurately estimate management needs and viability potential for the elements of concern at many valley bottom sites. Although information needs are immense, independent research has been minimal to date (Cooper and Severn 1992). Effective management will require a much better understanding of the hydrologic connections between surface and shallow and deep groundwater resources of the Closed Basin, and how they vary temporally and spatially. Management of the valley bottom sites presented in this report will require, therefore, not only local protection of on-site wetland elements, but secure water resources, and greater understanding of how current and anticipated water uses within the watershed will affect the wetlands. For an accurate assessment of the risks to Closed Basin biodiversity posed by water development, further quantitative research linking hydrology, vegetation, and wetland obligate fauna is imperative.

Wetland Conversion

Conversion of wetland types can also have cumulative impacts on wetland functions and wetland biodiversity across the landscape. For example, agriculture and some wetland restoration/enhancement projects often convert wetlands from one type (e.g. saline wet meadows) to a different type of wetland (e.g. freshwater marsh). Many waterbird species benefit from such projects, however many other species suffer. For example, the San Luis Valley sandhills skipper (*Polites sabuleti* ssp. *ministigma*) (G5T3 S3) is an endemic subspecies found in the alkaline grasslands of the San Luis Valley. This species uses saltgrass (*Distichlis spicata*) as a host plant. This graminoid is often found in alkaline areas such as playas, saline wet meadows, and near springs. Thus, conversion of these wetland types can have cumulative impact on habitat for this rare, endemic subspecies.

Development

Residential development is a localized but increasing threat in the San Luis Valley. Although growth rates in the San Luis Valley have lagged well behind most other Colorado regions, it is likely that the Valley may begin to receive "overflow" development pressure. Development creates a number of stresses, including habitat loss and fragmentation, introduction of non-native species, fire suppression, and domestic animals (dogs and cats) (Oxley et al., 1974; Coleman and Temple, 1994; Knight et al., 1995). Habitat loss to development is considered irreversible and a

very serious problem. Development also tends to occur adjacent to water courses in this arid region, with consequent effects on aquatic and riparian habitats.

Mining
Mining has been a traditional industry in the San Luis Valley for over a century. Poorly planned or managed mining operations have the potential to impact biodiversity for decades after the activity has ceased. However, mining does not appear to have been a major activity within Southern Alamosa and Costilla counties.

Livestock Grazing
Domestic livestock is a traditional industry of the San Luis Valley, and has left a much more varied imprint. Depending upon grazing practices and local environmental conditions, impacts can be minimal, moderate and largely reversible (slight shifts in species composition, willow browsing), or severe and irreversible (extensive gullying, introduction of non-native forage species, extirpation of local willow populations). Also, "pest" control of unwanted rodents and predators can impact native fauna (D. Armstrong, pers. comm.). Stresses due to sediment deposition and water quality changes from improper grazing practices are more difficult to judge, but they may be detrimental to aquatic biota (Gifford et al., 1975). Riparian and grassland communities, and rare plants found on rangelands, such as Ripley's milkvetch, are particularly vulnerable to livestock use.

Observations during the field assessment for this report indicated that livestock impacts are most severe along riparian areas. Non-native species and degraded willow stands are abundant in riparian habitats of this area.

Logging
Most logging operations require a large network of roads. The impacts from roads can result in threats to biodiversity (see "Roads" below for more detailed discussion). The Forest Service monitors logging closely, nonetheless, problems can still occur. Timber harvesting occurs on a few of the large private ranches in Costilla County.

Recreation
Recreation, once very local and perhaps even unnoticeable, is on the increase and may become a threat to the San Luis Valley 's ecology. Like grazing, recreation practices and their stresses differ, mostly between motorized and non-motorized activities. All terrain vehicles (ATVs) are becoming increasingly popular and the National Forests are a favorite area for ATV use (especially for big-game retrieval). BLM lands are also used. ATVs can disrupt migration and breeding patterns, and fragment habitat for native resident species. This activity can also threaten rare plants found in non-forested areas.

Non-motorized recreation, mostly hikers but also some mountain biking, presents a different set of problems (Cole and Knight, 1990; Knight and Cole, 1991; Holmes et al., 1993). Wildlife behavior can be significantly altered by repeat visits of hikers/bicyclists. Trampling of sensitive plant species, particularly in high alpine areas (among the most popular destinations for hikers), is of concern along the most popular areas such as 14,000 ft. peak routes (Spackman, pers. comm.).

Roads
Expansion of the existing road network will detrimentally affect the heritage values of the region. Roads are correlated with a wide variety of impacts to natural communities, including invasion of non-native plant species, increased depredation and parasitism of bird nests, increased impacts of

pets, fragmentation of habitats, erosion, pollution, and road mortality. Additionally, roads can affect hydrology by intercepting surface and sub-surface flows.

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

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

Non-native Species

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

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

Although non-native species are mentioned repeatedly as stresses in the above discussions, because they can come from so many activities they are included here as a general threat as well. Non-native plants or animals and can have wide ranging impacts. Non-native plants can increase dramatically under the right conditions and essentially dominate a previously natural area. This can generate secondary effects on animals (particularly invertebrates) that depend on native plant species for forage, cover, or propagation. Whitetop (*Cardaria* spp.), is an introduced, highly aggressive weed found in irrigated areas and low wetlands that is very difficult to control. Cheatgrass (*Bromus tectorum*), smooth brome (*Bromus inermis*), and crested wheatgrass

(*Agropyron spicatum*) are hardy, xeric grasses from Eurasia that are also very difficult to control (H. Dixon, pers. comm.).

Some species introduced for waterbird use in wetland enhancement and restoration projects are potentially invasive. For example, many smartweed (*Polygonum* sp.) species, barnyard grass (*Echinochloa crus-galli*), and millet (*Panicum miliaceum*) are not native to Colorado but will readily invade wetland habitats (Weber and Whitman 2001).

Fragmentation and Edge Effects

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

THE NATURAL HERITAGE NETWORK AND BIOLOGICAL DIVERSITY

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

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

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

Colorado is inhabited by some 800 vertebrate species and subspecies, and tens of thousands of invertebrate species. In addition, the state has approximately 4,300 species of plants and more than 450 recognized plant associations that represent upland and wetland ecosystems. It is this rich natural heritage that has provided the basis for Colorado's diverse economy. Some components of this heritage have always been rare, while others have become imperiled with human-induced changes in the landscape. This decline in biological diversity is a global trend resulting from human population growth, land development, and subsequent habitat loss. Globally, the loss in species diversity has become so rapid and severe that Wilson (1988) has compared the phenomenon to the great natural catastrophes at the end of the Paleozoic and Mesozoic eras.

The need to address this loss in biological diversity has been recognized for decades in the scientific community. However, many conservation efforts made in this country were not based upon preserving biological diversity; instead, they primarily focused on preserving game animals, striking scenery, and locally favorite open spaces. To address the absence of a methodical, scientifically based approach to preserving biological diversity Dr. Robert Jenkins of The Nature Conservancy pioneered the Natural Heritage Methodology in the early 1970s.

Recognizing that rare and imperiled species are more likely to become extinct than common ones, the Natural Heritage Methodology ranks species according to their rarity or degree of imperilment. The ranking system is scientifically based upon the number of known locations of the species as well as their biology and known threats. By ranking the relative rarity or imperilment of a species, the quality of its populations, and the importance of associated

conservation sites, the methodology can facilitate the prioritization of conservation efforts so the most rare and imperiled species may be preserved first. As the scientific community realized that plant associations are equally important as individual species, this methodology has been applied to ranking and preserving rare plant associations, as well as the best examples of common associations.

The Natural Heritage Methodology is used by Natural Heritage Programs throughout North, Central, and South America, forming an international database network. The 85 Natural Heritage Network data centers are located in each of the 50 U.S. states, five provinces of Canada, and 13 countries in South and Central America and the Caribbean. This network enables scientists to monitor the status of species from a state, national, and global perspective. Information collected by the Natural Heritage Programs can provide a means to protect species before the need for legal endangerment status arises. It can also enable conservationists and natural resource managers to make informed, objective decisions in prioritizing and focusing conservation efforts.

What is Biological Diversity

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

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

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

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

Community Diversity — the variety of plant communitiess or associations within an area that represent the range of species relationships and inter-dependence. These associations may be diagnostic or even restricted to an area. Although the terms plant association and plant community have been described by numerous ecologists, no general consensus of their meaning has developed. The terms are similar, somewhat overlapping, and are often used more or less interchangeably. The U.S. National Vegetation Classification (USNVC) (Anderson et al. 1998), the accepted national standard for vegetation, defines a community as an "assemblage of species that co-occur in defined areas at certain times and that have the potential to interact with one another", and a plant association as a type of plant community with "definite floristic composition, uniform habitat conditions, and uniform physiognomy" (Flahault and Schroter 1910). Identifying and protecting representative examples of plant communities ensures conservation of multiple numbers of species, biotic interactions, and ecological process. Using communities as a "coarse-filter" enables conservation efforts to work toward protecting a more complete spectrum of biological diversity.

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

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

COLORADO NATURAL HERITAGE PROGRAM

To place this document in context, it is useful to understand the history and functions of the Colorado Natural Heritage Program (CNHP).

CNHP is the state's primary comprehensive biological diversity data center, gathering information and field observations to help develop statewide conservation priorities. After operating in the Colorado Division of Parks and Outdoor Recreation for 14 years, the Program was relocated to the University of Colorado Museum in 1992, and then to the College of Natural Resources at Colorado State University in 1994, where it has operated since.

The multi-disciplinary team of scientists, planners, and information managers at CNHP gathers comprehensive information on the rare, threatened, and endangered species and significant plant associations of Colorado. Life history, status, and locational data are incorporated into a continually updated data system. Sources include published and unpublished literature, museum and herbaria labels, and field surveys conducted by knowledgeable naturalists, experts, agency personnel, and our own staff of botanists, ecologists, and zoologists.

The Biological and Conservation Data System (BCD) was the original database developed by The Nature Conservancy to be used by all Natural Heritage Programs to house data about imperiled species. The database includes taxonomic group, global and state rarity rank, federal and state legal status, observation source, observation date, county, township, range, watershed, and other relevant facts and observations. Recently, NatureServe, the parent organization to all Heritage programs, has updated BCD utilizing current technology and database capabilities. The new database, BIOTICS (Biodiversity Tracking and Conservation System), is currently being implemented throughout the Natural Heritage Network. The Colorado Natural Heritage Program began using BIOTICS for digitizing and mapping occurrences of rare plants, animals, and plant associations and tracking their distribution and life history information. These rare species and plant associations are referred to as “elements of natural diversity” or simply “elements.”

Concentrating on site-specific data for each element enables CNHP to evaluate the significance of each location for the conservation of biological diversity in Colorado and in the nation. By using species imperilment ranks and quality ratings for each location, priorities can be established to

guide conservation action. A continually updated locational database and priority-setting system such as that maintained by CNHP provides an effective, proactive land-use planning tool.

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

- What species and ecological associations 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 associations 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 is threatening 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, Colorado State Parks, Colorado Department of Transportation, the Bureau of Land Management, and the U.S. Forest Service. Numerous local governments and private entities, such as consulting firms, educators, landowners, county commissioners, and non-profit organizations, also work closely with CNHP. Use of the data by many different individuals and organizations encourages a cooperative and proactive approach to conservation, thereby reducing the potential for conflict.

THE NATURAL HERITAGE RANKING SYSTEM

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

Ranking species and ecological assocations according to their imperilment status provides guidance for where Natural Heritage Programs should focus their information-gathering activities. For species deemed secure, only general information needs to be maintained by Natural Heritage Programs. Fortunately, the more common and secure species constitute the

majority of most groups of organisms. On the other hand, for those species that are by their nature rare, more detailed information is needed. Because of these species' rarity, gathering comprehensive and detailed population data can be less daunting than gathering similarly comprehensive information on more abundant species.

To determine the status of species within Colorado, CNHP gathers information on plants, animals, and plant associations. Each of these elements of natural diversity is assigned a rank that indicates its relative degree of imperilment on a five-point scale (for example, 1 = extremely rare/imperiled, 5 = abundant/secure). The primary criterion for ranking elements is the number of occurrences (in other words, the number of known distinct localities or populations). This factor is weighted more heavily than other factors because an element found in one place is more imperiled than something found in twenty-one places. Also of importance are the size of the geographic range, the number of individuals, the trends in both population and distribution, identifiable threats, and the number of protected occurrences.

Element imperilment ranks are assigned both in terms of the element's degree of imperilment within Colorado (its State-rank or S-rank) and the element's imperilment over its entire range (its Global-rank or G-rank). Taken together, these two ranks indicate the degree of imperilment of an element. For example, the lynx, which is thought to be secure in northern North America but is known from less than five current locations in Colorado, is ranked G5 S1 (globally-secure, but critically imperiled in this state). The Rocky Mountain Columbine, which is known only in Colorado from about 30 locations, is ranked a G3 S3 (vulnerable both in the state and globally, since it only occurs in Colorado and then in small numbers). Further, a tiger beetle that is only known from one location in the world at the Great Sand Dunes National Monument is ranked G1 S1 (critically imperiled both in the state and globally, because it exists in a single location). CNHP actively collects, maps, and electronically processes specific occurrence information for animal and plant species considered extremely imperiled to vulnerable in the state (S1 - S3). Several factors, such as rarity, evolutionary distinctiveness, and endemism (specificity of habitat requirements), contribute to the conservation priority of each species. Certain species are "watchlisted," meaning that specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted. A complete description of each of the Natural Heritage ranks is provided in Table 3.

This single rank system works readily for all species except those that are migratory. Those animals that migrate may spend only a portion of their life cycles within the state. In these cases, it is necessary to distinguish between breeding, non-breeding, and resident species. As noted in Table 3, ranks followed by a "B," for example S1B, indicate that the rank applies only to the status of breeding occurrences. Similarly, ranks followed by an "N," for example S4N, refer to non-breeding status, typically during migration and winter. Elements without this notation are believed to be year-round residents within the state.

Global imperilment ranks are based on the range-wide status of a species. State imperilment ranks are based on the status of a species in an individual state. State and Global ranks are denoted with an "S" or a "G" respectively, followed by a number or letter. These ranks should not be interpreted as legal designations.

Table 3. Definition of natural heritage imperilment ranks.

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

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

Legal Designations for Rare Species

Natural Heritage imperilment ranks should not be interpreted as legal designations. Although most species protected under state or federal endangered species laws are extremely rare, not all rare species receive legal protection. Legal status is designated by either the U.S. Fish and Wildlife Service under the Endangered Species Act or by the Colorado Division of Wildlife under Colorado Statutes 33-2-105 Article 2. In addition, the U.S. Forest Service recognizes some

species as “Sensitive,” as does the Bureau of Land Management. Table 4 defines the special status assigned by these agencies and provides a key to abbreviations used by CNHP.

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

Table 4. Federal and State Agency special designations for rare species.

Federal Status:	
1. U.S. Fish and Wildlife Service (58 Federal Register 51147, 1993) and (61 Federal Register 7598, 1996)	
LE	Listed Endangered: defined as a species, subspecies, or variety in danger of extinction throughout all or a significant portion of its range.
E (S/A)	Endangered: treated as endangered due to similarity of appearance with listed species.
LT	Listed Threatened: defined as a species, subspecies, or variety likely to become endangered in the foreseeable future throughout all or a significant portion of its range.
P	Proposed: taxa formally proposed for listing as Endangered or Threatened (a proposal has been published in the Federal Register, but not a final rule).
C	Candidate: taxa for which substantial biological information exists on file to support proposals to list them as endangered or threatened, but no proposal has been published yet in the Federal Register.
2. U.S. Forest Service (Forest Service Manual 2670.5) (noted by the Forest Service as "S”)	
FS	Sensitive: those plant and animal species identified by the Regional Forester for which population viability is a concern as evidenced by: Significant current or predicted downward trends in population numbers or density. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.
3. Bureau of Land Management (BLM Manual 6840.06D) (noted by BLM as “S”)	
BLM	Sensitive: those species found on public lands designated by a State Director that could easily become endangered or extinct in a state. The protection provided for sensitive species is the same as that provided for C (candidate) species.
4. State Status:	
The Colorado Division of Wildlife has developed categories of imperilment for non-game species (refer to the Colorado Division of Wildlife’s Chapter 10 – Nongame Wildlife of the Wildlife Commission's regulations). The categories being used and the associated CNHP codes are provided below.	
E	Endangered: those species or subspecies of native wildlife whose prospects for survival or recruitment within this state are in jeopardy, as determined by the Commission.
T	Threatened: those species or subspecies of native wildlife which, as determined by the Commission, are not in immediate jeopardy of extinction but are vulnerable because they exist in such small numbers, are so extremely restricted in their range, or are experiencing such low recruitment or survival that they may become extinct.
SC	Special Concern: those species or subspecies of native wildlife that have been removed from the state threatened or endangered list within the last five years; are proposed for federal listing (or are a federal listing “candidate species”) and are not already state listed; have experienced, based on the best available data, a downward trend in numbers or distribution lasting at least five years that may lead to an endangered or threatened status; or are otherwise determined to be vulnerable in Colorado.

Element Occurrences and their Ranking

Actual locations of elements, whether they are single organisms, populations, or plant associations, are referred to as element occurrences. The element occurrence is considered the most fundamental unit of conservation interest and is at the heart of the Natural Heritage Methodology. To prioritize element occurrences for a given species, an element occurrence rank (EO-Rank) is assigned according to the ecological quality of the occurrences whenever sufficient information is available. This ranking system is designed to indicate which occurrences are the

healthiest and ecologically the most viable, thus focusing conservation efforts where they will be most successful. The EO-Rank is based on three factors:

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

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

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

Each of these factors is rated on a scale of A through D, with A representing an excellent grade and D representing a poor grade. These grades are then averaged to determine an appropriate EO-Rank for the occurrence. If not enough information is available to rank an element occurrence, an EO-Rank of E is assigned. EO-Ranks and their definitions are summarized in Table 5.

Table 5. Element occurrence ranks and their definitions.

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

Potential Conservation Areas and Their Ranking

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

The goal of the PCA process is to identify a land area that can provide the habitat and ecological processes upon which a particular element occurrence, or suite of element occurrences, depends for its continued existence. The best available knowledge about each species' life history is used in conjunction with information about topographic, geomorphic, hydrologic features, vegetative

cover; and current and potential land uses. In developing the boundaries of a Potential Conservation Area, CNHP scientists consider a number of factors that include, but are not limited to:

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

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

Off-Site Considerations

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

Ranking of Potential Conservation Areas

CNHP uses element and element occurrence ranks to assess the overall biological diversity significance of a PCA, which may include one or many element occurrences. Based on these ranks, each PCA is assigned a biological diversity rank (or B-rank). See Table 6 for a summary of these B-ranks.

Table 6. Natural Heritage Program biological diversity ranks and their definitions.

B1	Outstanding Biodiversity Significance: 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 Biodiversity 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 Biodiversity 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 Biodiversity Significance: Other A- or B-ranked occurrences of a G4 or G5 community C-ranked occurrence of a G3 element A- or B-ranked occurrence of a G4 or G5 S1 species (or at least C-ranked if it is the only state, provincial, national, or ecoregional occurrence) Concentration of A- or B-ranked occurrences of G4 or G5 N1-N2, S1-S2 elements (four or more) D-ranked occurrence of a G2 element At least C-ranked occurrence of a disjunct G4 or G5 element Concentration of excellent or good occurrences (A- or B-ranked) of G4 S1 or G5 S1 elements (four or more)
B5	General or State-wide Biological Diversity Significance: good or marginal occurrence of common community types and globally secure S1 or S2 species.

Protection Urgency Ranks

Protection urgency ranks (P-ranks) refer to the timeframe in which it is recommended that conservation protection occur. In most cases, this rank refers to the need for a major change of protective status (for example agency special area designations or ownership). The urgency for protection rating reflects the need to take legal, political, or other administrative measures to protect the area. Table 7 summarizes the P-ranks and their definitions.

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

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

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

- Forces that threaten the existence of one or more element occurrences at a site. For example, development that would destroy, degrade or seriously compromise the long-term viability of an element occurrence; or timber, range, recreational, or hydrologic management that is incompatible with an element occurrence's existence;

- The inability to undertake a management action in the absence of a protection action; for example, obtaining a management agreement;

- In extraordinary circumstances, a prospective change in ownership or management that will make future protection actions more difficult.

Management Urgency Ranks

Management urgency ranks (M-ranks) indicate the timeframe in which it is recommended that a change occur in management of the element or site. This rank refers to the need for management in contrast to protection (for example, increased fire frequency, decreased grazing, weed control, etc.). The urgency for management rating focuses on land use management or land stewardship action required to maintain element occurrences at the potential conservation area.

A management action may include biological management (prescribed burning, removal of non-natives, mowing, etc.) or people and site management (building barriers, rerouting trails, patrolling for collectors, hunters, or trespassers, etc.). Management action does not include legal, political, or administrative measures taken to protect a potential conservation area. Table 8 summarizes M-ranks and their definitions.

Table 8. 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.

METHODS

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

COLLECT AVAILABLE INFORMATION

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

IDENTIFY RARE OR IMPERILED SPECIES AND SIGNIFICANT PLANT ASSOCIATIONS WITH POTENTIAL TO OCCUR IN SOUTHERN ALAMOSA AND COSTILLA COUNTIES

The list of plant associations thought to occur in Southern Alamosa and Costilla counties 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 (USNVC) (Anderson et al. 1998), the accepted national standard for vegetation. The CSWCC utilized and integrated previously collected data from the Classification of Riparian Wetland Plant Associations of Colorado (Kittel et al. 1999), CNHP wetland surveys, and Colorado State University. The CSWCC incorporated all these data on riparian and other wetlands collected during the past 12 years as well as data from other researchers to avoid duplication of effort.

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

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

IDENTIFY TARGETED INVENTORY AREAS

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

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

The above information was used to delineate 55 survey areas that were believed to have high probability of harboring natural heritage resources.

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

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

CONTACT LANDOWNERS

Attaining permission to conduct surveys on private property was essential to this project. Once survey sites were chosen, land ownership of these areas was determined using records at the Southern Alamosa and Costilla counties assessor's office. Landowners were then either contacted by phone or mail 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 properties surveyed without landowner permission.**

CONDUCT FIELD SURVEYS

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

The methods used in the surveys necessarily 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 in order to capture and document their presence. These are summarized below:

Amphibians: visual or with aquatic nets
Birds: visual or by song/call, evidence of breeding sought
Wetland plant associations: visual, collect qualitative or quantitative composition, soil, hydrological, and function data

When necessary and permitted, voucher specimens were collected and deposited in local university museums and herbaria.

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

Field surveys also included a wetland functional evaluation. Some of the PCAs profiled in this report were not visited by the author of this report but rather by previous CNHP ecologists. For these PCAs, no functional evaluation is given. For those PCAs visited by the Principal Investigator, a qualitative wetland functional evaluation is detailed in the PCA profile. Site visits and assessments were conducted on the following two levels:

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

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

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

General Field Information

- list of all plant associations in the wetland complex, including the amount of wetland area covered by that community. In almost all cases, plant associations were immediately placed within CNHP's Statewide Wetland Classification. However, on rare occasions a plant association was encountered which could not be easily classified based on the stands that had been previously sampled.
- vegetation data for each major plant association in the wetland were collected using visual ocular estimates of species cover in a representative portion of the plant association.
- sketch of the site layout, with distribution of community types indicated (this was generally done on the 7.5-min. USGS topographic map, but occasionally for clarity a separate map was drawn on the site survey form).
- UTM coordinates collected from Garmin GPS 12 Personal Navigator.
- elevation (from 7.5-min. USGS topographic maps).
- current and historic land use (e.g., grazing, logging, recreational use) when apparent.
- notes on geology and geomorphology.
- reference photos of the site.
- indicators of disturbance such as logging, grazing, flooding, etc.

Natural Heritage Information

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

General Wetland Information

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

Qualitative Functional Assessment

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

Restoration Potential

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

DELINEATE POTENTIAL CONSERVATION AREA BOUNDARIES

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

RESULTS

CNHP ecologists identified 55 wetland/riparian Targeted Inventory Areas (TIAs) that merited on-site investigation (Figure 4 and Figure 5). Of the 55 TIAs, 35% are encompassed within Potential Conservation Areas (Figure 4). An effort was made to select sites that potentially had natural hydrology, native species composition, and vegetation structure intact. However, on-site inspection revealed that many of the wetland TIAs (33%) were heavily impacted by roads, buildings, non-native species, agriculture, and/or grazing or were considered to be common types and were dropped from the inventory (Figure 4). Due to time limitations or denied permission, 32% of the TIAs were not visited (Figure 4). Figure 5 depicts all the TIAs within the study area.

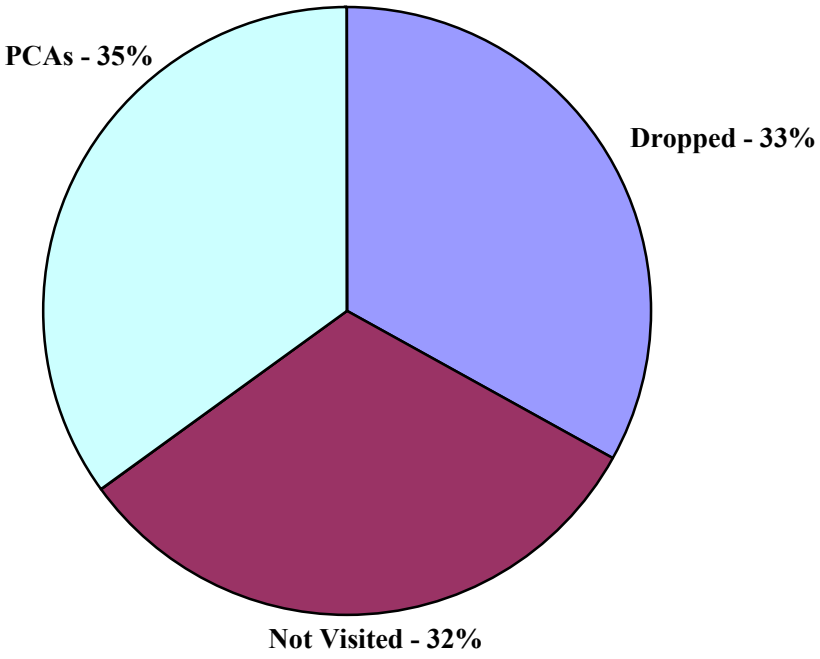
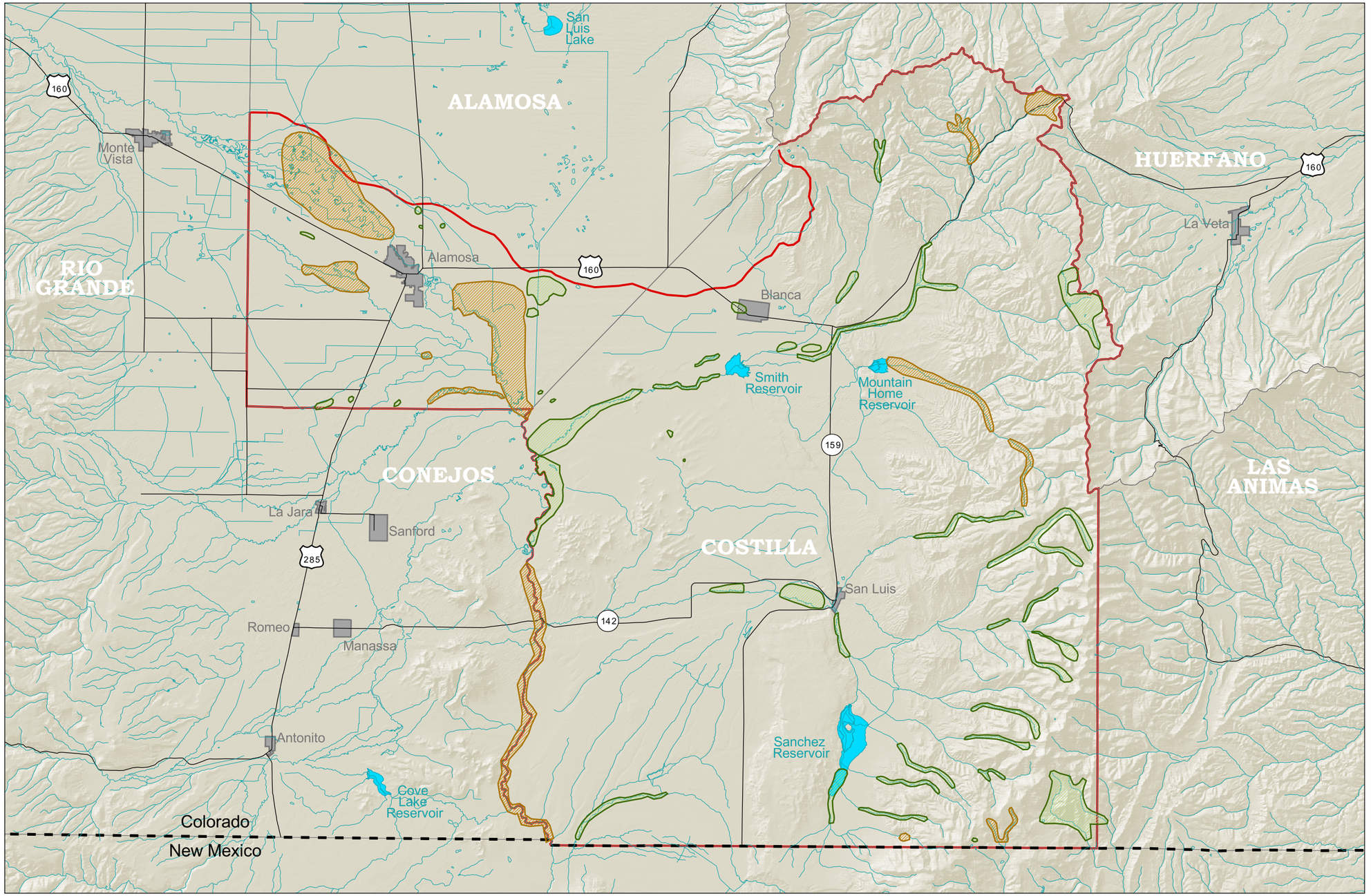


Figure 4. Summary of Targeted Inventory Areas.

Figure 5. CNHP Wetland and Riparian Targeted Inventory Areas.



Colorado Natural Heritage Program

Colorado State University
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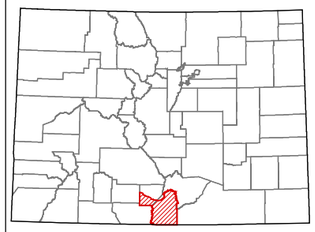
Fort Collins, CO 80523-8002

Map Date: 24 May 2004

Wetland and Riparian Targeted Inventory Areas

- Visited
- Not Visited

Location in Colorado



Base Data

- Large Lakes/Reservoirs
- Rivers, Streams, Creeks
- Highways
- Municipalities
- State Line
- Counties
- Study Area

National Elevation Database Produced by the U.S. Geological Survey, 1999

Disclaimer

The data are provided on an as-is, as-available basis without warranties of any kind, expressed or implied, including (but not limited to) warranties of merchantability, fitness for a particular purpose, and non-infringement. CNHP, Colorado State University and the State of Colorado further expressly disclaim any warranty that the data are error-free or current as of the date supplied.

SIGNIFICANT ELEMENTS ASSOCIATED WITH WETLANDS AND RIPARIAN AREAS

The following table presents CNHP elements of biological significance known to occur in the Potential Conservation Areas in this report. This is not a comprehensive list of the elements known to occur in or associated with wetlands in Southern Alamosa and Costilla counties, but rather only includes those elements deemed significant enough to be archived in CNHP's Biological Conservation Data System. Table 10 shows those elements known to occur in the study area but were not archived in CNHP's Biological Conservation Data System due to a lack of detailed information, or their widespread distribution, or because of their small size, poor condition, and/or poor landscape context.

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

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status
Animals				
Egretta thula	Snowy Egret	G5	S2B	
Empidonax traillii extimus	**Southwestern Willow Flycatcher**	**G5T1T2**	**S1?**	**LE, FS, E**
Himantopus mexicanus	Black-necked Stilt	G5	S3B	
Oncorhynchus clarki virginalis	Rio Grand cutthroat trout	G4T3	S3	FS/BLM, SC
Plegadis chihi	White-faced Ibis	G5	S2B	FS/BLM
Plants				
Cleome multicaulis	**Slender spiderflower**	**G2G3**	**S2S3**	**BLM**
Plant Communities				
Abies concolor-(Picea pungens)-Populus angustifolia/Acer glabrum	**Montane riparian forest**	**G2**	**S2**	
Carex pellita	**Montane wet meadow**	**G3**	**S3**	
Carex simulata	**Montane fen**	**G3**	**S3**	
Carex vesicaria	Montane wet meadow	G4Q	S1	
Cornus sericea	Foothills riparian shrubland	G4Q	S3	
Polygonum amphibium	Emergent wetland	G5	S3	
Populus angustifolia/Alnus incana	**Montane riparian forest**	**G3?**	**S3**	
Salix exigua/mesic graminoid	Montane riparian shrubland	G5	S5	
Salix exigua – Salix ligulifolia	**Montane riparian shrubland**	**G2G3**	**S2S3**	
Salix ligulifolia	**Montane riparian shrubland**	**G2G3**	**S2S3**	
Schoenoplectus pungens	**Emergent wetland**	**G3G4**	**S3**	

Table 10. Known elements of concern found in wetlands within the study area but not archived in CNHP's BIOTICS. Detailed descriptions of some of the wetland elements listed below can be found in the Natural History section of this document.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status
Invertebrates				
Polites sabuleti ministigma	San Luis Valley sandhills skipper	G5T3	S3	
Animals				
Asio flammeus	Short-eared Owl	G5	S2BSZN	
Grus canadensis tabida	Greater Sandhill Crane	G5T4	S2B, S4Z	FS, ST
Plants				
Hymenoxys (Picradenia) helenioides	Intermountain bitterweed	G3G4Q	S1	
Plant Communities				
Calamagrostis stricta	Montane wet meadow	GU	S1?Q	
Carex aquatilis	Montane wet meadow	G5	S4	
Carex utriculata	Montane wet meadow	G5	S4	
Deschampsia cespitosa	Montane wet meadow	G4?	S4	
Distichlis spicata	Montane wet meadow	G5	S3	
Eleocharis palustris	Emergent wetland	G5	S4	
Hippuris vulgaris	Emergent wetland	G5	S4	
Juncus balticus	Montane wet meadows	G5	S5	
Pinus pungens/Alnus incana	Montane riparian forest	G3	S3	
Populus angustifolia/Salix exigua	Montane riparian forest	G4	S4	
Sarcobatus vermiculatus/Distichlis spicata	Saline bottomland shrubland	G4	S1	
Schoenoplectus acutus	Emergent wetland	G5	S3	
Schoenoplectus maritimus	Emergent wetland	G4	S2	
Sparganium eurycarpum	Emergent wetland	GU	S2	
Typha latifolia	Emergent wetland	G5	S3	

SITES OF BIODIVERSITY SIGNIFICANCE

The 17 most important wetland sites in Southern Alamosa and Costilla counties are profiled in this section as Potential Conservation Areas (PCAs) with biodiversity ranks (Figure 6). These PCAs include the wetlands with the highest biodiversity significance, as well as the best examples of common wetland types present in the study area. Two B2, 13 B3, one B4, and one B5 Potential Conservation Areas were identified during this project. The highest ranking PCAs are the highest priorities for conservation action.

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

PCA Profile Explanation

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

Protection Urgency Rank: P#
A summary of major land ownership issues that may affect the long-term viability of the PCA and the element(s).

Management Urgency Rank: M#
A summary of major management issues that may affect the long-term viability of the PCA and the element(s).

Location: General location.

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

Size: Expressed in acres.

Elevation: Expressed in feet.

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

Biodiversity Rank Comments: A synopsis of the rare species and significant plant communities that occur within the proposed conservation area. A table within the area profile lists each element occurrence found in the PCA, global and state ranks of these elements, the occurrence ranks and federal and state agency special designations. See Table 3 for explanations of ranks and Table 4 for legal designations.

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

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

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

Soils Description: Soil profile descriptions were generally conducted at each PCA. When these profile descriptions were found to match the mapped soil type found in the county soil surveys, then reference is only given to that particular soil series and no profile description is provided. However, if a profile description did not match the mapped soil type, then profile descriptions are presented. Classification of these soils was conducted, when possible, using *Keys to Soil Taxonomy* (USDA 1994).

Wetland Functional Assessment: A summary of the functions and the proposed HGM classification, Cowardin system, and the plant community derived from CNHP's Statewide

Wetland Classification for the wetlands occurring within each Potential Conservation Area. (Note: Some of the PCAs profiled in this report were not visited by an author but rather by previous CNHP ecologists. For these PCAs, no functional evaluation is given. For those PCAs visited by the author, a wetland functional evaluation is detailed in the PCA profile.)

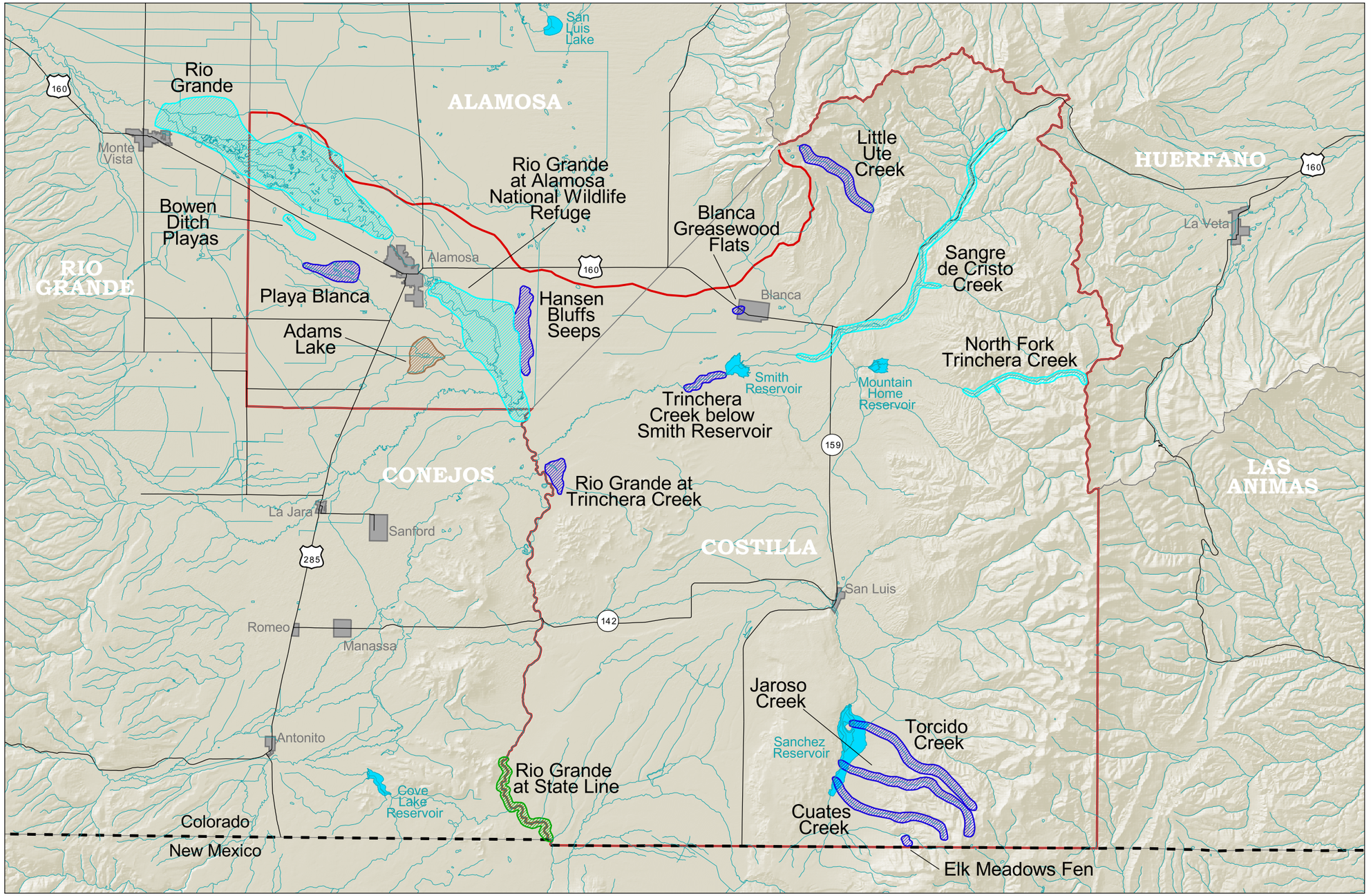
Restoration Potential: A brief summary describing the feasibility of restoring ecosystem processes at each PCA.

Table 11 displays the 17 PCAs discussed in this report. All of these PCAs merit protection, but available resources should be directed first toward the higher B-ranked PCAs (e.g., B2 & B3 PCAs). These PCAs alone do not represent a complete wetland conservation program; they represent only the rare and imperiled elements.

Table 11. Potential Conservation Areas, arranged by biodiversity rank (B-rank).

Potential Conservation Areas
B2
Bowen Ditch Playas
North Fork Trinchera Creek
Rio Grande at Alamosa National Wildlife Refuge
Sangre de Cristo Creek
B3
Blanca Greasewood Flats
Cuates Creek
Elk Meadows Fen
Hansen Bluffs Seeps
Jaroso Creek
Little Ute Creek
Playa Blanca
Rio Grande
Rio Grande at Trinchera Creek
Torcido Creek
Trinchera Creek Below Smith Reservoir
B4
Rio Grande at State Line
B5
Adams Lake

Figure 6. CNHP Wetland and Riparian Potential Conservation Areas.



Colorado Natural Heritage Program

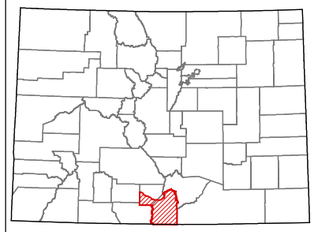
Colorado State University
8002 Campus Delivery
Fort Collins, CO 80523-8002

Map Date: 18 May 2004

Wetland and Riparian Potential Conservation Areas by Biodiversity Significance Rank

- B2: Very High Significance
- B3: High Significance
- B4: Moderate Significance
- B5: General Interest/Open Space

Location in Colorado



Base Data

- Large Lakes/Reservoirs
- Rivers, Streams, Creeks
- Highways
- Municipalities
- State Line
- Counties
- Study Area

National Elevation Database Produced by the U.S. Geological Survey, 1999

Disclaimer

POTENTIAL CONSERVATION AREAS

BOWEN DITCH PLAYAS POTENTIAL CONSERVATION AREA

Biodiversity Rank: B2. Very High biodiversity significance. This PCA supports an excellent example of the globally imperiled slender spiderflower.

Protection Urgency Rank: P3. Protection actions may be needed, but probably not within the next five years. It is estimated that current stresses may reduce the viability of the elements of the PCA if protection action is not taken. Any level of protection would likely benefit the element, including, and probably most importantly, the protection of water (both surface and groundwater) reaching the site.

Management Urgency Rank: M2. New management actions may be needed within 5 years to prevent the loss of the element occurrences within the PCA. Monitoring grazing would aid in understanding its impacts.

Location: This PCA is located just south of Hwy. 160, about 3 miles east of the Alamosa / Rio Grande county line.

U.S.G.S. 7.5-min. quadrangle: Alamosa West, Homelake, and Mount Pleasant School.

Legal Description: T38N R09E portions of S 27-29, 33, and 34.

Elevation: 7,575 – 7,585 ft. Approximate Size: 615 acres

General Description: Much of this area is flooded in early summer, and the soil remains fairly moist through the summer. Greasewood (*Sarcobatus vermiculatus*) and saltgrass (*Distichlis spicata*) are prevalent throughout the site. Bulrush (*Schoenoplectus* spp.), sedges (*Carex* spp.) are common in low areas. The slender spiderflower (*Cleome multicaulis*) is abundant and found throughout the area, although it was not found south of the Bowen Ditch.

Biodiversity Rank Justification: The slender spiderflower (*Cleome multicaulis*) has a global range from southern Wyoming to central Mexico. The San Luis Valley contains the most numerous, largest, and healthiest populations in the world. Slender spiderflower has a limited distribution due to its requirement of moist alkaline soil along with periodic soil disturbance. These habitat requirements limit the slender spiderflower to the edges of alkaline wet meadows and playas.

Table 12. Natural Heritage element occurrences at Bowen Ditch PCA.
Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plants					
Cleome multicaulis	**Slender spiderflower**	**G2G3**	**S2S3**	**BLM**	**A**

*EO=Element Occurrence.

Boundary Justification: The boundary is drawn to encompass the ecological processes believed necessary for long-term viability of the element. The boundaries provide many source areas for seed dispersal to buffer long-term population fluctuations of the elements. The boundary does not encompass the source of surface and ground water input to the site, thus any changes in the current status of groundwater pumping and water diversions from water bodies that recharge groundwater would likely affect the element.

Protection Comments: The PCA is privately owned. Any level of protection would likely benefit the element, including, and probably most importantly, the protection of water (both surface and groundwater) reaching the site.

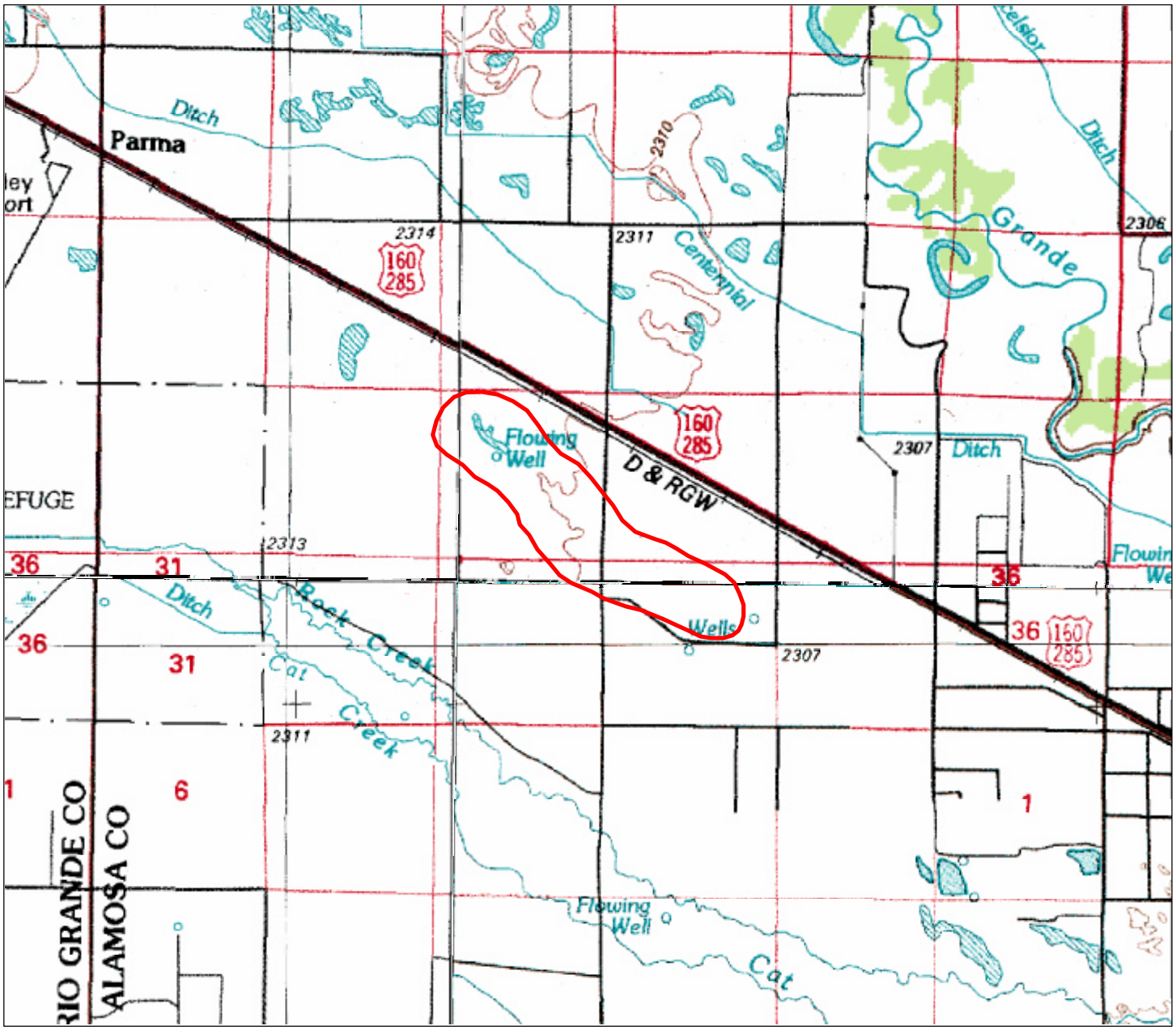
Management Comments: Horses were grazing the sedges and bulrushes but do not seem to be eating the slender spiderflower. This activity should be monitored to ensure grazing does not impact the slender spiderflower.

Soils Description: The most common soil types are the Mosca and Gunbarrel series. The Mosca is classified as a coarse-loamy, mixed, frigid Typic Natrargids (USDA 1973). These soils consist of well-drained alkali soils formed in calcerous, moderately coarse textured alluvium underlain by sand and gravel (USDA 1973). The Gunbarrel is classified as a Mixed, frigid, Typic Psammaquents (USDA 1973). It is a somewhat poorly drained, nearly level, sandy soil formed in mixed sandy alluvium. These soils have a high water table and are saline and alkali (USDA 1973).

Restoration Potential: Restoration, or prevention of further loss, of natural groundwater flow is critical to maintaining the ecological integrity of this PCA. This would require an immense collaboration with local water users, local landowners, municipalities, etc. However, although natural hydrology has been altered, the current hydrologic regime is supporting the elements found at this site.

Grazing practices may need to be minimized or a reasonable method of grazing, such as fencing off wet meadows, implemented in order to improve the health of the wetland vegetation. However, current management seems to be acceptable for maintaining the viability of the slender spiderflower.

Wetland Functional Assessment: CNHP wetland ecologists did not visit the wetland contained within this PCA during 2003. Thus, a functional assessment could not be conducted.



1 0 1 Miles

Projection: UTM, Zone13, NAD27

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254 General Services Bldg.
Fort Collins, CO 80523

map created 5 May 2004

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LEGEND

Bowen Ditch Playas
Potential Conservation Area

30 x 60 Minute Series Quads:
Alamosa, 37105a1
Blanca Peak, 37105e1
Del Norte, 37106e1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

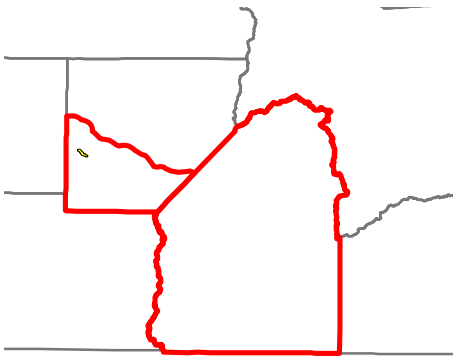


Figure 7. Bowen Ditch Playas Potential Conservation Area

NORTH FORK TRINCHERA CREEK POTENTIAL CONSERVATION AREA

Biodiversity Rank: B2. Very High biodiversity significance. The PCA supports good examples of a globally imperiled (G2) and globally vulnerable (G3?) riparian plant community and a fair example of the globally vulnerable Rio Grande cutthroat trout.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The PCA is privately owned. The landowner manages much of this area for wildlife as part of a commercial hunting operation. No immediate threats to ripraian area are foreseen.

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

Location: The PCA is located in the upper Trinchera Creek drainage on the Forbes Trinchera Ranch.

U.S.G.S. 7.5-min. quadrangles: McCarty Park, Ojito Peak, and Trinchera Ranch.

Legal Description: Unsurveyed

Elevation: 8,600-9,500 ft. **Size:** Approximately 1,616 acres

General Description: The PCA consists of a narrow riparian corridor surrounded by upland slopes dominated by mixed confier forest on north-facing slopes and pinyon-juniper on south-facing slopes.

Upstream, along the most narrow and steep stream reach within the PCA, white fir (*Abies concolor*), Douglas-fir (*Pseudotsua menziesii*), narrowleaf cottonwood (*Populus angustifolia*), aspen (*P. tremuloides*), and Rocky Mountain maple (*Acer glabrum*) dominate the riparian area.

Downstream, as the stream gradient lessens, the channel width somewhat widens, and soils become more fine-textured, narrowleaf cottonwood and thinleaf alder (*Alnus incana*) dominate along with river birch (*Betula occidentalis*). Structural diversity in both plant communities is good with a diverse tree canopy and a thick shrub understory. There are beaver ponds along this lower reach, where graminoids become more dominant. Downstream, the dominance of narrowleaf cottonwood and alder continues along Trinchera Creek, although past disturbances are more apparent in this area.

North Fork Trinchera Creek supports a fair, genetically pure, but transplanted (from West Indian Creek) population of the Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*) (Harig and Fausch 1996; Alves 1998). The population is unstable because of competition with non-native fish (CDOW 1986). Harig and Fausch (1996) report both brook trout (*Salvelinus fontinalis*) and rainbow trout (*Oncorhynchus mykiss*) as associated species. From 1998 surveys, the population is estimated at 1,324 individuals (Alves 1998). Anthropogenic barriers (irrigation structures) occur along the stream (Alves 2004).

Biodiversity Rank Justification: The PCA supports a good example of the globally imperiled (G2) montane riparian forest (*Abies concolor-Picea pungens-Populus angustifolia*/*Acer*

glabrum). This plant association is known only from southern Colorado in the San Juan and Sangre de Cristo mountains and but may occur in northern New Mexico. The association is a diverse, mixed conifer-deciduous forest occurring on active floodplains and streambanks of montane valley floors and is a mid- to late-seral community. High elevations and cool, shaded canyon bottoms create an environment for white fir and blue spruce. Here the active channel flooding and sediment deposition allows narrowleaf cottonwood to persist. On higher terraces that no longer experience flooding, the conifers may become the climax tree species. This PCA also supports a good example of a globally vulnerable (G3?) montane riparian forest (*Populus angustifolia*/*Alnus incana* ssp. *tenuifolia*). This association is known from New Mexico and Colorado. Although not well documented from other states, it is expected to occur throughout the range of narrowleaf cottonwood in the Rocky Mountains. In Colorado, this is a common community along montane streams, but few high quality examples exist. This association is highly threatened by improper livestock grazing, development and stream flow alterations.

The Rio Grande cutthroat trout's range once included the entire Rio Grande and Pecos River watersheds, and possibly the upper Canadian River as well (Trotter 1987). In Colorado, the species occupies less than 1% of its former range (Alves 1996), and wild, genetically pure stock populations are especially imperiled. Artificial habitat including wells, farm ponds, and extensive canal systems as well as human activities including dewatering, fishing and stocking, transbasin diversions, release of domestic sewage, stream channelization, and agricultural chemical applications have greatly modified the original aquatic ecosystem of the San Luis Valley (Zuckerman 1984). These modifications may have contributed directly to the decline in range of the native fishes of the Rio Grande drainage. Free-flowing streams with good quality water, healthy banks, and streamside vegetation within the upper Rio Grande watershed are vital habitat for this subspecies of trout.

Table 13. Natural Heritage element occurrences at North Fork Trinchera Creek PCA. Elements in bold are those upon which the PCA's B-rank is based. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Fish					
Oncorhynchus clarki virginalis	Rio Grande cutthroat trout	G4T3	S3	FS/BLM, SC	C
Plant Communities					
Abies concolor-(Picea) pungens-Populus angustifolia/Acer glabrum	**Montane riparian forest**	**G2**	**S2**		**B**
Populus angustifolia/Alnus incana ssp. *tenuifolia*	Montane riparian forest	G3?	S3		B

*EO=Element Occurrence.

Boundary Justification: The boundary includes a portion of Trinchera and North Fork Trinchera Creeks and the surrounding watershed. The boundary represents a preliminary estimate of the area needed to maintain local hydrological conditions. It should be noted that the hydrological processes necessary to the elements are not fully contained by the PCA boundaries. Any activities within the watershed such as water diversions, impoundments, improper livestock grazing, development, and mining could potentially be detrimental to the hydrology of the riparian area. The boundary represents the minimum area that should be considered for any conservation management plan.

Protection Comments: The PCA is privately owned. The landowner manages much of this area for wildlife as part of a commercial hunting operation. No immediate threats to ripraian area are foreseen.

Management Comments: Current management appears adequate. Although any intentional breaching of beaver dams may adversely affect hydrology. Uncontrolled deer/elk populations could impact the area but no signs of this were observed during the site visit. Road encroachment poses potential threats to all elements at this PCA, especially the Rio Grande cutthroat trout.

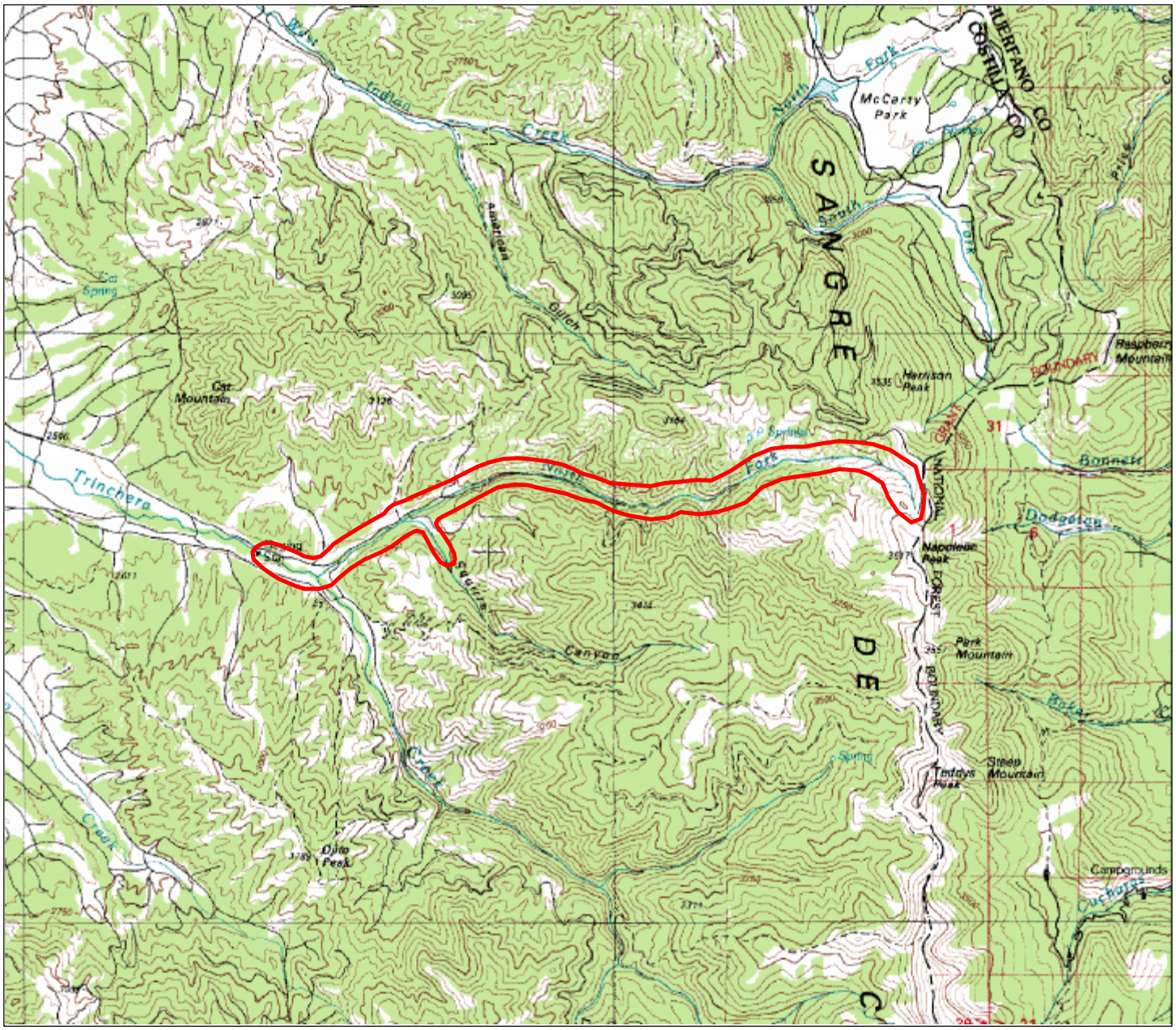
Soils Description: Soils within the riparian area are variable (fine to rocky) and alluvium derived. Near beaver ponds, soils are fine and are accumulating organic matter. The soils are not mapped.

Restoration Potential: Currently, the PCA does not need any major restoration. Should non-native species become an issue, they should be monitored and controlled. Referring to such resources as the Nature Conservancy's web site on invasive species (http://tncweeds.ucdavis.edu/index.html) or http://www.invasivespecies.gov/ may provide some assistance with control and eradication of non-native species.

Wetland Functional Assessment for the North Fork Trinchera Creek PCA:
Proposed HGM Class: Riverine **Subclass:** R2; R3/4
Cowardin System: Palustrine
CNHP's Wetland Classification: *Populus angustifolia/Alnus incana* ssp. *tenuifolia; Abies concolor*-(*Picea pungens*)-*Populus angustifolia/Acer glabrum*

Table 14. Wetland functional assessment for the riverine wetland at the North Fork Trinchera Creek PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	This riparian area appears to be functioning at its potential.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	There is a high density of shrubs and trees but a narrow floodplain. Beaver ponds aid in storage capability.
Sediment/Shoreline Stabilization	High	Dense growth of herbaceous and woody species along the streambank.
Groundwater Discharge/ Recharge	Yes	There are springs within the floodplain.
Dynamic Surface Water Storage	N/A	This wetland floods via overbank flow.
Biogeochemical Functions		
Elemental Cycling	Normal	A diverse canopy of herbaceous and woody species plus large quantities of woody debris, leaf litter, and soil organic matter suggest intact and functioning nutrient cycles.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Intact nutrient cycles, dense and diverse cover of vegetation, and beaver ponds provide high capacity to perform this function, however there is very little input from upstream or local sources.
Biological Functions		
Habitat Diversity	High	There are forested, scrub-shrub, emergent, and open water wetland habitats.
General Wildlife Habitat	High	The forest, shrub, and herbaceous canopies provide a diversity of vegetation structure, which along with high vegetation volume, provide excellent habitat for birds, mammals, and insects.
General Fish/Aquatic Habitat	High	Stable streambanks, overhanging vegetation, and a diversity of riffles/pools provide excellent aquatic habitat. Fish are present in the creek, including the Rio Grande cutthroat trout.
Production Export/Food Chain Support	Moderate	A permanent water source and large quantities of allochthonous organic substrates provide various sources of carbon (both dissolved and particulate) and nutrients for downstream ecosystems. However, the width of the riparian area is narrow.
Uniqueness	Low	Similar community types are common in nearby areas.



1 0 1 Miles

Projection: UTM, Zone13, NAD27

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LEGEND

North Fork Trinchera Creek Potential Conservation Area

30 x 60 Minute Series Quads: Alamosa, 37105a1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

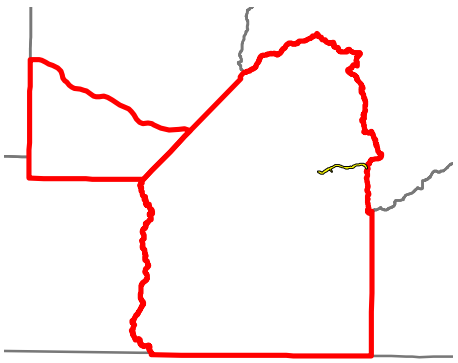


Figure 8. North Fork Trinchera Creek Potential Conservation Area

RIO GRANDE AT ALAMOSA NATIONAL WILDLIFE REFUGE POTENTIAL CONSERVATION AREA

Biodiversity Rank: B2. Very High biodiversity significance. The PCA supports a ?? occurrence of the globally critically imperiled Southwestern Willow Flycatcher, an occurrence of the globally imperiled slender spiderflower, and multiple examples of common wetland plant communities.

Protection Urgency Rank: P3. Protection actions may be needed, but probably not within the next five years. It is estimated that current stresses may reduce the viability of the elements of the PCA if protection action is not taken on the western side of the Rio Grande. The portion of the PCA east of the Rio Grande is managed by the USFWS.

Management Urgency Rank: M3. New management actions may be needed within five years to maintain the current quality of the element occurrences in the PCA. Non-native species, grazing impacts, and water diversions are of concern.

Location: This site includes the Rio Grande and portions of its floodplain near the Alamosa National Wildlife Refuge.

U.S.G.S. 7.5-min. quadrangle: Alamosa East, Lasauses, and Pikes Stockade

Legal Description: T36N, R11E S 3-6, 8, 9, 16, 21;
T37N, R10E S 11-14, 24;
T37N, R11E S 16-22, 27-34.

Elevation: 7,500-7,530 ft. Approximate Size: 11,397 acres

General Description: The Rio Grande, in the San Luis Valley, is a sediment-dominated system. Historically, the Rio Grande was a braided, dynamic, and avulsive system (RGHRP 2001). Structures and diversions associated with irrigation have altered the dynamics of the Rio Grande (RGHRP 2001). For example, near Del Norte the Rio Grande is now confined to two moderately entrenched channels whereas historically the river had constant streamflow through multiple channels. Between Monte Vista and Alamosa, the reach contained with this PCA, the river is dominated by a single active channel with numerous abandoned or inactive channels, meander scars, and sloughs interspersed in the floodplain (RGHRP 2001). Although channel avulsion, meander cutoff, and overbank flow still occur along this reach, historical dynamics which created the myriad of meanders scars, inactive channels, and sloughs in the area, no longer occur as the river is under capacity (RGHRP 2001). Near Alamosa, the Rio Grande is confined by a series of levees which transport water and sediment through city limits to downstream reaches (RGHRP 2001). The reach downstream of Alamosa is considered to be depositional and has a very flat channel slope (RGHRP 2001).

This PCA encompasses a segment of the Rio Grande River and its floodplain downstream of the City of Alamosa to the southern tip of the Alamosa National Wildlife Refuge (Refuge). This area was historically referred to as the "Alamosa Marshes" and documented as one of the largest wetland complexes in the San Luis Valley by the 1878 Wheeler expedition maps (U.S. Army Corps of Engineers 1878). Historically, the area was grazed by domestic livestock and irrigated for forage production (USFWS 2002). Following the establishment of the Alamosa National

Wildlife Refuge in 1962, irrigation continued in many areas. This practice has maintained saturated and/or inundated conditions for longer periods than historically occurred in many wetlands (USFWS 2002). During early June, the Rio Grande may leave its banks and flood a small area for a short amount of time (USFWS 2002). Otherwise, flooding along the reach contained in this PCA rarely occurs due to the extensive use of water from the 48 irrigation diversions upstream of the Refuge (USFWS 2002). Few impoundments have been created on the Refuge due to the amount of natural oxbows, channels, and depression created by historically flooding of the Rio Grande. Since flooding has decreased in frequency and volume from historical patterns, many of these natural wetland basins are supplied with irrigation water via the water management infrastructure developed by historical cattle ranches, to support wetland habitat for waterbirds and other wildlife (USFWS 2002). The USFWS pumps approximately 1,541 acre-feet from 53 artesian wells within its boundaries and diverts approximately 13,750 acre-feet from the Rio Grande to supply irrigation water to the Refuge (USFWS 2002). The Closed Basin Canal, constructed in 1983 by the Bureau of Reclamation, bisects the Refuge and provides water to the Refuge as mitigation for wetlands impacted from Closed Basin project (USFWS 2002).

Water management (e.g. irrigation), the Rio Grande, and alluvial groundwater support numerous wetland types, such as decadent cottonwood riparian forests, emergent wetlands, semipermanent wetlands, willow shrublands, and fresh and saline wet meadows. These wetland types are scattered throughout the floodplain and constitute a diverse oasis of wetland habitat in Colorado's driest mountain valley. The wetlands support a diverse array of nesting, migrating, and wintering water birds, songbirds, and raptors. Many species of water birds, shorebirds, and songbirds nest on the Refuge. The Refuge produces 5,000 – 8,000 ducks, annually (USFWS 2002). Many species of mammals, including elk, coyote, deer, porcupine, rabbits, beaver, muskrats, weasels, etc., are found on the Refuge (USFWS 2002). Bald Eagles (*Haliaeetus leucocephalus*) and Southwestern Willow Flycatchers (*Empidonax traillii extimus*) are Federally Listed Threatened and Endangered species that are documented on the Refuge, and other Species of Management Concern, such as the American Bittern (*Botaurus lentiginosus*), Black Tern (*Chlidonias niger*), Burrowing Owls (*Athene cunicularia*), Ferruginous Hawk (*Buteo regalis*), and White-Faced Ibis (*Plegadis chihi*) also are found on the Refuge (USFWS 2002).

The riverbanks in this PCA are mainly dominated by willow and graminoid species. Many of these willow stands support populations of the Federally Endangered Southwestern Willow Flycatcher. The Rio Grande Headwaters Restoration Project (2001) estimates that 41-60% of the reach in this PCA contains large stands of willows along at least one bank while cottonwoods are few and periodically present.

Willow shrublands are a common vegetation type along the Rio Grande riverbanks. Coyote willow (*Salix exigua*) is the most common species while mountain willow (*S. monticola*), strapleaf willow (*S. eriocephala* var. *ligulifolia*), and Pacific willow (*S. lasiandra* var. *lasiandra*) are occasionally present. The understory consists of various graminoids such as Kentucky bluegrass, wooly sedge (*Carex pellita*), Nebraska sedge (*C. nebrascensis*), smooth brome (*Bromus inermis*), Baltic rush (*Juncus balticus*), common horsetail (*Equisetum arvense*), and western wheatgrass and forbs such as silverweed (*Argentina anserina*), whitetop (*Lepidium latifolium*), Indian hemp (*Apocynum cannabinum*), and wild mint (*Mentha arvense*). Structural diversity is low as there is typically a dense shrub canopy (3-8 ft. tall) and a dense to sparse understory of herbaceous species. The size of these willow stands also varies, however within this site most are linear (5-20ft. wide) and of various lengths.

These willow shrublands are important habitat for the Federally Listed Endangered Southwestern Willow Flycatcher which breed in relatively dense riparian vegetation near surface water or saturated soil (Southwestern Willow Flycatcher Recovery Team Technical Subgroup 2002). The Southwestern Willow Flycatcher is decreasing due to extensive habitat loss and modification caused by alteration of surface and groundwater levels by agriculture and development, changes in flood and fire regimes due to dams and channelization, clearing of vegetation for human use, livestock grazing, changes in soil and water chemistry from altered hydrological cycles, and non-native plants (USFWS 2002).

The range of the Southwestern Willow Flycatcher spans over seven States. Habitat and breeding characteristics, potential threats, management concerns, and recovery objectives vary over this large region. Thus, the range of the Southwestern Willow Flycatcher has been divided into six Recover Units to ensure recovery efforts are in alignment with the biological and logistical realities of each region (Southwestern Willow Flycatcher Recovery Team Technical Subgroup 2002).) Due to recent genetic work confirming Southwestern Willow Flycatcher (*Empidonax traillii extimus*) populations in the San Luis Valley, the Final Recovery Plan for the Southwestern Willow Flycather has included the San Luis Valley within the range of this subspecies and has designated the San Luis Valley as a Management Unit within the Rio Grande Recover Unit (Southwestern Willow Flycatcher Recovery Team Technical Subgroup 2002). Important nesting habitat is found along a portion of the Rio Grande, including this PCA. These critical habitat areas exist in a range of conditions, due to various levels of grazing, past clearing for agriculture, and altered hydrology (USFWS 2002).

HawksAloft conducted willow flycatcher surveys throughout the San Luis Valley in 2002 and 2003. Some of the willow shrublands in this PCA were found to support breeding populations of the Willow Flycatcher (*Empidonax traillii*) (Hawks Aloft 2003). Given that they were recorded during the breeding season, they are assumed to be the Southwestern Willow Flycatcher (Terry Ireland, personal communication, 2004). Almost all are associated with shrublands dominated by coyote willow. CNHP visited most of the breeding locations within this PCA, as well as other locations along the Rio Grande.

The U.S. Fish and Wildlife Service (USFWS) manage much of the floodplain within this PCA. Although there is not much active management of wetland topography, the USFWS does manage water supply to many of the old river channels, oxbows, and basins in the eastern portion of the floodplain. Many of these old river bottoms and managed areas are permanently saturated. Hardstem bulrush (*Scirpus acutus*), cattail (*Typha latifolia*), arrowhead (*Sagittaria cuneata*), mare's tail (*Hippuris vulgaris*), common spikerush (*Eleocharis palustris*), and American mannagrass (*Glyceria grandis*) are dominant in the freshwater marsh areas. The sloughs are lined with various species of willow (*Salix exigua*, *S. monticola*, and *S. eriocephala* var. *ligulifolia*). In open water areas, species such as water ladysthumb (*Polygonum amphibium*), floating pondweed (*Potamogeton gramineus*), mare's tail, duckweed (*Lemna minor*), and giant bur-reed (*Sparganium eurycarpum*) dominate. Wet meadows occur in low-lying areas where awned sedge (*Carex atherodes*), woolly sedge, short-beaked sedge (*C. simulata*), and beaked sedge (*C. utriculata*) are the predominate species.

In more saline areas, saltgrass (*Distichlis spicata*) and Baltic rush (*Juncus balticus*) dominate wet meadows. Common threesquare (*Scirpus pungens*), alkaline bulrush (*Scirpus maritimus*), and slim reedgrass (*Calamagrostis stricta*) are common in saline marshes and often form large stands. Saline bottomland shrublands, the matrix vegetation type in the San Luis Valley, dominate in areas that are not heavily irrigated. Species such as greasewood (*Sarcobatus vermiculatus*), saltgrass, and Baltic rush are predominant. The globally imperiled slender spiderflower (G2G3)

(*Cleome multicaulis*) can often be found in these saline wet meadows. CNHP is aware of one population within this PCA, however additional ones may be present.

Non-native species such as Russian knapweed (*Acroptilon repens*), Canada thistle (*Cirsium arvense*), whitetop (*Lepidium latifolium*), smooth brome (*Bromus inermi*s), reed canarygrass (*Phalaris arundinacea*), and quackgrass (*Elymus repens*) are common. Whitetop is especially a problem near the southern end of the Refuge where it dominates hundreds of acres. Eurasian watermilfoil (*Myriophyllum spicatum*) has been found on the Refuge at the terminal end of the Closed Basin Canal (USFWS 2002).

Biodiversity Rank Justification: There are multiple known breeding locations for the globally critically imperiled (G5T1T2) Soutwestern Willow Flycatcher (*Empidonax traillii extimus*) contained in the PCA. The Southwestern Willow Flycatcher reaches it's northernmost range in the San Luis Valley. Numerous threats, such as agricultural clearing, impacts from excessive grazing, and water diversions, have decreased the amount and quality of southwestern willow flycatcher habitat range-wide (Southwestern Willow Flycatcher Recovery Team Technical Subgroup 2002).

The slender spiderflower (*Cleome multicaulis*) has a global range from southern Wyoming to central Mexico. The San Luis Valley contains the most numerous, largest, and healthiest populations in the world. Slender spiderflower has a limited distribution due to its requirement of moist alkaline soil along with periodic soil disturbance, such as pocket gopher (*Thomomys talpoides*) diggings. These habitat requirements limit the slender spiderflower to the edges of alkaline wet meadows and playas. The San Luis Valley contains the most numerous, largest, and healthiest populations in the world.

The sandbar willow / mesic graminoid riparian shrubland, although very common, is extremely important for the survival of the Southwestern Willow Flycatcher populations at this site. Numerous other communities such as common threesquare, hardstem bulrush, alkali bulrush, and slimstem reedgrass are found at this site, but due to the hydrologic manipulation occurring in these stands, they were not documented and entered in BIOTICS. However, they provide important wildlife habitat at this site.

Table 15. Natural Heritage element occurrences at Rio Grande at Alamosa National Wildlife Refuge PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Birds					
Empidonax traillii extimus	**Southwestern willow flycatcher**	**G5T1T2**	**S1**	**LE, FS, E**	**B**
Empidonax traillii extimus	**Southwestern willow flycatcher**	**G5T1T2**	**S1**	**LE, FS, E**	**B**
Plants					
Cleome multicaulis	Slender spiderflower	G2G3	S2S3	BLM	E
Plant Communities					
Salix exigua / Mesic graminoid	Coyote willow / mesic graminoid riparian shrubland	G5	S5		C

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

Boundary Justification: The site boundary encompasses a large portion of the Rio Grande's floodplain. Topography within the site is very flat. Important hydrologic inputs include alluvial groundwater which is associated with water levels in the river, surface water runoff from rain events, and periodic overbank flooding of the Rio Grande. Hydrological input from the Closed Basin canal also supports many of the wetlands within the PCA. The site boundary was drawn to incorporate an area where these natural processes would maintain viable populations of the elements. The boundary provides a buffer from nearby agriculture fields and roads where surface runoff may contribute excess nutrients and/or herbicides/pesticides that could be detrimental to the elements. The site contains many old oxbows and sloughs that could provide a source for recruitment for species associated with the elements. It should be noted that the hydrological processes necessary to the elements are not fully contained by the boundaries established for this site. Given that the elements are closely tied to natural processes associated with the Rio Grande, any upstream activities could detrimentally affect the elements.

Protection Comments: Most of the PCA is contained in the Alamosa National Wildlife Refuge and is managed by the U.S. Fish and Wildlife Service. The remaining areas of the PCA are privately owned and mostly consist of irrigated meadows for hay production and grazing pasture on the western side of the Rio Grande.

Management Comments: Recreation (mostly hunting, education, and bird watching) is the dominant use of the Refuge. Livestock grazing and associated hay production occur on much of the PCA outside the Refuge. Control of non-native plant species is an issue for this site. Whitetop, Canada thistle, Russian knapweed, and Eurasian watermilfoil are currently on the radar screen of the Refuge staff (USFWS 2002). The spread of the native giant reed is also a concern to Refuge personnel. Changes in upstream water use have the potential to affect the integrity of the elements at this PCA. Alterations of current water management within the PCA may also affect the elements.

Soils Description: Soils are variable within this large site and there are numerous soil types in the PCA. Some of the more common types in the wetland areas are mapped as the Alamosa, Arena, and Vastine series. Marsh and wet alluvial land are also mapped as general soil types. The Alamosa is a Fine-loamy, mixed, frigid Typic Argiaquoll (USDA 1973). These soils are deep and poorly to somewhat poorly drained. The Arena is classified as a Fine-loamy, mixed, frigid, Aquentic Durorthids (USDA 1973). These soils are somewhat poorly drained and poorly drained, saline and alkali soils that have a duripan at a depth of 30-40 inches. They formed in alluvium in old floodplains. The Vastine is classified as Fine-loamy over sand or sandy-skeletal, mixed, noncalcerous, frigid, Typic Haplaquolls (USDA 1973). These soils are poorly drained, nearly level soils on bottomland areas which formed in fine-textured, stratified alluvium (USDA 1973).

Restoration Potential: Restoration of natural hydrologic processes would require an immense collaboration with upstream water users, local landowners, municipalities, etc. Wetland functions such as flood attenuation, biogeochemical functions, etc., have been impacted by hydrologic alterations and a large-scale restoration project could improve those functions. However, although natural hydrology has been altered, the current hydrologic regime is supporting the elements found at this site.

Future and present restoration projects focusing on restoring and/or enhancing a diversity of fluvial processes which raise groundwater levels, encourage periodic flooding, and create a mosaic of wetland and riparian vegetation types will most likely succeed in restoring many of the functions compromised by past human-induced impacts. Altering fluvial processes in the Rio

Grande will likely require much use of structural measures, many of which result in additional problems downstream. Other, non-structural activities may allow the natural creation of new riparian vegetation communities and also enhance existing ones by restoring a diversity of age classes, vertical complexity, and increasing species richness which are important for maintaining and improving habitat for the Southwestern Willow Flycatcher (Southwestern Willow Flycatcher Recovery Team Technical Subgroup 2002). For example, it may be necessary to manage beaver populations in those areas where cottonwood/willow planting have occurred or in those areas where cottonwood and willow are the only food source for beaver, as these areas will be decimated (RGHRP 2001). Management actions might include removal (consult the Colorado Division of Wildlife for such actions) or preferably, by creating habitat conditions which provide an alternative food source for the beaver (i.e. cattails) thereby alleviating damage to cottonwoods and willows (RGHRP 2001).

Current land use patterns allow for overuse of many areas by livestock. The primary concerns from such activity are uncontrolled non-native species invasions, increased erosion and downcutting of the stream banks, and subsequent lowering of water tables. Grazing practices should be minimized or a reasonable method of grazing, such as year-round exclusion of grazing in the riparian zone, or limiting grazing to the dormant season, or allowing localized access to the Rio Grande for watering may improve the health of the riparian vegetation and hence the riparian ecosystem as a whole. The management of livestock grazing within the riparian corridor can be a substantial restoration tool (RGHRP 2001). Organizations such as Partners for Wildlife, Natural Resource Conservation Service, and the Colorado Division of Wildlife may provide assistance for assessing and implementing the proper grazing regime of a particular site.

The Rio Grande Headwaters Restoration Project (2001) thoroughly addresses those issues related to a large-scale restoration effort along the upper Rio Grande. Readers are encouraged to consult this document (RGHRP 2001) for more specific information, especially regarding structural restoration techniques.

Wetland Functional Assessment for the Rio Grande at Alamosa National Wildlife Refuge PCA:
Proposed HGM Class: Riverine **Subclass:** R3
Cowardin System: Palustrine
CNHP's Wetland Classification: *Salix exigua /* mesic graminoid; *Populus angustifolia / Salix exigua*

Table 16. Wetland functional assessment for the riverine wetland at the Rio Grande at Alamosa National Wildlife Refuge PCA.

Function	Rating	Comments
Overall Functional Integrity	Below Potential	This wetland appears to be functioning below potential due to the amount of hydrological alteration and vegetation clearing in the floodplain. However, given the extent and diversity of wetland types in the area, the site still provides important functions.
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Dense cover of shrubs and herbaceous vegetation and an extensive floodplain provide high ability to attenuate flooding. However, water diversions and altered sediment dynamics have altered the frequency and volume of seasonal flooding on the Rio Grande.
Sediment/Shoreline Stabilization	Moderate	Some immediate banks along the Rio Grande are well vegetated while others are susceptible to erosion. This is likely due to alterations in hydrology and direct impacts associated with grazing.
Groundwater Discharge/ Recharge	Yes	The Rio Grande likely recharges the unconfined aquifer and alluvial aquifers.
Dynamic Surface Water Storage	N/A	Flooding occurs in this wetland due to overbank flow.
Biogeochemical Functions		
Elemental Cycling	Disrupted	The presence of aerated water (the river) and large areas of saturated soil (oxbows, sloughs) provide a gradient for various nutrient transformations. However, alteration of the herbaceous understory, such as a change in species composition (prevalence of non-native species) may disrupt nutrient cycles. Altered hydrology has also disrupted nutrient cycles by eliminating normal flushing cycles and lack of deposition of organic material from floodwaters.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Removal of excess nutrients and sediment (e.g. from upstream and local livestock, municipal water treatment plants, and agricultural activity) is likely being performed by this wetland considering the large area in which such transformations could occur prior to reaching the river. Dense herbaceous and woody vegetation in the floodplain along with periodic overbank flooding provides high potential for this area to function as a sink for sediments/nutrients/toxicants. Toxicants and sediments from nearby roads are likely also intercepted in the floodplain prior to reaching the river. However, this is moderated by altered hydrology.
Biological Functions		
Habitat Diversity	High	The wetland site consists of aquatic bed, emergent, scrub-shrub, forested, and open water habitats.
General Wildlife Habitat	High	This area provides browse and cover for deer, coyote, black

		bear, and other large and small mammals. Oxbows and sloughs provide open water for waterbirds. However, livestock, agricultural clearing, and nearby roads have eliminated much wildlife habitat in the area. The willow shrublands along the riparian area provide important habitat for the Federally Endangered Southwestern Willow Flycatcher. Wet meadows, emergent wetlands, and open water wetlands provide nesting and migratory habitat for numerous species of birds and mammals, which in turn provide forage for birds of prey such as eagles, hawks, and falcons.
General Fish/Aquatic Habitat	Moderate	Being a large river system, many fish species are likely to occur to occur in this stretch of the river. Back channels and old abandoned oxbows may provide suitable habitat for many fishes. However, native trout are rare to absent in this reach of the Rio Grande (RGHRP 2001) due to hydrological alteration and the introduction of non- native species.
Production Export/Food Chain Support	High	A permanent water source and allochthonous organic substrates provide various sources of carbon (both dissolved and particulate) and nutrients for downstream ecosystems. Although some areas lack a diversity of structural vegetation classes (e.g. herbaceous layer is minimal), because the area is so large and encompasses a variety of habitats, food chain support is high. This function is being negatively affected by the prevalence of non-native species such as whitetop, Canada thistle, and Russian knapweed and lack of historical flooding regime.
Uniqueness	High	Large riparian floodplain forests in Alamosa and Costilla counties have largely been reduced and/or impacted by grazing and agriculture. The presence of such a large complex of cottonwood and willow support populations of the Federally Endangered Southwestern Willow Flycatcher.

Wetland Functional Assessment for the the Rio Grande at Alamosa National Wildlife Refuge PCA:

Proposed HGM Class: Depressional **Subclass:** D2 (numerous old stream channels and oxbows)

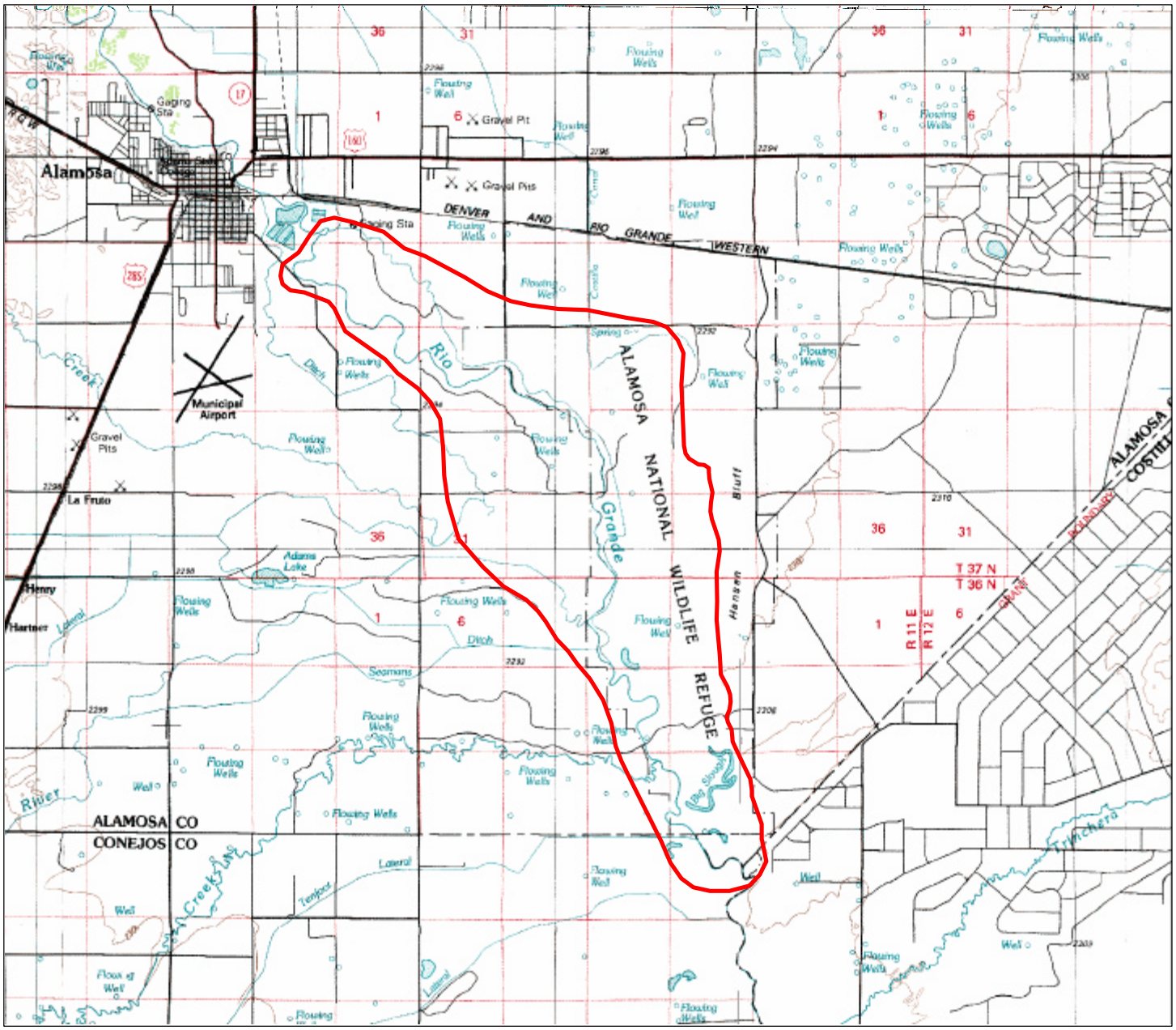
Cowardin System: Palustrine

CNHP's Wetland Classification: *Carex pellita, Carex simulata, Polygonum amphibium*

Table 17. Wetland functional assessment for the riverine wetland at the Rio Grande at Alamosa National Wildlife Refuge PCA.

Function	Rating	Comments
Overall Functional Integrity	Below Potential	This wetland appears to be functioning below potential due to the amount of hydrological alteration and vegetation clearing in the floodplain. However, given the extent and diversity of wetland types in the area, the site still provide important functions..
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Periodic overbank flow can settle in this wetland basins providing short-term storage. However, water diversions and altered sediment dynamics have altered the frequency and volume of seasonal flooding on the Rio Grande. In addition, many of these basins are artificially filled with irrigation water.
Sediment/Shoreline Stabilization	Moderate	Does not occur along a natural surface drainage. However, these areas are densely vegetated, providing stabilization during high flows.
Groundwater Discharge/ Recharge	Yes	Most of these wetlands are supported by discharge from the alluvial and unconfined aquifer.
Dynamic Surface Water Storage	High	There are numerous old stream channels and oxbows that retain standing water.
Biogeochemical Functions		
Elemental Cycling	Disrupted	The presence of standing water and large areas of saturated soil (oxbows, sloughs) provide a gradient for various nutrient transformations. However, alteration of the herbaceous understory, such as a change in species composition (prevalence of non-native species) may be disrupting nutrient cycles. Altered hydrology has also disrupted nutrient cycles by eliminating normal flushing cycles and lack of deposition of organic material from floodwaters.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Removal of excess nutrients and sediment (e.g. from upstream and local livestock, municipal water treatment plants, and agricultural activity) is likely being performed by this wetland considering the large area in which such transformations could occur prior to reaching the river. Dense herbaceous and woody vegetation along with periodic overbank flooding provides high potential for this area to function as a sink for sediments/nutrients/toxicants. Toxicants and sediments from nearby roads are likely also intercepted in these wetlands prior to reaching the river. However, this is moderated by altered hydrology.
Biological Functions		
Habitat Diversity	High	The wetland site consists of aquatic bed, emergent, scrub-shrub, and open water habitats.
General Wildlife Habitat	High	This area provides browse and cover for deer, coyote, black bear, and other large and small mammals. Oxbows and

		sloughs provide open water for waterbirds. However, livestock, agricultural clearing, and nearby roads have eliminated much wildlife habitat in the area. The willow shrublands along the riparian area provide important habitat for the Federally Endangered Southwestern Willow Flycatcher. Wet meadows, emergent wetlands, and open water wetlands provide nesting and migratory habitat for numerous species of birds and mammals, which in turn provide forage for birds of prey such as eagles, hawks, and falcons.
General Fish/Aquatic Habitat	Moderate	Some fish may exist in old stream channels and oxbows. Dense cover of vegetation along the banks of these areas could provide potential habitat. Aquatic vegetation provides good cover and supports many aquatic invertebrates.
Production Export/Food Chain Support	Moderate to High	Dense emergent and aquatic vegetation cover support local food chain dynamics by sustaining healthy invertebrate populations. Export of organic substances and associated nutrients is limited due to restricted outlets.
Uniqueness	Moderate	The density of depressional wetlands found in this area is not common in the project area. The presence of such a large complex of cottonwood and willow along with many depressional wetlands support populations of the Federally Endangered Southwestern Willow Flycatcher



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LEGEND

Rio Grande at
Alamosa National Wildlife Refuge
Potential Conservation Area

30 x 60 Minute Series Quad:
Alamosa, 37105a1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

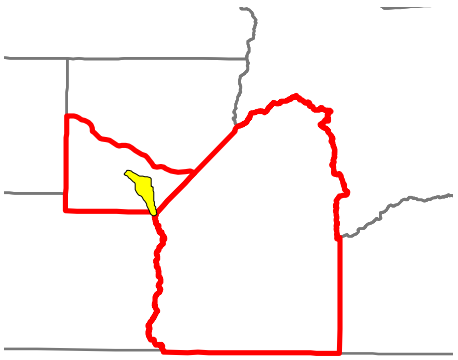


Figure 9. Rio Grande at Alamosa National Wildlife Refuge Potential Conservation Area

SANGRE DE CRISTO CREEK POTENTIAL CONSERVATION AREA

Biodiversity Rank: B2. Very High biodiversity significance. The PCA supports a good example of a globally imperiled wetland plant community and a fair example of the globally vulnerable Rio Grande cutthroat trout.

Protection Urgency Rank: P3. Protection actions may be needed, but probably not within the next five years. It is estimated that current stresses may reduce the viability of the elements of the PCA if protection action is not taken. A small portion of the site is a Costilla County Park, however, much of the site has no formal protection and is owned by numerous landowners affiliated with a subdivision on Forbes-Trinchera ranch.

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

Location: This PCA is located along Sangre de Cristo Creek near the town of Fort Garland, CO.

U.S.G.S. 7.5-min. quadrangle: Fort Garland and Trinchera Ranch

Legal Description: Unsurveyed

Elevation: 7,800 – 8,200 ft. Approximate Size: 5,597 acres

General Description: This PCA encompasses a portion of Sangre de Cristo Creek near the town of Fort Garland. This reach of Sangre de Cristo Creek has a moderately wide floodplain and is very sinuous. Near the upstream extent of the PCA, the floodplain narrows. Although bounded by railroad tracks, bridges, etc., this occurrence is wider than those seen on lower reaches where agriculture is constricting vegetation to very narrow stands. Much of the creek and old channels are dominated by a dense stand of strapleaf willow (*Salix ligulifolia*) and sandbar willow (*S. exigua*). Other species present in these stands include red-osier dogwood (*Cornus sericea*), river birch (*Betula occidentalis*), slimstem reedgrass (*Calamagrostis stricta*), and false Solomon's seal (*Maianthemum stellatum*). To a much lesser extent, stands of sandbar willow and wild licorice (*Glycyrrhiza lepidota*) and numerous mesic forbs are also prevalent. Narrowleaf cottonwood (*Populus angustifolia*) is occasionally present along the creek. Some non-native species and native increasers are present throughout the riparian area.

The uplands are dominated by rabbitbrush (*Chrysothamnus nauseosus*) and sagebrush (*Artemisia* sp.). Surrounding hilltops are covered with pinyon-juniper woodlands. Pocket gopher mounds are common. Much of the immediate watershed is scattered with homes. A county park is nearby as well as many roads. Hwy. 160 parallels the creek through the entire PCA. The site appears to have been disturbed in the past, but is now exhibiting luxurious growth.

Sangre de Creek supports a fair, genetically pure, historic (native) population of the Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*) (Harig and Fausch 1996; Alves 1998). Alves (2004) estimates that there are approximately 275 fish/acre in the creek. The population is at risk because of low population numbers (biomass) and competition with brook trout (*Savelinus fontinalis*) (Alves 2004; Alves 1998). Harig and Fausch (1996) note that rainbow trout (*Oncorhynchus mykiss*) were previously stocked in the stream.

Biodiversity Rank Justification: The globally imperiled (G2G3) montane willow carr (*Salix ligulifolia*) is only known from Colorado, but it is expected to occur in New Mexico. The association is a medium- to tall-willow shrubland occurring on saturated floodplains and streambanks of montane elevations. It occurs in moderately wide valleys along low terraces and floodplains, streambanks of narrower streams, below active beaver ponds where multiple channels create vegetated islands, along slightly sinuous, broad channels, and along more sinuous channels with well developed floodplains. Strapleaf willow is highly palatable to livestock; therefore, season-long grazing, especially late summer and early fall browsing, should be avoided in order to maintain the vigor of woody species (Hansen et al. 1995). Overuse by livestock may cause the site to dry and become dominated by introduced grass species such as Kentucky bluegrass (*Poa pratensis*) or smooth brome (*Bromus inermis*) (Manning and Padgett 1995). With continued overuse, the willow species will decline and eventually become eliminated from the site (Hansen et al. 1995). Beaver are important in maintaining this plant association. Beaver dams raise the water table, which is beneficial to willow and sedge species as well as other hydrophytic plants. Beaver dams also help control bank erosion, channel downcutting, and the loss of sediment downstream (Hansen et al. 1995).

The Rio Grande cutthroat trout's range once included the entire Rio Grande and Pecos River watersheds, and possibly the upper Canadian River as well (Trotter 1987). In Colorado, the species occupies less than 1% of its former range (Alves 1996), and wild, genetically pure stock populations are especially imperiled. Artificial habitat including wells, farm ponds, and extensive canal systems as well as human activities including dewatering, fishing and stocking, transbasin diversions, release of domestic sewage, stream channelization, and agricultural chemical applications have greatly modified the original aquatic ecosystem of the San Luis Valley (Zuckerman 1984). These modifications may have contributed directly to the decline in range of the native fishes of the Rio Grande drainage. Free-flowing streams with good quality water, healthy banks, and streamside vegetation within the upper Rio Grande watershed are vital habitat for this subspecies of trout.

Table 18. Natural Heritage element occurrences at Sangre de Cristo Creek PCA.
Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plant Communities					
Salix ligulifolia	**Montane willow carr**	**G2G3**	**S2S3**		**B**
Fish					
Oncorhynchus clarki virginalis	Rio Grande cutthroat trout	G4T3	S3	FS/BLM, SC	C

*EO=Element Occurrence.

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 Sangre de Cristo 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 PCA boundaries. Given that the elements are dependent on natural hydrological processes associated with the Sangre de Cristo 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.

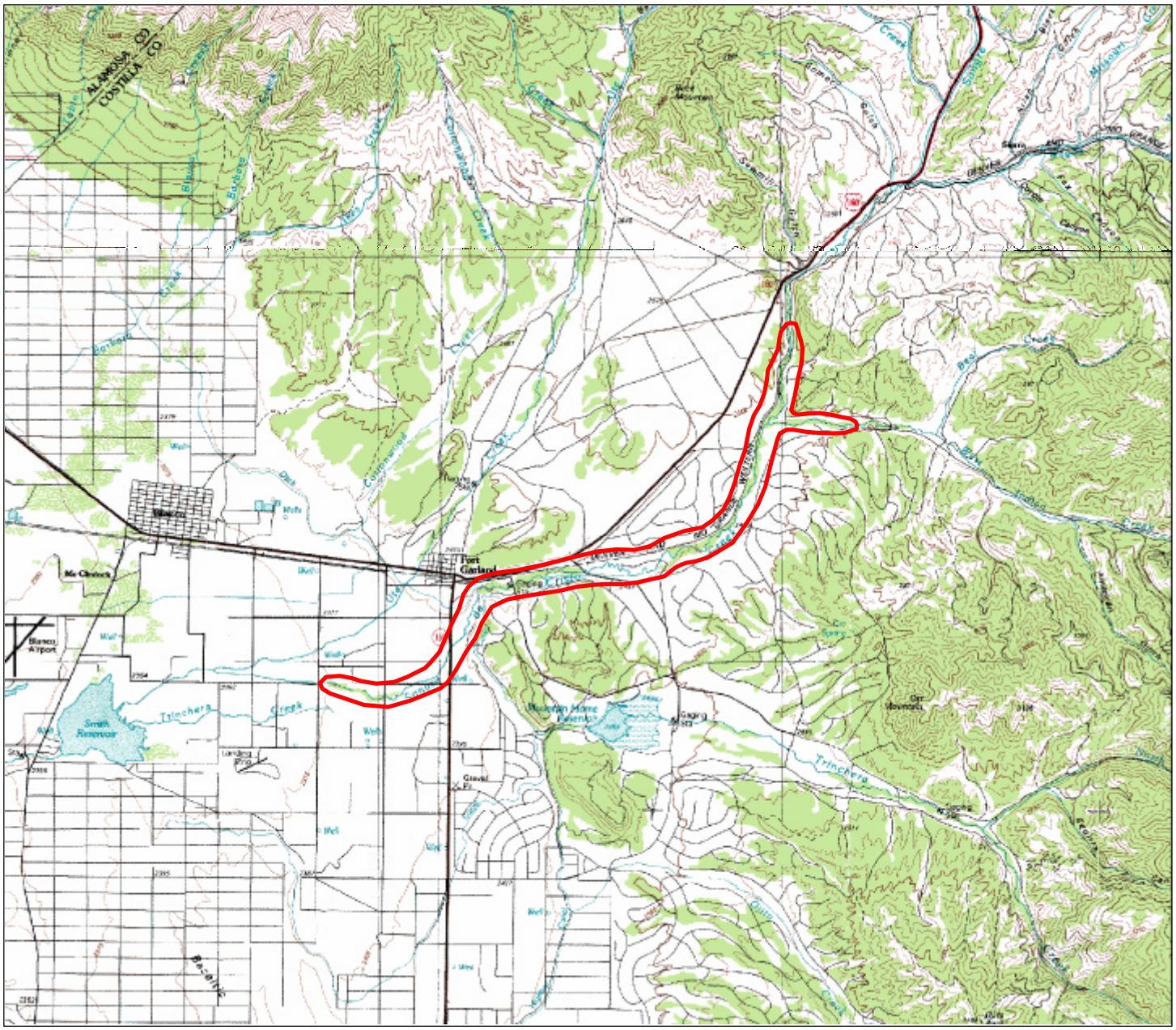
Protection Comments: A small portion of the site is a Costilla County Park, however, much of the site has no formal protection and is owned by numerous landowners affiliated with a subdivision on Forbes-Trinchera ranch.

Management Comments: The County park is used recreationally, mostly by horse riders. Native plant increasers are prevalent and should be monitored as they may indicate a need to implement and or shift management. No grazing occurs within the site. The hydrology is altered by upstream water diversions.

Soils Description: Soils are not mapped at this site. Soil is mixed alluvium.

Restoration Potential: Restoration should focus on upstream water use. Restoration of natural hydrologic processes would require an immense collaboration with upstream water users, local landowners, municipalities, etc. Wetland functions such as biogeochemical functions, etc., have likely been impacted by hydrologic alterations and a large-scale restoration project could improve those functions. However, although natural hydrology has been altered, the current hydrologic regime is supporting the elements found at this site.

Wetland Functional Assessment: CNHP wetland ecologists did not visit the wetland contained within this PCA during 2003. Thus, a functional assessment could not be conducted. However, notes from a previous visit by CNHP indicate that streambanks are well vegetated and stable, flooding occurs, but may be altered from water diversions. Input of toxicants, sediment, and nutrients is likely occurring from Hwy. 160 and nearby homes. Algae was observed growing in slow moving water, possibly indicating nutrient enrichment. No grazing occurred on site, resulting in dense and lush vegetation growth.



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LEGEND

Sangre de Cristo Creek Potential Conservation Area

30 x 60 Minute Series Quads:
Alamosa, 37105a1
Blanca Peak, 37105e1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

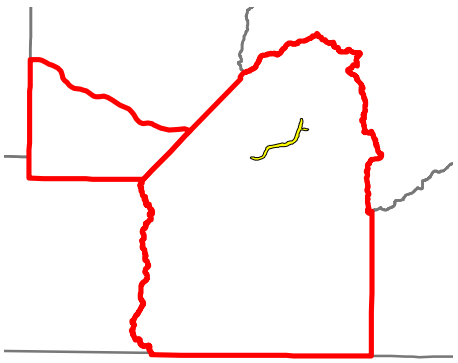


Figure 10. Sangre de Cristo Creek Potential Conservation Area

BLANCA GREASEWOOD FLATS POTENTIAL CONSERVATION AREA

Biodiversity Rank: B3. High biodiversity significance. This PCA supports a fair example of the globally imperiled slender spiderflower.

Protection Urgency Rank: P3. Protection actions may be needed, but probably not within the next five years. It is estimated that current stresses may reduce the viability of the elements of the PCA if protection action is not taken. Any level of protection would likely benefit the element, including, and probably most importantly, the protection of water (both surface and groundwater) reaching the site.

Management Urgency Rank: M2. New management actions may be needed within 5 years to prevent the loss of the element occurrences within the PCA. Non-native species, grazing impacts, and water diversions are of concern.

Location: This PCA is located just west of the town of Blanca, CO.

U.S.G.S. 7.5-min. quadrangle: Blanca

Legal Description: Unsurveyed

Elevation: 7,700 ft. Approximate Size: 154 acres

General Description: This PCA is comprised of 150+ acres of greasewood (*Sarcobatus vermiculatus*) flats. Greasewood and saltgrass (*Distichlis spicata*) dominate much of the area, however Baltic rush (*Juncus balticus*) is dominant in wet meadows. Other species present include sedges (*Carex* sp.), arrowgrass (*Triglochin* sp.), and horsetail (*Equisetum* sp.). Non-natives such as Canada thistle (*Cirsium arvense*), Russian thistle (*Salsola kali*), and kochia (*Kochia scoparia*) are also common.

Cattle grazing occurs on site and is negatively affecting species composition as indicate by the prevalence of non-natives and native increasers.

Slender spiderflower (*Cleome multicaulis*) is found in the wet meadow area. Only a few plants were observed but more may be present in adjacent areas.

Biodiversity Rank Justification: The slender spiderflower (*Cleome multicaulis*) has a global range from southern Wyoming to central Mexico. The San Luis Valley contains the most numerous, largest, and healthiest populations in the world. Slender spiderflower has a limited distribution due to its requirement of moist alkaline soil along with periodic soil disturbance. These habitat requirements limit the slender spiderflower to the edges of alkaline wet meadows and playas.

Table 19. Natural Heritage element occurrences at Blanca Greasewood Flats PCA.
Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plants					
Cleome multicaulis	**Slender spiderflower**	**G2G3**	**S2S3**	**BLM**	**C**

*EO=Element Occurrence.

Boundary Justification: The boundary is drawn to encompass the ecological processes believed necessary for long-term viability of the element. The boundaries provide many source areas for seed dispersal to buffer long-term population fluctuations of the elements. The boundary does not encompass the source of surface and ground water input to the site, thus any changes in the current status of groundwater pumping and water diversions from areas that recharge groundwater would likely affect the element.

Protection Comments: The PCA is privately owned. Any level of protection would likely benefit the element, including, and probably most importantly, the protection of water (both surface and groundwater) reaching the site.

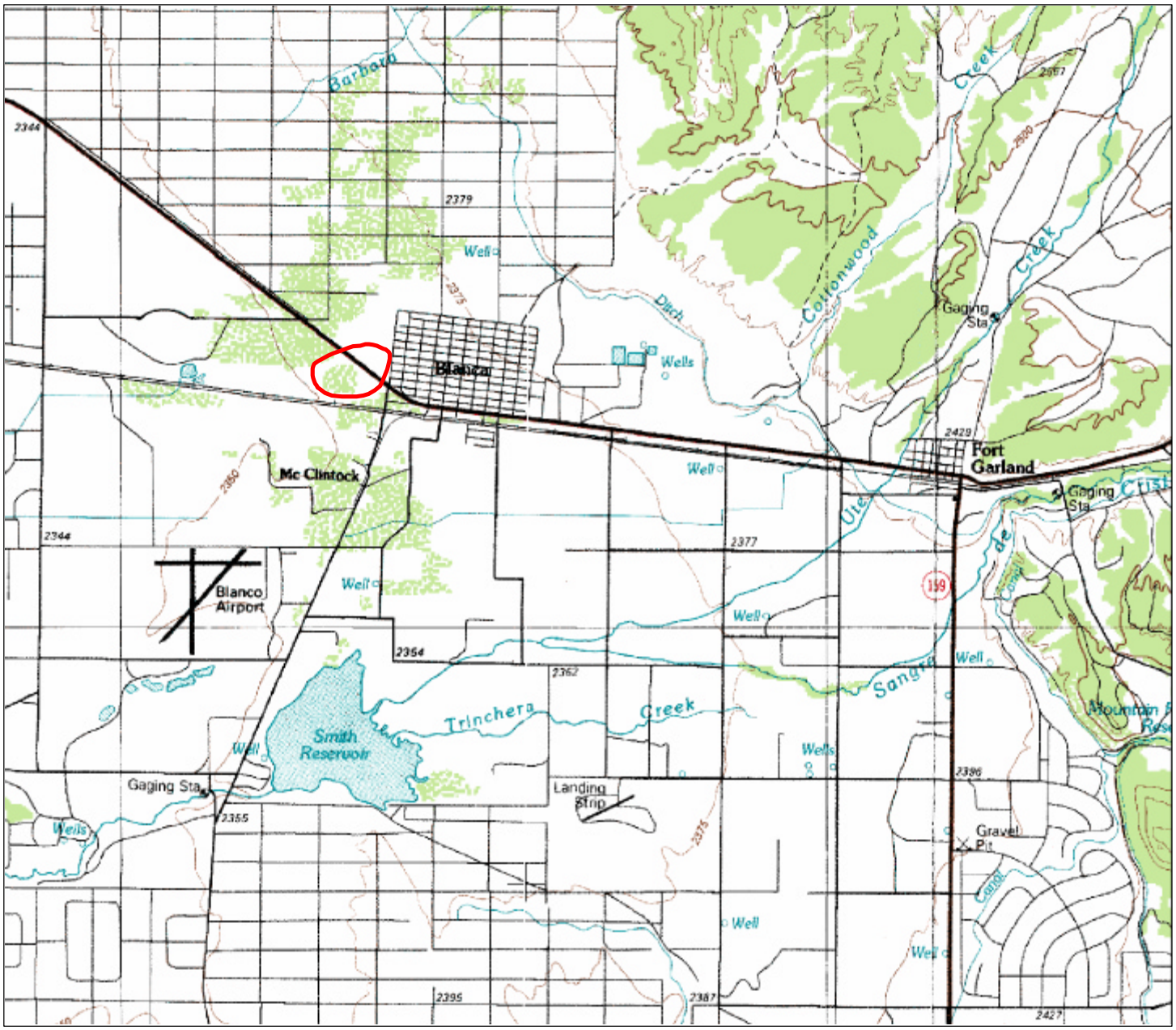
Management Comments: Resting the areas from additional grazing will increase the vigor of native wetland species, which may help control the spread of non-native species.

Soils Description: Soils are not mapped at this site. Soil texture was sandy-loam.

Restoration Potential: Restoration opportunities should target control of non-native plant species. Grazing practices should be minimized or a reasonable method of grazing, such as fencing off wet meadows, implemented in order to improve the health of the wetland vegetation. Depending on upstream water diversions, water tables could begin to rise and restore many wetland areas which are currently impacted by trampling. Minimizing further local groundwater withdrawal is critical to restoring hydrology at this PCA.

A rise in local water tables would likely aid in controlling and/or eradicating some non-natives. However, species such as Canada thistle pose a more difficult challenge. Resting the areas from additional grazing will increase the vigor of native wetland species, which may help control the spread of non-native species. Referring to such resources as the Nature Conservancy's web site on invasive species (http://tncweeds.ucdavis.edu/index.html) or http://www.invasivespecies.gov/ may provide some assistance with control and eradication of non-native species.

Wetland Functional Assessment: CNHP wetland ecologists did not visit the wetland contained within this PCA during 2003. Thus, a functional assessment could not be conducted. However, given the impact from excessive livestock use, it is hypothesized that some wetland functions have been negatively impacted.



1 0 1 Miles

Projection: UTM, Zone13, NAD27

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LEGEND

Blanca Greasewood Flats Potential Conservation Area

30 x 60 Minute Series Quad: Alamosa, 37105a1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

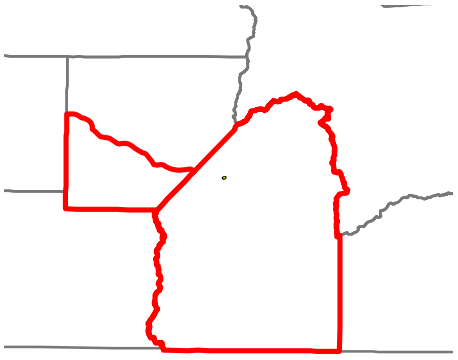


Figure 11. Blanca Greasewood Flats Potential Conservation Area

CUATES CREEK POTENTIAL CONSERVATION AREA

Biodiversity Rank: B3. High biodiversity significance. The PCA supports an excellent population of the globally vulnerable Rio Grande cutthroat trout. Considering that this is a historic and native population (not stocked) this site's Biodiversity Rank was elevated to a B3 as opposed to a B4.

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

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

Location: This PCA is located south of San Luis near the Colorado/New Mexico state line.

U.S.G.S. 7.5-min. quadrangle: La Valley and Sanchez Reservoir

Legal Description: Unsurveyed

Elevation: 8,300 – 11,600 ft. Approximate Size: 2,265 acres

General Description: This PCA encompasses most of the Cuates Creek drainage. The site spans from the subalpine to montane zones, flowing through a diversity of riparian plant community types.

Cuates Creek supports an excellent, genetically pure, and historic population of the Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*). Alves (2004) estimates that there are approximately 254 fish/mile in the creek. The population is stable and secure. Some artificial barriers (irrigation ditches) occur in the lower portion of the drainage. No other fish have been documented in the creek (Alves 2004).

Biodiversity Rank Justification: The Rio Grande cutthroat trout's range once included the entire Rio Grande and Pecos River watersheds, and possibly the upper Canadian River as well (Trotter 1987). In Colorado, the species occupies less than 1% of its former range (Alves 1996), and wild, genetically pure stock populations are especially imperiled. Artificial habitat including wells, farm ponds, and extensive canal systems as well as human activities including dewatering, fishing and stocking, transbasin diversions, release of domestic sewage, stream channelization, and agricultural chemical applications have greatly modified the original aquatic ecosystem of the San Luis Valley (Zuckerman 1984). These modifications may have contributed directly to the decline in range of the native fishes of the Rio Grande drainage. Free-flowing streams with good quality water, healthy banks, and streamside vegetation within the upper Rio Grande watershed are vital habitat for this subspecies of trout.

Table 20. Natural Heritage element occurrences at Cuates Creek PCA.
Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Fish					
Oncorhynchus clarki virginalis	**Rio Grande cutthroat trout**	**G4T3**	**S3**	**FS/BLM, SC**	**A**

*EO=Element Occurrence.

Boundary Justification: The boundaries incorporate an area that will allow natural ecological processes such as large woody debris recruitment, adequate canopy cover (to regulate stream temperature), and new channel formation to maintain viable populations of the trout along Cuates Creek. This boundary indicates the minimum area that should be considered for any conservation management plan. Some hillslope areas which may contribute runoff to Cuates Creek are not encompassed in the boundary although any activity in these areas should be considered for any conservation management plan.

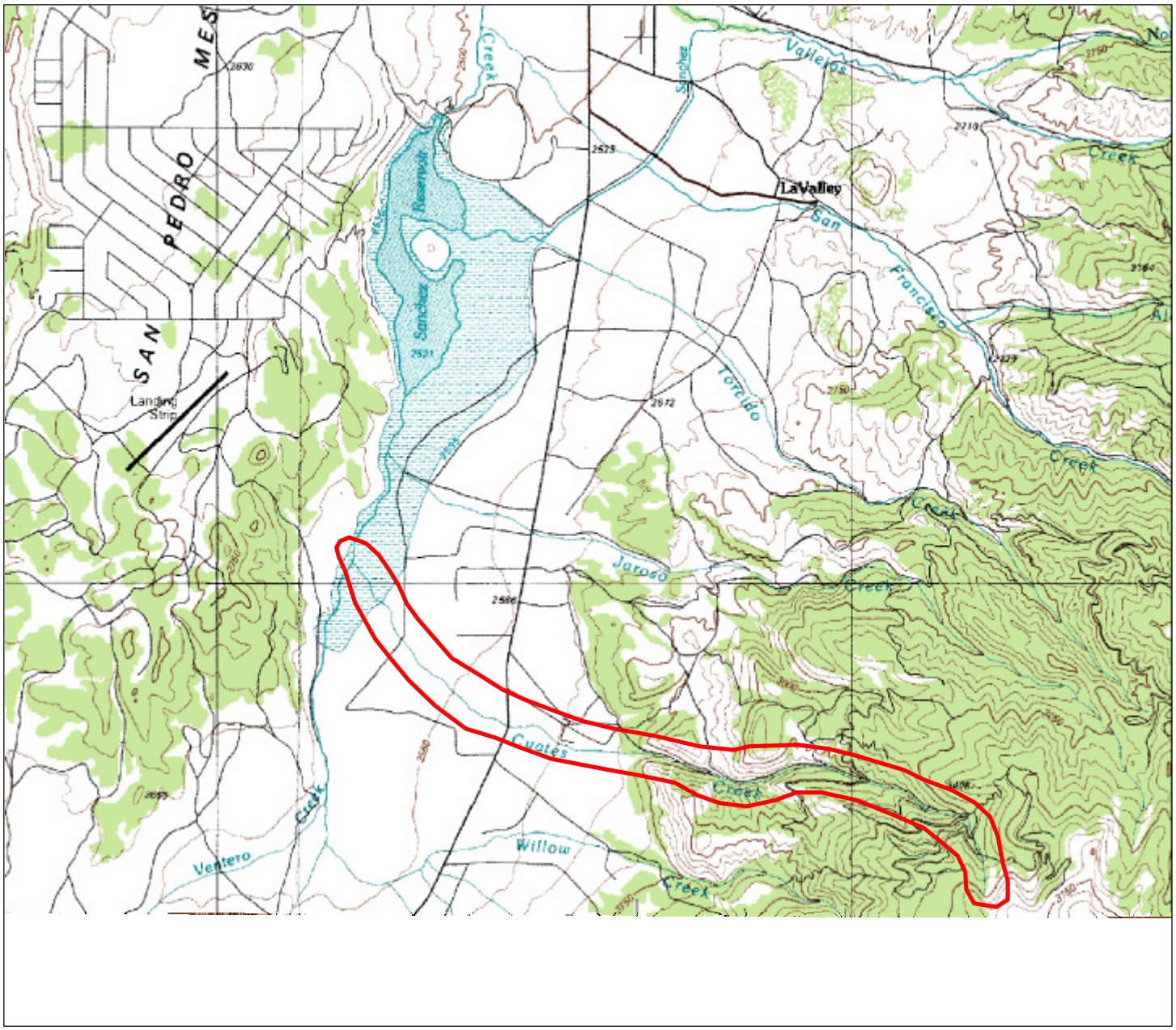
Protection Comments: The entire stretch of the creek occurs on a private ranch.

Management Comments: CNHP wetland ecologists did not visit this PCA during 2003. Thus, it is unknown what management concerns and/or needs exist for this site. The health of the trout population suggests that current management may be adequate for the viability of the trout.

Soils Description: Soils are not mapped at this site but are likely derived from mixed alluvium.

Restoration Potential: CNHP wetland ecologists did not visit this PCA during 2003. Thus, it is unknown what the restoration potential is for this site.

Wetland Functional Assessment: CNHP wetland ecologists did not visit this PCA during 2003. Thus, a functional assessment could not be conducted.



1 0 1 Miles

Projection: UTM, Zone13, NAD27

Colorado Natural Heritage Program
Colorado State University
College of Natural Resources
254 General Services Bldg.
Fort Collins, CO 80523

map created 5 May 2004

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LEGEND

Cuates Creek
Potential Conservation Area

30 x 60 Minute Series Quad:
Alamosa, 37105a1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

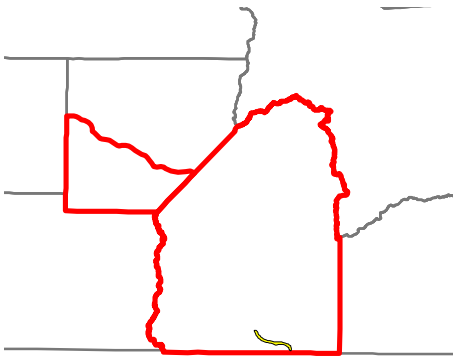


Figure 12. Cuates Creek Potential Conservation Area

ELK MEADOWS FEN POTENTIAL CONSERVATION AREA

Biodiversity Rank: B3. High biodiversity significance. The PCA supports a good example of a state critically imperiled wetland plant community. The site also supports a fen, which are one of Colorado's rare wetland types.

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

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

Location: This PCA is located along near the New Mexico state line in southern Costilla County.

U.S.G.S. 7.5-min. quadrangle: La Valley and Big Costilla Peak

Legal Description: Unsurveyed

Elevation: 9,700 – 10,000 ft. Approximate Size: 173 acres

General Description: The topography of this PCA appears to have been glaciated. Spruce-fir dominates north-facing slopes while a diverse mix of confiers occurs on the opposing south-facing slopes. The landform is unique in that a large wetland (some of which is a fen) sits at the base of the "tongue" of a concave ridge between two drainages. An impermeable layer appears to direct groundwater downslope along the long axis of the ridge, as opposed to flowing down to one of the drainages on either side of the ridge. Groundwater discharges along the entire base of this ridge supporting the wetland. What appears to be a terminal moraine constrains the groundwater to a small basin. Topo maps show this area as open water, however very little open water was observed during the site visit. Only a few locations show signs of holding small pools. The seeps support sedge meadows, some of which have developed organic soils (peat) and are considered fens.

Scientists call both fens and bogs "peatlands." Peatlands are wetlands with organic soils that consist of at least 12-18% organic-carbon content (by weight) (USDA 1994). They form where the rate of plant growth exceeds the rate of decomposition of litter. Both saturated soils and cool climates contribute to the conditions necessary for peatland formation.

Peat accumulates slowly in all southern Rocky Mountain peatlands, anywhere from 4.3 to 16.2 inches per thousand years (Cooper 1990; Chimner and Cooper 2002). The slow accumulation rates suggest that peatlands cannot be restored to historic conditions after massive disturbance in any time period relevant to humans.

Fens are peatlands that remain saturated primarily as a result of water percolating up from the ground with some contribution from surface water runoff. Peatlands are often classified along a chemical gradient (pH and concentration of cations such as Ca^{2+}, Na^{+}, K^{+}, and Mg^{2+}) (Cooper and Andrus 1994). The gradient is typically as follows: ombrotrophic bogs and poor fens are

characterized by low pH and low cation concentration, whereas rich and extreme rich fens are characterized by high pH and high cation concentration. Most fens in Colorado would be considered "intermediate" or "rich" fens. The fen in this PCA falls within this category. These terms do not refer to the number of species in the wetland. They refer instead to the levels of nutrients (calcium, magnesium, etc.) in the water.

Most of the fen at this PCA is dominated by water sedge (*Carex aquatilis*) and to a lesser extent beaked sedge (*Carex utriculata*). Near the eastern portion of the fen, groundwater discharge supports a small but high quality stand of blister sedge (*Carex vesicaria*). Bluejoint reedgrass (*Calamagrostis canadensis*) and tufted hairgrass (*Deschampsia cespitosa*) are also common in this area. Further toward the north end of the wetland, soils are not organic rather have a mollic epipedon.

The site is very remote. A few old roads lead to the wetland, but are not used often as the site sits on a private ranch. Livestock graze the area but impacts were only observed along the periphery of the wetland where soil compaction may be occurring.

Biodiversity Rank Justification: The state critically imperiled (G4Q S1) blister sedge (*Carex vesicaria*) plant association occurs at this site. This association has a wide regional distribution, but has only been documented in very small patches on the landscape. The association is documented from only a few stands in Colorado, which may represent its southern distribution. The association forms open meadows similar to the beaked sedge plant association. As with beaked sedge, it occurs along the shores of lakes and ponds in shallow water, as well as in poorly drained basins and along rivers and streams. The water table typically remains above the ground surface throughout the year.

Fens, which are formed by stable discharge of groundwater, are one of Colorado's rare wetland types. They require wet, anaerobic soils, carbon accumulation from vigorous plant growth, low soil temperatures, and thousands of years to form their characteristic organic soils. Once formed, these organic soils are essentially irreplaceable in any management time frame. Due to their rarity and status as a non-renewable resource, the U.S. Fish and Wildlife Service has placed fens in Resource Category One, which requires "no loss of habitat value".

Table 21. Natural Heritage element occurrences at Elk Meadows Fen PCA.
Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plant Communities					
Carex vesicaria	**Montane fen**	**G4Q**	**S1**		**B**

*EO=Element Occurrence.

Boundary Justification: Boundaries incorporate those areas of groundwater discharge and adjacent areas to allow for dispersal and movement of vegetation. It should be noted that the hydrological processes necessary to the elements are not fully contained by the PCA boundaries. Additional research should identify critical areas to protect for groundwater recharge, as groundwater is critical to the viability of the elements in the PCA. This boundary indicates the minimum area that should be considered for any conservation management plan.

Protection Comments: The current owner appears to manage the site adequately for protection of the elements.

Management Comments: The affects of livestock and native ungulates grazing should be monitored. Should such activites threaten the elements, management could be adjusted accordingly.

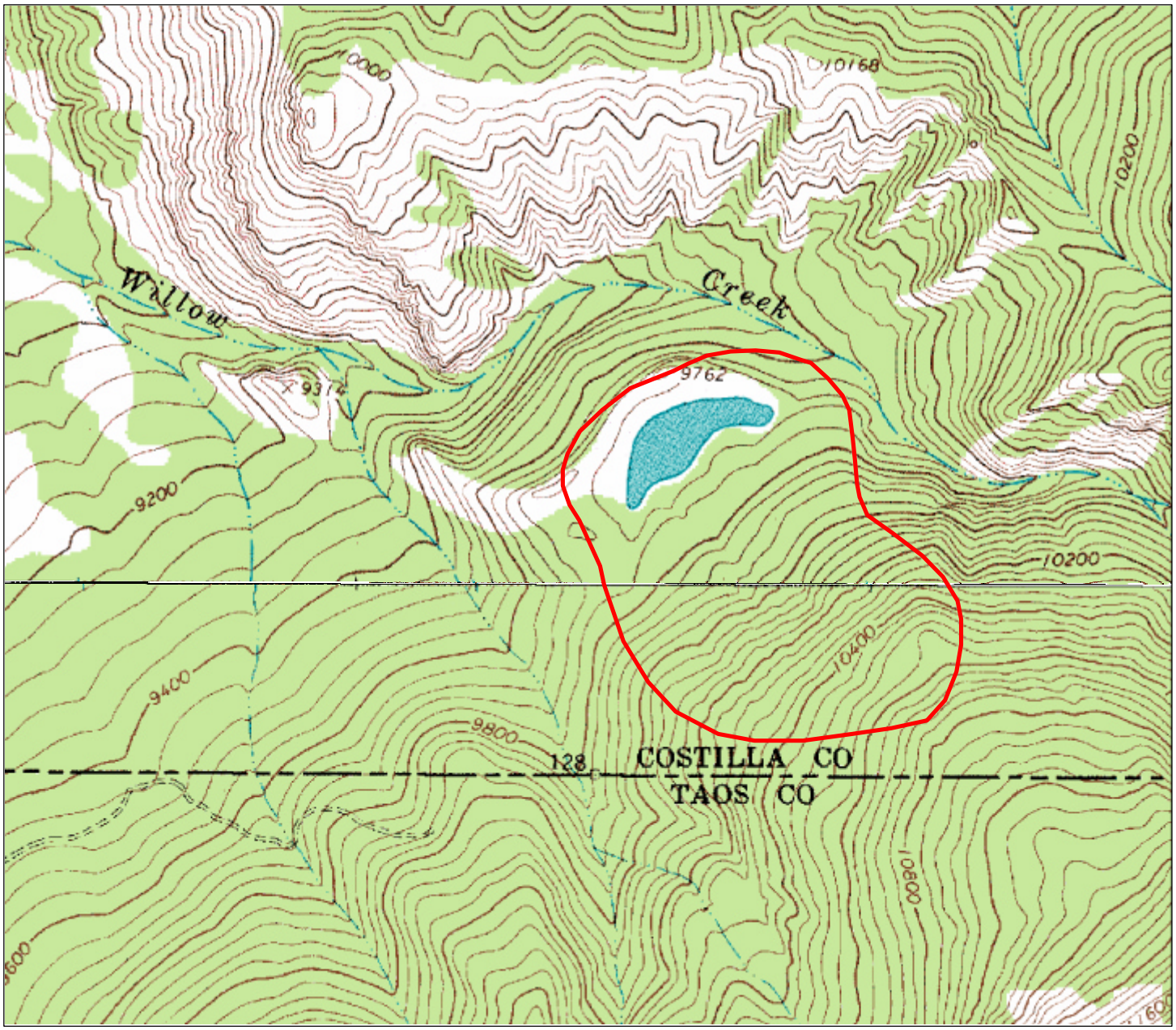
Soils Description: Soils are not mapped at this site. However, organic soils (peat) were present in areas where groundwater discharge is persistent.

Restoration Potential: The area require no restoration activities at this time.

Wetland Functional Assessment for the Elk Meadows Fen PCA:
Proposed HGM Class: Slope **Subclass:** S2
Cowardin System: Palustrine
CNHP's Wetland Classification: *Carex vesicaria, Carex aquatilis, Carex utriculata,* and *Deschampsia cespitosa.*

Table 22. Wetland functional assessment for the slope wetland at the Elk Meadows Fen PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	This wetland appears to be functioning at potential.
Hydrological Functions		
Flood Attenuation and Storage	N/A	This wetland does not experience overbank flow, rather is hydrologically supported by groundwater discharge..
Sediment/Shoreline Stabilization	N/A	Does not occur along a natural surface drainage.
Groundwater Discharge/ Recharge	Yes	This wetland is supported by groundwater discharge.
Dynamic Surface Water Storage	High	Organic soils and a topographic basin store large quantities of water.
Biogeochemical Functions		
Elemental Cycling	Normal	Large areas of saturated soil provide a gradient for various nutrient transformations. Vegetation growth is vigorous and soil organic matter is accumulating.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Removal of excess nutrients (e.g. from upstream and local livestock) associated with groundwater is likely being performed by this wetland. Dense herbaceous vegetation provides high potential for this area to function as a sink for sediments/nutrients/toxicants. Inputs of toxicants and sediments from nearby roads is likely minimal.
Biological Functions		
Habitat Diversity	Moderate	The wetland site consists of fen, wet meadows, small pools, and a few shrubs.
General Wildlife Habitat	Moderate	The fen and wet meadows provide browse and cover for deer, coyote, black bear, and other large and small mammals and cover, nesting habitat, and food for some songbirds and birds of prey such as eagles, hawks, and falcons.
General Fish/Aquatic Habitat	Low	There is minimal suitable habitat for aquatic organisms.
Production Export/Food Chain Support	Moderate	Dense emergent and fen vegetation support local food chain dynamics by sustaining healthy invertebrate populations. Export of organic substances and associated nutrients is limited due to restricted outlets.
Uniqueness	Moderate	Fens are one of Colorado's rare wetland types. They require thousands of years to form their characteristic organic soils. Once formed, these organic soils are essentially irreplaceable in any management time frame. Due to their rarity and status as a non-renewable resource, the U.S. Fish and Wildlife Service has placed fens in Resource Category One, which requires "no loss of habitat value".



0 1 Miles

Projection: UTM, Zone13, NAD27

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map created 5 May 2004

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LEGEND

Elk Meadows Fen
Potential Conservation Area

7.5 Minute Series Quads:
Big Costilla Peak, 36105h3
La Valley, 37105a3

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

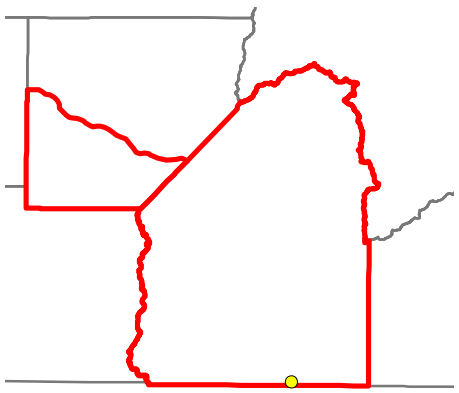


Figure 13. Elk Meadows Fen Potential Conservation Area

HANSEN BLUFFS SEEPS POTENTIAL CONSERVATION AREA

Biodiversity Rank: B3. High biodiversity significance. The PCA supports an occurrence of the globally imperiled slender spiderflower, and examples of two common wetland plant communities.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future.Most of the PCA is contained in the Alamosa National Wildlife Refuge and is managed by the U.S. Fish and Wildlife Service.

Management Urgency Rank: M3. New management actions may be needed within five years to maintain the current quality of the element occurrences in the PCA. The impact of local and regional groundwater pumping on groundwater discharge at this site should be researched as changes in upstream water use have the potential to affect the integrity of the elements at this PCA.

Location: This PCA is located along the eastern boundary of the Alamosa National Wildlife Refuge.

U.S.G.S. 7.5-min. quadrangle: Alamosa East and Baldy

Legal Description: T36N, R11E S 2, 3;
T37N, R11E S 14, 15, 22, 23, 26, 27, 34, and 35.

Elevation: 7,500-7,550 ft. Approximate Size: 2,184 acres

General Description: This PCA encompasses the eastern portion of the Alamosa National Wildlife Refuge. Groundwater discharges at various locations along the base of Hansen Bluffs. These seeps support sedge meadows, some of which have developed organic soils (peat) and are considered fens. The presence of a fen at this low of an elevation is unusual for Colorado as most fens in Colorado occur above 9,000 ft. Some old channels and slough also exist in the site.

Scientists call both fens and bogs "peatlands." Peatlands are wetlands with organic soils that consist of at least 12-18% organic-carbon content (by weight) (USDA 1994). They form where the rate of plant growth exceeds the rate of decomposition of litter. Both saturated soils and cool climates contribute to the conditions necessary for peatland formation.

Peat accumulates slowly in all southern Rocky Mountain peatlands, anywhere from 4.3 to 16.2 inches per thousand years (Cooper 1990; Chimner and Cooper 2002). The slow accumulation rates suggest that fens cannot be restored to historic conditions after massive disturbance in any time period relevant to humans.

Fens are peatlands that remain saturated primarily as a result of water percolating up from the ground with some contribution from surface water runoff. Peatlands are often classified along a chemical gradient (pH and concentration of cations such as Ca^{2+}, Na^{+}, K^{+}, and Mg^{2+}) (Cooper and Andrus 1994). The gradient is typically as follows: ombrotrophic bogs and poor fens are characterized by low pH and low cation concentration, whereas rich and extreme rich fens are characterized by high pH and high cation concentration. Most fens in Colorado would be

considered "intermediate" or "rich" fens. The fen in this PCA falls within this category. These terms do not refer to the number of species in the wetland. They refer instead to the levels of nutrients (calcium, magnesium, etc.) in the water.

The fen in this PCA is supported by groundwater discharge from the base of Hansen Bluff. Groundwater appears to be upwelling in numerous locations as indicated by small open pools of water, which proved to be deep when probed with a sharpshooter, scattered along the north and eastern boundaries of the fen. The fen also has a concave shape. Groundwater is associated with either the confined and/or unconfined aquifer of the San Luis Valley. Much of the perimeter of the fen was fairly dry, suggesting that groundwater pumping may be drying this site.

The fen is characterized by analogue sedge (*Carex simulata*) occurring in the wettest areas where a floating mat has formed (the area is quacking). This is mostly near open pools of water where groundwater discharge is persistent. Nebraska sedge (*Carex nebrascensis*), beaked sedge (*C. utriculata*), slimstem reedgrass (*Calamagrostis stricta*), cattail (*Typha latifolia*), and hardstem bulrush (*Schoenoplectus acutus*) are also found near these areas. It is unclear why the latter two are established (e.g. excess nutrients, prior disturbance, or simply a nearby source for establishment) and if these species are increasing/decreasing. Further away from discharge points, water sedge (*Carex aquatilis*) and tufted hairgrass (*Deschampsia cespitosa*) dominate. Other species present include common spikerush (*Eleocharis palustris*), scratchgrass (*Muhlenbergia asperifolia*), threesquare (*Schoenoplectus pungens*), foxtail barley (*Hordeum jubatum*), ticklegrass (*Agrostis scabra*), rabbitfoot grass (*Polypogon monspeliensis*), silver weed (*Anserina argentea*), Canada thistle (*Cirsium arvense*), willowherb (*Epilobium leptophyllum*), Nuttall's sunflower (*Helianthus nuttallii*), dock (*Rumex triangulivalvis*), buyan (*Spaerophysa salsula*), checkermallow (*Sidalcea neomexicana*), water parsnip (*Sium suave*), white panicle aster (*Aster lanceolatus* var. *hesperius*), Lindley's aster (*Aster foliaceus*), and the infrequent northern bog aster (*Aster junciformis*). No shrubs occur in the fen.

The sloughs are dominated by hardstem bulrush (*Scirpus acutus*), cattail (*Typha latifolia*), arrowhead (*Sagittaria cuneata*), mare's tail (*Hippuris vulgaris*), common spikerush (*Eleocharis palustris*), water ladysthumb (*Polygonum amphibium*), floating pondweed (*Potamogeton gramineus*), mare's tail, duckweed (*Lemna minor*), and giant bur-reed (*Sparganium eurycarpum* and American mannagrass (*Glyceria grandis*).

Some hydrological alteration appears to have occurred as some peat areas are now dry. This is presumed to be from local groundwater pumping. Non-native species are low in abundance in fen, however are common along fringes of the fen. Past grazing activities may have contributed to presence of non-native species.

Grazing occurred here in the past, however only deer and elk now use the site. Groundwater pumping, if proven to be drying this site, would need to cease to restore natural hydrology. Greasewood (*Sarcobatus vermiculatus*) and rabbitbrush (*Chrysothamnus nauseousus*) dominate upland areas while multiple wetland communities dominate the surrounding lowlands. Further west of the bluffs, the area is hydrologically associated with the Rio Grande and water management activities by the U.S. Fish and Wildlife Service. Although there is not much active management of wetland topography, the USFWS does manage water supply to many of the old river channels, oxbows, and basins in this portion of the floodplain (USFWS 2002). Many of these old river bottoms and managed areas are permanently saturated. Please see the Rio Grande at Alamosa National Wildlife Refuge PCA profile in this document for further details on the wetlands in this area.

Biodiversity Rank Justification: The slender spiderflower (*Cleome multicaulis*) has a global range from southern Wyoming to central Mexico. The San Luis Valley contains the most numerous, largest, and healthiest populations in the world. Slender spiderflower has a limited distribution due to its requirement of moist alkaline soil along with periodic soil disturbance. These habitat requirements limit the slender spiderflower to the edges of alkaline wet meadows and playas.

The globally vulnerable (G3) analogue sedge montane fen (*Carex simulata*) is known from Colorado, Idaho, Montana, Nevada, Oregon, Utah, Wyoming, and may possibly occur in California. It is commonly found with many other sedge species, but its presence is associated with deep organic soils and a perennially high water table.

In addition to the above elements, this PCA has biodiversity significance due to the presence of a fen at a low elevation. Fens below 9,000 ft. are rare in Colorado. Another large fen is known to have occurred in the San Luis Valley at a similar elevation (Spring Creek Fen, on the Monte Vista National Wildlife Refuge) but it has been highly impacted by groundwater pumping and is no longer wet or even saturated. The fen at this PCA may be one of the lowest occurring fens in Colorado.

Table 23. Natural Heritage element occurrences at Hansen Bluffs Seeps PCA.
Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plants					
Cleome multicaulis	**Slender spiderflower**	**G2G3**	**S2S3**	**BLM**	**E**
Plant Communities					
Carex simulata	Montane fen	G4	S3		B

*EO=Element Occurrence.

Boundary Justification: Boundaries incorporate those areas of groundwater discharge and adjacent areas to allow for dispersal and movement of vegetation. It should be noted that the hydrological processes necessary to the elements are not fully contained by the PCA boundaries. Additional research should identify critical areas to protect for groundwater recharge, as groundwater is critical to the viability of the elements in the PCA. This boundary indicates the minimum area that should be considered for any conservation management plan.

Protection Comments: Most of the PCA is contained in the Alamosa National Wildlife Refuge and is managed by the U.S. Fish and Wildlife Service.

Management Comments: Recreation (mostly hunting, education, and bird watching) is the dominant use of the Refuge. The impact of local and regional groundwater pumping on groundwater discharge at this site should be researched as changes in upstream water use have the potential to affect the integrity of the elements at this PCA.

Soils Description: Soils in the wetland areas are mostly mapped as the Arena and Vastine series. Marsh and wet alluvial land are also mapped as general soil types. The Arena is classified as a Fine-loamy, mixed, frigid, Aquentic Durorthids (USDA 1973). These soils are somewhat poorly drained and poorly drained, saline and alkali soils that have a duripan at a depth of 30-40 inches. They formed in alluvium in old floodplains. The Vastine is classified as Fine-loamy over sand or sandy-skeletal, mixed, noncalcerous, frigid, Typic Haplaquolls (USDA 1973). These soils are

poorly drained, nearly level soils on bottomland areas which formed in fine-textured, stratified alluvium (USDA 1973).

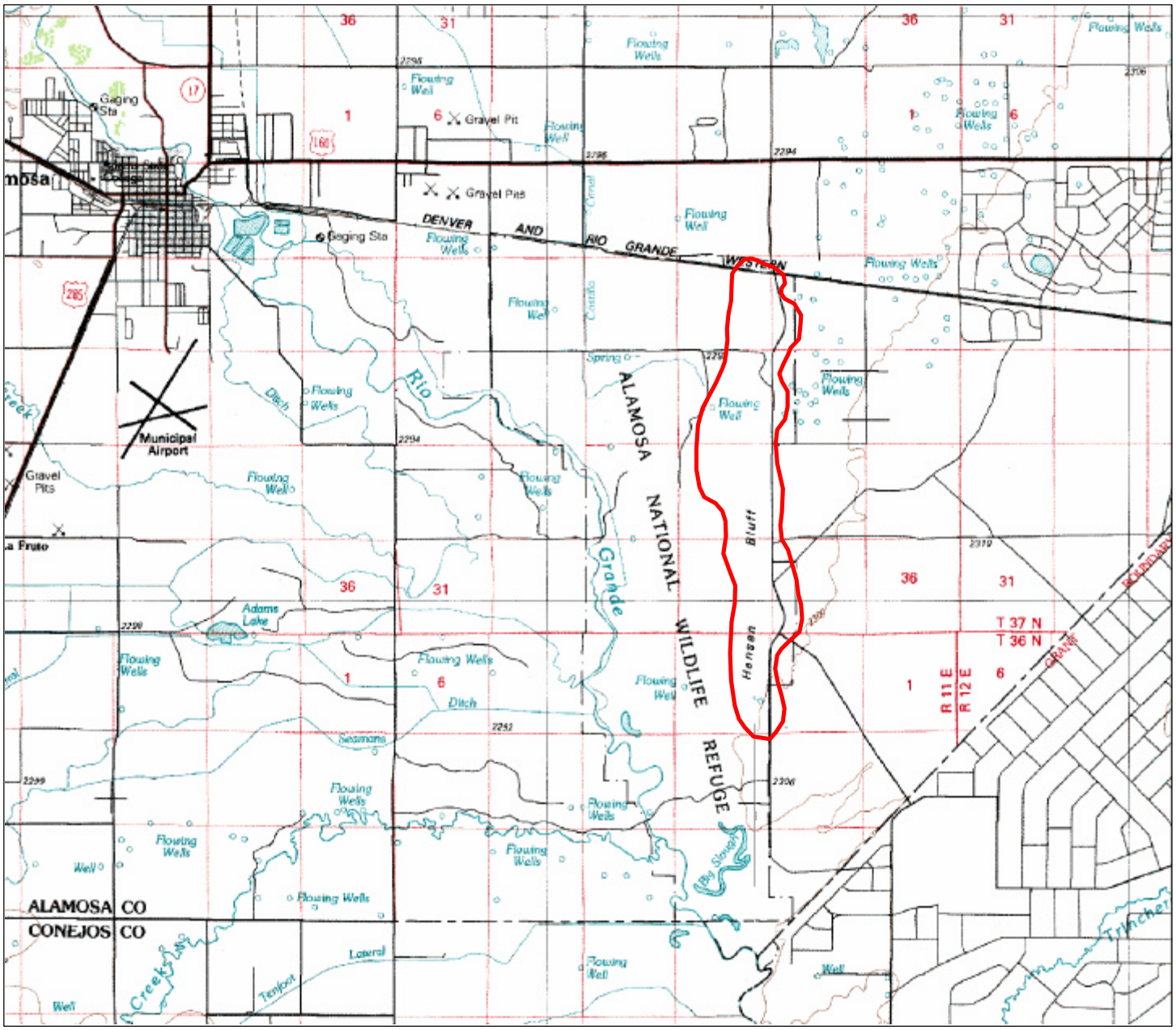
The fen had an organic soil profile at least 3 ft. deep. Using a 3 ft. sharpshooter, mineral soil was not reached upon digging a three foot soil pit. The peat was mostly hemic material.

Restoration Potential: Dried peat areas suggest that groundwater pumping is decreasing groundwater discharge into the fen. However, further research needs to quantify how much is related to climatic fluctuation or human-use. Given the presence of peat, it is assumed that the source of groundwater is not highly susceptible to climatic variation within a short time frame. Restoration, or prevention of further loss, of natural groundwater flow is critical to maintaining the ecological integrity of the fen. This would require an immense collaboration with local water users, local landowners, municipalities, etc.

Wetland Functional Assessment for the Hansen Bluffs Seeps PCA:
Proposed HGM Class: Slope **Subclass:** S2 **Cowardin System:** Palustrine
CNHP's Wetland Classification: *Carex simulata, Carex utriculata,* and *Deschampsia cespitosa.*

Table 24. Wetland functional assessment for the slope wetland at the Hansen Bluffs Seeps PCA.

Function	Rating	Comments
Overall Functional Integrity	At Potential	This wetland appears to be functioning at potential. However, due to a decrease in groundwater discharge, some functions may be negatively affected.
Hydrological Functions		
Flood Attenuation and Storage	N/A	This wetland does not experience overbank flow, rather is hydrologically supported by groundwater discharge..
Sediment/Shoreline Stabilization	N/A	Does not occur along a natural surface drainage.
Groundwater Discharge/ Recharge	Yes	This wetland is supported by groundwater discharge associated with the confined and/or unconfined aquifer.
Dynamic Surface Water Storage	High	Extensive organic soils store large quantities of water.
Biogeochemical Functions		
Elemental Cycling	Somewhat Disrupted	The presence of standing water and large areas of saturated soil provide a gradient for various nutrient transformations. However, altered groundwater hydrology has also disrupted nutrient cycles on the fringe of the wetland.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	Removal of excess nutrients and sediment (e.g. from upstream and local livestock, municipal water treatment plants, and agricultural activity) associated with groundwater is likely being performed by this wetland. Dense herbaceous vegetation provides high potential for this area to function as a sink for sediments/nutrients/toxicants. Toxicants and sediments from nearby roads are likely also intercepted in these wetlands prior to reaching the river. However, this is moderated by altered hydrology.
Biological Functions		
Habitat Diversity	Moderate	The wetland consists of fen, wet meadows, and freshwater marsh.
General Wildlife Habitat	Moderate	The fen, wet meadows, emergent wetlands, and open water wetlands provides browse and cover for deer, coyote, black bear, and other large and small mammals and cover, nesting habitat, and food for some songbirds, waterbirds, and birds of prey such as eagles, hawks, and falcons.
General Fish/Aquatic Habitat	Low	There is minimal suitable habitat for aquatic organisms. Some fish may occur in some sloughs.
Production Export/Food Chain Support	Moderate	Dense emergent and fen vegetation support local food chain dynamics by sustaining healthy invertebrate populations. Export of organic substances and associated nutrients is limited due to restricted outlets.
Uniqueness	High	Fens are one of Colorado's rare wetland types, especially below 9,000 feet. They require thousands of years to form their characteristic organic soils. Once formed, these organic soils are essentially irreplaceable in any management time frame. Due to their rarity and status as a non-renewable resource, the U.S. Fish and Wildlife Service has placed fens in Resource Category One, which requires "no loss of habitat value".



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LEGEND

Hansen Bluffs Seeps
Potential Conservation Area

30 x 60 Minute Series Quads:
Alamosa, 37105a1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

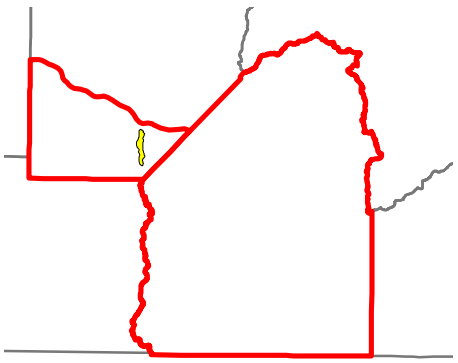


Figure 14. Hansen Bluffs Seeps Potential Conservation Area

JAROSO CREEK POTENTIAL CONSERVATION AREA

Biodiversity Rank: B3. High biodiversity significance. The PCA supports an excellent population of the globally vulnerable Rio Grande cutthroat trout. Considering that this is a historic and native population (not stocked) this site's Biodiversity Rank was elevated to a B3 as opposed to a B4.

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

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

Location: This PCA is located south of San Luis near the Colorado/New Mexico state line.

U.S.G.S. 7.5-min. quadrangle: La Valley and Sanchez Reservoir

Legal Description: Unsurveyed

Elevation: 8,300 – 12,000 ft. Approximate Size: 2,940 acres

General Description: This PCA encompasses most of the Jaroso Creek drainage. The site spans from the subalpine to montane zones, flowing through a diversity of riparian plant community types. The creek feeds into Sanchez Reservoir and Ventero Creek.

Jaroso Creek support an excellent, genetically pure, and historic (native) population of the Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*). The population is stable and secure. Irrigation diversions occasionally dry up the creek prior to reaching Sanchez Reservoir, thereby serving as a temporary barrier (Alves 1996). No other fish have been documented in the creek although brook trout (*Salvelinus fontinalis*) were observed in 1995 (Alves 2004).

Biodiversity Rank Justification: The Rio Grande cutthroat trout's range once included the entire Rio Grande and Pecos River watersheds, and possibly the upper Canadian River as well (Trotter 1987). In Colorado, the species occupies less than 1% of its former range (Alves 1996), and wild, genetically pure stock populations are especially imperiled. Artificial habitat including wells, farm ponds, and extensive canal systems as well as human activities including dewatering, fishing and stocking, transbasin diversions, release of domestic sewage, stream channelization, and agricultural chemical applications have greatly modified the original aquatic ecosystem of the San Luis Valley (Zuckerman 1984). These modifications may have contributed directly to the decline in range of the native fishes of the Rio Grande drainage. Free-flowing streams with good quality water, healthy banks, and streamside vegetation within the upper Rio Grande watershed are vital habitat for this subspecies of trout.

Table 25. Natural Heritage element occurrences at Jaroso Creek PCA.
Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Fish					
Oncorhynchus clarki virginalis	**Rio Grande cutthroat trout**	**G4T3**	**S3**	**FS/BLM, SC**	**A**

*EO=Element Occurrence.

Boundary Justification: The boundaries incorporate an area that will allow natural ecological processes such as large woody debris recruitment, adequate canopy cover (to regulate stream temperature), and new channel formation to maintain viable populations of the trout along Jaroso Creek. This boundary indicates the minimum area that should be considered for any conservation management plan. Some hillslope areas which may contribute runoff to Jaroso Creek are not encompassed in the boundary although any activity in these areas should be considered for any conservation management plan.

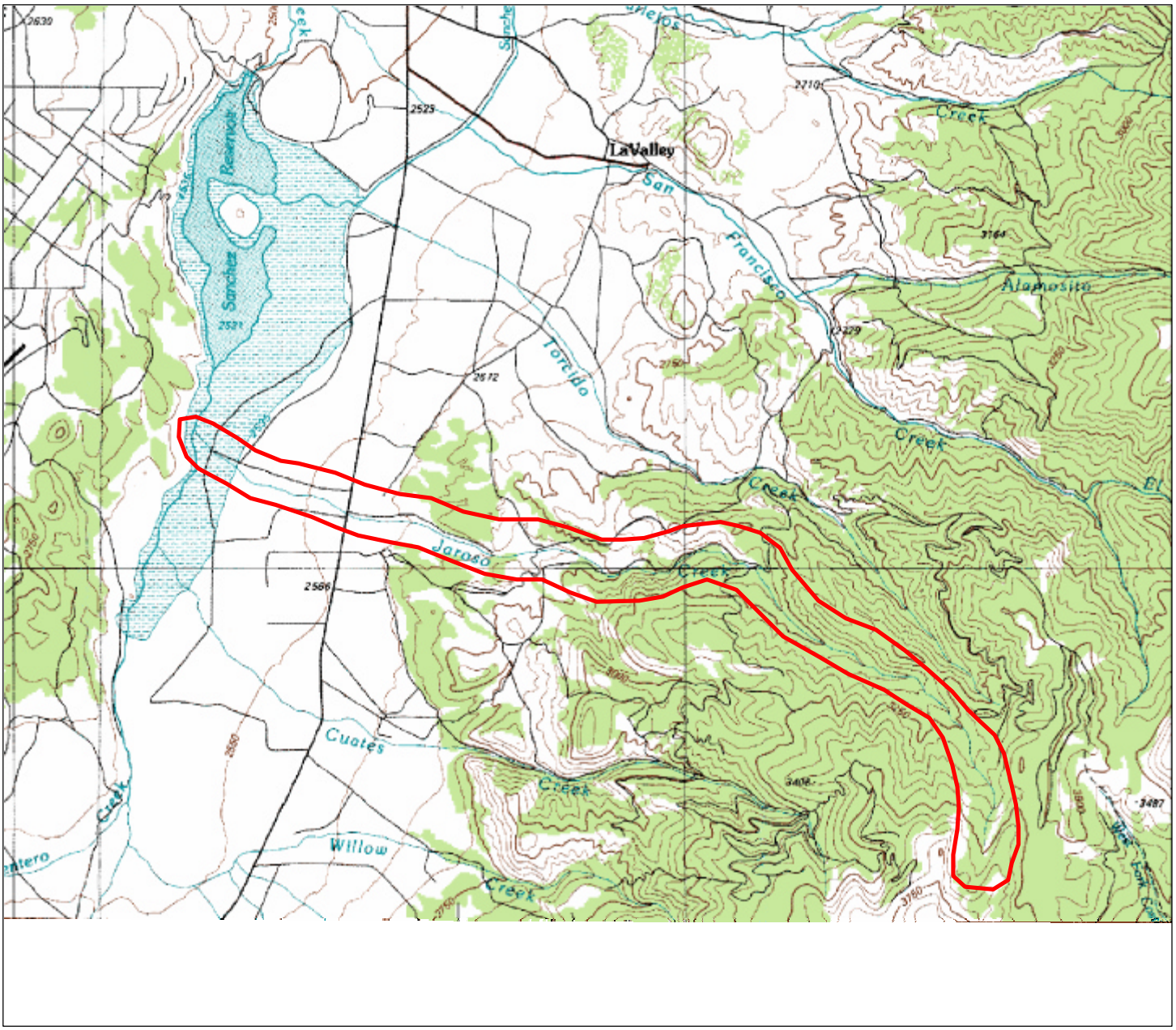
Protection Comments: The entire stretch of the creek occurs on a private ranch.

Management Comments: CNHP wetland ecologists did not visit this PCA during 2003. Thus, it is unknown what management concerns and/or needs exist for this site. The health of the trout population suggests that current management may be adequate for the viability of the trout. Alves (1996) suggests that a migration barrier be constructed near the Taylor Ranch boundary and that the riparian area be protected from impacts associated with livestock grazing, road construction, and timber harvest activities.

Soils Description: Soils are not mapped at this site but are likely derived from mixed alluvium.

Restoration Potential: CNHP wetland ecologists did not visit this PCA during 2003. Thus, it is unknown what the restoration potential is for this site.

Wetland Functional Assessment: CNHP wetland ecologists did not visit this PCA during 2003. Thus, a functional assessment could not be conducted.



1 0 1 Miles

Projection: UTM, Zone13, NAD27

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LEGEND

Jaroso Creek
Potential Conservation Area

30 x 60 Minute Series Quads:
Alamosa, 37105a1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

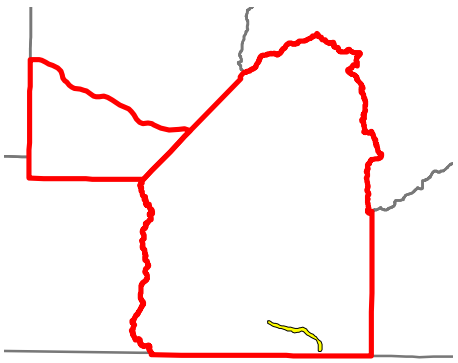


Figure 15. Jaroso Creek Potential Conservation Area

LITTLE UTE CREEK POTENTIAL CONSERVATION AREA

Biodiversity Rank: B3. High biodiversity significance. The PCA supports a good example of the globally vulnerable Rio Grande cutthroat trout. Considering that this site supports a genetically pure population the site's Biodiversity Rank was elevated to a B3 as opposed to a B4.

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

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

Location: This PCA begins on the eastern flank of Blanca Peak.

U.S.G.S. 7.5-min. quadrangle: Blanca Peak

Legal Description: Unsurveyed

Elevation: 8,800 – 11,600 ft. Approximate Size: 2,079 acres

General Description: This PCA encompasses most of the Little Ute Creek drainage, a small tributary of Ute Creek. The site spans from the subalpine to montane zones, flowing through a diversity of riparian plant community types.

Little Ute Creek supports a good, genetically pure, but transplanted population of the Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*). The population occurs above a natural barrier (waterfall) and is free of competition from non-native fish (Alves 1998). Historically, Little Ute Creek is not thought to have supported Rio Grande cutthroat trout (Harig and Fausch 1996). The current population is a result of stocking from Placer Creek (1978) and West Indian Creek (1981 and 1987) (Harig and Fausch 1996). The population is stable and secure but has a low abundance of individuals (Alves 1998).

Biodiversity Rank Justification: The Rio Grande cutthroat trout's range once included the entire Rio Grande and Pecos River watersheds, and possibly the upper Canadian River as well (Trotter 1987). In Colorado, the species occupies less than 1% of its former range (Alves 1996), and wild, genetically pure stock populations are especially imperiled. Artificial habitat including wells, farm ponds, and extensive canal systems as well as human activities including dewatering, fishing and stocking, transbasin diversions, release of domestic sewage, stream channelization, and agricultural chemical applications have greatly modified the original aquatic ecosystem of the San Luis Valley (Zuckerman 1984). These modifications may have contributed directly to the decline in range of the native fishes of the Rio Grande drainage. Free-flowing streams with good quality water, healthy banks, and streamside vegetation within the upper Rio Grande watershed are vital habitat for this subspecies of trout.

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

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Fish					
Oncorhynchus clarki virginalis	**Rio Grande cutthroat trout**	**G4T3**	**S3**	**FS/BLM, SC**	**B**

*EO=Element Occurrence.

Boundary Justification: The boundaries incorporate an area that will allow natural ecological processes such as large woody debris recruitment, adequate canopy cover (to regulate stream temperature), and new channel formation to maintain viable populations of the trout along Little Ute Creek. This boundary indicates the minimum area that should be considered for any conservation management plan. Some hillslope areas which may contribute runoff to Little Ute Creek are not encompassed in the boundary although any activity in these areas should be considered for any conservation management plan.

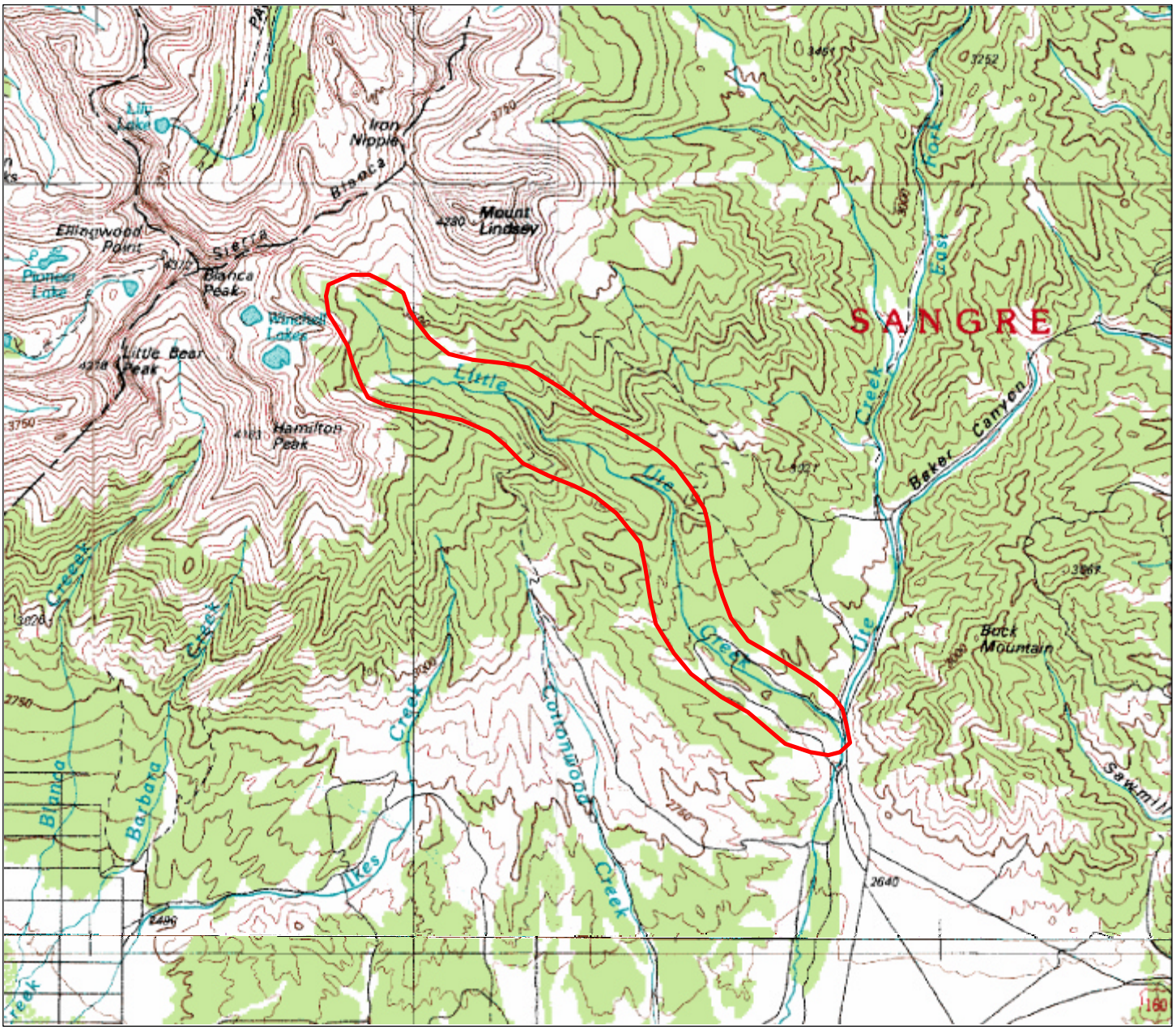
Protection Comments: The entire stretch of the creek occurs on a private ranch.

Management Comments: CNHP wetland ecologists did not visit this PCA during 2003. Thus, it is unknown what management concerns and/or needs exist for this site. The health of the trout population suggests that current management may be adequate for the viability of the trout. Although small, the population is secure from competition with non-native trout (Alves 1997). Alves (1997) suggests to transplant additional Rio Grande cutthroat trout from refugia populations to increase genetic diversity. Alves (1997) also suggests that cooperation with the landowners is necessary to ensure the stream is protected from impacts associated with timber harvesting.

Soils Description: Soils are not mapped at this site but are likely derived from mixed alluvium.

Restoration Potential: CNHP wetland ecologists did not visit this PCA during 2003. Thus, it is unknown what the restoration potential is for this site.

Wetland Functional Assessment: CNHP wetland ecologists did not visit this PCA during 2003. Thus, a functional assessment could not be conducted.



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LEGEND

Little Ute Creek
Potential Conservation Area

30 x 60 Minute Series Quads:
Blanca Peak, 37105e1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

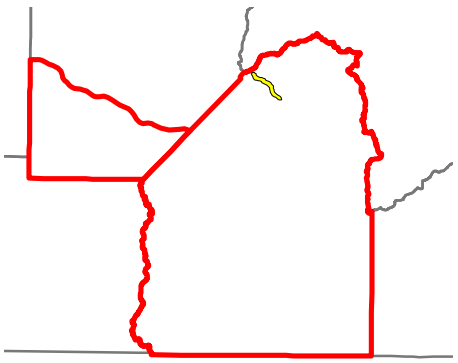


Figure 16. Little Ute Creek Potential Conservation Area

PLAYA BLANCA POTENTIAL CONSERVATION AREA

Biodiversity Rank: B3. High biodiversity significance. The PCA supports a fair example of the globally imperiled slender spiderflower.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The site is protected as a State Wildlife Area, managed by the Colorado Division of Wildlife.

Management Urgency Rank: M3. New management actions may be needed within five years to maintain the current quality of the element occurrences in the PCA. Management of the site does not address the presence of the plant and should hydrological inputs from the hatchery change, this may negatively affect the slender spiderflower population.

Location: This PCA is located at the Playa Blanca State Wildlife Area.

U.S.G.S. 7.5-min. quadrangle: Alamosa West

Legal Description: T37N R09E S portions of: 1-3, 10-12;
T37N R10E S portions of: 6 and 7.

Elevation: 7,550 – 7,570 ft. Approximate Size: 1,644 acres

General Description: This PCA contains saline wet meadows, marsh, and bottomland shrublands all of which are hydrologically supported from surface water inputs and likely, some groundwater discharge. A series of open water, saline ponds occur in the area. Historically, the area between Rock Creek and La Jara Creek was referred to as the "Llano Blanca" or "White Plain" and likely refers to salt crusts exposed on the soil surface from groundwater seepage (Simmons 1999). Thus, most of the wetlands in this PCA were likely supported by surface flow and shallow groundwater from Rock Creek. Discharge from the unconfined and/or confined aquifer may also have been important. Due to groundwater pumping and water diversions, Rock Creek does not maintain its historical hydrological regime. The area now appears to receive more surface water than the natural regime would have provided due to the presence of the Colorado Division of Wildlife's aquatic species hatchery just upstream. Discharge from the hatchery (which was previously a tilapia farm) flows directly into the wetland basins in the PCA. A few berms have been constructed, impounding and spreading water through the area. Downstream, surface water infiltrates into the soil and doesn't appear to flow into any defined channel. Wetland vegetation is very lush in these areas. Hardstem bulrush (*Schoenoplectus acutus*) and alkali bulrush (*S. maritimus*) occupy wettest sites along with common spikerush (*Eleocharis palustris*). Nevada bulrush (*Amphiscirpus nevadensis*), sea-blite (*Suaeda calceoliformis*), arrowgrass (*Triglochin concinna*), and common threesquare (*Schoenoplectus pungens*) occur in the next outer "ring". Baltic rush (*Juncus balticus*), foxtail barley (*Hordeum jubatum*) and saltgrass (*Distichlis spicata*) meadows surround these areas. The globally imperiled slender spiderflower (*Cleome multicaulis*) was found in the latter community in a narrow band where hydrology/salinity allow the species to thrive. Slender spiderflower is also thriving along the lower margins of these dikes. Some grazing occurs in the area.

Saline bottomland shrublands, the matrix vegetation type in the San Luis Valley, dominate most of the PCA. Species such as greasewood (*Sarcobatus vermiculatus*) and saltgrass are the dominant species in this vegetation type.

A county road bisects the PCA and agriculture and rural housing are nearby. Canada thistle (*Cirsium arvense*) and whitetop (*Lepidium latifolium*) are present in drier areas especially in Baltic rush meadows. Non-native species are not abundant in or near ponds.

Biodiversity Rank Justification: The slender spiderflower (*Cleome multicaulis*) has a global range from southern Wyoming to central Mexico. The San Luis Valley contains the most numerous, largest, and healthiest populations in the world. Slender spiderflower has a limited distribution due to its requirement of moist alkaline soil along with periodic soil disturbance, such as pocket gopher (*Thomomys talpoides*) diggings. These habitat requirements limit the slender spiderflower to the edges of alkaline wet meadows and playas.

Numerous other common communities such as common threesquare, hardstem bulrush, and alkali bulrush are found at this site, but due to the hydrologic manipulation occurring in these stands, they did not meet CNHP's requirements for an element occurrence. However, they provide important wildlife habitat at this site.

Table 27. Natural Heritage element occurrences at Playa Blanca PCA.
Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plants					
Cleome multicaulis	**Slender spiderflower**	**G2G3**	**S2S3**	**BLM**	**C**

*EO=Element Occurrence.

Boundary Justification: The boundary is drawn to encompass the ecological processes believed necessary for long-term viability of the element. The boundaries provide many source areas for seed dispersal to buffer long-term population fluctuations of the elements. The boundary does not encompass the source of surface and ground water input to the site, thus any changes in the current status of groundwater pumping and water diversions from water bodies that recharge groundwater would likely affect the element.

Protection Comments: The site is protected as a State Wildlife Area, managed by the Colorado Division of Wildlife.

Management Comments: Current management seems to support the viability of the slender spiderflower population. However, management of the site does not address presence of the plant and should hydrological inputs from the hatchery change, this may negatively affect the slender spiderflower population.

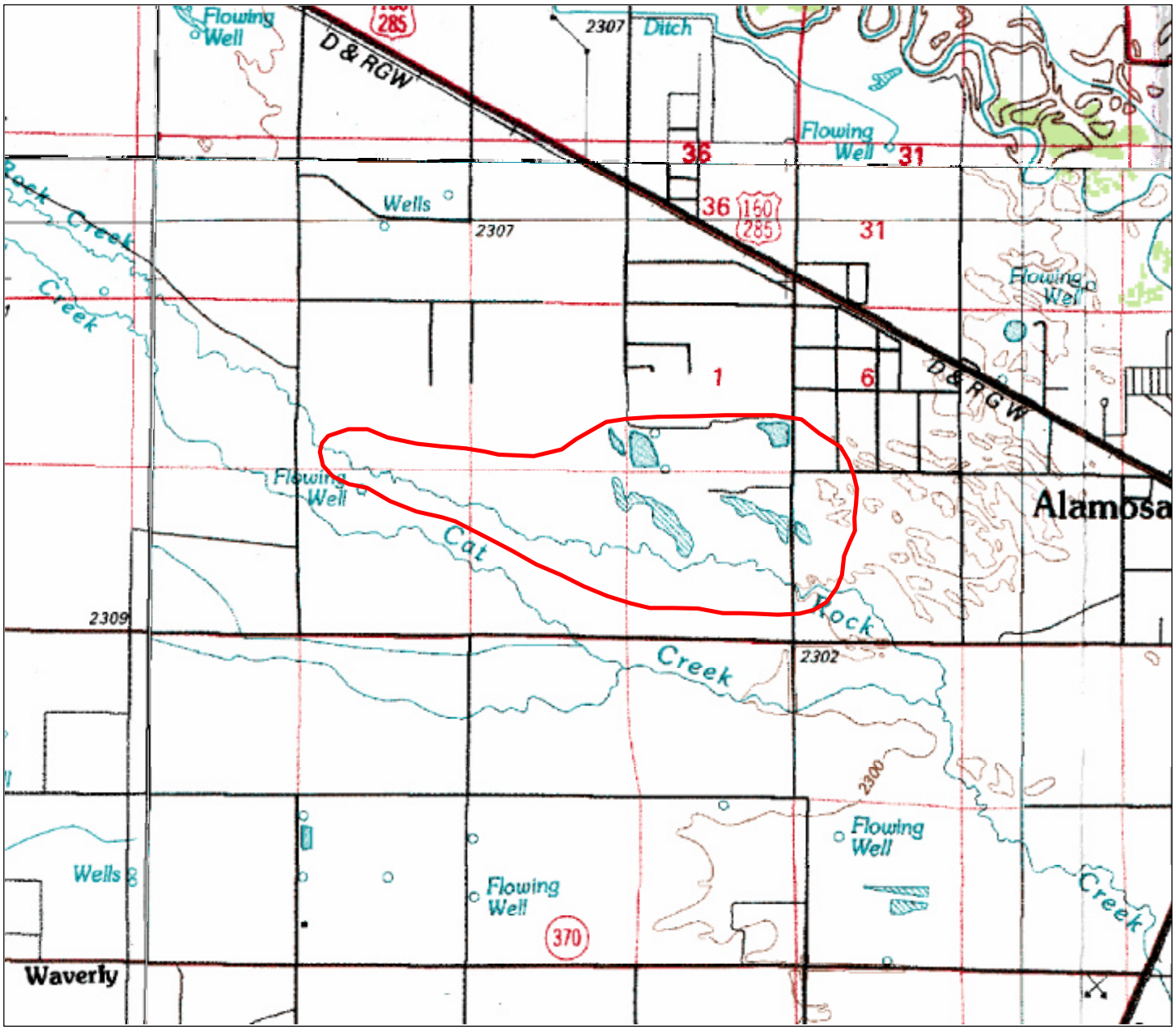
Soils Description: The most common soils in wetland areas are Arena, Gunbarrel, and Hooper (both clay loam and loamy sand) series. The Arena is classified as a Fine-loamy, mixed, frigid, Aquentic Durorthids (USDA 1973). These soils are somewhat poorly drained and poorly drained, saline and alkali soils that have a duripan at a depth of 30-40 inches. They formed in alluvium in old floodplains. The Gunbarrel is classified as a Mixed, frigid, Typic Psammaquents (USDA 1973). It is a somewhat poorly drained, nearly level, sandy soil formed in mixed sandy alluvium. These soils have a high water table and are saline and alkali (USDA 1973). The Hooper is classified as Clayey over sand or sandy-skeletal, montmorillonitic, frigid, Typic Natrargids (USDA 1973). These soils are well drained, moderately fine-textured, nearly level soils on floodplains. They are strongly alkali and underlain by sand (USDA 1973).

Restoration Potential: Restoration, or prevention of further loss, of natural groundwater flow is critical to maintaining the ecological integrity of this PCA. This would require an immense collaboration with local water users, local landowners, municipalities, etc. However, although natural hydrology has been altered, the current hydrologic regime is supporting the elements found at this site.

Wetland Functional Assessment for the Playa Blanca PCA:
Proposed HGM Class: Depressional **Subclass:** D2/3
Cowardin System: Palustrine
CNHP's Wetland Classification: *Schoenoplectus acutus, S. pungens, S. maritimus.*

Table 28. Wetland functional assessment for the depressional wetland at the Playa Blanca PCA.

Function	Rating	Comments
Overall Functional Integrity	Below Potential	This wetland appears to be functioning below potential due to a manipulated hydrology.
Hydrological Functions		
Flood Attenuation and Storage	Low	This wetland does not experience overbank flow, rather is hydrologically supported by groundwater discharge and surface input from a controlled source. However, occasionally high floods from Rock Creek may flood the wetland basins.
Sediment/Shoreline Stabilization	Moderate	Dense vegetation stabilizes soils during rare high flow events associated with Rock Creek.
Groundwater Discharge/ Recharge	Yes	This wetland is supported by groundwater discharge associated with the alluvial, confined and/or unconfined aquifers.
Dynamic Surface Water Storage	Moderate	The wetland basins can hold large quantities of water. However, most are filled with a controlled source, thus leaving little room for natural storage should it be needed.
Biogeochemical Functions		
Elemental Cycling	Somewhat Disrupted	The presence of standing water (pools) and large areas of saturated soil provide a gradient for various nutrient transformations. Altered hydrology may disrupted nutrient cycles relative to reference conditions (change from seasonal playa to semi-permanent saline marsh)
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Removal of excess nutrients and sediment (e.g. from upstream and local livestock, hatchery, and agricultural activity) associated with groundwater is likely being performed by this wetland. Dense herbaceous vegetation provides high potential for this area to function as a sink for sediments/nutrients/toxicants. Toxicants and sediments from nearby roads are likely also intercepted in these wetlands prior to reaching the river.
Biological Functions		
Habitat Diversity	Moderate	The wetland site consists of wet meadows, small pools, and freshwater marsh.
General Wildlife Habitat	Moderate	The wet meadows, emergent wetlands, and open water wetlands provides browse and cover for deer, coyote, black bear, and other large and small mammals and cover, nesting habitat, and food for songbirds, waterbirds, and birds of prey such as eagles, hawks, and falcons.
General Fish/Aquatic Habitat	Low	There is minimal suitable habitat for aquatic organisms. Some fish may occur in some ponds.
Production Export/Food Chain Support	High	Dense wet meadow and emergent vegetation and open water support local food chain dynamics by sustaining healthy invertebrate populations. Export of organic substances and associated nutrients is limited due to restricted outlets downstream.
Uniqueness	Low	Similar wetland types exists in the SLV. In addition, much of this site is managed.



1 0 1 Miles

Projection: UTM, Zone13, NAD27

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LEGEND

Playa Blanca
Potential Conservation Area

30 x 60 Minute Series Quads:
Alamosa, 37105a1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

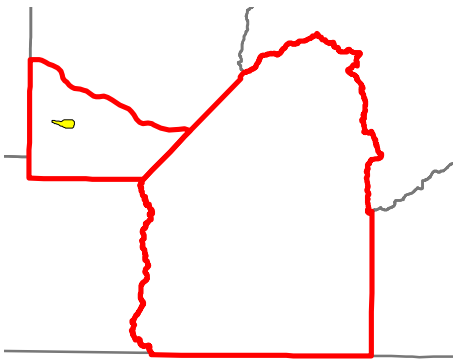


Figure 17. Playa Blanca Potential Conservation Area

RIO GRANDE POTENTIAL CONSERVATION AREA

Biodiversity Rank: B3. High biodiversity significance. The Rio Grande PCA supports a fair example of the globally imperiled Southwestern Willow Flycatcher, two fair examples of a plant imperiled on a global scale, two fair examples of wetland plant communities vulnerable on a global scale, a fair example of a riparian plant community imperiled on a global scale, one good example of a wetland plant community vulnerable in Colorado.

Protection Urgency Rank: 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. Although two State Wildlife Areas are located within the site, most of the site is privately owned.

Management Urgency Rank: M3. New management actions may be needed within five years to maintain the current quality of the element occurrences in the PCA. Non-native species, grazing impacts, residential development, and water diversions are of concern.

Location: This site includes the Rio Grande and portions of its floodplain between Monte Vista and Alamosa, CO.

U.S.G.S. 7.5-min. quadrangle: Homelake, Monte Vista, Mount Pleasant School, and Alamosa West

Legal Description:
T38N, R08E S 1, 2, 3, 12;
T38N, R09E S 1-18, 21-26;
T38N, R10E S 18-20, 28-33;
T39N, R08E S 20-36;
T39N, R09E S 31-34.

Elevation: 7,545-7,650 ft. Approximate Size: 22,945 acres

General Description: The Rio Grande, in the San Luis Valley, is a sediment-dominated system. Historically, the Rio Grande was a braided, dynamic, and avulsive system (RGHRP 2001). Structures and diversions associated with irrigation have altered the dynamics of the Rio Grande (RGHRP 2001). For example, near Del Norte the Rio Grande is now confined to two moderately entrenched channels whereas historically the river had constant streamflow through multiple channels. Between Monte Vista and Alamosa, the river is dominated by a single active channel with numerous abandoned or inactive channels, meander scars, and sloughs interspersed in the floodplain (RGHRP 2001). Although channel avulsion, meander cutoff, and overbank flow still occur along this reach, historical dynamics which created the myriad of meanders scars, inactive channels, and sloughs in the area, no longer occur as the river is under capacity (RGHRP 2001). Nonetheless, current and past features resulting from the hydrological dynamics of the Rio Grande dominate the landscape along this reach. The reach between Monte Vista and Alamosa is considered to be depositional and very avlusive (RGHRP 2001).

Near Alamosa, the Rio Grande is confined by a series of levees which transport water and sediment through city limits to downstream reaches (RGHRP 2001).

This PCA encompasses a segment of the Rio Grande and its floodplain between the municipalities of Monte Vista and Alamosa. Inactive channels, sloughs, abandoned oxbows, and alluvial groundwater associated with the river support numerous wetland types, such as decadent cottonwood riparian forests, marshes, open water wetlands, willow shrublands, and fresh and saline wet meadows, within this site. These wetland types are scattered throughout the floodplain and constitute a diverse oasis of wetland habitat in Colorado's driest mountain valley.

Cottonwood density along the Rio Grande in the San Luis Valley is thought to be less than historical times due to the impact of agricultural clearing in the floodplain and altered hydrological dynamics necessary for cottonwood regeneration (RGHRP 2001). However, Pike noted, during his 1807 expedition, that cottonwoods were largely absent from the Rio Grande between Alamosa and the confluence with the Conejos River (Simmons 1999). Depending on the exact location in which he reached the Rio Grande, this would suggest that the extensive cottonwood galleries just upstream of Alamosa (those contained in this PCA) were not present or were much smaller in extent at this time, given their conspicuous presence today. Although some regeneration is occurring, most cottonwood stands remaining within the PCA are of a mature class. Downstream of this PCA, large cottonwood stands decrease in abundance as the riverbanks are mainly dominated by willow and graminoid species. The Rio Grande Headwaters Restoration Project (2001) estimates that 41-60% of the reach between Monte Vista and Alamosa contains large stands of dense cottonwood stands or willow vegetation along at least one bank. Cottonwood density is especially high at the Rio Grande/Alamosa county line where cottonwood and willow density reach 81-100% cover of at least one side of the river.

Mature cottonwood stands are dominated by narrowleaf cottonwood (*Populus angustifolia*) with an understory of western wheatgrass (*Pascopyrum smithii*), smooth brome (*Bromus inermis*), quackgrass (*Elymus repens*), and Kentucky bluegrass (*Poa pratensis*). Most stands have a predominant non-native understory. Canada thistle (*Cirsium arvense*) is very common. Shrubs such as black twinberry (*Lonicera involucrata*), rabbitbrush (*Chrysothamnus nauseous*), and various willows (*Salix* sp.) are occasionally present in the understory.

Willow shrublands are a common vegetation type growing along the Rio Grande riverbanks. Coyote willow (*Salix exigua*) is the most common species while mountain willow (*S. monticola*), strapleaf willow (*S. eriocephala* var. *ligulifolia*), and Pacific willow (*Salix lasiandra* var. *lasiandra*) are occasionally present. The understory consists of various graminoids such as Kentucky bluegrass, wooly sedge (*Carex pellita*), Nebraska sedge (*C. nebrascensis*), smooth brome, Baltic rush (*Juncus balticus*), common horsetail (*Equisetum arvense*), and western wheatgrass and forbs such as silverweed (*Argentina anserina*), whitetop (*Lepidium latifolium*), Indian hemp (*Apocynum cannabinum*), and wild mint (*Mentha arvense*). Structural diversity is low as there is typically a dense shrub canopy (3-8 ft. tall) and a dense to sparse understory of herbaceous species. The width and length of these willow stands varies within this site.

These willow shrublands are important habitat for the Federally Listed Endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*) which breed in relatively dense riparian vegetation near surface water or saturated soil (Southwestern Willow Flycatcher Recovery Team Technical Subgroup 2002). The Southwestern Willow Flycatcher is decreasing due to extensive habitat loss and modification caused by alteration of surface and groundwater levels by agriculture and development, changes in flood and fire regimes due to dams and channelization, clearing of vegetation for human use, livestock grazing, changes in soil and water chemistry from altered hydrological cycles, and non-native plants (USFWS 2002).

The range of the Southwestern Willow Flycatcher spans over seven states. Habitat and breeding characteristics, potential threats, management concerns, and recovery objectives vary over this large region. Thus, the range of the Southwestern Willow Flycatcher has been divided into six Recover Units to ensure recovery efforts are in alignment with the biological and logistical realities of each region (Southwestern Willow Flycatcher Recovery Team Technical Subgroup 2002).) Due to recent genetic work confirming Southwestern Willow Flycatcher populations in the San Luis Valley, the Final Recovery Plan for the Southwestern Willow Flycather has included the San Luis Valley within the range of this subspecies and has designated the San Luis Valley as a Management Unit within the Rio Grande Recover Unit (Southwestern Willow Flycatcher Recovery Team Technical Subgroup 2002). Important nesting habitat is found along a portion of the Rio Grande, including this PCA. These critical habitat areas exist in a range of conditions, due to various levels of grazing, past clearing for agriculture, and altered hydrology (USFWS 2002).

HawksAloft conducted willow flycatcher surveys throughout the San Luis Valley in 2002 and 2003. Some of the willow shrublands in this PCA were found to support breeding populations of the Willow Flycatcher (*Empidonax traillii*) (Hawks Aloft 2003). Given that they were recorded during the breeding season, they are assumed to be the Southwestern Willow Flycatcher (Terry Ireland, personal communication, 2004). Almost all are associated with shrublands dominated by coyote willow. CNHP visited most of the breeding locations within this PCA, as well as other locations along the Rio Grande.

The old river bottoms are permanently saturated and in a few places a deep accumulation of peat can be found. Hardstem bulrush (*Schoenoplectus acutus*), cattail (*Typha latifolia*), arrowhead (*Sagittaria cuneata*), mare's tail (*Hippuris vulgaris*), common spikerush (*Eleocharis palustris*), and American mannagrass (*Glyceria grandis*) are dominant in many of the old river bottoms. The sloughs have permanent standing water and are lined with various species of willow (*Salix exigua*, *S. monticola*, and *S. eriocephala* var. *ligulifolia*). In open water areas, species such as water ladysthumb (*Polygonum amphibium*), floating pondweed (*Potamogeton gramineus*), mare's tail, duckweed (*Lemna minor*), greater duckweed (*Spirodela polyrhiza*), an aquatic liverwort (*Ricciocarpus natans*), and bur-reed (*Sparganium angustifolium*) dominate. Wet meadows occur in low-lying areas where awned sedge (*Carex atherodes*), woolly sedge, short-beaked sedge (*C. simulata*), and beaked sedge (*C. utriculata*) are the predominate species.

In more saline areas, saltgrass (*Distichlis spicata*) and Baltic rush (*Juncus balticus*) dominate wet meadows. Common threesquare (*Scirpus pungens*), alkaline bulrush (*Scirpus maritimus*), and slim reedgrass (*Calamagrostis stricta*) are common in saline marshes. Saline bottomland shrublands, the matrix vegetation type in the San Luis Valley, dominate in areas that are not heavily irrigated or under cultivation. Species such as greasewood (*Sarcobatus vermiculatus*), saltgrass, and Baltic rush are predominant here.

Scattered throughout the saline meadows and saline bottomland shrublands are populations of the globally imperiled slender spiderflower (*Cleome multicaulis*). A population of the slender spiderflower, northwest of Rio Grande State Wildlife Area, appears to be taking advantage of the soil disturbance caused by livestock grazing. For example, in areas that would appear to be too moist for this species, it has established on the rims of livestock "pits." These pits are formed when livestock hoofs push soil up above the surrounding soil surface, due to their heavy weight and very moist soil. This microtopography appears to be very beneficial for slender spiderflower in this population. It is not clear how palatable or preferred slender spiderflower is to livestock as forage, but this population appears to be tolerant of current grazing management. The current landowner grazes this area in early spring and late summer. This rotation may allow slender

spiderflower to flower and set seed prior to being subjected to grazing impacts in late summer. More information is needed to determine seed viability when passing through ungulates and the general mechanisms for pollination and dispersal for slender spiderflower. Another population of slender spiderflower was found south of the Rio Grande and just north of Centennial Ditch in Alamosa County.

Irrigated pastures are dominated by many wet meadow species such as common spikerush, arrowgrass (*Triglochin maritima*), redtop (*Agrostis gigantea*) and Baltic rush. Grazing occurs in much of the area and there is a conspicuous presence of non-native species. Most notable are Canada thistle, buyan (*Sphaerophysa salsula*), smooth brome (*Bromus inermi*s), reed canarygrass (*Phalaris arundinacea*) and quackgrass.

Natural overbank flooding still occurs, however the frequency and volume has been altered due to upstream water diversions and water control structures. Irrigation, via numerous ditches, is prevalent. Water control structures and levees dictate movement and impoundment of water within State Wildlife Areas and local wetland enhancement projects to benefit some wildlife species. Although the natural hydrology of the site has been severely altered, many of the site's wetlands are associated with old river bottoms and sloughs where a high alluvial groundwater table, associated with the Rio Grande and local irrigation, still support the hydrology of many local wetlands.

Biodiversity Rank Justification: There are multiple known breeding locations for the globally critically imperiled (G5T1T2) Soutwestern Willow Flycatcher (*Empidonax traillii extimus*) contained in the PCA. The Southwestern Willow Flycatcher reaches its northernmost range in the San Luis Valley. Numerous threats, such as agricultural clearing, impacts from excessive grazing, and water diversions, have decreased the amount and quality of southwestern willow flycatcher habitat range-wide (Southwestern Willow Flycatcher Recovery Team Technical Subgroup 2002).

The slender spiderflower (*Cleome multicaulis*) has a global range from southern Wyoming to central Mexico. The San Luis Valley contains the most numerous, largest, and healthiest populations in the world. Slender spiderflower has a limited distribution due to its requirement of moist alkaline soil along with periodic soil disturbance, such as pocket gopher (*Thomomys talpoides*) diggings. These habitat requirements limit the slender spiderflower to the edges of alkaline wet meadows and playas.

The site also supports three types of wet meadows (*Carex simulata* and *C. pellita*), a water ladysthumb emergent wetland (*Polygonum amphibium*), and a montane riparian shrubland (*Salix ligulifolia*). The globally vulnerable (G3) wooly sedge wet meadow (*Carex pellita*) is documented from Oregon east to South Dakota and Montana south to Colorado and Kansas. This community has increased in abundance along regulated rivers on the Colorado Western Slope and may have decreased in abundance on streams on the eastern plains of Colorado. Few, pristine high-quality stands are known. The globally vulnerable (G3) analogue sedge wet meadow (*Carex simulata*) is known from Colorado, Idaho, Montana, Nevada, Oregon, Utah, Wyoming, and may possibly occur in California. It is commonly found with many other sedge species, but its presence is associated with deep organic soils and a perennially high water table. The globally imperiled (G2G3) strapleaf willow riparian shrubland (*Salix eriocephala* var. l*igulifolia*) is known only from Colorado, but it is expected to occur in New Mexico. This association occurs in moderately wide valleys along low terraces and floodplains, and streambanks of narrower streams. The water lady's thumb (*Polygonum amphibium*) emergent wetland is apparently secure (G4) and is found in sloughs and old oxbows where slow-moving water persists.

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

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Birds					
Empidonax traillii extimus	**Southwestern willow flycatcher**	**G5T1T2**	**S1**	**LE, FS, E**	**C**
Plants					
Cleome multicaulis	**Slender spiderflower**	**G2G3**	**S2S3**	**BLM**	**C**
Cleome multicaulis	**Slender spiderflower**	**G2G3**	**S2S3**	**BLM**	**C**
Cleome multicaulis	Slender spiderflower	G2G3	S2S3	BLM	E
Plant Communities					
Carex pellita	Montane wet meadow	G3	S3		C
Carex simulata	Montane wet meadow	G3	S3		C
Polygonum amphibium	Water ladysthumb emergent wetland	G4	S3		B
Salix ligulifolia	Montane willow carr	G2G3	S2S3		C

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

Boundary Justification: The site boundary encompasses a large portion of the Rio Grande's floodplain between Monte Vista and Alamosa. Topography within the site is very flat. Important hydrologic inputs include alluvial groundwater which is associated with water levels in the river, surface water runoff from rain events, and periodic overbank flooding of the Rio Grande. The site boundary was drawn to incorporate an area where these natural processes would maintain viable populations of the elements. The boundary provides a buffer from nearby agriculture fields and roads where surface runoff may contribute excess nutrients and/or herbicides/pesticides that could be detrimental to the elements. The site contains many old oxbows and sloughs that could provide a source for recruitment for species associated with the elements. It should be noted that the hydrological processes necessary to the elements are not fully contained by the boundaries established for this site. Given that the elements are closely tied to natural processes associated with the Rio Grande, any upstream activities could detrimentally affect the elements.

Protection Comments: Most of the PCA is privately owned. Two State Wildlife Areas (SWA), Rio Grande and Higel, are also contained in the PCA. Recreation (mostly hunting and fishing) appears to be the dominant use of the SWAs, however, some areas are grazed. The City of Alamosa manages a portion of the easternmost part of the PCA. The remaining areas of the PCA are privately owned and mostly consist of irrigated meadows for hay production and grazing pasture. Some alfalfa is also cultivated, especially on the south side of the river. One easement occurs on private land near the Alamosa/Rio Grande County line (RiGHT 2003).

Management Comments: Control of non-native plant species is an issue for this site. There are current efforts underway to control Canada thistle (*Cirsium arvense*) populations (both within the SWAs and private parcels). The success of such efforts should be monitored and management should change if current methods are not successful. A change in upstream water use has the potential to affect the integrity of the elements at this PCA. Alterations of current water management within the PCA may also affect the elements. Much of the floodplain has been cleared in the past for agricultural purposes. Such activity should cease to improve habitat, especially for the Federally Endangered Southwestern Willow Flycatcher.

Soils Description: Soils are variable and there are numerous soil types in the PCA. Some of the more common types in the wetland areas are mapped as the Alamosa, Homelake, Mosca, San Luis, Typic Fluvaquents, and Typic Torrifluvents. The Alamosa is a Fine-loamy, mixed, frigid Typic Argiaquoll (USDA 1980). These soils are deep and poorly to somewhat poorly drained. The Homelake is classified as Fine-loamy, mixed Aquic Fluveaquentic Haploborolls (USDA 1973). These soils are somewhat poorly drained and are formed in medium-textured mixed alluvium (USDA 1973). The Mosca is classified as a coarse-loamy, mixed, frigid Typic Natrargids (USDA 1973). These soils consist of well-drained alkali soils formed in calcerous, moderately coarse textured alluvium underlain by sand and gravel (USDA 1973). The San Luis is classified as a Fine-loamy over sandy or sandy-skeletal, mixed, frigid, Aquic Natrargids (USDA 1980). These soils are somewhat poorly drained, formed in alluvium in old floodplains, and are strongly alkaline. Soil texture in the Typic Fluvaquents ranges from loam to clay loam. These soils are typically found in nearly level floodplain areas where old stream channel and oxbows are present. The Typic Torrifluvents range in texture from loam to sandy loam. Many of the wetland plant communities (*Polygonum amphibium*, *Carex atherodes*, *C. lanuginosa*) discussed above were found in areas mapped as Typic Torrifluvents. However, further investigation of the soils indicated that most of these were Typic Fluvaquents. In some old river channels, peat was observed.

Restoration Potential: Restoration of natural hydrologic processes would require an immense collaboration with upstream water users, local landowners, and the Colorado Division of Wildlife. Wetland functions such as flood attenuation, biogeochemical functions, etc., have likely been impacted by hydrologic alterations and a large-scale restoration project could improve those functions. However, although natural hydrology has been altered, the current hydrologic regime is supporting the elements found at this site. Enhancement efforts such as non-native species control, removal of water control structures, decrease in water diversions, and improved grazing regimes could improve the biological integrity of this site.

Future and present restoration projects focusing on restoring and/or enhancing a diversity of fluvial processes which raise groundwater levels, encourage periodic flooding, and create a mosaic of wetland and riparian vegetation types will most likely succeed in restoring many of the functions compromised by past human-induced impacts. Altering fluvial processes will likely require much use of structural measures, many of which result in additional problems downstream. Other, non-structural activities may allow the natural creation of new riparian vegetation communities and also enhance existing ones by restoring a diversity of age classes, vertical complexity, and increasing species richness which are important for maintaining and improving habitat for the Southwestern Willow Flycatcher (Southwestern Willow Flycatcher Recovery Team Technical Subgroup 2002). For example, it may be necessary to manage beaver populations in those areas where cottonwood/willow plantings have occurred or in those areas where cottonwood and willow are the only food source for beaver, as these areas will be decimated (RGHRP 2001). Management actions might include removal (consult the Colorado Division of Wildlife for such actions) or preferably, the creation of conditions which provide an alternative food source for the beaver (i.e. cattails) thereby alleviating damage to cottonwoods and willows (RGHRP 2001). Current land use patterns allow for overuse of many areas by livestock. The primary concerns from such activity are uncontrolled non-native species invasions, increased erosion and downcutting of the stream banks, and subsequent lowering of water tables. Grazing practices should be minimized or a reasonable method of grazing, such as year-round exclusion of grazing in the riparian zone, limiting grazing to the dormant season, or allowing localized access to the Rio Grande for watering may improve the health of the riparian vegetation and hence the riparian ecosystem as a whole. The management of livestock grazing within the riparian corridor can be a substantial restoration tool (RGHRP 2001). Organizations

such as USFWS's Partners for Fish and Wildlife, Natural Resource Conservation Service, and the Colorado Division of Wildlife may provide assistance for assessing and implementing the proper grazing regime of a particular site.

The Rio Grande Headwaters Restoration Project (2001) thoroughly addresses those issues related to a large-scale restoration effort along the upper Rio Grande. Readers are encouraged to consult this document (RGHRP 2001) for more specific information, especially regarding structural restoration techniques.

Currently, there are 14 wetland restoration/enhancement projects occurring within the PCA boundaries (RiGHT, 2003). Information regarding each specific project was not obtained for this project.

Wetland Functional Assessment for the Rio Grande PCA:
Proposed HGM Class: Riverine **Subclass:** R3
Cowardin System: Palustrine
CNHP's Wetland Classification: *Salix ligulifolia, Populus angustifolia / Salix exigua; Salix exigua /* mesic graminoid

Table 30. Wetland functional assessment for the riverine wetland at the Rio Grande PCA.

Function	Rating	Comments
Overall Functional Integrity	Below Potential	This wetland appears to be functioning below potential due to the amount of hydrological alteration and vegetation clearing in the floodplain. However, given the extent and diversity of wetland types in the area, the site still provide important functions..
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Dense cover of woody vegetation and an extensive floodplain provide high ability to attenuate flooding. However, water diversions and altered sediment dynamics have altered the frequency and volume of seasonal flooding on the Rio Grande.
Sediment/Shoreline Stabilization	Moderate	Some immediate banks along the Rio Grande are well vegetated while others are susceptible to erosion. This is likely due to alterations in hydrology and direct impacts associated with grazing.
Groundwater Discharge/ Recharge	Yes	The Rio Grande likely recharges the unconfined and alluvial aquifers.
Dynamic Surface Water Storage	N/A	Flooding occurs in this wetland due to overbank flow.
Biogeochemical Functions		
Elemental Cycling	Disrupted	The presence of aerated water and large areas of saturated soil provide a gradient for various nutrient transformations. However, alteration of the herbaceous understory, such as a change in species composition (prevalence of non-native species) may be disrupting nutrient cycles. Altered hydrology has also disrupted nutrient cycles by eliminating normal flushing cycles and lack of deposition of organic material from floodwaters.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Removal of excess nutrients and sediment (e.g. from upstream and local livestock, municipal water treatment plants, and agricultural activity) is likely being performed by this wetland considering the large area in which such transformations could occur prior to reaching the river. Dense herbaceous and woody vegetation in the floodplain along with periodic overbank flooding provides high potential for this area to function as a sink for sediments/nutrients/toxicants. Toxicants and sediments from nearby roads are also likely intercepted in the floodplain. However, this is moderated by altered hydrology.
Biological Functions		
Habitat Diversity	High	The wetland site consists of aquatic bed, emergent, scrub-shrub, forested, and open water habitats.
General Wildlife Habitat	High	This area provides browse and cover for deer, coyote, black bear, and other large and small mammals. Oxbows and sloughs provide open water for waterbirds. However, livestock, agricultural clearing, and nearby roads have

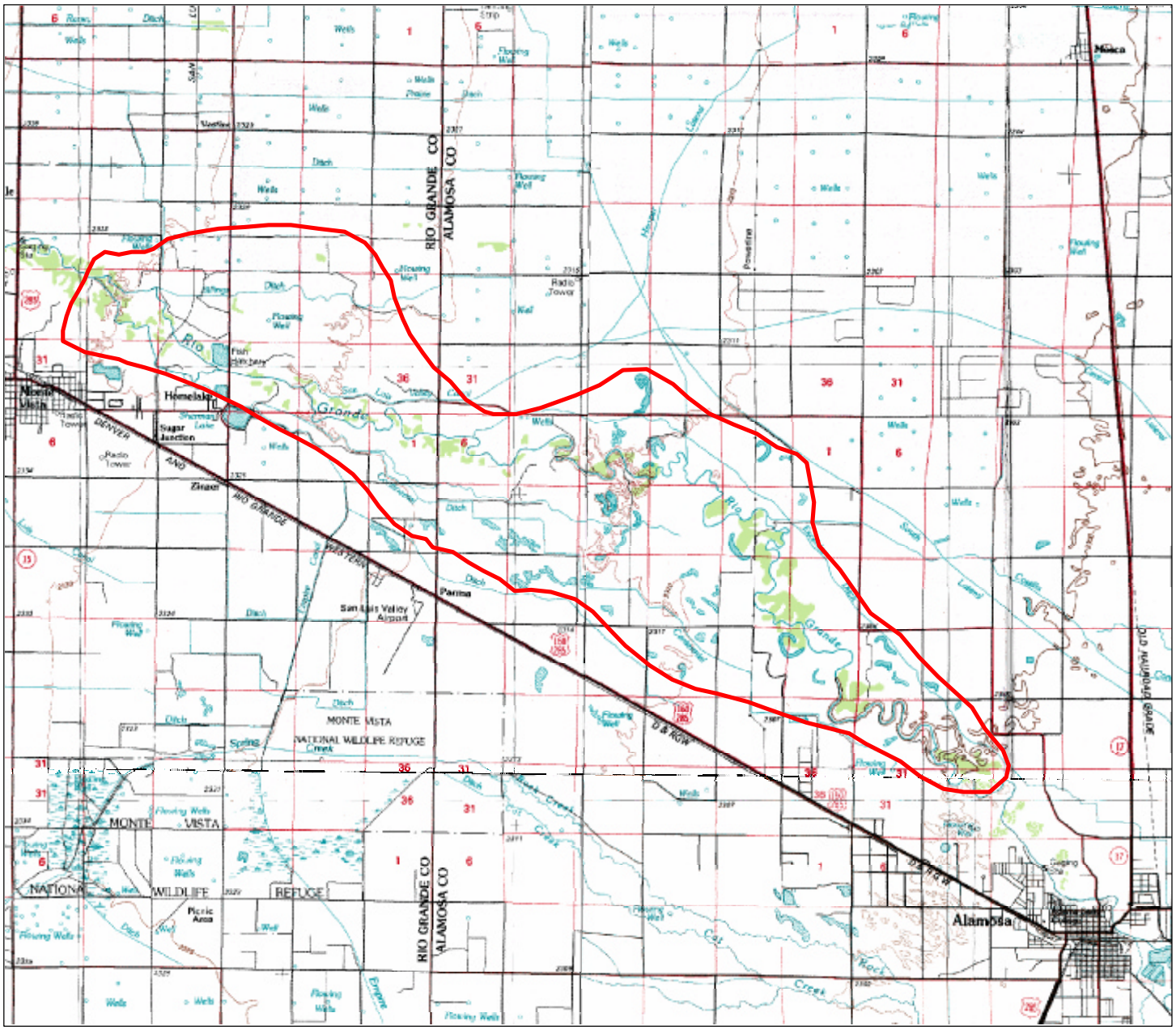
		eliminated much wildlife habitat in the area. The willow shrublands along the riparian area provide important habitat for the Federally Endangered Southwestern Willow Flycatcher. Wet meadows, emergent wetlands, and open water wetlands provide nesting and migratory habitat for numerous species of birds and mammals, which in turn provide forage for birds of prey such as eagles, hawks, and falcons. Wet meadows and irrigated pastures provide migratory habitat for Sandhill Cranes.
General Fish/Aquatic Habitat	Moderate	Being a large river system, many fish species are likely to occur to occur in this stretch of the river. Back channels and old abandoned oxbows may provide suitable habitat for many fishes. However, native trout are rare to absent in this reach of the Rio Grande (RGHRP 2001).
Production Export/Food Chain Support	High	A permanent water source and allochthonous organic substrates provide various sources of carbon (both dissolved and particulate) and nutrients for downstream ecosystems. Although some areas lack a diversity of structural vegetation classes (e.g. herbaceous layer is minimal), because the area is so large and encompasses a variety of habitats, food chain support is high. This function is being negatively affected by the prevalence of non-native species such as smooth brome, Canada thistle, and Russian knapweed and lack of historical flooding regime.
Uniqueness	High	Large riparian floodplain forests in Alamosa and Costilla counties have largely been reduced and/or impacted by grazing and agriculture. The presence of such a large complex of cottonwood and willow support populations of the Federally Endangered Southwestern Willow Flycatcher.

Wetland Functional Assessment for the Rio Grande PCA:
Proposed HGM Class: Depressional **Subclass:** D2
Cowardin System: Palustrine
CNHP's Wetland Classification: *Carex pellita, Carex simulata, Polygonum amphibium, Schoenoplectus acutus, Typha latifolia.*

Table 31. Wetland functional assessment for the riverine wetland at the Rio Grande PCA.

Function	Rating	Comments
Overall Functional Integrity	Below Potential	This wetland appears to be functioning below potential due to the amount of hydrological alteration and vegetation clearing in the floodplain. However, given the extent and diversity of wetland types in the area, the site still provide important functions..
Hydrological Functions		
Flood Attenuation and Storage	Moderate	Periodic overbank flow can settle in the wetland basins providing short-term storage. However, water diversions and altered sediment dynamics have altered the frequency and volume of seasonal flooding on the Rio Grande.
Sediment/Shoreline Stabilization	Moderate	Wetlands occurs in a closed basin. However, these areas are densely vegetated, providing stabilization during rare high flow events.
Groundwater Discharge/ Recharge	Yes	Most of these wetlands are supported by discharge from the alluvial and unconfined aquifer.
Dynamic Surface Water Storage	High	There are numerous old stream channels and oxbows that retain standing water.
Biogeochemical Functions		
Elemental Cycling	Disrupted	The presence of standing water and large areas of saturated soil (oxbows, sloughs) provide a gradient for various nutrient transformations. However, alteration of the herbaceous understory, such as a change in species composition (prevalence of non-native species) may be disrupting nutrient cycles. Altered hydrology has also disrupted nutrient cycles by eliminating normal flushing cycles and lack of deposition of organic material from floodwaters.
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Removal of excess nutrients and sediment (e.g. from upstream and local livestock, municipal water treatment plants, and agricultural activity) is likely being performed by this wetland considering the large area in which such transformations could occur prior to reaching the river. Dense herbaceous and woody vegetation along with periodic overbank flooding provides high potential for this area to function as a sink for sediments/nutrients/toxicants. Toxicants and sediments from nearby roads are likely also intercepted in these wetlands prior to reaching the river. However, this is moderated by altered hydrology.
Biological Functions		
Habitat Diversity	High	The wetland site consists of aquatic bed, emergent, scrub-shrub, and open water habitats.
General Wildlife Habitat	High	This area provides browse and cover for deer, coyote, black bear, and other large and small mammals. Oxbows and sloughs provide open water for waterbirds. However, livestock, agricultural clearing, and nearby roads have eliminated much wildlife habitat in the area. The willow shrublands along the riparian area provide important habitat

		for the Federally Endangered Southwestern Willow Flycatcher. Wet meadows, emergent wetlands, and open water wetlands provide nesting and migratory habitat for numerous species of birds and mammals, which in turn provide forage for birds of prey such as eagles, hawks, and falcons. Wet meadows, emergent wetlands, and open water wetlands provide nesting and migratory habitat for numerous species of birds and mammals. Waterbirds such as Great Blue Heron, Snowy Egret, Cinnamon Teal, Gadwall, Common Snipe, and Wilson's Phalarope were observed. Other birds observed included Red-winged Blackbirds, Yellow-headed Blackbirds, Marsh Wren, and a Northern Harrier. Many frogs were heard but not seen. Snails and many insects were also observed in the area.
General Fish/Aquatic Habitat	Moderate	Some fish may exist in old stream channels and oxbows. Dense cover of vegetation along the banks of these areas could provide potential habitat. Aquatic vegetation provides good cover and supports many aquatic invertebrates.
Production Export/Food Chain Support	Moderate to High	Dense emergent and aquatic vegetation cover support local food chain dynamics by sustaining healthy invertebrate populations. Export of organic substances and associated nutrients is limited due to restricted outlets.
Uniqueness	Moderate	The density of depressional wetlands is not common in the project area. The presence of such a large complex of cottonwood and willow along with many depressional wetlands support populations of the Federally Endangered Southwestern Willow Flycatcher



1 0 1 Miles

Projection: UTM, Zone13, NAD27

Colorado Natural Heritage Program
Colorado State University
College of Natural Resources
254 General Services Bldg.
Fort Collins, CO 80523

map created 5 May 2004

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LEGEND

Rio Grande
Potential Conservation Area

30 x 60 Minute Series Quads:
Alamosa, 37105a1
Blanca Peak, 37105e1
Del Norte, 37106e1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

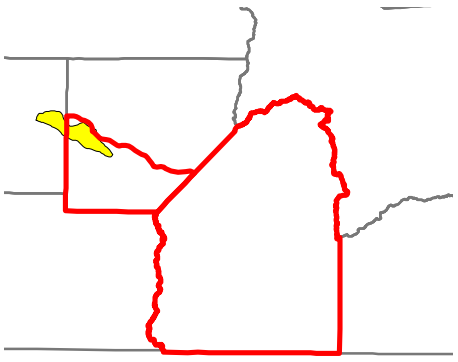


Figure 18. Rio Grande Potential Conservation Area

RIO GRANDE AT TRINCHERA CREEK POTENTIAL CONSERVATION AREA

Biodiversity Rank: B3. High biodiversity significance. The PCA supports two fair examples of the globally imperiled slender spiderflower, and a fair example of a common wetland plant community.

Protection Urgency Rank: P3. Protection actions may be needed, but probably not within the next five years. It is estimated that current stresses may reduce the viability of the elements of the PCA if protection action is not taken. The PCA is privately owned. Any level of protection would likely benefit the element, including, and probably most importantly, the protection of water (both surface and groundwater) reaching the site.

Management Urgency Rank: M3. New management actions may be needed within five years to maintain the current quality of the element occurrences in the PCA. Resting the areas from additional grazing will increase the vigor of native wetland species.

Location: This PCA is located just south of the confluence of Trinchera Creek and the Rio Grande in Costilla County.

U.S.G.S. 7.5-min. quadrangle: Lasauses

Legal Description: Unsurveyed

Elevation: 7,500 ft. Approximate Size: 918 acres

General Description: This PCA occurs on the eastern side of the Rio Grande a bit south of where Trinchera Creek merges with the Rio Grande. Most of the wetlands appear to be hydrologically supported by the local alluvial aquifer, which is present due to the convergence of Trinchera Creek, Conejos River, and the Rio Grande. Floodplain wetlands are plentiful on both sides of the Rio Grande in this area. Fresh and saline wet meadows and marshes occur within the PCA. Agricultural fields surround the wetlands on the eastern side.

The Rio Grande, in the San Luis Valley, is a sediment-dominated system. Historically, the Rio Grande was a braided, dynamic, and avlusive system (RGHRP 2001). Structures and diversions associated with irrigation have altered the dynamics of the Rio Grande (RGHRP 2001). For example, near Del Norte the Rio Grande is now confined to two moderately entrenched channels whereas historically the river had constant streamflow through multiple channels. Between Monte Vista and Alamosa, the reach contained with this PCA, the river is dominated by a single active channel with numerous abandoned or inactive channels, meander scars, and sloughs interspersed in the floodplain (RGHRP 2001). Although channel avulsion, meander cutoff, and overbank flow still occur along this reach, historical dynamics which created the myriad of meanders scars, inactive channels, and sloughs in the area, no longer occur as the river is under capacity (RGHRP 2001). Near Alamosa, the Rio Grande is confined by a series of levees which transport water and sediment through city limits to downstream reaches (RGHRP 2001). The reach downstream of Alamosa is considered to be depositional and has a very flat channel slope (RGHRP 2001).

Hardstem bulrush (*Scirpus acutus*), common threesquare (*S. pungens*), and common spikerush dominate in the marshes. Saline wet meadows surround the marshes and are dominated by

saltgrass (*Distichlis spicata*), sea blite (*Suaeda calceoliformis*), and Baltic rush (*Juncus balticus*). Greasewood (*Sarcobatus vermiculatus*) is also scattered throughout these areas. The globally imperiled slender spiderflower (*Cleome multicaulis*) is found in these saline wet meadows.

Biodiversity Rank Justification: The slender spiderflower (*Cleome multicaulis*) has a global range from southern Wyoming to central Mexico. The San Luis Valley contains the most numerous, largest, and healthiest populations in the world. Slender spiderflower has a limited distribution due to its requirement of moist alkaline soil along with periodic soil disturbance, such as pocket gopher (*Thomomys talpoides*) diggings. These habitat requirements limit the slender spiderflower to the edges of alkaline wet meadows and playas. The San Luis Valley contains the most numerous, largest, and healthiest populations in the world.

The globally apparently secure (G3G4) common threesquare herbaceous vegetation is occurs in Colorado, Kansas, Montana, Nebraska, South Dakota, Utah, Wyoming, and Saskatchewan. Few of these are large or in pristine condition. This plant association forms small low-stature (1-3 ft, or 0.3-1 m) marshes in low-lying swales, abandoned channels, and overflow channels where the soils remain saturated. The water table is generally at or near the surface. This association also occurs on silt and sandbars within the active channel where the water velocity is lowest. The globally apparently secure (G4) hardstem bulrush community is widespread.

Table 32. Natural Heritage element occurrences at Rio Grande at Trinchera Creek PCA.
Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plants					
Cleome multicaulis	**Slender spiderflower**	**G2G3**	**S2S3**	**BLM**	**C**
Cleome multicaulis	**Slender spiderflower**	**G2G3**	**S2S3**	**BLM**	**C**
Plant Communities					
Schoenoplectus pungens	Common threesquare Herbaceous vegetation	G3G4	S3		C
Schoenoplectus acutus	Hardstem bulrush Herbaceous vegetation	G4	S2S3		B

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

Boundary Justification: The site boundary encompasses a portion of the Rio Grande's floodplain. Topography within the site is very flat. Important hydrologic inputs include alluvial groundwater which is associated with water levels in the river, surface water runoff from rain events, and periodic overbank flooding of the Rio Grande. The site boundary was drawn to incorporate an area where these natural processes would maintain viable populations of the elements. The boundary provides a buffer from nearby agriculture fields and roads where surface runoff may contribute excess nutrients and/or herbicides/pesticides that could be detrimental to the elements. The site contains oxbows and sloughs that could provide a source for recruitment for species associated with the elements. It should be noted that the hydrological processes necessary to the elements are not fully contained by the boundaries established for this site. Given that the elements are closely tied to natural processes associated with the Rio Grande, Conejos River, and Trinchera Creek, any upstream activities in these drainages could detrimentally affect the elements.

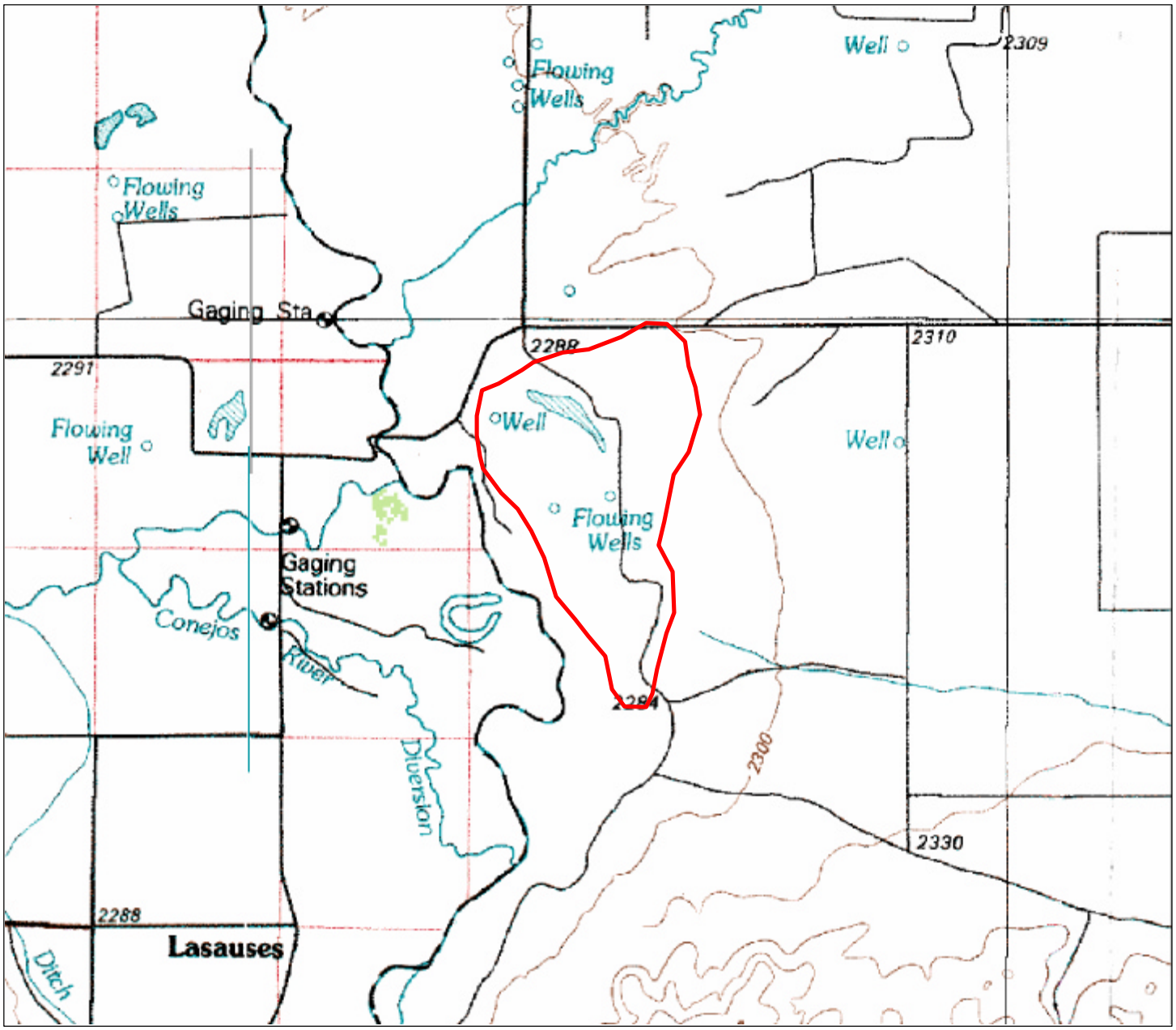
Protection Comments: The PCA is privately owned. Any level of protection would likely benefit the element, including, and probably most importantly, the protection of water (both surface and groundwater) reaching the site.

Management Comments: Resting the areas from additional grazing will increase the vigor of native wetland species. Excessive grazing is compacting soil and trampling vegetation.

Soils Description: Soils are not mapped at this site. Soil texture was sandy clay.

Restoration Potential: Grazing practices should be minimized or a reasonable method of grazing, such as fencing off wet meadows, implemented in order to improve the health of the wetland vegetation.

Wetland Functional Assessment: CNHP wetland ecologists did not visit the wetland contained within this PCA during 2003. Thus, a functional assessment could not be conducted. However, given the impact from excessive livestock use, it is hypothesized that some wetland functions have been negatively impacted.



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map created 5 May 2004

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LEGEND

Rio Grande at Trinchera Creek Potential Conservation Area

30 x 60 Minute Series Quads:
Alamosa, 37105a1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

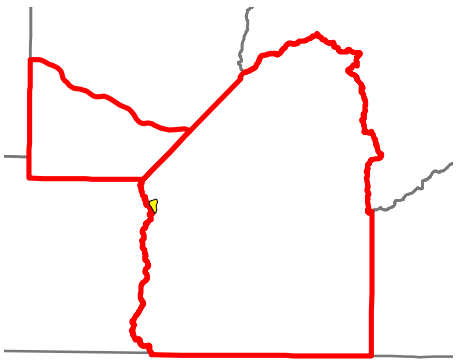


Figure 19. Rio Grande at Trinchera Creek Potential Conservation Area

TORCIDO CREEK POTENTIAL CONSERVATION AREA

Biodiversity Rank: B3. High biodiversity significance. The PCA supports an excellent population of the globally vulnerable Rio Grande cutthroat trout.

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

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

Location: This PCA is located south of San Luis near the Colorado/New Mexico state line.

U.S.G.S. 7.5-min. quadrangle: La Valley and Sanchez Reservoir

Legal Description: Unsurveyed

Elevation: 8,300 – 11,200 ft. Approximate Size: 2,853 acres

General Description: This PCA encompasses most of the Torcido Creek drainage. The site spans from the subalpine to montane zones, flowing through a diversity of riparian plant community types. Torcido Creek feeds into Sanchez Reservoir and Ventero Creek.

Torcido Creek support an excellent, genetically pure, and historic (native) population of the Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*). The population is stable and secure (Alves 2004). Irrigation diversions occasionally dry up the creek prior to reaching Sanchez Reservoir, thereby serving as a temporary barrier (Alves 1996; (Harig and Fausch 1996). No other fish have been documented in the creek (Harig and Fausch 1996).

Biodiversity Rank Justification: The Rio Grande cutthroat trout's range once included the entire Rio Grande and Pecos River watersheds, and possibly the upper Canadian River as well (Trotter 1987). In Colorado, the species occupies less than 1% of its former range (Alves 1996), and wild, genetically pure stock populations are especially imperiled. Artificial habitat including wells, farm ponds, and extensive canal systems as well as human activities including dewatering, fishing and stocking, transbasin diversions, release of domestic sewage, stream channelization, and agricultural chemical applications have greatly modified the original aquatic ecosystem of the San Luis Valley (Zuckerman 1984). These modifications may have contributed directly to the decline in range of the native fishes of the Rio Grande drainage. Free-flowing streams with good quality water, healthy banks, and streamside vegetation within the upper Rio Grande watershed are vital habitat for this subspecies of trout.

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

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Fish					
Oncorhynchus clarki virginalis	**Rio Grande cutthroat trout**	**G4T3**	**S3**	**FS/BLM, SC**	**A**

*EO=Element Occurrence.

Boundary Justification: The boundaries incorporate an area that will allow natural ecological processes such as large woody debris recruitment, adequate canopy cover (to regulate stream temperature), and new channel formation to maintain viable populations of the trout along Torcido Creek. This boundary indicates the minimum area that should be considered for any conservation management plan. Some hillslope areas which may contribute runoff to Torcido Creek are not encompassed in the boundary although any activity in these areas should be considered for any conservation management plan.

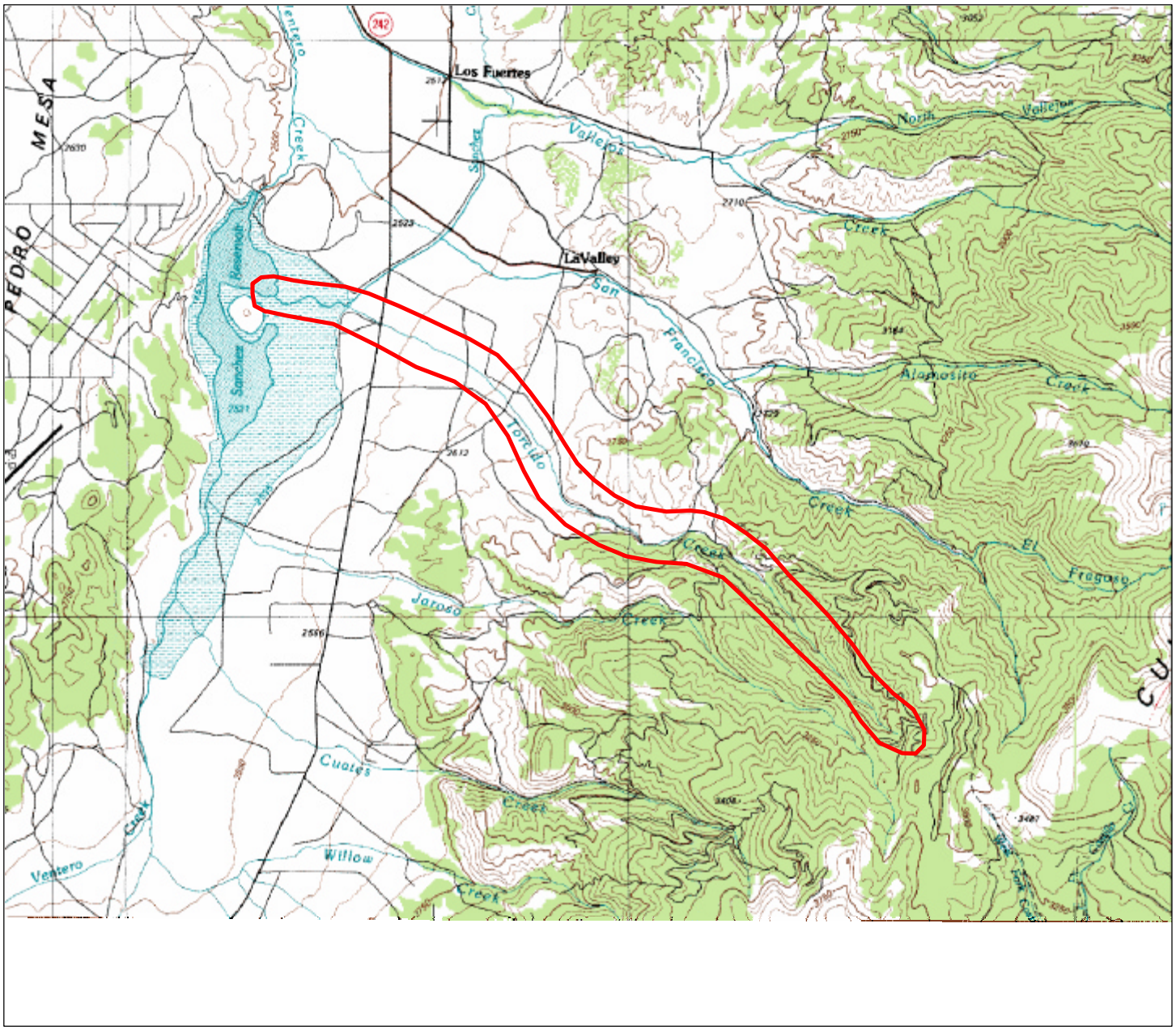
Protection Comments: The entire stretch of the creek occurs on a private ranch.

Management Comments: CNHP wetland ecologists did not visit this PCA during 2003. Thus, it is unknown what management concerns and/or needs exist for this site. The health of the trout population suggests that current management may be adequate for the viability of the trout. Alves (1996) suggests that the riparian area be protected from impacts associated with livestock grazing, road construction, and timber harvest activities.

Soils Description: Soils are not mapped at this site but are likely derived from mixed alluvium.

Restoration Potential: CNHP wetland ecologists did not visit this PCA during 2003. Thus, it is unknown what the restoration potential is for this site.

Wetland Functional Assessment: CNHP wetland ecologists did not visit this PCA during 2003. Thus, a functional assessment could not be conducted.



1 0 1 Miles

Projection: UTM, Zone13, NAD27

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map created 5 May 2004

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LEGEND

Torcido Creek
Potential Conservation Area

30 x 60 Minute Series Quads:
Alamosa, 37105a1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

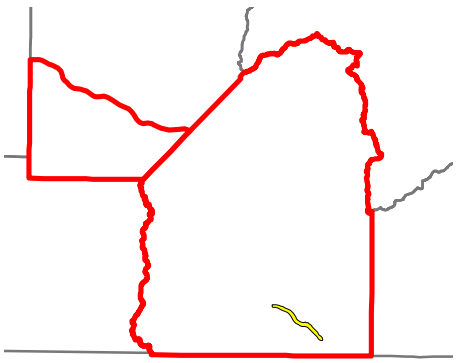


Figure 20. Torcido Creek Potential Conservation Area

TRINCHERA CREEK BELOW SMITH RESERVOIR POTENTIAL CONSERVATION AREA

Biodiversity Rank: B3. High biodiversity significance. The PCA supports a good example of a globally imperiled wetland plant community.

Protection Urgency Rank: P3. Protection actions may be needed, but probably not within the next five years. It is estimated that current stresses may reduce the viability of the elements of the PCA if protection action is not taken. The site has no formal protection and is privately owned.

Management Urgency Rank: M3. New management actions may be needed within five years to maintain the current quality of the element occurrences in the PCA. Agriculture and water management have highly disturbed this site. However, the presence of the dams likely provide a hydrological regime which would otherwise not support the current riparian plant community.

Location: This PCA is located along Trinchera Creek just below Smith Reservoir.

U.S.G.S. 7.5-min. quadrangle: Blanca and Blanca SE

Legal Description: Unsurveyed

Elevation: 7,650 – 7,720 ft. Approximate Size: 684 acres

General Description: This PCA encompasses a portion of Trinchera Creek occurring just below Smith Reservoir. The creek has a narrow channel and is cutting across (and now confined by) agricultural fields of potatos, hay, and wheat. Smith Reservior sits behind a dam on Trinchera Creek in a basalt canyon. Downstream of the dam there is a small irrigation dam impounding the creek once again. The surrounding hills are covered with rabbitbrush (*Chrysothamnus greenii*) and blue grama (*Bouteloua gracilis*), farmhouses, barns, fields, and equipment.

The riparian area consists of a narrow band of vegetation along the streambanks. Strapleaf willow (*Salix ligulifolia*) and sandbar *willow* (*S. exigua*) are dense and have an understory of wooly sedge (*Carex pellita*), scratchgrass (*Muhlenbergia asperifolia*), Baltic rush (*Juncus balticus*), and numerous mesic forbs. The hydrology of the site is highly altered due to the presence of the upstream dam, irrigation dam downstream, and a multitude of water diversions along the creek. However, the current hydrology is supporting the riparian plant community. A change in hydrology may shift riparian species composition. There is little direct perturbation to the riparian vegetation. Some non-native species and native increasers are present along the periphery of the riparian plant community.

Biodiversity Rank Justification: The globally imperiled (G2G3) montane willow carr (*Salix exigua-S. ligulifolia*) is a newly described association known only from Colorado, but it is expected to occur in New Mexico. This plant association occurs in the wettest part of the riparian area, usually adjacent to the channel on low point bars, islands, low streambanks and overflow channels. The streams are broad and meandering with sandy beds or braided channels.

This plant association can produce abundant, high quality forage for livestock. Season-long grazing, especially late summer and early fall browsing, should be avoided to maintain the vigor of woody species (Hansen et al. 1995). Overuse by livestock may cause the site to dry and

become dominated by introduced grass species such as Kentucky bluegrass (*Poa pratensis*) or smooth brome (*Bromus inermis*) (Manning and Padgett 1995). With continued overuse, the willow species will decline and eventually become eliminated from the site (Hansen et al. 1995).

Beaver are important in maintaining this plant association. Beaver dams raise the water table, which is beneficial to willow and sedge species as well as other hydrophytic plants. Beaver dams also help control bank erosion, channel downcutting, and the loss of sediment downstream (Hansen et al. 1995).

Table 34. Natural Heritage element occurrences at Trinchera Creek Below Smith Reservoir PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plant Communities					
Salix exigua-Salix ligulifolia	**Montane willow carr**	**G2G3**	**S2S3**		**C**

*EO=Element Occurrence.

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 Trinchera 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 PCA boundaries. It should be noted that an altered hydrological regime supports the riparian plant community at this site. Thus, should hydrology change, a corresponding change in riparian vegetation would be expected. This boundary indicates the minimum area that should be considered for any conservation management plan.

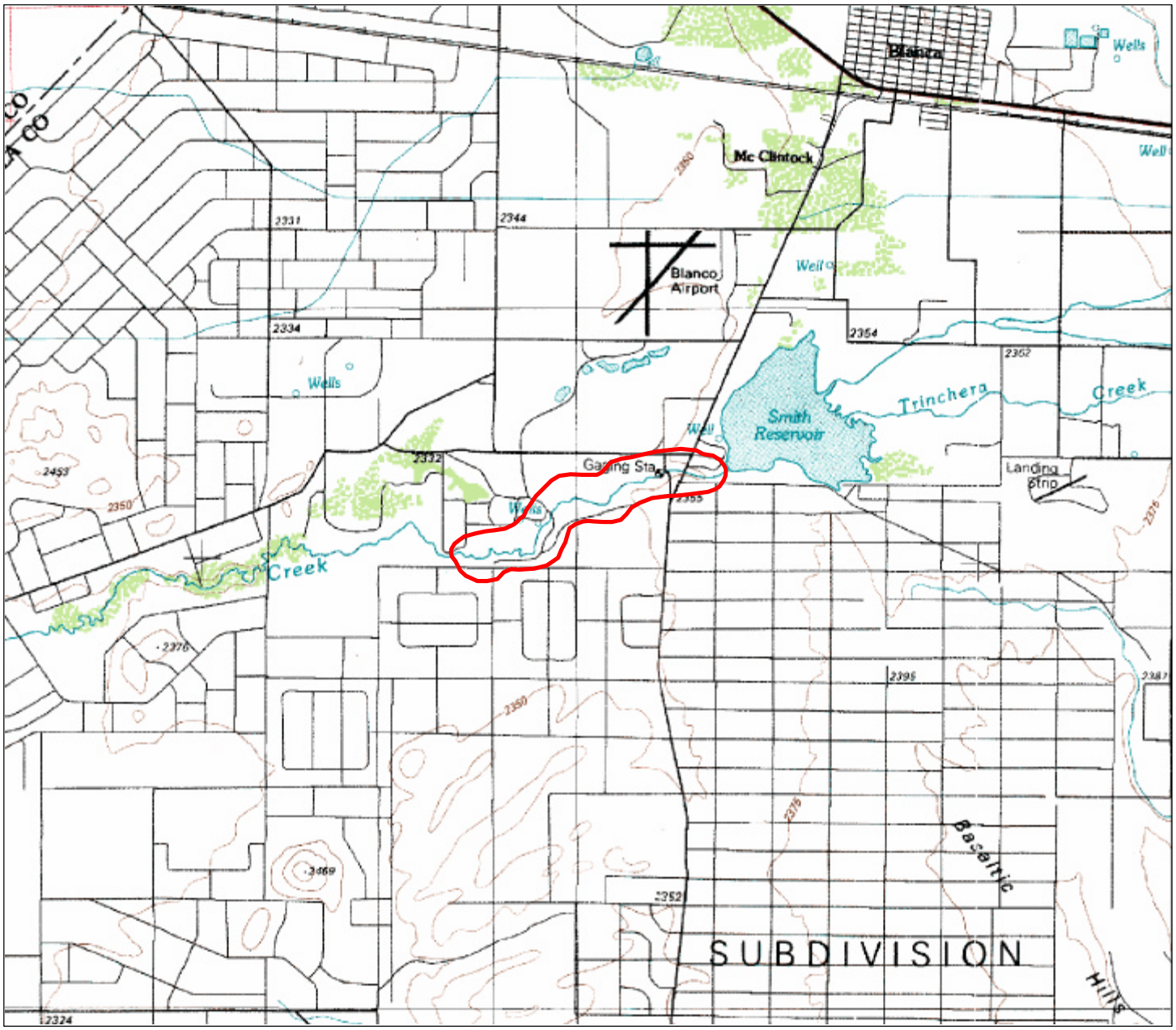
Protection Comments: The site has no formal protection and is privately owned.

Management Comments: Agriculture and water management have highly disturbed this site. However, the presence of the dams likely provide a hydrological regime which would otherwise not support the current riparian plant community.

Soils Description: Soils are not mapped at this site. Soil is mixed alluvium.

Restoration Potential: Restoration should focus on upstream water use. Restoration of natural hydrologic processes would require an immense collaboration with upstream water users, local landowners, municipalities, etc. Wetland functions such as biogeochemical functions, etc., have likely been impacted by hydrologic alterations and a large-scale restoration project could improve those functions. However, although natural hydrology has been altered, the current hydrologic regime is supporting the elements found at this site.

Wetland Functional Assessment: CNHP wetland ecologists did not visit the wetland contained within this PCA during 2003. Thus, a functional assessment could not be conducted. However, notes from a previous visit by CNHP indicate that streambanks are well vegetated and stable, due to a lack of direct disturbance. However, dams and water diversions have highly altered hydrology thereby impacting many functions such as flood flow alteration, biogeochemical functions, and aquatic habitat.



1 0 1 Miles

Projection: UTM, Zone13, NAD27

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LEGEND

Trinchera Creek
Below Smith Reservoir
Potential Conservation Area

30 x 60 Minute Series Quads:
Alamosa, 37105a1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

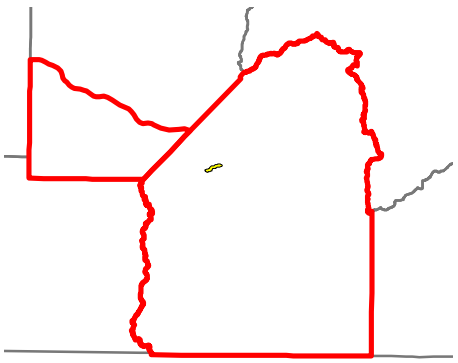


Figure 21. Trinchera Creek Below Smith Reservoir Potential Conservation Area

RIO GRANDE AT STATE LINE POTENTIAL CONSERVATION AREA

Biodiversity Rank: B4. Moderate biodiversity significance. The PCA supports one fair example of a globally vulnerable wetland plant community and one fair example of a globally apparently secure riparian plant community.

Protection Urgency Rank: P4. No protection actions are needed in the foreseeable future. The site is inaccessible and no threats are foreseen.

Management Urgency Rank: M3. New management actions may be needed within five years to maintain the current quality of the element occurrences in the PCA. Resting the areas from additional grazing will increase the vigor of native wetland species.

Location: This PCA is located along the Rio Grande near the Colorado / New Mexico state line.

U.S.G.S. 7.5-min. quadrangle: Kiowa Hill and Sky Valley Ranch

Legal Description: East side of Rio Grande is unsurveyed;
T32N R11E portions of S 4, 9, 14, 15, 23, 24, 28, and 33.

Elevation: 7,400 – 7,700 ft. Approximate Size: 2,254 acres

General Description: The Rio Grande, in the San Luis Valley, is a sediment-dominated system. Historically, the Rio Grande was a braided, dynamic, and avlusive system (RGHRP 2001). Structures and diversions associated with irrigation have altered the dynamics of the Rio Grande (RGHRP 2001). For example, near Del Norte the Rio Grande is now confined to two moderately entrenched channels whereas historically the river had constant streamflow through multiple channels. Between Monte Vista and Alamosa, the reach contained with this PCA, the river is dominated by a single active channel with numerous abandoned or inactive channels, meander scars, and sloughs interspersed in the floodplain (RGHRP 2001). Although channel avulsion, meander cutoff, and overbank flow still occur along this reach, historical dynamics which created the myriad of meanders scars, inactive channels, and sloughs in the area, no longer occur as the river is under capacity (RGHRP 2001). Near Alamosa, the Rio Grande is confined by a series of levees which transport water and sediment through city limits to downstream reaches (RGHRP 2001). The reach downstream of Alamosa is considered to be depositional and has a very flat channel slope (RGHRP 2001).

This PCA occurs near the Colorado / New Mexico state line. The Rio Grande flows through a box canyon through this reach. Streambanks are narrow and often steep, although point bars are scattered along the reach. Development of riparian vegetation in many areas is minimal. Where it has developed, vegetation is patchy and occurs as a mosaic. The riparian vegetation is clearly differentiated between a stand of wooly sedge (*Carex pellita*) along the immediate banks and a stand of shrubs, consisting of red-osier dogwood (*Cornus sericea*), sandbar willow (*Salix exigua*), skunkbrush (*Rhus trilobata*), wild hops (*Humulus lupulus* subsp. *americanus*), and wax currant (*Ribes cereum*) at a slightly higher elevation from the river. Signs of beaver activity are present, but nothing too recent. Whitetop (*Lepidium latifolium*) and Canada thistle are prevalent along this reach of the river.

The hydrology of the Rio Grande is highly altered due to upstream water diversions, groundwater pumping, livestock use, development, and channelization. The present riparian vegetation is supported by the altered hydrological flows and thus is adapted to the current hydrological regime. If historical flows were present, species composition, structure, and density may be different. The site is not grazed as access is very difficult due to the steep canyon walls.

Biodiversity Rank Justification: The globally vulnerable (G3) wooly sedge wet meadow (*Carex pellita*) is documented from Oregon east to Montana and South Dakota south to Colorado and Kansas. This community has increased in abundance along regulated rivers on the Colorado Western Slope and may have decreased in abundance on streams on the eastern plains of Colorado. Few, pristine high-quality stands are known, and no stands are formally protected.

The globally apparently secure (G4Q) foothills riparian shrubland (*Cornus sericea*) is a common riparian type that occurs in several western states. In Colorado, this is a common association, however, poor livestock management threatens it. This plant association occurs adjacent to stream channels and near seeps on moist toeslopes of canyon walls. It also occurs on narrow benches in ravines and on narrow terraces of wider valleys.

Table 35. Natural Heritage element occurrences at Rio Grande at State Line PCA.
Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Plant Communities					
Carex pellita	**Montane wet meadow**	**G3**	**S3**		**C**
Cornus sericea	Foothills Riparian Shrubland	G4Q	S3		C

*EO=Element Occurrence.

Boundary Justification: The site boundary encompasses a portion of the Rio Grande and adjacent cliffs. Topography within the site is very steep. The site boundary was drawn to incorporate an area where these natural processes would maintain viable populations of the elements. It should be noted that the hydrological processes necessary to the elements are not fully contained by the boundaries established for this site. Given that the elements are closely tied to natural processes associated with the Rio Grande, any upstream activities could detrimentally affect the elements.

Protection Comments: The BLM owns the western portion while private land occurs on the east side. Due to the inaccessible nature of the site, protection actions are not necessary in the foreseeable future.

Management Comments: Control of non-native plants such as whitetop and Canada thistle, should be targeted. Changes in upstream water use have the potential to affect the integrity of the elements at this PCA.

Soils Description: Soils are not mapped at this site. Soil texture is variable, with finer sediment occurring where sedges are common and coarser, rock soils where shrubs are growing.

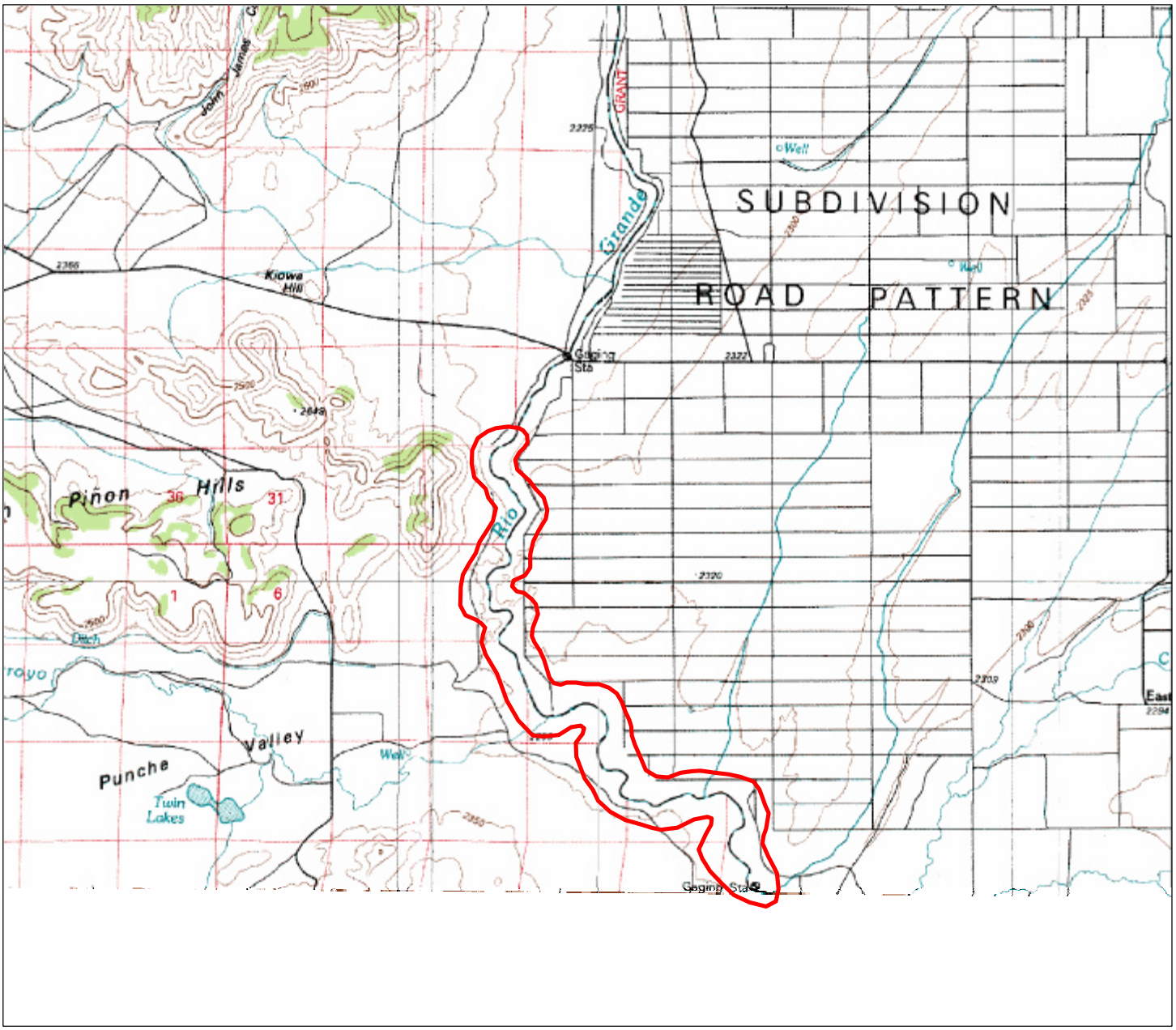
Restoration Potential: Restoration should focus on upstream issues along the Rio Grande. Restoration of natural hydrologic processes would require an immense collaboration with upstream water users, local landowners, municipalities, etc. Wetland functions such as biogeochemical functions, etc., have been impacted by hydrologic alterations and a large-scale

restoration project could improve those functions. However, although natural hydrology has been altered, the current hydrologic regime is supporting the elements found at this site.

Future and present restoration projects focusing on restoring and/or enhancing a diversity of fluvial processes which raise groundwater levels, encourage periodic flooding, and create a mosaic of wetland and riparian vegetation types will most likely succeed in restoring many of the functions compromised by past human-induced impacts. Altering fluvial processes in the Rio Grande will likely require much use of structural measures, many of which result in additional problems downstream. Other, non-structural activities may allow the natural creation of new riparian vegetation communities and also enhance existing one by restoring a diversity of age classes, vertical complexity, and increasing species richness.

The Rio Grande Headwaters Restoration Project (2001) thoroughly addresses those issues related to a large-scale restoration effort along the upper Rio Grande. Readers are encouraged to consult this document (RiGHT, 2003) for more specific information, especially regarding structural restoration techniques.

Wetland Functional Assessment: CNHP wetland ecologists did not visit the wetland contained within this PCA during 2003. Thus, a functional assessment could not be conducted. However, given the impact from altered hydrology, it is hypothesized that some wetland functions have been negatively impacted.



1 0 1 Miles

Projection: UTM, Zone13, NAD27

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LEGEND

Rio Grande at State Line
Potential Conservation Area

30 x 60 Minute Series Quads:
Alamosa, 37105a1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

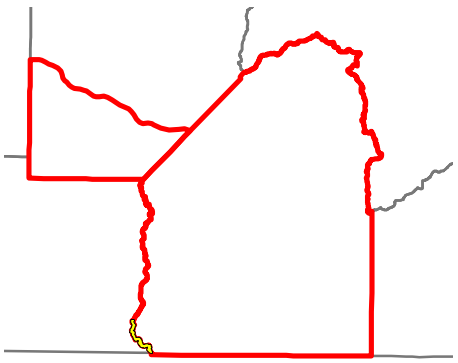


Figure 22. Rio Grande at State Line Potential Conservation Area

ADAMS LAKE POTENTIAL CONSERVATION AREA

Biodiversity Rank: B5. General biodiversity significance. The PCA supports fair examples of three globally common breeding waterbirds.

Protection Urgency Rank: P3. Protection actions may be needed, but probably not within the next five years. It is estimated that current stresses may reduce the viability of the elements of the PCA if protection action is not taken. The site is currently under private ownership.

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

Location: This PCA is located about four miles south of Alamosa, CO.

U.S.G.S. 7.5-min. quadrangle: Alamosa East

Legal Description: T36N R10E portions of S1, 2, and 3;
T37N R10E portions of S34, 35, and 36.

Elevation: 7,530 – 7,535 ft. Approximate Size: 1,705 acres

General Description: Adams Lake sits in a topographic basin just south of Alamosa, CO and about a ½ mile north of the Alamosa River. Rock Creek is about 1 ½ miles to the north. Thus, groundwater discharge associated with the alluvial aquifers of these two drainages may have, historically, been a critical hydrological source of Adams Lake. Seasonal snowmelt and rainfall may have also been important to the hydrology of this site. Aerial photographs from 1955, 1963, and 1988 indicate that irrigation runoff from the Carmel Drain, Empire Lateral Canal, and a local artesian well are currently the main hydrological sources of the lake. Since 2002, lake levels have been very low due to the recent drought in the San Luis Valley.

Adams Lake is a moderately sized body of water in the San Luis Valley. It is surrounded by a thin margin of freshwater marsh vegetation. Much of the surrounding upland areas consist of various combinations of greasewood (*Sarcobatus vermiculatus*), rabbitbrush (*Chrysothamnus nauseosus*), alkali sacaton (*Sporobolus airoides*), Baltic rush (*Juncus balticus*), and saltgrass (*Distichlis spicata*).

Horned pondweed (*Zannichellia palustris*) was the dominant aquatic plant observed in Adams Lake. Hardstem bulrush (*Schoenoplectus acutus*) and wooly sedge (*Carex pellita*) occupy much of the freshwater marsh. Cattail (*Typha latifolia*) and common threesquare (*Schoenoplectus pungens*) also occur in small patches around the lake. Numerous willows (*Salix exigua* and *S. lasiandra* ssp. *caudata*) and cottonwood (*Populus deltoides* ssp. *monilifera*) are found sporadically along the lakeshore.

Surrounding the freshwater marsh is a mesic meadow comprised of Baltic rush, saltgrass, and numerous weedy species such as whitetop (*Lepidium latifolium*) and Russian knapweed (*Acroptilon repens*). This area appears to be periodically mowed. A ranch road also runs through the area, working its way east of the lake where livestock corrals and pastures are located.

To the north of Adams Lake is a large marsh and wet meadow complex. Aerial photographs from 1955, 1963, and 1988 suggest that the site is hydrologically supported by irrigation runoff from the Carmel Drain. Much of this area was dry during the 2004 site visit, however previous years growth of common spikerush (*Eleocharis palustris*) and hardstem bulrush were dominant over much of the marsh area. Whitetop was abundant within the common spikerush stands while goosefoot (*Chenopodium* sp.) and rabbitfoot grass (*Polypogon monspeliensis*) were abundant in the "understory" of the hardstem bulrush stands. The peripheral of the large marsh was more alkaline and dominated by Nuttall's alkaligrass (*Puccinellia nuttalliana*), alkali bulrush (*Schoenoplectus maritimus*), saltgrass, sea-blite (*Suaeda calceoliformis*), and arrowgrass (*Triglochin maritimus*). Whitetop and Canada thistle (*Cirsium arvense*) were abundant in this area.

Biodiversity Rank Justification: This site supports breeding populations of two state imperiled (S2B) birds, the Snowy Egret (*Egretta thula*) and White-Faced Ibis (*Plegadis chihi*) and one state vulnerable (S3B) bird, the Black-necked Stilt (*Himantopus mexicanus*).

Adams Lake is well known in the San Luis Valley as a very productive and important waterbird area. The lake and surrounding wetlands provide important habitat for many migratory birds such as nesting White-Faced Ibis, Black-crowned Night Heron, Snowy Egret, Eared and Western Grebes, and several species of diving ducks (USFWS 2002). The San Luis Valley supports the largest breeding colonies of White-Faced Ibis in Colorado and Adams Lake is one of three large nesting colonies in the San Luis Valley (UWFWS 2002). Water levels at each of the three sites often vary independently, thus protecting each of the breeding sites provides alternative sites for those birds unable to breed in areas with low water levels. This is especially important for White-Faced Ibis, as they are very sensitive to changes in water levels during the nesting period (UWFWS 2002).

Table 36. Natural Heritage element occurrences at Adams Lake PCA. Elements in bold are those upon which the PCA's B-rank is based.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank
Birds					
Egretta thula	**Snowy Egret**	**G5**	**S2B**		**C**
Plegadis chihi	**White-faced Ibis**	**G5**	**S2B**		**C**
Himantopus mexicanus	Black-necked Stilt	G5	S3B		C

*EO=Element Occurrence.

Boundary Justification: In general, most hydrological input to Adams Lake occurs from managed irrigation system, thus ecological processes are highly manipulated. However, boundaries are drawn to encompass the ecological processes believed necessary for long term viability of the element. These boundaries will ensure continued natural surface flow and thus allow lake levels to persist at natural levels, which is crucial to the survival of the wetland plant communities surrounding the lake which support the breeding waterbird populations. The boundaries also provide a small buffer from nearby agriculture where surface runoff may contribute excess nutrients and sediment. Those areas important for recharging groundwater levels and those associated with upstream irrigation are not included in the site boundaries. This boundary indicates the minimum area that should be considered for any conservation management plan.

Protection Comments: The site is currently under private ownership.

Management Comments: 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. Native increasers and non-native species are prevalent and should be monitored as they may indicate a need to implement and or shift management. Grazing occurs within the site and hay meadows are managed nearby.

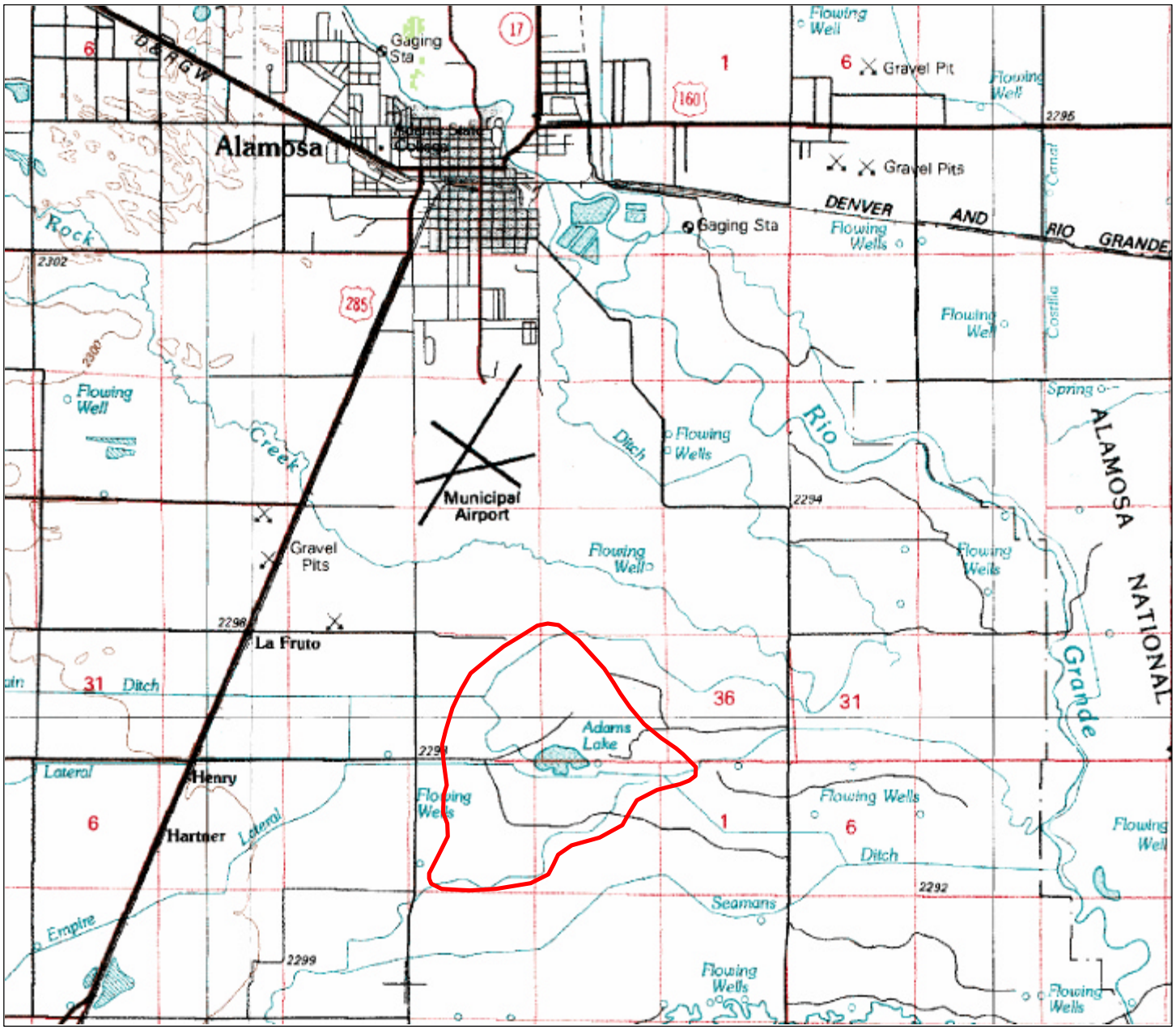
Soils Description: Soils in the Adams Lake area are mapped as Acacio, LaSauses, and La Jara series. The Acacio is Fine-loamy, mixed, frigid, Typic Haplargids and is a well drained, slightly to moderately saline soil with a high concentration of gypsum. They formed on alluvial plains in medium-textured, calcareous, alluvial material (USDA 1973). The LaSauses is a Fine, mixed, nonacid, frigid, Aeric Halaquepts and is a poorly drained, nearly level, saline-alkali soil on floodplains. They formed in medium textured and fine textured alluvial material (USDA 1973). Hydric soil indicators such as gleying and mottles are often observed in LaSauses soils (USDA 1973). The LaJara is a Coarse-loamy, mixed, calcareous, frigid, Typic Haplaquolls and is a poorly drained, nearly level soil on floodplains. They mostly occur in wet, low-lying areas near La Jara Creek and the Alamosa River. They formed in medium textured to moderately coarse textured alluvium (USDA 1973). Soils are simply mapped as "Marsh" within the majority of the wettest areas (marsh and wet meadow complex) (USDA 1973).

Restoration Potential: Restoration should focus on upstream water use. Restoration of natural hydrologic processes would require an immense collaboration with upstream water users, local landowners, municipalities, etc. Wetland functions such as biogeochemical functions, have likely been impacted by hydrologic alterations and a large-scale restoration project could improve those functions. However, although natural hydrology has been altered, the current hydrologic regime is supporting the elements found at this site.

Wetland Functional Assessment for the Adams PCA:
Proposed HGM Class: Depressional **Subclass:** D2/3
Cowardin System: Palustrine
CNHP's Wetland Classification: *Eleocharis palustris, Schoenoplectus acutus, S. pungens, S. maritimus.*
Table 37. Wetland functional assessment for the depressional wetland at the Adams Lake PCA.

Function	Rating	Comments
Overall Functional Integrity	Below Potential	This wetland appears to be functioning below potential due to a manipulated hydrology.
Hydrological Functions		
Flood Attenuation and Storage	N/A	This wetland does not experience overbank flow, rather is hydrologically supported by groundwater discharge and surface input from irrigation canals.
Sediment/Shoreline Stabilization	N/A	This wetland does not experience overbank flow, rather is hydrologically supported by groundwater discharge and surface input from irrigation canals.
Groundwater Discharge/ Recharge	Yes	This wetland is likely supported by some groundwater discharge associated with the alluvial, confined and/or unconfined aquifers.
Dynamic Surface Water Storage	Moderate	The wetland basins can hold large quantities of water. However, much of the storage is from irrigation canals, thus leaving little room for natural storage should it be needed.
Biogeochemical Functions		
Elemental Cycling	Disrupted	The presence of standing water (pools) and large areas of saturated soil provide a gradient for various nutrient transformations. Altered hydrology may disrupt nutrient cycles relative to reference conditions (change from seasonal playa to semi-permanent saline marsh)
Removal of Imported Nutrients, Toxicants, and Sediments.	High	Removal of excess nutrients and sediment (e.g. from upstream and local livestock, hatchery, and agricultural activity) associated with groundwater is likely being performed by this wetland. Dense herbaceous vegetation provides high potential for this area to function as a sink for sediments/nutrients/toxicants. Toxicants and sediments from nearby roads are likely also intercepted in these wetlands prior to reaching downstream creeks and rivers.
Biological Functions		
Habitat Diversity	Moderate	The wetland site consists of wet meadows, small pools, and freshwater marsh.
General Wildlife Habitat	Moderate	This area provides browse and cover for deer, coyote, black bear, and other large and small mammals. Oxbows and sloughs provide open water for waterbirds. However, livestock, agricultural clearing, and nearby roads have eliminated much wildlife habitat in the area. The willow shrublands along the riparian area provide important habitat for the Federally Endangered Southwestern Willow Flycatcher. Wet meadows, emergent wetlands, and open water wetlands provide nesting and migratory habitat for numerous species of birds and mammals, which in turn provide forage for birds of prey such as eagles, hawks, and falcons.
General Fish/Aquatic Habitat	Low	Aquatic habitat occurs within Adams Lake, however the seasonal nature of water levels likely precludes any fish from surviving in the lake. Outside of the lake, there is minimal

		suitable habitat for aquatic organisms.
Production Export/Food Chain Support	High	Dense wet meadow and emergent vegetation and open water support local food chain dynamics by sustaining healthy invertebrate populations. Export of organic substances and associated nutrients is limited due to controlled outlets downstream.
Uniqueness	Moderate	This site is an important breeding area for waterbirds.



Colorado Natural Heritage Program
Colorado State University
College of Natural Resources
254 General Services Bldg.
Fort Collins, CO 80523

map created 5 May 2004

Disclaimer

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LEGEND

Adams Lake
Potential Conservation Area

30 x 60 Minute Series Quads:
Alamosa, 37105a1

Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

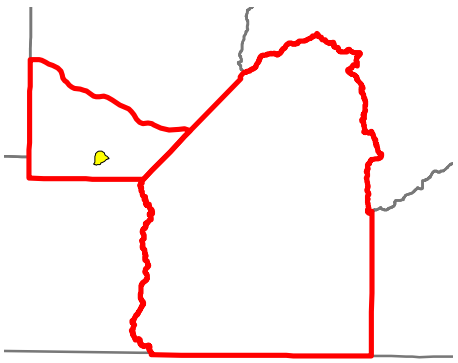


Figure 23. Adams Lake Potential Conservation Area

NATURAL HISTORY INFORMATION

RARE AND IMPERILED ANIMALS DEPENDENT ON WETLANDS OF SOUTHERN ALAMOSA AND COSTILLA COUNTIES

Short-Eared Owl (*Asio flammeus*)

Photo from CNHP Photo database

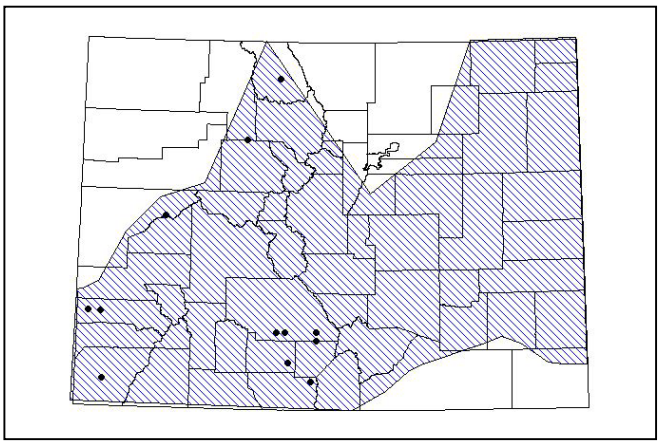
Taxonomy:
Class: Aves
Order: Strigiformes
Family: Tytonidae
Genus: *Asio*

Taxonomic Comments:

CNHP Ranking: G5 S2B, SZN

State/Federal Status:

Habitat Comments: The Short-eared Owl inhabits open fields, marshes, dunes, and grasslands, as well as shrub-steppes and agricultural lands (CBBA 1998). They nest on the ground amid vegetation tall and dense enough to conceal the incubating female (Clark 1975).



Distribution: This owl's winter range extends from the southern one-third of the western U.S. across to the southern two-thirds of the eastern U.S. (CNHP 2003). In cooler parts of their range, including Colorado, they migrate seasonally, and Colorado hosts more of this species in the winter than in the summer (CBBA 1998).

Important Life History Characteristics: The Short-eared Owl nests and fledges their young between Late-May and Mid-June (CBBA 1998).

Known Threats and Management Issues: Loss of habitat due to more intensive agriculture and urbanization, including the greening of the formerly treeless Great Plains with shelterbelts and riparian forests may partly explain the apparent decline of Short-eared Owl populations in Colorado, especially near the Front Range (CBBA 1998). Nest predation may also increase when nest-destroying feral dogs and cats, foxes, and skunks proliferate with human settlement (CBBA 1998).

Potential Conservation Areas: Not documented in CNHP's BIOTICS but observed at Adams Lake.

Southwestern Willow Flycatcher
(*Empidonax traillii extimus*)
(text from NatureServe www.natureserve.org)

Taxonomy:
Class: Aves
Order: Passeriformes
Family: Tyrannidae
Genus: *Empidonax*

Taxonomic Comments:

CNHP Ranking: G5T1T2

State/Federal Status: LE, FS, E

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).

Photo from Finch and Stoleson 2000

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).

Potential Conservation Areas: Rio Grande and Rio Grande at Alamosa National Wildlife Refuge

Greater Sandhill Crane
(*Grus canadensis tabidia*)

Photo from CNHP Photo database

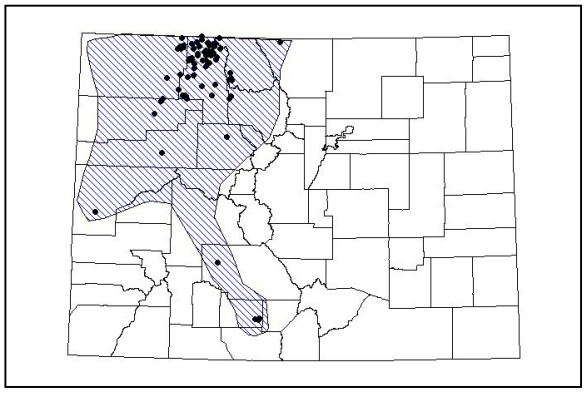
Taxonomy:
Class: Aves
Order: Gruiformes
Family: Gruidae
Genus: *Grus*

Taxonomic Comments:

CHNP Ranking:

State/Federal Status:

Habitat Comments: Sandhill cranes have been found breeding in a variety of wetland habitats, particularly flooded fields and beaver ponds, marshes, and wet meadows (CBBA 1998).



Distribution: The greater sandhill crane winters in southern North America and Central America and breeds in northern North America (NGS 1997). Sandhill cranes are abundant spring and fall migrants in the San Luis Valley and occasional to irregular migrants along river valleys of eastern plains, and valleys and parklands of the western mountains of Colorado (Andrews and Righter 1992).

Important Life History Characteristics: Sandhill cranes begin nesting in May, and fledge their young in June and July (CBBA 1998). After the young reach the flight stage, Colorado's cranes use ranch hayfields as staging grounds for their southern migration.

Known Threats and Management Issues: Drainage of and /or vegetative encroachment on preferred mud flats and sandbar habitats in river and meadow systems along migratory routes, in addition to the availability of spilled grains in adjacent agricultural areas are key conservation considerations for this species (Renner et al. 1991).

Potential Conservation Areas: Not documented in any PCAs but is known to occur throughout the study area.

Black-necked Stilt
(*Himantopus mexicanus*)
(text from NatureServe www.natureserve.org)

Taxonomy:
Class: Aves
Order: Charadriiformes
Family: Recurvirostridae
Genus: *Himantopus*

Taxonomic Comments:

CNHP Ranking: G5 S3B
State/Federal Status:

Photo from www.natureserve.org

Habitat Comments: The Black-necked Stilt's habitat is shallow salt or fresh water with soft muddy bottom; grassy marshes, wet savanna, mudflats, shallow ponds, flooded fields, borders of salt ponds and mangrove swamps (Tropical to Temperate zones) (AOU 1983, Raffaele 1983).

They nest along shallow water of ponds, lakes, swamps, or lagoons and may nest on the ground or in shallow water on a plant tussock.

Black-necked Stilts actively feed in shallow water; they pluck food from the surface of water or mud, or probe in soft mud; may peck or sweep bill to capture prey in water (Cullen, 1994, Wilson Bull. 106:508-513). Eats a variety of insects (e.g., bugs, beetles, caddisflies, mosquito larvae, grasshoppers), polychaetes, crustaceans, snails. Also feeds on some small fishes as well as the seeds of aquatic plants.

Distribution: Globally secure due primarily to large range, but occurrence tends to be much localized; population trends are poorly known for many regions. Large range but localized. BREEDS: locally on Atlantic coast from mid-Atlantic states south to southern Florida, and from southern Oregon, Idaho, northern Utah, southern Colorado, eastern New Mexico, central Kansas, Gulf Coast of Texas, and southern Louisiana and the Bahamas south through Middle America, Antilles, and most of South America to southern Chile and southern Argentina (AOU 1983); may breed also in eastern Montana and western South Dakota; resident in Hawaii (all main islands except Lanai). Mainly resident south of U.S. Some authors treat populations at the southern end of the range from central to southern South America as a distinct species (*H. melanurus*). NORTHERN WINTER: mostly southern California, southern coastal Texas, and Florida south through breeding range (AOU 1983). Morrison et al. (2001) state that the species appears to be expanding its range along the northern edge in recent years.

Important Life History Characteristics: tall slender wader with a long straight slender bill, black (male) or brownish (female) upperparts, white underparts, very long red or pink legs and feet, and a white spot above the eye; immatures have buffy edges on the dark feathers of the upperparts. Social; usually in loose groups of up to 50 (Costa Rica, Stiles and Skutch 1989). Mainly resident south of U.S., though of variable abundance in winter in Puerto Rico (Raffaele 1983). Interior U.S. breeding populations make extensive seasonal migrations.

Known Threats and Management Issues: Loss of wetland habitat.

Potential Conservation Areas: Adams Lake.

Rio Grande cutthroat trout
(*Oncorhynchus clarki virginalis*)

Photo: Unknown

Taxonomy:
Class: Osteichthyes
Order: Salmoniformes
Family: Salmonidae
Genus: *Oncorhynchus*

Taxonomic Comments: Readily hybridizes (or introgresses) with other spring spawning trout such as introduced rainbow trout or other subspecies of cutthroat (Sublette et al. 1990). See Behnke (1992) for a discussion of taxonomic history.

CNHP Rank: G4T3/S3

Distribution: Global and State range: Historic range is not definitely known, but probably encompassed all "trout waters" in the Rio Grande drainage, including the Chama, Jemez, and Rio San Jose drainages (Sublette et al. 1990).

Known Locations in Study Site: During the 1998 survey this subspecies was not actively searched for, however, previous documentation places this subspecies in the watershed that flows through the study area.

Habitat Comments: Most populations are restricted to small headwater streams (Behnke 1992) where allochthonous materials are the primary energy input (Sublette et al. 1990). As with other subspecies, the native habitat included lakes and higher order streams.

Known Threats and Management Issues: Habitat degradation or loss and threats from fish diseases are believed to be important threats to this subspecies (Sue Swift, pers. comm.). Other threats include hybridization (or introgression) and competition with introduced salmonids. Breeding stock for reintroduction and other management purposes is being developed at Mescalero National Fish Hatchery (Sublette et al. 1990). It is estimated that the Rio Grande cutthroat trout occupies less than 1% of its original habitat in Colorado (Alves 1996). Genetically pure populations tend to be found only in small, isolated headwater streams (Propst and McInnis 1975). To help manage and conserve this subspecies in Colorado, remaining habitat should be protected and non-native fishes removed and kept out.

Potential Conservation Areas: Cuates Creek, Jaroso Creek, Little Ute Creek, North Fork Trinchera Creek, Sangre de Cristo Creek, and Torcido Creek.

White-faced Ibis
(*Plegadis chihi*)

Photo from CNHP Photo database

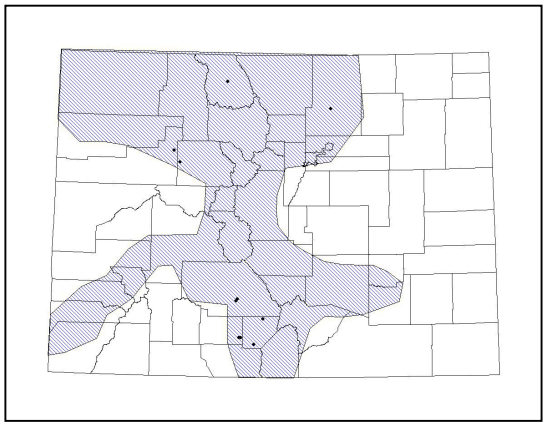
Taxonomy:
Class: Aves
Order: Ardeidae
Family: Threskiornithidae
Genus: *Plegadis*

Taxonomic Comments:

CNHP Ranking: G5 S2B

State/Federal Status:

Habitat Comments: White-faced Ibises feed in wet hay meadows and flooded agricultural croplands as well as in marshes and the shallow water of ponds, lakes, and reservoirs (Ryder and Manry 1994). Most ibises nesting in Colorado favor tall emergents such as bulrushes and cattails growing as "islands" surrounded by water more that 45 cm deep (Ryder 1998).



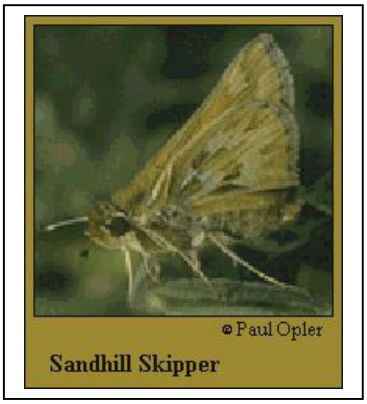
Distribution: In North America the White-faced Ibis nests from central Mexico to Louisiana and Texas (mainly coastal) and throughout the Great Basin. In Colorado, this species mainly nests in the San Luis Valley (Ryder 1998).

Important Life History Characteristics: Most ibises leave Colorado in September, some as late as October. Breeding populations vary considerably from year to year, depending on water levels in favored marshes (Ryder 1967).

Known Threats and Management Issues: Habitat deterioration due to wetland degradation, cattle grazing, and human encroachment pose threats to this species (Ryder and Manry 1994).

Potential Conservation Areas: Adams Lake.

San Luis sandhill skipper
(*Polites sabuleti ministigma*)



Taxonomy:
Class: Insecta
Order: Lepidoptera
Family: Hesperiidae
Genus: *Polites*

Taxonomic Comments: *Polites sabuleti ministigma* Scott is a geographically isolated subspecies of a wider spread species (Scott 1982). Limited to the San Luis Valley and Arkansas River canyon in southern Colorado (Scott 1982).

CNHP Rank: G5T3S3

Distribution: Global range: Limited to the San Luis Valley and Arkansas River Canyon of Southern Colorado (Scott 1982). State range: Known from Saguache County, near the towns of Crestone and Moffat; Alamosa County, at the Great Sand Dunes National Monument, near Big Spring Creek, and near White Ranch; Chafee County, near Salida; and Hayden Creek in Fremont County (Pineda and Ellingson 1998, Rondeau et al. 1997, Scott 1982).

Habitat Comments: Rondeau et al. (1998) reports that this species apparently prefers the lower lying, moister habitats where its host plant, alkaline salt grass (*Distichlis spicata*) is encountered. This graminoid is often found in the more alkaline areas of the playa lakes system, and along some shorelines at springs within the sand sheet near the Great Sand Dunes National Monument.

Phenology: Flight as adults takes place in June (Scott 1986). Little is known about its immature stages.

Food Comments: The larval hostplant is known to be alkaline salt grass (*Distichlis spicata*).

Known Threats and Management Issues: Continued surveys are encouraged to further determine range of this species within the San Luis Valley and the Arkansas River watershed. Additionally, as this species is considered to be an isolated and endemic subspecies (Scott 1982), research to determine the validity of its subspecies status is highly encouraged. Research on the biology and ecology are necessary to facilitate an understanding of the habitat requirements for this species. Adults are encountered in the playas of ephermeral lakes after the water has evaporated and the larval host plant has appeared in its place; therefore, emphasis on understanding the importance of hydrology in habitat maintenance and viability of this species is of primary concern, due to past, on-going, and future water development in the San Luis Valley (Rondeau et al. 1998).

Potential Conservation Areas: Not documented in any PCAs but is known to occur in the study area.

Slender spiderflower
(*Cleome multicaulis*)

(text from NatureServe www.natureserve.org)

Photo from CNHP Photo database

Taxonomy:
Class: Dicotyledoneae
Order: Capparales
Family: Capparaceae
Genus: *Cleome*

CNHP Rank: G2G3 S2S3

Distribution: Historically, this species occurred in rare, suitable habitats in southcentral Colorado and from southeastern Arizona east to western Texas and south to northern Mexico, with 1 disjunct population in central Wyoming. However, the species is in apparent decline. The Arizona populations have not been confirmed since the 1940's and species has not been seen in New Mexico in recent times (the collections from Las Cruces, New Mexico date from 1851). Although there are now over 25 documented occurrences in Colorado alone, the species appears highly threatened, especially by water projects, and it occurs in few protected areas. The fact that it is an annual, along with its habitat specificity, may make it more vulnerable to chance extinction in a string of bad years or due to other stochastic events. The San Luis Valley in Colorado contains the most numerous, largest, and healthiest populations in the world. Slender spiderflower has a limited distribution due to its requirement of moist alkaline soil along with periodic soil disturbance, such as pocket gopher (*Thomomys talpoides*) diggings. These habitat requirements limit the slender spiderflower to the edges of alkaline wet meadows and playas.

Habitat Comments: The margins of moist, slightly saline depressions, such as alkali sinks, alkaline meadows, and old lake beds.

Known Threats and Management Issues: Water projects in San Luis Valley will threaten habitat by lowering water tables or increasing lake coverage.

Potential Conservation Areas: Rio Grande, Blanca Greasewood Flats, Bowen Ditch Playas, Hansen Bluffs Seeps, Playa Blanca, and Rio Grande at Trinchera Creek.

Intermountain bitterweed
(*Hymenoxys (Picradenia) helenioides*)

Taxonomy:
Class: Dicotyledoneae
Order: Asterales
Family: Asteraceae
Genus: Hymenoxys

Taxonomic Comments: Recognized as a species by Kartesz (1994 checklist and 1999 Floristic Synthesis), and by many others (e.g., Parker, Cronquist), but not by Weber (Colorado Flora 1996), who suggests it may be of hybrid origin. Kartesz (letter to Larry Morse, 25Nov99) considers it "well-defined". The species is in a genus of about 27 species all confined to America.

CNHP Rank: G3G4Q S1

Distribution: Range includes south and central Utah (where it is considered more common than once thought due to confusion with another plant), northeastern Arizona, and southeastern Nevada. Also reported from two sites in Colorado and from New Mexico.

Habitat Comments: Common in mountain brush, sagebrush, and aspen communities.

Known Threats and Management Issues: Unknown

Potential Conservation Areas: Not documented in any PCAs but is known to occur in the study area.

RARE AND IMPERILED WETLAND PLANT COMMUNITIES OF SOUTHERN ALAMOSA AND COSTILLA COUNTIES

(Adapted from Carsey et al. 2003)

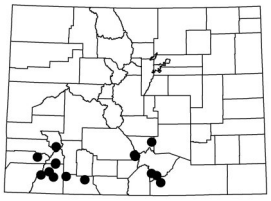
White fir - (Blue spruce) - Narrowleaf cottonwood / Rocky Mountain maple ForesT (*Abies concolor* - (*Picea pungens*) - *Populus angustifolia / Acer glabrum)*

Photo from CNHP Photo database

Global rank/State rank:
G2 / S2

HGM subclass: R3/4

Colorado elevation range:
7,200-9,100 ft (2,200-2,770 m)



General Description

The *Abies concolor-(Picea pungens)-Populus angustifolia/Acer glabrum* (white fir-blue spruce-narrowleaf cottonwood/Rocky Mountain maple) plant association is a diverse, mixed conifer-deciduous forest occurring on active floodplains and stream banks of montane valley floors. The presence of *Abies concolor* distinguishes this community from the more common *Populus angustifolia-Picea pungens/Alnus incana* (narrowleaf cottonwood-blue spruce/thinleaf alder) plant association, and is indicative of the southern-most mountains in Colorado. *Picea pungens* (blue spruce) is often an upper canopy component but is not present in all stands. This is reflected in the association name by placing *Picea pungens* in parentheses.

This community is located in narrow to moderately wide valleys, 50-300 ft (17-100 m) on immediate stream banks, floodplains and upper terraces, 1-6.5 ft, 1.5 ft avg. (0.3-2.0 m, 0.35 avg. m), above the channel high-water level. Streams are steep to moderately steep, straight to moderately sinuous (2-6%, average 4% gradient). The soils are well drained and poorly developed mineral soils with shallow sandy loams over coarse alluvial materials.

Vegetation Description

The upper canopy is diverse, dominated by *Populus angustifolia* (narrowleaf cottonwood) and *Abies concolor* (white fir) and usually including several other tree species such as *Picea pungens* (blue spruce), *Abies lasiocarpa* (subalpine fir), and *Pseudotsuga menziesii* (Douglas-fir). Shrubs are thickest near the stream channel with *Acer glabrum* (Rocky Mountain maple) being the most commonly encountered and abundant species. Other shrubs often present include *Alnus incana* ssp. *tenuifolia* (thinleaf alder), *Betula occidentalis* (river birch), *Cornus sericea* (red-osier dogwood), *Amelanchier utahensis* (Utah serviceberry), *Jamesia americana* (wax flower), *Lonicera involucrata* (twinberry honeysuckle), *Mahonia repens* (Oregon grape), *Salix bebbiana* (Bebb willow), *S. drummondiana* (Drummond willow), *S. monticola* (mountain willow), *Symphoricarpos* spp. (snowberry), *Ribes* spp. (current), and *Rosa woodsii* (Woods rose).

The herbaceous undergrowth is variable, depending on site conditions, but is generally sparse, with less than 20% total cover. No one species is present in all stands. Common forb species include *Heracleum maximum* (common cowparsnip), *Geranium richardsonii* (Richardson geranium), *Vicia americana* (American vetch), *Viola* spp. (violet), *Osmorhiza berteroi* (sweet cicely), *Maianthemum stellatum* (starry false Solomon seal), *Mertensia ciliata* (tall fringed bluebells). Graminoid species include *Elymus glaucus* (blue wildrye), *Bromus inermis* (smooth brome), and *Poa pratensis* (Kentucky bluegrass).

Ecological Processes

This plant association is a mid- to late-seral community. High elevations and cool, shaded canyon bottoms create an environment for *Abies concolor* (white fir) and *Picea pungens* (blue spruce). The active channel flooding and sediment deposition along the reach allows *Populus angustifolia* (narrowleaf cottonwood) to persist. On higher terraces that no longer experience flooding, *Abies* and *Picea* may become the climax tree species.

Potential Conservation Areas: North Fork Trinchera Creek

Avg. Cover %	(Range)	Species Name	# Plots (N=15)
45	(20-100%)	Populus angustifolia	14
33	(5-60%)	Picea pungens	6
29	(5-66%)	Abies concolor	13*
20	(1-62%)	Acer glabrum	12
15	(1-50%)	Alnus incana ssp. tenuifolia	10
13	(1-36%)	Pseudotsuga menziesii	10
12	(1-27%)	Salix drummondiana	5
8	(1-30%)	Heracleum maximum	5
7	(1-30%)	Amelanchier alnifolia	7
7	(1-30%)	Elymus glaucus	5
6	(1-20%)	Lonicera involucrata	8
5	(1-10%)	Symphoricarpos oreophilus	5

Other species with < 5% average cover present in at least 10% of plots:
Rudbeckia laciniata var. ampla (1-10%), Taraxacum officinale (1-7%), Rosa woodsii (1-10%), Geranium richardsonii (1-7%), Poa pratensis (1-11%), Maianthemum stellatum (1-4%), Thalictrum fendleri (1-3%), Chamerion angustifolium ssp. circumvagum (1-4%), Actaea rubra ssp. arguta (1-3%), Equisetum arvense (1-3%), Galium triflorum (1-3%), Mertensia ciliata (1-3%), Oxypolis fendleri (1%), Achillea millefolium var. occidentalis (1%).

*Abies concolor occurred in all stands, but was not captured in every sample plot.

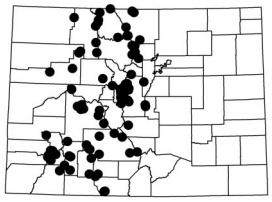
Water sedge Herbaceous Vegetation (*Carex aquatilis*)

Photo from CNHP Photo database

Global rank/State rank:
G5 / S4

HGM subclass: S1/2

Colorado elevation range:
7,600-11,800 ft (2,300-3,600 m)



General Description
Carex aquatilis (water sedge) is a common, widespread plant association that can occur as large meadows in high montane valleys or as narrow strips bordering ponds and streams at lower elevations. It occurs in a variety of environmental settings in the montane and subalpine zones. A clear dominance by *Carex aquatilis* and low cover of *C. utriculata* (beaked sedge) or *Pedicularis groenlandica* (elephanthead lousewort) set this plant association apart from closely related types.

This plant association occurs in a variety of valley types, but the largest expanses occur in broad, low-gradient valleys where large snow-melt fed swales and slopes dominate the landscape. It can also grow in fine sediments at the margins of lakes and beaver ponds. The largest occurrences are found adjacent to narrow, deep, sinuous streams. Some stands occur along steep streams, others along wide, shallow streams, as well as where beaver dams and ponds have altered the channel morphology. Soils are mostly deep, dark colored heavy clays, silts or organic layers over more skeletal layers. Soils are often saturated to the surface, and if not, mottling is commonly present within 10 cm of the surface.

Vegetation Description
This plant association is characterized by a dense rhizomatous meadow of *Carex aquatilis* (water sedge), usually accompanied by a few other graminoids species such as *Calamagrostis canadensis* (bluejoint reedgrass) or *Deschampsia caespitosa* (tufted hairgrass). *Eleocharis quinqueflora* (fewflower spikerush) can be abundant on organic substrates. *Carex utriculata* (beaked sedge) may be present. When present, *Carex utriculata* (beaked sedge) is usually not more than one third the cover of *C. aquatilis* (water sedge) cover. If it is more than that, the stand may be a *Carex aquatilis* - *Carex utriculata* (water sedge- beaked sedge) or *Carex utriculata* (beaked sedge) plant association. Forbs are often present, although sometimes inconspicuously. Species include *Epilobium* spp. (willowweed), *Pedicularis groenlandica* (elephanthead lousewort), *Caltha leptosepala* (marsh marigold), *Cardamine cordifolia* (heartleaf bittercress), and *Mertensia ciliata* (tall fringed bluebells).

Ecological Processes
Presence of *Carex utriculata* (beaked sedge) may indicate the site has progressed from the more wet *Carex utriculata* community to the current less mesic conditions, and may become dominated by *Salix planifolia* (planeleaf willow) or *Salix wolfii* (Wolf willow). *Carex aquatilis* (water sedge) associations trap sediment from overbank flows which forms a clay pan, eventually raising the water table. This process drives retrogressive succession and a plant association dominated by *Carex utriculata* takes over on these sites.

Potential Conservation Areas: Not documented in any PCA but known in the study area.

Avg. Cover %	(Range)	Species Name	# Plots (N=133)	Other species with < 5% average cover present in at least 10% of plots:
60	(5-95%)	Carex aquatilis	133	Taraxacum officinale (0.1-20%), Cardamine cordifolia (1-15%), Achillea millefolium var. occidentalis (1-36%), Poa pratensis (1-7%), Geum macrophyllum var. perincisum (0.1-5%), Pedicularis groenlandica (0.1-10%), Rhodiola rhodantha (0.1-5%).
13	(0.1-48%)	Caltha leptosepala	30	
10	(1-30%)	Carex utriculata	35	
9	(1-40%)	Calamagrostis canadensis	27	
6	(0.1-31%)	Deschampsia caespitosa	40	
6	(1-30%)	Juncus balticus var. montanus	19	
5	(0.1-30%)	Salix planifolia	32	

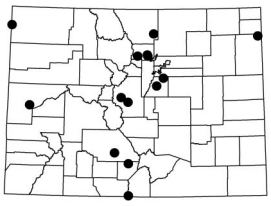
Woolly sedge Herbaceous Vegetation
(*Carex pellita* (=*lanuginosa*)

Photo from CNHP Photo database

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* (scouring rush 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.

Potential Conservation Areas: Rio Grande at State Line. Also known throughout the study area.

Avg. Cover %	(Range)	Species Name	# Plots (N=22)
73	(20 -98%)	Carex pellita	22
25	(10-40%)	Phalaris arundinacea	2
12	(3-20%)	Polygonum amphibium var. emersum	2
11	(0.1-40%)	Mentha arvensis	6
10	(0.1-20%)	Muhlenbergia asperifolia	2
10	(0.1-30%)	Poa pratensis	7
10	(1-20%)	Argentina anserina	7
9	(1-40%)	Eleocharis palustris	7
8	(5-10%)	Calamagrostis stricta	2
6	(5-7%)	Lycopus asper	2

Other species with < 5% average cover present in at least 10% of plots:

Deschampsia caespitosa (1-10%), Carex praegracilis (2-5%), Hordeum jubatum ssp. jubatum (0.1-10%), Carex nebrascensis (0.1-5%), Agrostis gigantea (2.5-3%), Schoenoplectus pungens (1-5%), Cirsium arvense (1-4%), Juncus balticus var. montanus (0.1-5%), Polygonum lapathifolium (0.1-2%), Rumex crispus (0.1-1%), Equisetum arvense (0.1-1%), Juncus torreyi (0.1-1%).

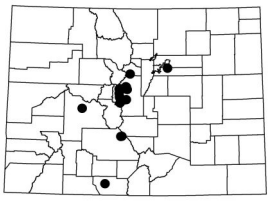
Analogue sedge Herbaceous Vegetation
(*Carex simulata*)

Photo from CNHP Photo database

Global rank/State rank:
G4 / S3

HGM subclass: S1/2

Colorado elevation range:
5,600-11,700 ft (1,700-3,560 m)



General Description
Carex simulata (analogue sedge) is found only on quaking fens in Colorado (occasionally may persist on drying fens). It is commonly found with many other sedge species, but its presence is associated with deep organic soils and a perennially high water table. *Carex simulata* (analogue sedge) fens are known from Larimer County south to the San Luis Valley, and are more or less restricted to the high mountain valleys in the central part of the state.

This community is located on saturated organic soils in moderate to wide valleys. The surface of the ground is hummocky, and "quakes" when walked or jumped on. Streams are low gradient and highly sinuous to broader and slightly steeper. Soils are deep, dark brown to black, 100% peat, saturated to the surface.

Vegetation Description
Graminoids dominate this meadow association with 90-100% vegetative cover. *Carex simulata* (analogue sedge) may not be the most abundant species, but it is always present, and serves as the indicator species for this association. A variety of other *Carex* (sedge) species may be present, and even more abundant, including *Carex aquatilis* (water sedge), *Carex utriculata* (beaked sedge), and *Carex nebrascensis* (Nebraska sedge). *Juncus balticus* var. *montanus* (mountain rush) and other graminoids may also be present. A variety of forbs may be inconspicuously present (total cover <10%). A few scattered shrubs, usually in stunted form, contribute little cover when present. They may include *Salix geyeriana* (Geyer willow), *Salix monticola* (mountain willow), and *Dasiphora floribunda* (shrubby cinqefoil).

Concentric rings or a mosaic of patches of other herbaceous wetland types can be adjacent and intermixed with *Carex simulata* (analogue sedge) fens. Herbaceous wetland plants include *Carex nebrascensis* (Nebraska sedge), *Carex utriculata* (beaked sedge) and *Juncus balticus* var. *montanus* (mountain rush).

Ecological Processes
Little is known about the successional processes of this plant association. Deep accumulations of peat suggest long-term stability. Changes in the natural hydrological regime have the potential to greatly affect the composition of this association.

Potential Conservation Areas: Hansen Bluffs Seeps

Avg. Cover %	(Range)	Species Name	# Plots (N=33)
67	(5-90%)	Carex simulata	33
21	(1-45%)	Carex utriculata	4
16	(1-47%)	Carex aquatilis	10
11	(1-30%)	Carex nebrascensis	5
11	(1-28%)	Juncus balticus var. montanus	9

Other species with < 5% average cover present in at least 10% of plots:
Deschampsia caespitosa (1-10%), Triglochin maritimum (1-10%), Eleocharis palustris (1-7%), Ranunculus cymbalaria (1-5%), Poa pratensis (1-5%), Pedicularis groenlandica (1-2%), Calamagrostis stricta (1-3%), Dodecatheon pulchellum (0.1-1%), Epilobium lactiflorum (0.1-1%).

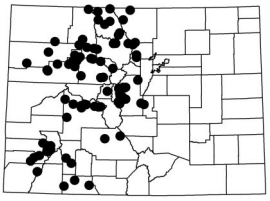
Beaked sedge Herbaceous Vegetation
(*Carex utriculata*)

Photo from CNHP Photo database

Global rank/State rank:
G5 / S5

HGM subclass: D1, D2/3, R2, 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 of wet swales and overflow channels along low-gradient streams. 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 149. 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* (beaked sedge) stand. Individual willows tend to be very short if present, either from limiting growth conditions (extremely cold and/or extremely wet), or because of heavy browsing by wildlife or livestock. The elevation of the site determines which willow species are in and adjacent to *Carex utriculata* (beaked sedge) stands. Willow species that are present may include: *Salix monticola* (mountain willow), *S. drummondiana* (Drummond willow), *S. 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 a *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*.

Potential Conservation Areas: Not documented in any PCA but known in the study area.

Avg. Cover %	(Range)	Species Name	# Plots (N=144)	Other species with < 5% average cover present in at least 10% of plots:
71	(7-100%)	Carex utriculata	144	Equisetum arvense (0.1-20%), Glyceria striata (0.1-10%), Deschampsia caespitosa (1-10%), Geum macrophyllum var. perincisum (0.1-15%), Poa pratensis (1-10%).
9	(0.1-50%)	Carex aquatilis	41	
7	(0.1-30%)	Calamagrostis canadensis	21	
7	(1-20%)	Carex microptera	15	
7	(1-20%)	Juncus balticus var. montanus	16	
6	(1-10%)	Salix monticola	15	
5	(0.1-15%)	Mentha arvensis	15	

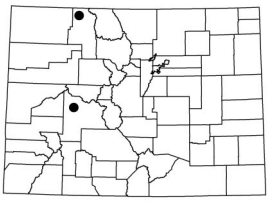
Blister sedge Herbaceous Vegetation
(*Carex vesicaria*)

Photo from CNHP Photo database

Global rank/State rank:
G4Q / S1

HGM subclass: R3/4, S1/2

Colorado elevation range:
8,000-9,700 ft (2,430-3,000 m)



General Description
The *Carex vesicaria* (blister sedge) plant association forms open meadows similar to the *Carex utriculata* (beaked sedge) plant association. As with *Carex utriculata*, it occurs along the shores of lakes and ponds in shallow water, as well as in poorly drained basins and along rivers and streams. The water table typically remains above the ground surface throughout the year. A single stand of *Carex vesicaria* found on the Colorado West Slope has significant cover of *Carex utriculata*, but is distinct from the *Carex utriculata* plant association because of the high cover of *Carex vesicaria*.

Soils are typically Histosols, except in young stands along streambanks where the soil is coarse- to fine-textured alluvium.

Vegetation Description
Carex vesicaria (blister sedge) forms nearly monotypic stands, however, *Carex utriculata* may be present. On wetter sites, emergent wetland plants such as *Sparganium* spp. (burreed) may be sparsely present. On drier sites, *Deschampsia caespitosa* (tufted hairgrass) and *Galium trifidum* (three petal bedstraw) may be present in low amounts.

Ecological Processes
A persistently high water table and thick organic soil horizons provide conditions favorable to the long-term dominance of *Carex vesicaria* (blister sedge). As with other wetland communities, vegetation composition will likely change with the alteration of the hydrology. If water levels remain below the soil surface permanently, the dominant species may shift to *Carex utriculata* (beaked sedge).

Potential Conservation Areas: Elk Meadows Fen

Avg. Cover %	(Range)	Species Name	# Plots (N=2)
68	(50-85%)	Carex vesicaria	2
40	—	Carex aquatilis	1
30	—	Fragaria virginiana ssp. glauca	1
10	—	Potentilla gracilis	1
10	—	Carex utriculata	1
5	—	Salix monticola	1
1	—	Thalictrum fendleri	1

Other species with < 5% average cover present in at least 10% of plots:
Taraxacum officinale (1%), Symphyotrichum foliaceum (1%), Poa palustris (1%), Phleum pratense (1%), Geum macrophyllum var. perincisum (1%), Dasiphora floribunda (1%), Calamagrostis stricta (1%).

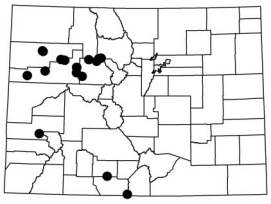
Red-osier dogwood Shrubland
(*Cornus sericea*)

Photo from CNHP Photo database

Global rank/State rank:
G4Q / S3

HGM subclass: R3/4, R5

Colorado elevation range:
5,800-8,800 ft (1,760-2,680 m)



General Description
The *Cornus sericea* (red-osier dogwood) plant association is a medium-height (3-6 ft, 1-2 m), shrubland that often forms continuous, narrow bands along stream banks, benches, and bars. It can form very dense, small stands with limited disturbance, often at the base of a cliff.

This plant association occurs adjacent to stream channels and near seeps on moist toeslopes of canyon walls. It also occurs on narrow benches in ravines and on narrow terraces of wider valleys. Stream channels are narrow and moderately steep with gravel streambeds. The soils are relatively deep silty to sandy clay loams with stratified layers.

Vegetation Description
This plant association is characterized by a dense stand of *Cornus sericea* (red-osier dogwood). Other abundant shrub species, which may be present include *Rosa woodsii* (Woods rose), *Symphoricarpos oreophilus* (mountain snowberry), *Ribes inerme* (whitestem gooseberry), *Betula occidentalis* (river birch), *Acer glabrum* (Rocky Mountain maple), and *Alnus incana* ssp. *tenuifolia* (thinleaf alder). While trees occasionally occur in or adjacent to and overhang some stands, typically this shrubland has no overstory canopy. Scattered tree species may include mature *Populus angustifolia* (narrowleaf cottonwood), *Picea pungens* (blue spruce), *Pinus ponderosa* (ponderosa pine), or *Pseudotsuga menziesii* (Douglas-fir). The herbaceous undergrowth is highly variable and depends on the amount of sunlight reaching the ground. Commonly encountered forbs include *Maianthemum stellatum* (starry false Solomon seal), *Geranium richardsonii* (Richardson geranium), *Mertensia ciliata* (tall fringed bluebells), and *Urtica dioica* (stinging nettle). Some stands are without an herbaceous understory.

Ecological Processes
Cornus sericea (red-osier dogwood) forms a relatively stable community because of its ability to form dense thickets through vegetative reproduction. Subsequent succession takes place over a long period of time. In Montana, this plant association is considered to be early-seral since it colonizes stream bars and adjacent floodplains. With time, the association may eventually become dominated by conifer or deciduous tree species.

Potential Conservation Areas: Rio Grande at State Line

Avg. Cover %	(Range)	Species Name	# Plots (N=18)
50	(20-99%)	Cornus sericea ssp. sericea	18
22	(5-40%)	Equisetum hyemale var. affine	3
20	(1-50%)	Ribes aureum	3
18	(3-40%)	Betula occidentalis	7
12	(1-40%)	Salix exigua	8
11	(1-30%)	Clematis ligusticifolia	3
9	(1-20%)	Picea pungens	7
9	(1-20%)	Alnus incana ssp. tenuifolia	8
8	(1-21%)	Populus angustifolia	3
8	(1-16%)	Abies lasiocarpa	4
7	(1-20%)	Acer glabrum	7
6	(1-20%)	Salix drummondiana	8
5	(1-10%)	Phleum pratense	3
5	(1-10%)	Prunus virginiana var. melanocarpa	5
5	(1-10%)	Pseudotsuga menziesii	3

Other species with < 5% average cover present in at least 10% of plots:
Rudbeckia laciniata var. ampla (1-10%), Rosa woodsii (1-20%), Rhus trilobata var. trilobata (1-10%), Lonicera involucrata (1-10%), Poa pratensis (1-10%), Ribes inerme (1-10%), Humulus lupulus var. lupuloides (1-10%), Heracleum maximum (1-10%), Aconitum columbianum (1-5%), Juniperus scopulorum (2-5%), Maianthemum stellatum (1-19%), Symphoricarpos oreophilus (1-10%), Solidago canadensis (1-5%), Elymus glaucus (1-5%), Equisetum arvense (1-10%), Populus tremuloides (1-5%), Osmorhiza depauperata (1-5%), Amelanchier utahensis (1-10%), Juncus balticus var. montanus (1-5%), Bromus lanatipes (1-5%), Geum macrophyllum var. perincisum (1-5%), Angelica ampla (1-5%), Taraxacum officinale (1-5%), Geranium richardsonii (1-5%), Urtica dioica ssp. gracilis (1-10%), Viola canadensis var. scopulorum (1-5%), Thalictrum fendleri (1-5%), Galium triflorum (1-5%), Mertensia ciliata (1-5%), Actaea rubra ssp. arguta (1-5%), Carex utriculata (1-3%), Agrostis gigantea (1-2%), Cardamine cordifolia (1%), Maianthemum racemosum ssp. amplexicaule (1%), Rubus idaeus ssp. strigosus (1%), Sambucus racemosa var. racemosa (1%), Chamerion angustifolium ssp. circumvagum (1%), Paxistima myrsinites (1%), Symphyotrichum ascendens (1%), Salix ligulifolia (1%).

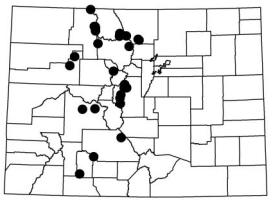
Tufted hairgrass Herbaceous Vegetation
(*Deschampsia caespitosa*)

Photo from CNHP Photo database

Global rank/State rank:
G4 / S4

HGM subclass: S1/2, S3/4

Colorado elevation range:
7,900-12,300 ft (2,400-3,750 m)



General Description
This dense, bunch-grass meadow occurs in broad, nearly flat, valley bottoms in openings of willow carrs (i.e., shrubland thickets) and coniferous forests in subalpine regions across Colorado. It is characterized by uniform to patchy cover of *Deschampsia caespitosa* (tufted hairgrass) with minor cover of other graminoids and forbs. Drier phases of this association grow on gentle slopes above the valley floor.

This meadow plant association generally occurs in broad, glaciated valleys on well-drained ridges and hummocks adjacent to low to moderate gradient streams. It occurs on sites with a moderately high water table, indicated by the presence of mottles or gleying in the soil at a depth of 8 in (20 cm). Stream channels are wide and moderately sinuous or narrow and highly sinuous. Soils are a shallow to deep organic layer over stratified sandy or silty loams and loamy sands.

Vegetation Description
This plant association is a meadow dominated by *Deschampsia caespitosa* (tufted hairgrass). Other graminoids may be abundant depending on local conditions, but no other species are consistently present. These include *Carex aquatilis* (water sedge), *Carex utriculata* (beaked sedge), and *Calamagrostis canadensis* (bluejoint reedgrass). Forb cover is highly variable, *Caltha leptosepala* (marsh marigold) is present in about half of all stands. Other forbs often, but not always, present include *Ranunculus alismifolius* (plantainleaf buttercup), *Rhodiola rhodantha* (redpod stonecrop), *Veronica wormskjoldii* (American alpine speedwell), and *Pedicularis groenlandica* (elephanthead lousewort). Occasionally, a few shrub stems from adjacent stands occur within this association, including *Dasiphora floribunda* (shrubby cinquefoil), *Salix planifolia* (planeleaf willow), and *Salix brachycarpa* (barrenground willow).

Ecological Processes
The *Deschampsia caespitosa* (tufted hairgrass) plant association can continue to occupy sites indefinitely under relatively stable conditions. *Deschampsia caespitosa* occurs along a broad moisture gradient from mesic and dry-mesic environments to those that are very wet. As sites become drier, *Deschampsia caespitosa* cover gradually decreases and *Dasiphora floribunda* (shrubby cinquefoil) cover may increase on sites with well-drained soils. In contrast, if a site becomes wetter, *Carex* (sedge) species may become dominant.

The presence of native increaser species such as *Juncus balticus* var. *montanus* (mountain rush) and non-native species such as *Poa pratensis* (Kentucky bluegrass) and *Taraxacum officinale* (dandelion) may indicate disturbed conditions. As disturbance levels increase, *Poa pratensis* may replace *Deschampsia caespitosa*. Many subalpine areas now dominated by *Poa pratensis* may have supported *Deschampsia caespitosa* communities in the past.

This is a common association in Colorado, however few pristine stands have been documented. It is highly threatened by heavy livestock grazing, invasion by non-native species, and reduced fire frequency.

Potential Conservation Areas: Known from Hansen Bluffs Seeps but not in BIOTICS.

Avg. Cover %	(Range)	Species Name	# Plots (N=31)
39	(10-80%)	Deschampsia caespitosa	31
16	(1-38%)	Ligusticum tenuifolium	6
16	(2-30%)	Juncus balticus var. montanus	6
13	(1-90%)	Poa pratensis	9
13	(1-50%)	Carex aquatilis	19
12	(6-20%)	Calamagrostis canadensis	3
11	(1-40%)	Carex microptera	7
11	(5-26%)	Argentina anserina	5
10	(1-20%)	Carex utriculata	3
10	(3-20%)	Arnica mollis	4
10	(1-45%)	Caltha leptosepala	16
9	(3-15%)	Hordeum jubatum ssp. jubatum	3
9	(1-15%)	Hordeum brachyantherum ssp. brachyantherum	3
8	(5-12%)	Carex illota	5
7	(2-11%)	Erigeron peregrinus ssp. callianthemus	4
6	(1-11%)	Trollius laxus ssp. albiflorus	4

Other species with < 5% average cover present in at least 10% of plots:
Carex scopulorum (3-4%), Trisetum wolfii (1-7%), Juncus drummondii (1-11%), Phleum alpinum (1-12%), Senecio triangularis (1-8%), Taraxacum officinale (1-9%), Salix planifolia (1-7%), Packera dimorphophylla (1-5%), Carex nigricans (1-8%), Symphyotrichum foliaceum (1-5%), Potentilla diversifolia (2-3%), Pedicularis groenlandica (0.1-5%), Achillea millefolium var. occidentalis (1-5%), Cardamine cordifolia (1-3%), Viola macloskeyi ssp. pallens (1-3%), Agrostis humilis (1-4%), Veronica wormskjoldii (1-4%), Polygonum bistortoides (0.1-5%), Plantago tweedyi (1-2%), Carex ebenea (1-2%), Ranunculus alismifolius var. montanus (1-3%), Juncus mertensianus (1-2%), Rhodiola rhodantha (0.1-3%), Fragaria virginiana ssp. glauca (1%), Castilleja sulphurea (1%), Antennaria corymbosa (1%), Stellaria umbellata (1%).

Inland saltgrass Herbaceous Vegetation
(*Distichlis spicata*)

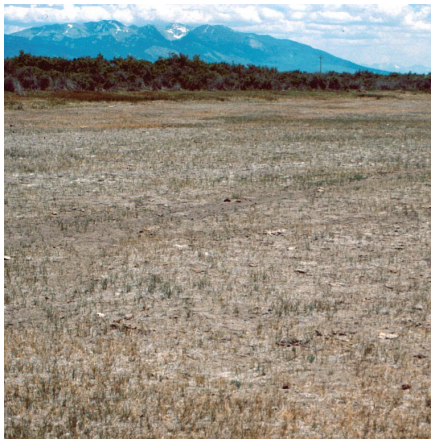
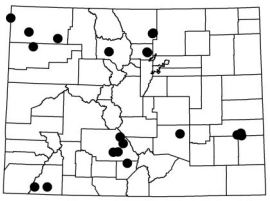


Photo from CNHP Photo database

Global rank/State rank:
G5 / S3

HGM subclass: F1

Colorado elevation range:
3,800-8,900 ft (1,150-2,700 m)



General Description
This plant association is characterized by sparse to thick stands of pure *Distichlis spicata* (inland saltgrass) growing on alkaline or saline soils in shallow basins, swales or on pond margins. This is a common association in Colorado, however, it has declined in abundance since European settlement. Large, pristine stands are virtually unknown. This association is threatened by agricultural conversion and groundwater development.

This plant association occurs on alkaline or saline soils (soils that have been formed from the accumulation of bases and soluble salts in poorly drained areas). This association occurs along narrow streams or the margins of playa lakes. Soil textures include sandy clay, sandy loam, or sandy clay loam with gravel and cobbles. The soils may be heavily gleyed and can have fine, distinct mottles at a depth of about 20 inches (50 cm).

Vegetation Description
This plant association is characterized by almost pure stands of *Distichlis spicata* (inland saltgrass) with up to 95% cover. Occasionally several clumps of *Ericameria nauseosa* ssp. *nauseosa* var. *glabrata* (rubber rabbitbrush) or *Sarcobatus vermiculatus* (black greasewood) can be present. In degraded stands, *Iva axillaris* (povertyweed) or *Bromus tectorum* (cheatgrass) can be present.

Ecological Processes
Distichlis spicata (inland saltgrass) is a warm season grass and grows from early summer until fall primarily from rhizomes. *Distichlis spicata* can tolerate low to moderately alkaline soils and is resistant to trampling by livestock. Cover of *Distichlis spicata* increases when grazing reduces competition from other plants, but eventually *Hordeum jubatum* (foxtail barley) or weedy species will take over if heavy grazing persists.

Potential Conservation Areas: Known throughout the study area.

Avg. Cover %	(Range)	Species Name	# Plots (N=37)
45	(2-95%)	Distichlis spicata	37
13	(5-30%)	Suaeda calceoliformis	5
9	(5-10%)	Puccinellia nuttalliana	4
8	(2-10%)	Iva axillaris	6
5	(0.1-15%)	Sporobolus airoides	5

Other species with < 5% average cover present in at least 10% of plots:
Schoenoplectus pungens (1-11.1%), Pascopyrum smithii (1-5%), Muhlenbergia asperifolia (0.1-6%), Juncus balticus var. montanus (1-8%), Hordeum jubatum ssp. jubatum (0.1-10%), Triglochin maritimum (0.1-5%), Cirsium arvense (0.1-5%).

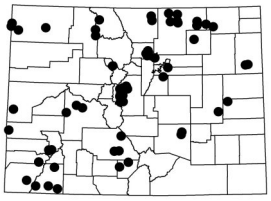
Common spikerush Herbaceous Vegetation (*Eleocharis palustris*)

Photo from CNHP Photo database

Global rank/State rank:
G5 / S4

HGM subclass: D2/3, D4/5, S1/2

Colorado elevation range:
3,800-11,400 ft (1,150-3,500 m)



General Description
The *Eleocharis palustris* (common spikerush) plant association is a conspicuous, if small, common emergent association that occurs in shallow, mostly still water. Most of the sites where it occurs experience water levels that fluctuate to some degree throughout the growing season. It is recognized by the clear dominance, although sometimes sparse cover, of *Eleocharis palustris*. The largest known occurrence consists of broad concentric rings around a series of playa lakes at The Nature Conservancy's Mishak Lake Preserve in the San Luis Valley in south central Colorado.

This association occurs on wet sand bars and on finer substrates in backwater areas within the stream channel at low elevations and in shallow waters of ponds in montane and subalpine regions. This association often occurs along narrow, sinuous headwater rivulets where groundwater flow is lateral, primarily fed from toeslope seeps. High elevation stands consistently occur on organic soils, or on a thick organic horizon that overlies fine to coarse alluvial material. Lower elevation stands occur on fresh alluvial deposits of fine-textured loamy sands, clays, clay loams, and sandy clays.

Vegetation Description
This community can be very sparse to quite dense, but *Eleocharis palustris* (common spikerush) is always the dominant species, and the only species always present. Because the *Eleocharis palustris* (common spikerush) plant association occurs within a wide elevational range, the species composition can be quite variable, but this community is easily recognized by its single, low herbaceous canopy cover of bright green, nearly pure stands of *Eleocharis palustris* (common spikerush). Other species, when present, can contribute as much as 40% cover, but never exceed that of the *Eleocharis palustris*. On the Colorado Western Slope in low elevation stands, co-occurring species can include *Phalaris arundinacea* (reed canarygrass) and *Juncus balticus* var. *montanus* (mountain rush) as well as the introduced *Melilotus officinalis* (yellow sweetclover) and *Bromus inermis* (smooth brome). Other species may include *Sparganium angustifolium* (narrowleaf burreed), *Lemna* spp. (duckweed) and *Potamogeton* spp. (pondweed). On the eastern plains, co-occurring species can include *Leersia oryzoides* (rice cutgrass), *Schoenoplectus pungens* (threesquare bulrush), *Panicum virgatum* (switchgrass), *Carex pellita* (woolly sedge), and *Spartina pectinata* (prairie cordgrass).

At higher, montane elevations other graminoids present include *Carex aquatilis* (water sedge), *C. utriculata* (beaked sedge), and *Deschampsia caespitosa* (tufted hairgrass). Forb cover is typically low, but can occasionally be abundant in some stands. Common forb species include *Pedicularis groenlandica* (elephanthead lousewort), *Rhodiola integrifolia* (ledge stonecrop), and *Caltha leptosepala* (marsh marigold).

Ecological Processes
At lower elevations the *Eleocharis palustris* (common spikerush) plant association occurs well within the active channel and is inundated annually. This early seral community colonizes backwater eddies and shallow edges of slow moving reaches of small and larger rivers. It is probably an ephemeral community, scoured out each year during high spring flows. At montane elevations, this association occurs in ponded sites on faster moving streams. If siltation occurs, sites may become dominated by *Carex utriculata* (beaked sedge). At higher elevations, this association appears to be stable. It occurs near seeps on soils with deep organic layers, often sapric, and saturated throughout the growing season.

Potential Conservation Areas: Known throughout the study area.

Avg. Cover %	(Range)	Species Name	# Plots (N=142)
47	(3-100%)	Eleocharis palustris	142
14	(0.1-63%)	Agrostis gigantea	12
8	(0.1-88%)	Hordeum jubatum ssp. jubatum	32
6	(0.1-29%)	Schoenoplectus pungens	25
5	(1-15%)	Beckmannia syzigachne	11
5	(0.1-40%)	Polygonum amphibium var. emersum	12

Other species with < 5% average cover present in at least 10% of plots:
Juncus balticus var. montanus (0.1-15%), Xanthium strumarium (0.1-15%), Schoenoplectus acutus\tabernaemontani (0.1-23%), Epilobium ciliatum ssp. glandulosum (0.1-15%), Argentina anserina (0.1-10%), Mentha arvensis (0.1-5%), Salix exigua (0.1-5%).

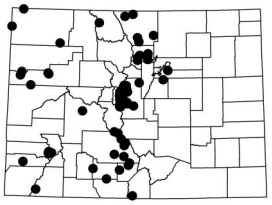
Mountain rush Herbaceous Vegetation
(*Juncus balticus* var. *montanus*)

Photo from CNHP Photo database

Global rank/State rank:
G5 / S5

HGM subclass: D2/3, D4/5, S3/4, R3/4

Colorado elevation range:
4,900-10,000 ft (1,500-3,050 m)



General Description
This plant association occurs as small, dense patches on flat stream benches, along overflow channels, near springs, and around ponds. It is characterized by a dense sward of *Juncus balticus* var. *montanus* (mountain rush) and often minor cover of *Carex* (sedge) species. Forb cover is generally low. This association is often considered to be a grazing-induced community since it is not palatable to livestock and increases with grazing.

Adjacent stream channels are highly variable and can be narrow and deeply entrenched, moderately wide and moderately sinuous, moderately wide and very sinuous, narrow and very sinuous, or braided. Soil textures are also variable. They range from sandy and well drained, to silty clay loams, to pure organic matter, however most stands occur on coarse-textured sandy loams with a high percentage of cobbles and gravel. Mottles or gleyed horizons are often present.

Vegetation Description
This plant association is very easy to recognize with its band of dark green following the channel path or surrounding depressions. *Juncus balticus* var. *montanus* (mountain rush) is the dominant and indicator species for this community. Because it occurs over a broad elevational and latitudinal range in Colorado, associated species are variable. Some of the more frequently encountered species include *Carex aquatilis* (water sedge), *Carex praegracilis* (clustered field sedge), *Carex utriculata* (beaked sedge), *Glyceria striata* (fowl mannagrass), *Distichlis spicata* (inland saltgrass) and *Eleocharis palustris* (common spikerush).

Forb cover is usually minor, and may include *Argentina anserina* (silverweed cinquefoil), *Achillea millefolium* var. *occidentalis* (western yarrow), *Mentha arvensis* (wild mint) or *Trifolium* spp.(clover). Degraded stands and grazing-induced stands of *Juncus balticus* var. *montanus* (mountain rush) can have high abundance of *Agrostis gigantea* (redtop), *Poa pratensis* (Kentucky bluegrass), *Phleum pratense* (timothy), and *Taraxacum officinale* (dandelion). Occasionally, a few tree or shrub seedlings may be present with 3-15% cover, including *Populus angustifolia* (narrowleaf cottonwood), *Dasiphora floribunda* (shrubby cinquefoil), and *Salix exigua* (sandbar willow).

Ecological Processes
In low-disturbance areas, this plant association appears to be a stable, climax community, often persisting in the absence of wetland conditions. It occupies frequently inundated swales and wet, low- to mid-elevation sites. However, in some areas, this association is considered to be grazing-induced. *Juncus balticus* var. *montanus* (mountain rush) is considered an increaser due to its low forage value and high tolerance to grazing. It usually increases in abundance on sites formerly dominated by *Deschampsia*

caespitosa (tufted hairgrass) or *Calamagrostis canadensis* (bluejoint reedgrass). Nearly pure stands of *Juncus balticus* var. *montanus* (mountain rush) indicate that the site may have been heavily grazed in the past.

Potential Conservation Areas: Known throughout the study area.

Avg. Cover %	(Range)	Species Name	# Plots (N=178)
54	(1-100%)	Juncus balticus var. montanus	178
19	(0.1-63%)	Agrostis gigantea	24
17	(1-55%)	Argentina anserina	67
16	(0.1-85%)	Poa pratensis	60
9	(0.1-40%)	Carex praegracilis	34
9	(1-25%)	Carex simulata	20
8	(0.1-30%)	Deschampsia caespitosa	67
8	(0.1-45%)	Phleum pratense	27
7	(0.1-30%)	Hordeum jubatum ssp. jubatum	40
6	(0.1-20%)	Plantago eriopoda	24
6	(0.1-15%)	Dasiphora floribunda	18
5	(0.1-30%)	Iris missouriensis	28
5	(0.1-30%)	Taraxacum officinale	48

Other species with < 5% average cover present in at least 10% of plots:
Poa secunda (0.1-10%), Potentilla gracilis (0.1-10%), Juncus longistylis (1-15%), Elymus trachycaulus ssp. trachycaulus (0.1-25%), Mentha arvensis (0.1-25%), Triglochin maritimum (0.1-15%), Pedicularis crenulata (0.1-15%), Calamagrostis stricta (0.1-15%), Achillea millefolium var. occidentalis (0.1-15%), Crepis runcinata ssp. runcinata (0.1-10%).

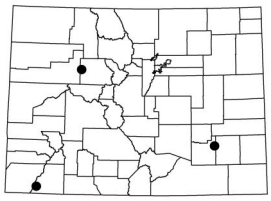
Common reed Herbaceous Vegetation
(*Phragmites australis*)

Photo from CNHP Photo database

Global rank/State rank:
G5 / S3

HGM subclass: R5

Colorado elevation range:
3,900-6,500 ft (1,200-1,980 m)



General Description
The *Phragmites australis* (common reed) plant association is a tall (3-5 ft, 1-1.5 m) reed community often growing in small wet patches at seeps and backwater areas of large floodplains, around the fringes of irrigation ponds, and ditches, and along railroad embankments that have poor drainage. The *Phragmites australis* (common reed) plant association was once thought to be widespread throughout western Colorado. Now, it occurs only in small, isolated patches where water has become impounded, such as adjacent to raised railroad beds, irrigation ditches, oxbow lakes, and other low-lying swampy areas. It is threatened by stream flow alterations, road building and maintenance.

This plant association occurs in seeps, along irrigation ditches and outflows, and in oxbow lakes. Soils are deep silty clay loams and sands, often with rich mottling at the level of the fluctuating water table.

Vegetation Description
This vegetation is characterized by tall (5-8 ft, 1.6-2.6 m) grasses in small pockets and stands in marshes and wetlands on broad floodplains. *Phragmites australis* (common reed) is the dominant and diagnostic species. While stands appear to be pure, monotypic stands of the grass, there are almost always a few other, if highly variable, species present. These include *Salix exigua* (sandbar willow), *Conyza canadensis* (Canadian horseweed), and *Apocynum androsaemifolium* (spreading dogbane).

Ecological Processes
Phragmites australis (common reed) generally requires seasonal flooding in the spring. This species has strong rhizomes that allow it to out compete all but the most aggressive weedy species. With heavy disturbance, however, non-native species such as *Cirsium arvense* (Canada thistle) may invade this plant association.

Potential Conservation Areas: Known from the Rio Grande at Alamosa National Wildlife Refuge.

Avg. Cover %	(Range)	Species Name	# Plots (N=3)
78	(65-88%)	Phragmites australis	3
38	—	Atriplex argentea	1
15	—	Bromus tectorum	1
15	—	Chrysothamnus viscidiflorus	1
10	(5-15%)	Conyza canadensis	2
5	—	Kobresia sibirica	1
5	—	Lactuca serriola	1

Other species with < 5% average cover present in at least 10% of plots:
Lepidium virginicum (4%), Salix exigua (1-5%), Bassia hyssopifolia (2%), Chenopodium album (2%), Cirsium arvense (2%), Asparagus officinalis (1%), Bromus commutatus (1%), Cardamine cordifolia (1%), Carduus nutans ssp. macrolepis (1%), Apocynum androsaemifolium (1%), Cirsium vulgare (1%), Glycyrrhiza lepidota (1%), Helianthus annuus (1%), Maianthemum stellatum (1%), Poa palustris (1%), Rudbeckia laciniata var. ampla (1%), Salix amygdaloides (1%), Artemisia michauxiana (0.1%).

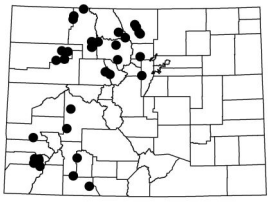
Blue spruce / Thinleaf alder Forest
(*Picea pungens / Alnus incana* ssp. *tenuifolia*)

Photo from CNHP Photo database

Global rank/State rank:
G3 / S3

HGM subclass:
R2, R3/4, R5

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 5-70% 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* (red-osier dogwood), *Ribes lacustre* (current), *Acer glabrum* (Rocky Mountain maple), *Vaccinium* spp. (whortleberry), *Salix boothii* (Booth willow), and *Salix wolfii* (Wolf willow).

The forb canopy layer is thick, up to 50% total cover and species-rich, often with more than 40 species represented in one stand. Species include *Actaea rubra* (baneberry), *Conioselinum scopulorum* (Rocky Mountain hemlockparsley), *Oxypolis fendleri* (cowbane), *Geranium richardsonii* (Richardson geranium), *Heracleum maximum* (common cowparsnip), *Maianthemum stellatum* (starry false Solomon seal), *Mertensia ciliata* (tall fringed bluebells), *Rudbeckia laciniata* var. *ampla* (cutleaf cornflower), and *Equisetum arvense* (field horsetail).

Ecological Processes
In deep, narrow canyons with swift-moving streams and narrow floodplains and benches, *Picea pungens* (blue spruce) appears to be a climax riparian species, and will remain until removed or damaged by a catastrophic flood. In Colorado, the closely related *Picea pungens/Equisetum arvense* (blue spruce/field horsetail) plant association is considered an indicator of frequent flooding. With less frequent flooding, this association may gradually change to a *Picea pungens/Alnus incana* ssp. *tenuifolia* (blue spruce/thinleaf alder) plant association.

Potential Conservation Areas: Not documented in any PCAs but known from the study area.

Avg. Cover %	(Range)	Species Name	# Plots (N=35)
32	(1-70%)	Picea pungens	35
28	(1-80%)	Alnus incana ssp. tenuifolia	34*
12	(1-85%)	Calamagrostis canadensis	13
12	(1-55%)	Salix exigua	5
12	(1-50%)	Abies lasiocarpa	15
9	(1-28%)	Acer glabrum	6
9	(1-32%)	Salix bebbiana	7
9	(1-28%)	Salix monticola	7
9	(1-18%)	Populus tremuloides	8
8	(1-45%)	Equisetum arvense	27
8	(1-40%)	Salix drummondiana	16
8	(1-20%)	Ribes lacustre	7
7	(1-32%)	Ribes inerme	10
7	(1-18%)	Pinus contorta	6
5	(1-25%)	Poa pratensis	20
5	(1-30%)	Lonicera involucrata	26
5	(0.1-20%)	Rudbeckia laciniata var. ampla	14
5	(1-10%)	Cornus sericea	8
5	(0.1-20%)	Trifolium repens	8

Other species with < 5% average cover present in at least 10% of plots:

Saxifraga odontoloma (1-10%), Symphoricarpos oreophilus (1-20%), Heracleum maximum (1-15%), Rubus idaeus ssp. strigosus (0.1-20%), Mertensia ciliata (1-10%), Thalictrum fendleri (1-10%), Streptopus amplexifolius var. chalazatus (1-10%), Senecio triangularis (1-10%), Erigeron speciosus var. speciosus (1-9%), Maianthemum stellatum (0.1-13%), Geranium richardsonii (0.1-10%), Bromus ciliatus var. ciliatus (1-11%), Actaea rubra ssp. arguta (1-10%), Salix ligulifolia (1-5%), Rosa woodsii (1-10%), Aconitum columbianum (1-10%), Taraxacum officinale (0.1-15%), Poa palustris (1-5%), Amelanchier alnifolia (1-10%), Phleum pratense (1-10%), Cardamine cordifolia (1-10%), Urtica dioica ssp. gracilis (1-10%), Elymus glaucus (1-10%), Galium triflorum (1-10%), Luzula parviflora (0.1-8%), Conioselinum scopulorum (0.1-5%), Dasiphora floribunda (1-7%), Chamerion angustifolium ssp. circumvagum (1-10%), Osmorhiza depauperata (0.1-10%), Fragaria virginiana ssp. glauca (1-5%), Glyceria striata (0.1-5%), Achillea millefolium var. occidentalis (1-5%), Galium boreale (1-5%), Orthilia secunda (1-3%), Viola canadensis var. scopulorum (0.1-3%), Carex microptera (1-3%), Vicia americana (1-5%), Oxypolis fendleri (1-3%), Osmorhiza berteroi (1-3%), Geum macrophyllum var. perincisum (0.1-5%), Prunella vulgaris (1%), Ranunculus macounii (1%).

*Alnus incana ssp. tenuifolia occurred in all stands, but was not captured in every sample plot.

Water smartweed Emergent Wetland
Polygonum amphibium

(text from NatureServe www.natureserve.org)

Photo from CNHP Photo database

Global rank/State rank:
G5 / S3

HGM subclass:
D2

Colorado elevation range:
6,725-8,860 ft (2050-2,700 m)

General Description
This community is found primarily in the western United States and one province in Canada. It occurs over a wide elevational range from near sea level to over 2700 m. Stands are found in permanently flooded depressions, such as margins of lake shores and oxbow lakes in river floodplains. The vegetation is characterized by the dominance or codominance of *Polygonum amphibium*, a hydromorphically rooted emergent forb. Associates may include species of *Potamogeton* and other aquatic plants.

Vegetation Description
This wetland vegetation type occurs in shallow water along the edges of ponds and lakes. Floating-leaved aquatic forbs cover at least 30% of the water's surface (Kunze 1994). *Polygonum amphibium* often forms dense, nearly monotypic stands. *Lemna minor, Potamogeton natans, Sagittaria* spp., *Spirodela polyrrhiza*, and *Wolffia* spp. are occasionally present.

Ecological Processes
This wetland occurs in shallow water around the edges of ponds and lakes in western North America. Elevation varies depending on geographical location. Stands reported along the Columbia River and in the Great Plains are located just above sea level, in Montana between 640-1080 m, in northeastern Utah at 1420 m, and in Colorado from 2050-2700 m. Sites include oxbow lakes and backwater areas of the Columbia floodplains, seasonally flooded basins in the floodplains of the Green River, in glacial ponds or prairie potholes in northern Montana, in shallow lakes in the mountains of Colorado, and in flooded basins of central and western South Dakota, and possibly the Sandhills of Nebraska. Stands are located in standing water that is permanent or present at least during the growing season. The pond bottoms are composed of finer sediments, organic muck, clay, or silt.

Potential Conservation Areas: Rio Grande

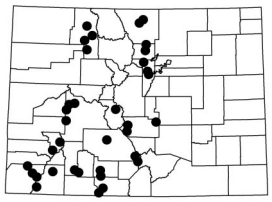
Narrowleaf cottonwood / Thinleaf alder Woodland
(*Populus angustifolia* / *Alnus incana* ssp. *tenuifolia*)

Photo from CNHP Photo database

Global rank/State rank:
G3 / S3

HGM subclass: R3/4

Colorado elevation range:
6,200-8,900 ft (1,900-2,700 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) 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 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* (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).

Potential Conservation Areas: North Fork Trinchera Creek

Avg. Cover %	(Range)	Species Name	# Plots (N=37)	Other species with < 5% average cover present in at least 10% of plots:
35	(1-80%)	Alnus incana ssp. tenuifolia	37	Acer glabrum (1-10%), Rosa woodsii (1-30%), Heracleum maximum (0.1-15%), Pyrola asarifolia ssp. asarifolia (1-10%), Poa palustris (1-10%), Taraxacum officinale (1-20%), Juniperus scopulorum (1-11%), Salix ligulifolia (1-10%), Lonicera involucrata (0.1-10%), Equisetum arvense (0.1-18%), Oxypolis fendleri (1-11%), Urtica dioica ssp. gracilis (1-10%), Prunus virginiana var. melanocarpa (1-7%), Maianthemum stellatum (0.1-10%), Osmorhiza depauperata (1-4%), Achillea millefolium var. occidentalis (0.1-12%), Clematis ligusticifolia (1-3%), Juncus balticus var. montanus (1-6%), Vicia americana (1-5%), Mertensia ciliata (1-5%), Galium triflorum (1-4%), Thalictrum fendleri (1-5%), Geum macrophyllum var. perincisum (1-6%), Geranium richardsonii (1-5%), Fragaria virginiana ssp. glauca (1-5%), Chamerion angustifolium ssp. circumvagum (1-3%), Galium boreale (1-3%), Mentha arvensis (1-4%), Symphoricarpos rotundifolius (1-3%), Galium trifidum ssp. subbiflorum (1-3%), Actaea rubra ssp. arguta (0.1-3%), Phleum pratense (1%), Equisetum laevigatum (0.1-1%).
18	(1-40%)	Agrostis gigantea	5	
13	(1-30%)	Salix lucida ssp. caudata,	14	
13	(3-28%)	Betula occidentalis	5	
12	(1-48%)	Trifolium repens	7	
11	(3-35%)	Salix drummondiana	10	
10	(1-30%)	Poa pratensis	26	
10	(1-30%)	Cornus sericea ssp. sericea	12	
10	(1-34%)	Populus tremuloides	5	
8	(1-32%)	Salix exigua	8	
7	(1-15%)	Agrostis stolonifera	6	
7	(1-14%)	Salix monticola	9	
6	(1-22%)	Cardamine cordifolia	5	
6	(0.1-40%)	Dactylis glomerata	9	
6	(1-20%)	Rubus idaeus ssp. strigosus	6	
6	(1-17%)	Calamagrostis canadensis	8	
6	(1-14%)	Pseudotsuga menziesii	7	
5	(1-14%)	Salix bebbiana	8	
5	(1-11%)	Ribes inerme	5	
5	(1-20%)	Rudbeckia laciniata var.	12	

Narrowleaf cottonwood / Sandbar willow Woodland
(*Populus angustifolia* / *Salix exigua*)

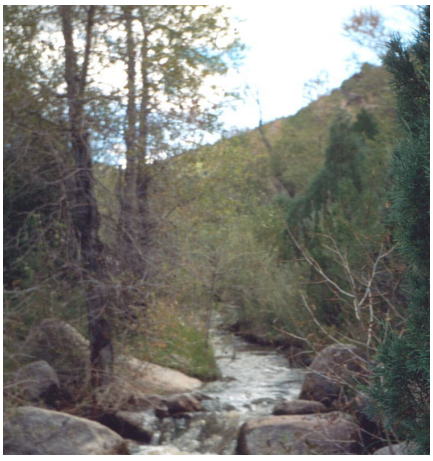
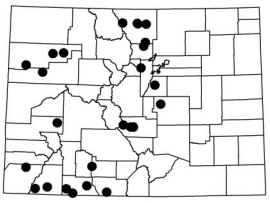


Photo from CNHP Photo database

Global rank/State rank:
G4 / S4

HGM subclass: R3/4, R5

Colorado elevation range:
6,300-7,500 ft (1,900-2,300 m)



General Description
This is a very common plant association of young seedling and sapling *Populus angustifolia* (narrowleaf cottonwood) intermixed with *Salix exigua* (sandbar willow). The association occupies point bars, gravel bars, benches and low areas that are flooded annually.

This plant association occurs on recently flooded point bars, low terraces, and stream benches. It is usually well within the active channel and immediate floodplain of the stream and does not occur more than 3-6 ft (1-2 m) above the high-water mark. Stream channels are wide and slightly sinuous, or wide and moderately sinuous. Soils are skeletal (40% gravel and 10-20% cobbles) and shallow, 15 inches (35 cm) deep, sands, sandy loams, sandy clay loams, or silty clays over coarse alluvial material.

Vegetation Description
This plant association represents the early, successional stage of nearly all *Populus angustifolia* (narrowleaf cottonwood) dominated plant associations, and is characterized by an open to dense stand *Populus angustifolia* (narrowleaf cottonwood) young trees, seedlings and saplings with *Salix exigua* (sandbar willow). *Populus* x *acuminata* (lanceleaf cottonwood) may also be present in similar age classes. Other more widely scattered trees occurring in fewer than 20% of sampled stands include: *Abies lasiocarpa* (subalpine fir), *Picea engelmannii* (Engelmann spruce), *Pinus ponderosa* (ponderosa pine), and *Picea pungens* (blue spruce).

The shrub canopy is typically at the same height of the seedling and sapling cottonwood trees, although older, transitional, stands will have taller, more mature trees with *Salix exigua* as an understory. Other shrubs that may be present include: *Alnus incana* ssp. *tenuifolia* (thinleaf alder), *Salix lucida* ssp. *caudata* or ssp. *lasiandra* (shining willow), *Salix ligulifolia* (strapleaf willow), *Salix drummondiana* (Drummond willow), and *Salix bebbiana* (Bebb willow).

The herbaceous undergrowth is generally invasive, non-native and sparse from frequent flooding disturbance. Non-native species include: *Poa pratensis* (Kentucky bluegrass), *Trifolium repens* (white clover), *Agrostis stolonifera* (creeping bentgrass) (1%), *Linaria vulgaris* (butter and eggs), *Taraxacum officinale* (dandelion), *Medicago lupulina* (black medick), *Phleum pratense* (timothy), *Melilotus officinalis* (yellow sweetclover), *Dactylis glomerata* (orchardgrass), and *Elymus repens* (quackgrass). Native herbaceous species that can be present include: *Equisetum arvense* (field horsetail), *Achillea millefolium* var. *occidentalis* (western yarrow), *Rudbeckia laciniata* (cutleaf coneflower), *Carex microptera* (big head sedge), *Carex pellita* (woolly sedge), and *Mentha arvensis* (wild mint).

Ecological Processes
Populus angustifolia/Salix exigua (narrowleaf cottonwood/sandbar willow) is one of the earliest successional stages of a cottonwood-dominated plant association. *Populus angustifolia* and *Salix exigua* seeds often germinate together on freshly deposited sandbars. If the site becomes more stable and less frequently flooded (i.e., the stream channel migrates away from the site), the *Populus angustifolia* saplings mature, but the *Salix exigua* population eventually declines. The association can become one of several mid- or late-seral floodplain types including *Populus angustifolia/Alnus incana* ssp. *tenuifolia* (narrowleaf

cottonwood/thinleaf alder) and *Populus angustifolia/ Cornus sericea* (narrowleaf cottonwood/red-osier dogwood).

Potential Conservation Areas: Known from Rio Grande and Rio Grande at Alamosa National Wildlife Refuge but not in CNHP's BIOTICS.

Avg. Cover %	(Range)	Species Name	# Plots (N=27)	Other species with < 5% average cover present in at least 10% of plots:
38	(15-80%)	Populus angustifolia	27	Phleum pratense (1-10%), Poa compressa (1-15%), Heterotheca villosa (1-10%), Juncus balticus var. montanus (0.1-10%), Juniperus scopulorum (1-8%), Eleocharis palustris (1-5%), Taraxacum officinale (0.1-20%), Rudbeckia laciniata var. ampla (0.1-5%), Clematis ligusticifolia (0.1-6%), Mentha arvensis (1-5%), Rosa woodsii (0.1-5%), Achillea millefolium var. occidentalis (1-3%), Carex microptera (1%),.
22	(1-64%)	Salix exigua	24*	
17	(0.1-40%)	Agrostis gigantea	5	
13	(1-70%)	Poa pratensis	19	
11	(1-40%)	Trifolium pratense	5	
10	(1-88%)	Equisetum arvense	11	
8	(1-20%)	Salix lucida ssp. caudata, lasiandra	6	
6	(1-30%)	Melilotus officinalis	10	
6	(1-38%)	Trifolium repens	12	
6	(1-20%)	Medicago lupulina	9	
5	(1-12%)	Salix ligulifolia	5	
5	(1-19%)	Bromus inermis	6	
5	(2-10%)	Alnus incana ssp. tenuifolia	7	
5	(1-10%)	Dactylis glomerata	4	

*Salix exigua was present in all stands, but was not captured in every sample plot.

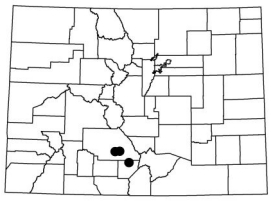
Black greasewood / Inland saltgrass Shrubland
(*Sarcobatus vermiculatus / Distichlis spicata*)

Photo from CNHP Photo database

Global rank/State rank:
G4 / S2

HGM subclass: F1

Colorado elevation range:
5,500-7,650 ft (1,700-2,300 m)



General Description
Sarcobatus vermiculatus (black greasewood) forms expansive shrublands on alkaline soils with a perennial high water table in southern and western Colorado. In the San Luis valley, it grows between playa lakes on sandy hummocks. The shrubs are 2-4 ft (0.6-1.2 m) tall and usually have non-overlapping canopies. The understory is sparse, open herbaceous cover of *Distichlis spicata* (inland saltgrass) and other salt tolerant species.

This community occurs on the highest ground between salt flat depressions called playa lakes in the northern part of the San Luis Valley. The shrubs occur on hummocks, approximately 4 ft (1.2 m) above the lake bed. Soils are deep, fine-textured sandy loams to clay loams. The surface soil is very hard when dry, but the subsurface soils, below 12 in (30 cm), are of a friable loamy texture.

Vegetation Description
The shrub canopy is fairly open with 18-30% cover of *Sarcobatus vermiculatus* (black greasewood). *Ericameria nauseosa* ssp. *nauseosa* var. *glabrata* (rubber rabbitbrush) may also occur. The herbaceous understory is a dry carpet of *Distichlis spicata* (inland saltgrass) with up to 40% cover. Other graminoid species which may be present are *Juncus balticus* var. *montanus* (mountain rush) and *Spartina gracilis* (alkali cordgrass). Forb cover is minimal.

Ecological Processes
Sarcobatus vermiculatus (black greasewood) and other salt flat vegetation often occur as bands or rings of species around a salt flat or depression. This visible zonation is caused by the change in dominant species and their relative tolerances to soil salinity and depth to groundwater. Soil characteristics may also play a role in the mosaic of shrub species on the landscape.

In the San Luis Valley, a large playa lake ecosystem supports the largest and most pristine example of *Sarcobatus vermiculatus* (black greasewood) shrublands in the state. The playas are ephemeral to perennial shallow lakes, depending on the variation in the annual precipitation.

Sarcobatus vermiculatus (black greasewood) shrublands are long-lived, self-perpetuating communities. Seedlings can survive under parent shrubs, where salinity is the highest. Seeds germinate in spring when surface soils are wet with spring runoff, and the salinity is most diluted. Although characteristic of desert climates, greasewood cannot tolerate droughts and grows only at the edges of lakes or arroyos or in sites with at high water table. Greasewood has salt glands adapted for excreting excess salts, often increasing the soil salinity over time.

Potential Conservation Areas: Known from Rio Grande at Alamosa National Wildlife Refuge and throughout the study area but not in CNHP's BIOTICS.

Avg. Cover %	(Range)	Species Name	# Plots (N=7)
25	(18-30%)	Sarcobatus vermiculatus	7
25	(10-40%)	Distichlis spicata	7
11	(1-20%)	Spartina gracilis	2
8	(5-10%)	Ericameria nauseosa ssp. nauseosa var. glabrata	2
6	(3-8%)	Juncus balticus var. montanus	2
Other species with < 5% average cover present in at least 10% of plots:			
Suaeda calceoliformis (2%), Lepidium latifolium (1%), Almutaster pauciflorus (1%), Lepidium alyssoides (0.1-2%).			

Sandbar willow / Mesic graminoid Shrubland
(*Salix exigua* / Mesic graminoid)

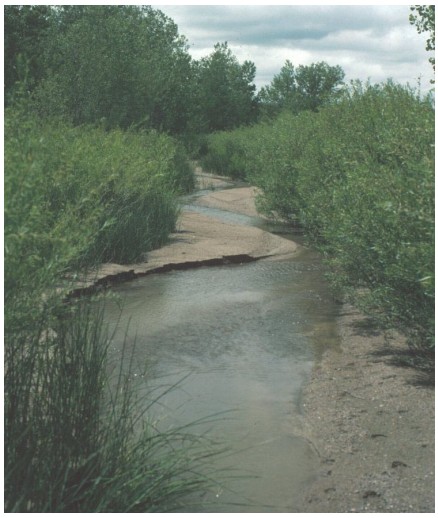
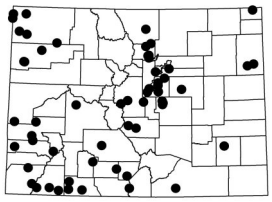


Photo from CNHP Photo database

Global rank/State rank:
G5 / S5

HGM subclass: R3/4, R5

Colorado elevation range:
3,400-9,600 ft (1,040-2,930 m)



General Description
Salix exigua (sandbar willow) is one of the most common willow species in Colorado. and is characteristic of two associations, the *Salix exigua*/mesic graminoid and the *Salix exigua*/barren ground. Both may be nearly pure stands of the willow, with few other species present. An undergrowth of dense grasses and forbs covering at least 30% of the ground falls into the mesic graminoid type, while an undergrowth of a few, widely scattered forbs and grasses, where exposed cobbles or sand characterizes the ground cover, constitutes the *Salix exigua*/barren ground association. The *Salix exigua*/mesic graminoid association generally occurs along backwater channels and other perennially wet, but less scoured sites, such as floodplain swales and irrigation ditches while the *Salix exigua*/barren ground association occurs within the annual flood zone of a river on point bars, islands, sand or cobble bars and stream banks.

This plant association usually occurs within 3 feet (1 m) vertical distance of the stream channel on point bars, low floodplains, terraces and along overflow channels. It can also occur away from the stream channel in mesic swales or along the margins of beaver ponds. Stream channels are broad to narrow and meandering with sand or cobble beds. Soils are typically somewhat more developed than the *Salix exigua*/barren ground plant association due to a slightly more stable environment and greater input of organic matter. Textures are typically loamy sands interspersed with layers of silty clays and alternating with coarse sands. Upper layers (10-30 cm) often have 25-30% organic matter.

Vegetation Description
Salix exigua (sandbar willow) dominates the canopy of this association, giving the association its characteristic grayish-green color. Other shrub species can also be present including *Rosa woodsii* (Woods rose), *Salix bebbiana* (Bebb willow), *Salix ligulifolia* (strapleaf willow), *Salix monticola* (mountain willow), *Salix lucida* (ssp. *caudata* or ssp. *lasiandra*) (shining willow), *Salix planifolia* (planeleaf willow), *Salix geyeriana* (Geyer willow), and *Alnus incana* ssp. *tenuifolia* (thinleaf alder). The undergrowth has at least 20-35% cover of various graminoid (and sometimes forb) species, although no single species is consistently present. Species include *Poa pratensis* (Kentucky bluegrass), *Juncus balticus* var. *montanus* (mountain rush), *Cirsium* spp. (thistle), *Carex pellita* (woolly sedge), and *Eleocharis palustris* (common spikerush). Forb cover is generally low, but can include a high percentage of non-native species such as *Medicago lupulina* (black medick) and *Melilotus officinalis* (yellow sweetclover).

Ecological Processes
This plant association is typical of recent floodplains and highly disturbed, low, wet areas and is considered early-seral. The amount of herbaceous growth in the understory is an indication of the amount of time

since the last scouring (or depositional) flood event. *Salix exigua* (sandbar willow) is an excellent soil stabilizer with a deep root system and flexible stems that can withstand flooding. *Salix exigua* reduces erosion potential by increasing the friction of stream flow, trapping sediments and building a protected seed bed for a number of tree and shrub species. The presence of cottonwood seedlings within this association indicates succession to a cottonwood stand (and may represent the *Populus angustifolia* or *Populus deltoides/Salix exigua* plant associations), if seedlings survive subsequent flooding events.

Potential Conservation Areas: Rio Grande and Rio Grande at Alamosa National Wildlife Refuge.

Avg. Cover %	(Range)	Species Name	# Plots (N=118)
64	(5-100%)	Salix exigua	118
22	(1-88%)	Agrostis gigantea	48
21	(0.1-63%)	Elymus lanceolatus	16
17	(2-38%)	Agrostis stolonifera	14
16	(0.1-100%)	Poa pratensis	58
16	(0.1-60%)	Carex pellita	28
14	(0.1-63%)	Juncus balticus var. montanus	33
12	(0.1-85%)	Bromus inermis	22
12	(0.1-38%)	Tamarix ramosissima	12
10	(0.1-38%)	Schoenoplectus pungens	23
10	(1-80%)	Rosa woodsii	22
9	(0.1-31%)	Melilotus officinalis	27
8	(0.1-40%)	Eleocharis palustris	29
7	(1-20%)	Salix monticola	14
7	(1-38%)	Equisetum arvense	34
7	(1-15%)	Symphyotrichum lanceolatum ssp. hesperium var. hesperium	17
7	(1-38%)	Glycyrrhiza lepidota	16
6	(0.1-38%)	Cirsium arvense	28
6	(0.1-23%)	Salix ligulifolia	15
5	(1-18%)	Trifolium repens	13
5	(0.1-38%)	Populus deltoides	22

Other species with < 5% average cover present in at least 10% of plots:
Plantago major (0.1-24%), Hordeum jubatum ssp. jubatum (1-22%), Achillea millefolium var. occidentalis (0.1-38%), Mentha arvensis (0.1-30%), Taraxacum officinale (0.1-10%), Epilobium ciliatum ssp. glandulosum (0.1-5%), Elymus canadensis (0.1-10%), Verbascum thapsus (0.1-16%), Equisetum laevigatum (0.1-5%).

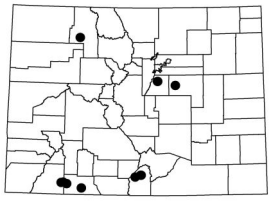
Sandbar willow - Strapleaf willow Shrubland
(*Salix exigua - Salix liguifolia* (=*S. eriocephala* var. *ligulifolia*)

Photo from CNHP Photo database

Global rank/State rank:
G2G3 / S2S3

HGM subclass: R3/4, R5

Colorado elevation range:
5,700-8,000 ft (1,700-2,450 m)



General Description
The *Salix exigua-Salix ligulifolia* (sandbar willow-strapleaf willow) plant association is a medium- to tall-willow shrubland occurring on saturated pointbars and active stream channels of foothill tributary streams. In the mountains, *Salix ligulifolia* mixes with *Salix monticola* (mountain willow) and *Salix drummondiana* (Drummond willow), forming the *Salix ligulifolia* (strapleaf willow) plant association. In the foothills, *Salix ligulifolia* mixes with *Salix exigua* (sandbar willow) and *Salix lucida* (shining willow), forming the *Salix exigua-Salix ligulifolia* (sandbar willow-strapleaf willow) plant association.

This plant association occurs in the wettest part of the riparian area, usually adjacent to the channel on low point bars, islands, low stream banks and overflow channels. The streams are broad and meandering with sandy beds or braided channels. Soils of foothill sites are shallow sandy clay loams and sands over unconsolidated alluvial material with thin buried layers of organic material.

Vegetation Description
This plant association is predominantly tall stands of *Salix ligulifolia* (strapleaf willow) mixed with *Salix exigua* (sandbar willow). Other shrubs that may be present include *Salix lucida* ssp. *caudata* (shining willow), *Rosa woodsii* (Woods rose), *Quercus gambelii* (Gambel oak), *Symphoricarpos* spp. (snowberry), *Prunus virginiana* (chokecherry), *Crataegus rivularis* (river hawthorn), *Alnus incana* ssp. *tenuifolia* (thinleaf alder), and *Betula occidentalis* (river birch). The herbaceous undergrowth is dominated by any number of species, including *Carex pellita* (woolly sedge), *Carex nebrascensis* (Nebraska sedge), *Eleocharis palustris* (common spikerush), *Lactuca serriola* (prickly lettuce), *Juncus balticus* var. *montanus* (mountain rush), *Muhlenbergia asperifolia* (alkali muhly), *Rudbeckia laciniata* var. *ampla* (cutleaf coneflower), *Calamagrostis stricta* (slimstem reedgrass), *Cirsium arvense* (Canadian thistle), *Bromus tectorum* (cheatgrass), and *Bromus inermis* (smooth brome).

Ecological Processes
This plant association appears to be an early- to mid-seral community. It occupies point bars and low stream banks that are flooded annually in the spring. It may be a transition zone between the common low elevation *Salix exigua* (sandbar willow) plant association and the less common montane elevation *Salix ligulifolia* (strapleaf willow) dominated associations.

Potential Conservation Areas: Trinchera Creek Below Smith Reservoir

Avg. Cover %	(Range)	Species Name	# Plots (N=12)
38	(15-70%)	Salix ligulifolia	12
31	(8-85%)	Salix exigua	11
21	(1-40%)	Bromus inermis	2
18	(10-25%)	Alnus incana ssp. tenuifolia	2
16	(1-46%)	Carex pellita	6
16	(10-21%)	Cornus sericea	2
12	(1-37%)	Maianthemum stellatum	4
12	(8-15%)	Rudbeckia laciniata var. ampla	2
10	(7-13%)	Muhlenbergia asperifolia	2
10	(1-26%)	Populus deltoides	3
8	(1-20%)	Cirsium arvense	4
8	(1-20%)	Lactuca serriola	3
7	(1-12%)	Salix lucida ssp. caudata, lasiandra	3
7	(1-12%)	Betula occidentalis	2
6	(1-9%)	Dactylis glomerata	3
6	(2-10%)	Equisetum hyemale var. affine	2
6	(1-10%)	Bromus tectorum	2
5	(1-10%)	Juncus balticus var. montanus	4
5	(5-5%)	Geranium richardsonii	2
5	(1-9%)	Agrostis stolonifera	2
5	(1-12%)	Poa pratensis	9

Other species with < 5% average cover present in at least 10% of plots:
Symphyotrichum lanceolatum ssp. hesperium var. hesperium (4-5%), Galium boreale (1-6%), Symphoricarpos oreophilus (1-6%), Populus angustifolia (2-5%), Equisetum laevigatum (1-7%), Taraxacum officinale (1-5%), Iris missouriensis (2-3%), Clematis ligusticifolia (1-4%), Rosa woodsii (1-6%), Carex microptera (1-3%), Medicago lupulina (1-3%), Alopecurus aequalis (1-3%), Apocynum androsaemifolium (1-3%), Mentha arvensis (1-3%), Eleocharis palustris (1-3%), Vicia americana (1-4%), Glycyrrhiza lepidota (1-3%), Achillea millefolium var. occidentalis (1-2%), Equisetum arvense (1-3%), Elymus trachycaulus ssp. trachycaulus (1%), Plantago major (1%), Medicago sativa (1%), Trifolium repens (1%), Verbascum thapsus (1%), Schoenoplectus acutus\tabernaemontani (1%), Rhus trilobata var. trilobata (1%).

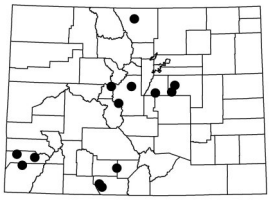
Strapleaf willow Shrubland
(*Salix liguifolia* (=*S. eriocephala* var. *ligulifolia)*

Photo from CNHP Photo database

Global rank/State rank:
G2G3 / S2S3

HGM subclass: S1/2, R2, R3/4

Colorado elevation range:
6,350-10,200 ft (1,900-3,100 m)



General Description
The *Salix ligulifolia* (strapleaf willow) plant association is a medium- to tall-willow shrubland occurring on saturated floodplains and stream banks of montane and lower subalpine elevations. *Salix ligulifolia* often mixes with *Salix exigua* (sandbar willow) and *Salix lucida* (shining willow) in the foothills, forming the *Salix exigua-Salix ligulifolia* (sandbar willow-strapleaf willow) plant association. In the mountains, *Salix ligulifolia* mixes with *Salix monticola* (mountain willow) and *Salix drummondiana* (Drummond willow) where it grows in relatively broad valley bottoms.

This association occurs in moderately wide valleys along low terraces and floodplains, and stream banks of narrower reaches. The plant association occurs along reaches with vegetated islands between multiple channels below an active beaver pond, along slightly sinuous broad channels, along more sinuous channels with well developed floodplains, and along steep narrow gullies. Soils are saturated sandy loams and clay loams with a high organic matter content in the upper layers.

Vegetation Description
This association has a canopy dominated by *Salix ligulifolia* (strapleaf willow), usually mixed with several other willow species. *Salix ligulifolia* (strapleaf willow) is the key diagnostic species, other willows may have equal cover, but in general do not exceed that of *Salix ligulifolia*. Other willows that may be present include *Salix monticola* (mountain willow), *Salix geyeriana* (Geyer willow), *Salix bebbiana* (Bebb willow), *Salix lucida (*ssp. *caudata* or ssp. *lasiandra)* (shining willow), *Salix wolfii* (Wolf willow), and *Salix planifolia* (planeleaf willow). Additional shrubs that may be present include *Alnus incana* ssp. *tenuifolia* (thinleaf alder), *Cornus sericea* (red-osier dogwood), and *Dasiphora floribunda* (shrubby cinquefoil).

The herbaceous undergrowth can be dense in undisturbed stands with *Carex utriculata* (beaked sedge), *Carex nebrascensis* (Nebraska sedge), *Carex pellita* (woolly sedge), *Juncus balticus* var. *montanus* (mountain rush), and *Calamagrostis canadensis* (bluejoint reedgrass). Forb cover is generally low, but some species are abundant, including *Taraxacum officinale* (dandelion), *Achillea millefolium* var. *occidentalis* (western yarrow), *Thalictrum fendleri* (Fendler meadowrue), and *Fragaria virginiana* (strawberry). No herbaceous species was consistantly present with high abundance, so none was chosen as diagnostic.

Ecological Processes
This association appears to be a long-lived mid to late-seral type since it is associated with beaver activity and saturated soils throughout the growing season.

Potential Conservation Areas: Sangre de Cristo Creek

Avg. Cover %	(Range)	Species Name	# Plots (N=13)
34	(18-66%)	Salix ligulifolia	13
26	(15-36%)	Carex nebrascensis	2
20	(3-41%)	Carex utriculata	5
17	(1-35%)	Salix lucida ssp. caudata, lasiandra	7
15	(3-43%)	Salix monticola	9
13	(1-25%)	Salix exigua	6
12	(2-27%)	Calamagrostis canadensis	6
12	(6-21%)	Salix planifolia	3
11	(2-26%)	Carex aquatilis	3
10	(1-19%)	Thalictrum fendleri	2
10	(1-28%)	Poa pratensis	10
9	(1-25%)	Juncus balticus var. montanus	6
8	(3-13%)	Typha latifolia	2
8	(1-34%)	Trifolium repens	6
7	(5-8%)	Scirpus microcarpus	2
6	(3-10%)	Alnus incana ssp. tenuifolia	3
6	(5-7%)	Betula nana	2
5	(1-10%)	Taraxacum officinale	8
5	(2-8%)	Chamerion angustifolium ssp. circumvagum	2
5	(3-6%)	Poa palustris	2

Other species with < 5% average cover present in at least 10% of plots:
Dasiphora floribunda (1-10%), Salix geyeriana (1-12%), Carex pellita (1-8%), Mentha arvensis (1-9%), Fragaria virginiana ssp. glauca (1-12%), Eleocharis palustris (1-7%), Cirsium arvense (2-4%), Salix bebbiana (3%), Equisetum arvense (1-6%), Mertensia ciliata (1-4%), Achillea millefolium var. occidentalis (1-7%), Conioselinum scopulorum (2-3%), Geranium viscosissimum var. incisum (1-4%), Agrostis stolonifera (2-3%), Geum macrophyllum var. perincisum (1-4%), Deschampsia caespitosa (1-4%), Trifolium pratense (1-3%), Carex microptera (1-3%), Phleum pratense (1-3%), Heracleum maximum (1-2%), Iris missouriensis (1-2%), Juncus articulatus (1-2%), Picea pungens (1-2%), Bromus inermis (1-2%), Potentilla pulcherrima (1-2%), Cicuta douglasii (1-2%), Oxypolis fendleri (1%), Platanthera dilatata var. albiflora (1%), Plantago major (1%), Populus angustifolia (1%), Galium triflorum (1%), Medicago lupulina (1%), Ambrosia artemisiifolia var. elatior (1%), Maianthemum stellatum (1%), Rumex crispus (1%), Carex hassei (1%).

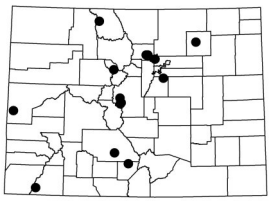
Hardstem bulrush - Softstem bulrush Herbaceous Vegetation
(*Schoenoplectus acutus* var. *acutus - Schoenoplectus tabernaemontani*)

Photo from CNHP Photo database

Global rank/State rank:
G3 / S2S3

HGM subclass: D2/3, D4/5?

Colorado elevation range:
4,300-10,000 ft (1,300-3,050 m)



General Description
The *Schoenoplectus acutus* var. *acutus*-*Schoenoplectus tabernaemontani* (hardstem bulrush-softstem bulrush) plant association occurs in marshes, along the margins of lakes and ponds, and in backwater areas of rivers in water up to 3 ft (1 m) deep. This association occurs in small patches, below 10,000 ft (3,050 m). It is highly threatened by development, agricultural conversion, stream flow alterations, and wetland filling activities.

The *Schoenoplectus acutus* var. *acutus*-*Schoenoplectus tabernaemontani* (hardstem bulrush-softstem bulrush) plant association occurs in wet swales and overflow channels with standing water. It also occurs at the edges of beaver ponds, ditches, and railroad embankments. One stand occurred on a saturated floodplain where a perched water table emerged from the surrounding bedrock. Streams are large and slightly meandering. Soils of this association are deep heavy clays and silty loams with a high organic matter content. Soils remain saturated for most of the growing season and often have an anoxic gleyed layer within 20 inches (50 cm) of the soil surface, although the water table can drop as far as 3 ft (1 m) below the surface.

Vegetation Description
This association is characterized by nearly pure stands of *Schoenoplectus acutus* var. *acutus* (=*Scirpus acutus*) (hardstem bulrush) and/or *Schoenoplectus tabernaemontani* (=*Scirpus tabernaemontani*) (softstem bulrush), with a few other wetland species that may include *Eleocharis palustris* (common spikerush), *E. rostellata* (beaked spikerush), *Mimulus guttatus* (seep monkeyflower), *Sagittaria* spp. (arrowhead), *Carex* spp. (sedge), and *Nuphar lutea* ssp. *polysepala* (Rocky Mountain pondlily).

Other emergent wetland vegetation is commonly found with this plant association, such as stands of *Typha* spp. (cattail) and other *Scirpus* or *Schoenoplectus* spp. (bulrush species). Within the riparian zone, *Populus deltoides* (cottonwood) and *Salix amygdaloides* (peachleaf willow) may be present on the floodplain. On the open prairies along small streams, adjacent riparian vegetation types include stands of *Carex nebrascensis* (Nebraska sedge).

Ecological Processes
Schoenoplectus spp. (bulrush) stands are generally considered permanent wetland communities. They will remain in place unless the hydrologic regime is severely altered. Stands of *Schoenoplectus* are important to wildlife species, especially birds, for cover and nesting habitat.

Potential Conservation Areas: Known throughout the study area but not in CNHP's BIOTICS.

Avg. Cover %	(Range)	Species Name	# Plots (N=29)
77	(5-100%)	Schoenoplectus acutus\tabernaemontani	29
12	(1-38%)	Typha latifolia	8
9	(1-30%)	Eleocharis palustris	10
8	(0.1-38%)	Rorippa palustris ssp. hispida	5
7	(1-15%)	Rorippa nasturtium-aquaticum	3
6	(0.1-15%)	Lemna minor	4
5	(0.1-15%)	Epilobium ciliatum ssp. glandulosum	7

Other species with < 5% average cover present in at least 10% of plots:

Hippuris vulgaris (1-5%), Mentha arvensis (1%), Ranunculus cymbalaria (1%).

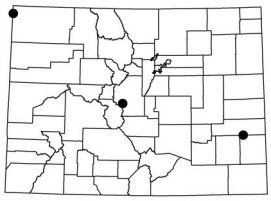
Cosmopolitan bulrush Herbaceous Vegetation
(*Schoenoplectus maritimus* (=*Bolboschoenus maritimus*)

Photo from CNHP Photo database

Global rank/State rank:
G4 / S2

HGM subclass: F1

Colorado elevation range:
3,800-8,950 ft (1,150-2,700 m)



General Description
This wetland plant association often occurs in standing water. The vegetation is characterized by a sparse cover of *Schoenoplectus maritimus* (cosmopolitan bulrush), few associated species and mostly open water. Livestock grazing is limited in this association due to the wet conditions.

This plant association occurs in wet swales and along narrow channels, spring-fed creeks, and back-water eddies of larger rivers.

Vegetation Description
Schoenoplectus maritimus dominates this sparsely vegetated wetland with 15-60% cover. Associated species can include *Salix exigua* (sandbar willow) and *Muhlenbergia asperifolia* (alkali muhly).

Adjacent riparian areas may support *Juncus balticus* var. *montanus* (mountain rush) wetlands, *Salix exigua* (sandbar willow) shrublands, and *Populus deltoides* (cottonwood) forests

Ecological Processes
Schoenoplectus maritimus (cosmopolitan bulrush) is an early colonizer and is able to persist under wet conditions. The wet conditions limit most forms of disturbance to this plant association.

Schoenoplectus maritimus helps filter sediments to build stream banks. This species is a prolific seed producer. Its rhizomes spread quickly into exposed areas and colonize mudflats and drawdown areas.

Potential Conservation Areas: Known throughout the study area but not in CNHP's BIOTICS.

Avg. Cover %	(Range)	Species Name	# Plots (N=3)
32	(14-60%)	Schoenoplectus maritimus	3
25	—	Melilotus officinalis	1
20	—	Salix exigua	1
20	—	Argentina anserina	1
6	(1-10%)	Muhlenbergia asperifolia	2
5	—	Puccinellia nuttalliana	1
5	—	Hordeum jubatum ssp. jubatum	1
5	—	Equisetum arvense	1

Other species with < 5% average cover present in at least 10% of plots:

Suaeda calceoliformis (3%).

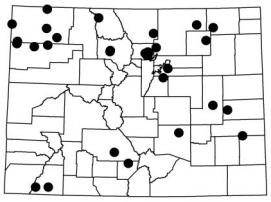
Common threesquare Herbaceous Vegetation
(*Schoenoplectus pungens*)

Photo from CNHP Photo database

Global rank/State rank:
G3G4 / S3

HGM subclass: D2/3

Colorado elevation range:
3,800-7,800 ft (1,050-2,400 m)



General Description
The *Schoenoplectus pungens (=Scirpus pungens)* (threesquare bulrush) plant association forms small low stature (1-3 ft, 0.3-1 m) marshes in low-lying swales, abandoned channels, and overflow channels where soils remain saturated. This association is characterized by pure stands of *Schoenoplectus pungens,* occasionally associated with a few other graminoid species.

This association also occurs on silt and sand bars within the active channel where the water velocity is lowest. Soils from the Colorado River Basin are black, anoxic, organic soils and gleyed, clay-loam, alkaline soils.

Vegetation Description
This plant association can be pure stands of *Schoenoplectus pungens* (threesquare bulrush). Some stands include other graminoids such as *Juncus balticus* var. *montanus* (mountain rush), *Hordeum jubatum* (foxtail barley), *Phragmites australis* (common reed), *Spartina gracilis* (alkali cordgrass), *Muhlenbergia asperifolia* (alkali muhly), and *Eleocharis palustris* (common spikerush). On alkaline soils, *Distichlis spicata* (inland saltgrass) is a common associate.

Ecological Processes
Schoenoplectus pungens (threesquare bulrush) is an early colonizer and is adapted to saturated conditions on streamsides, sandy shores, marshes, and reservoir margins. Because of the wet soil conditions and aggressive growth of *Schoenoplectus pungens*, most other species are precluded from the sites. Disturbance can cause the establishment of increaser species such as *Juncus balticus* var. *montanus* (mountain rush) and *Hordeum jubatum* (foxtail barley). Lowering the water table may dry the site and result in decreased cover of *Schoenoplectus pungens*. An increase in salinity may increase alkaline tolerant species.

Potential Conservation Areas: Rio Grande at Trinchera Creek and other parts of the study area.

Avg. Cover %	(Range)	Species Name	# Plots (N=94)
59	(6.5-100%)	Schoenoplectus pungens	94
19	(1-62%)	Agrostis gigantea	26
19	(0.1-90%)	Eleocharis palustris	34
14	(1-38%)	Juncus balticus var. montanus	21
9	(0.1-80%)	Mentha arvensis	17
5	(0.1-37%)	Hordeum jubatum ssp. jubatum	31
5	(1-15%)	Polygonum douglasii	9

Other species with < 5% average cover present in at least 10% of plots:
Schoenoplectus acutus\tabernaemontani (0.1-10%), Lycopus americanus (0.1-15%), Cirsium arvense (0.1-25%), Epilobium ciliatum ssp. glandulosum (0.1-15%), Muhlenbergia asperifolia (0.1-10%), Typha latifolia (1-5%).

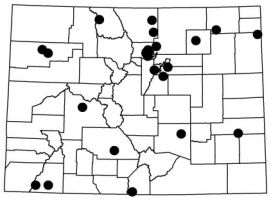
Cattail Herbaceous Vegetation
(*Typha angustifolia - Typha latifolia -* (*Typha domingensis*)

Photo from CNHP Photo database

Global rank/State rank:
G5 / S4

HGM subclass: D2/3, D4/5?

Colorado elevation range:
3,900-8,900 ft (1,530-3,500 m)



General Description
The *Typha angustifolia-Typha latifolia-(Typha domingensis)* (cattail) plant association is a commonly seen tall, dark green community growing in 2-4 feet of standing water. It is found in the shallow edges of ponds and lakes, and can occur in backwaters of larger river floodplains. This association is a common wetland community occurring throughout the western and midwestern states.

This plant association occurs in standing water at least 1 foot (0.3 m) in depth, although it will persist during drier periods. It is found along the margins of beaver ponds, overflow channels, backwater sloughs, floodplain swales, drainage ditches, behind railroad embankments, and any place where water collects and remains for two-thirds of the growing season. This association can be found on nearly every type of stream channel, but typically along meandering, low gradient streams. Soils are deep, heavy silty clay loam and organic mucks. Some profiles have 10-30% coarse material and are fairly well drained, others remain anoxic throughout most of the year.

Vegetation Description
Typha angustifolia (narrowleaf cattail) and/or *Typha latifolia* (broadleaf cattail) forms near-monotypic (70-85%) stands between 3 and 6 feet tall (1-2 m). *Typha domingensis* (southern cattail) is much less common than the other two species. It may or may not be present and is restricted to Western Slope stands. *Schoenoplectus acutus* and *Schoenoplectus tabernaemontani* are common associates. Other species which may be present include *Potamogeton* (pondweed) spp., *Spartina pectinata* (prairie cordgrass), and *Veronica* (speedwell) spp.

Ecological Processes
Typha angustifolia (narrowleaf cattail) occupies inundated and disturbed grounds and can tolerate deeper water and higher alkalinity levels than *T. latifolia* (broadleaf cattail). *Typha* species are prolific seed producers, spreading rapidly to become the early colonizers of wet mineral soil, and will persist under wet conditions. The roots and lower stems are well adapted to prolonged submergence but germination and establishment require periods of drawdown to expose bare soil.

This association may be declining in Colorado. It is threatened by development, wetland draining, and stream flow alterations. However it is also a natural invader to newly created wetlands, and will appear in newly ponded areas on its own.

Potential Conservation Areas: Known throughout the study area but not in CNHP's BIOTICS.

Avg. Cover %	(Range)	Species Name	# Plots (N=107)
75	(0.1-100%)	Typha latifolia	97
55	(2 -99%)	Typha angustifolia	18
36	(0.1-85%)	Lemna minor	23
17	(1-88%)	Eleocharis palustris	22
9	(0.1-37%)	Schoenoplectus acutus\tabernaemontani	36
7	(0.1-62%)	Polygonum lapathifolium	12
6	(0.1-37%)	Epilobium ciliatum ssp. glandulosum	27
5	(0.1-20%)	Schoenoplectus pungens	12

Other species with < 5% average cover present in at least 10% of plots:

Scirpus pallidus (0.1-10%).

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