SURVEY AND ASSESSMENT OF THE "ALAMOSA MARSHES" AREA, SAN LUIS VALLEY, COLORADO

Colorado Natural Heritage Program
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Natural Heritage Program COLORADO

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SURVEY AND ASSESSMENT OF THE "ALAMOSA MARSHES" AREA, SAN LUIS VALLEY, COLORADO

Prepared for:

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Cover photograph: Coyote willow (*Salix exigua*) and narrowleaf cottonwood (*Populus angustifolia*) along the banks of the Rio Grande within the Alamosa National Wildlife Refuge.

Photo taken by: Joe Rocchio

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EXECUTIVE SUMMARY

The area west of and within the current boundaries of the Alamosa National Wildlife Refuge was historically referred to as the "Alamosa Marshes". This area was documented as one of the largest wetland complexes in the San Luis Valley by the 1878 Wheeler Expedition maps. Following the establishment of the Alamosa National Wildlife Refuge in 1962, much of the Alamosa Marshes east of the Rio Grande were protected within the boundaries of the Refuge. The portion of the Alamosa Marshes west of the Rio Grande is currently under private ownership. Due to the connectivity of these wetlands with those within the Refuge, a better understanding of the biological and functional value of these areas is important for land management decisions.

The U.S. Fish and Wildlife Service (USFWS) contracted the Colorado Natural Heritage Program (CNHP) to assess the types, biodiversity significance, and the functions and restoration potential of the wetlands found in the area west of the Alamosa National Wildlife Refuge.

The purpose of this project is to provide a data resource for the USFWS in conducting proactive planning for wetland conservation within and near the Alamosa National Wildlife Refuge. The primary objective was to identify biologically significant wetlands within the study area.

Site selection was based on the objective of visiting every wetland type at various geomorphic positions within the study area. Using available resources and conducting roadside assessment, five Targeted Inventory Areas (TIAs) were identified, however CNHP was denied permission to access two of the TIAs.

Precipitation near Alamosa in 2002 was the 7th lowest on record at 4.42 inches. As a result, many of the wetlands in the study area were very dry. Wetland vegetation did not exhibit luxuriant growth in many areas and often was only represented by past year's growth. Thus, many wetland species which may occur in the study area were not observed during the 2003 field season.

One such species is the slender spiderflower (*Cleome multicaulis*). During the 2003 field survey, many areas in the study area appeared to be potential slender spiderflower habitat. However, slender spiderflower was not observed at any sites. It is unknown if this annual species is present in the seed bank but was unable to germinate due to drought conditions, or is simply not located within the study area. Further survey work should be conducted during a year of average precipitation for this species.

Saline wet meadows were the most common wetland type observed in the study area. The presences of bulrushes (*Schoenoplectus acutus* and *S. pungens*) indicate that saline/freshwater marsh areas are also in the area. Riparian areas were also present but were restricted to areas along La Jara Creek and the Rio Grande.

Although saline wet meadows are common, they continue to be converted to other wetland types, such as freshwater marshes for waterbird production. Although such activities benefit some species, 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.

No additional element occurrences were incorporated into CNHP's BIOITICS database as a result of this study. However, existing element occurrences were reevaluated.

Three of the five TIAs occur within two CNHP Potential Conservation Areas: Rio Grande at Alamosa National Wildlife Refuge (B2) and Adams Lake (B5). 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 the study area. 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 (e.g. slender spiderflower). Future surveys may 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 the Alamosa Marshes area, and Colorado.

INTRODUCTION

The area west of and within the current boundaries of the Alamosa National Wildlife Refuge was historically referred to as the "Alamosa Marshes" (U.S. Army Corps of Engineers 1878). This area was 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). Following the establishment of the Alamosa National Wildlife Refuge (Refuge) in 1962, much of the Alamosa Marshes east of the Rio Grande were protected within the boundaries of the Refuge. The portion of the Alamosa Marshes west of the Rio Grande is currently under private ownership. These areas are mostly managed as rangeland for domestic livestock.

The U.S. Fish and Wildlife Service (USFWS) contracted with the Colorado Natural Heritage Program (CNHP) to assess the types of wetlands, according to CNHP's *Comprehensive Statewide Wetlands Classification and Characterization: Wetland Plant Associations of Colorado* (Carsey et al. 2003a; Carsey et al. 2003b), their biodiversity significance, and evaluate the functions and restoration potential of the wetlands found in the area west of the Alamosa National Wildlife Refuge due to their connectivity with the wetlands within the Refuge.

The purpose of this project is to provide a wetland biodiversity data resource for the USFWS in conducting proactive planning for wetland conservation within and near the Refuge. This document should be considered a tool for managing lands that support rare wetland species and plant associations within this area, although there are limitations to the information within it. In particular, the survey work was conducted over 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 research. The drought in 2002 may have also biased the results of this study due to unfavorable conditions for the germination of some plant species, such as the slender spiderflower (*Cleome multicaulis*). Also, all areas in the study area were not surveyed. Due to limitations of land access, this report only includes information from readily observed species or from areas that biologists received permission to visit. Finally, although all wetland types observed are listed in this report, all wetland species or plant associations found within the study area may not be documented in the report due to the limitation described above. This project specifically targeted the species and plant communities that are tracked by CNHP (CNHP has a methodology specific to Natural Heritage Programs and this study was intended to survey for those species believed to be the most rare or the least known). The primary objective was to identify biologically significant wetlands within the study area. This project utilized the methodology that is used throughout Heritage Programs in North, South, and Central America to identify these biologically significant wetlands. 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, assess their conservation value, and to systematically prioritize these for conservation action. Wetland functions and restoration potential for each site visited were 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; U.S. Fish and Wildlife personnel and resources, National Wetland Inventory maps, and aerial photographs; and
- Conducting extensive field surveys.

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

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

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

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 (e.g., building up a site before constructing a home), and before dredging, ditching, or channelizing a wetland. The Clean Water Act exempts certain filling activities, such as normal agricultural activities.

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

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

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

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

WETLAND FUNCTIONS AND VALUES

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

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

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

- Recreation--wetlands provide areas for fishing, birdwatching, 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 with 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 sites 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," it is assumed that the wetland is not functioning to the capacity that it should (relative to other mineral soil flat wetlands).

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

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

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

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

Dynamic Surface Water Storage

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

Elemental Cycling

The cycling of nutrients, or the abiotic and biotic processes that convert elements from one form to another, is a fundamental ecosystem process which maintains a balance between living biomass and detrital stocks (Brinson et al. 1985). Disrupting nutrient cycles could cause an imbalance between the two resulting in one factor limiting the other. Thus, impacts to aboveground primary productivity or disturbances to the soil, which may cause a shift in nutrient cycling rates, could change soil fertility, alter plant species composition, and affect potential habitat functions. Indicators of wetlands with intact nutrient cycling need to be considered relative to wetlands within the same hydrogeomorphic class/subclass. Such indicators include high aboveground primary productivity and high quantities of detritus, within the range expected for that particular hydrogeomorphic class of wetlands.

Removal of Imported Nutrients, Toxicants, and Sediments

Nutrient retention/removal is the storing and/or transformation of nutrients within the sediment or vegetation. Inorganic nutrients can be transformed into an organic form and/or converted to another inorganic form via microbial respiration and redox reactions. For example, denitrification, which is a process that is mediated by microbial respiration, results in the transformation of nitrate (NO_3^-) to nitrous oxide (N_20) 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.
				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	Topographically flat	Precipitation	Two	F1-low	Salt flats in

Flat	wetland	and groundwater	directional	elevation with seasonal high water table	San Luis Valley

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 deserts 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 PCAs, 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 associations 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 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" (The Nature Conservancy 1999), and a plant association as a type of plant community with "definite floristic composition, uniform habitat conditions, and uniform physiognomy" (Flahault and Schroter 1910). The term plant "association" is hereafter used in lieu of "community" except when referring to a broader definition of community (e.g. natural community). Identifying and protecting representative examples of plant associations ensures conservation of multiple number of species, biotic interactions, and ecological process. Using associations 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) developed by The Nature Conservancy is used by all Natural Heritage Programs to house data about imperiled species. This database includes taxonomic group, global and state rarity rank, federal and state legal status, observation source, observation date, county, township, range, watershed, and other relevant facts and observations. The Colorado Natural Heritage Program also uses the Biodiversity Tracking and Conservation System (BIOTICS) for digitizing and mapping occurrences of rare plants, animals, and plant associations. These rare species and plant associations are referred to as "elements of natural diversity" or simply "elements."

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

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

- What species and ecological 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 PCAs 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 PCAs and the significant elements of biological diversity they contain?
- How can we measure our progress toward conservation goals?

CNHP has effective working relationships with several state and federal agencies, including the Colorado Department of Natural Resources, the Colorado Division of Wildlife, the Bureau of Land Management, 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 2. Definition of Natural Heritage Imperilment Ranks.

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

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

Legal Designations for Rare Species

Natural Heritage imperilment ranks should not be interpreted as legal designations. Although most species protected under state or federal endangered species laws are extremely rare, not all rare species receive legal protection. Legal status is designated by either the U.S. Fish and Wildlife Service under the Endangered Species Act or by the Colorado Division of Wildlife under Colorado Statutes 33-2-105 Article 2. In addition, the U.S. Forest Service recognizes some species as "Sensitive," as does the Bureau of Land Management. Table 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 3. Federal and State Agency Special Designations for Rare Species.

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

Element Occurrences and their Ranking

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

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

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

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

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

Table 4. Element Occurrence Ranks and their Definitions.

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

Potential Conservation Areas and Their Ranking

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

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

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

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

The boundaries presented are meant to be used for conservation planning purposes and have no legal status. The proposed boundary does not automatically recommend exclusion of all activity. Rather, the boundaries designate ecologically significant areas in which land managers may wish to consider how specific activities or land use changes within or near the site 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. For example, taken to the extreme, the threat of ozone depletion could expand every site to include the entire planet. The boundaries described in this report indicate the immediate, and therefore most important, area to be considered for protection. Continued landscape level conservation efforts 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 5. Natural Heritage Program Biological Diversity Ranks and their Definitions.

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

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 6. Natural Heritage Program Protection Urgency Ranks and their Definitions.

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

A protection action involves increasing the current level of protection accorded one or more tracts within a potential conservation area. It may also include activities such as educational or public relations campaigns, or collaborative planning efforts with public or private entities, to minimize adverse impacts to element occurrences at a PCA. 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 PCA. For example, development that would destroy, degrade or seriously compromise the long-term viability of an element occurrence; or timber, range, recreational, or hydrologic management that is incompatible with an element occurrence's existence;

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

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

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 PCA. This rank refers to the need for management in contrast to protection (for example, increased fire frequency, decreased grazing, weed control, etc.). The urgency for management rating focuses on land use management or land stewardship action required to maintain element occurrences at the potential conservation area.

A management action may include biological management (prescribed burning, removal of non-natives, mowing, etc.) or people and PCA 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 7. Natural Heritage Program Management Urgency Ranks and their Definitions.

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

METHODS

Site selection was based on the objective of visiting every wetland type at various geomorphic positions and elevations within the study area. Wetland types were defined using plant associations (Carsey et al. 2003a). 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 wetlands.

COLLECT AVAILABLE INFORMATION

CNHP databases were updated with information regarding the known locations of species and significant plant associations within study area. 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, and Rocky Mountain Herbarium. Both general and specific literature sources were incorporated into CNHP databases as either locational information or as biological data pertaining to a species in general. Such information covers basic species and community biology including range, habitat, phenology (timing), food sources, and substrates. This information was entered into CNHP's Biodiversity Tracking and Conservation System (BIOTICS).

IDENTIFY RARE OR IMPERILED SPECIES AND SIGNIFICANT PLANT ASSOCIATIONS WITH POTENTIAL TO OCCUR IN THE STUDY AREA

The list of plant associations thought to occur in the study area was derived from the *Comprehensive Statewide Wetlands Classification and Characterization: Wetland Plant Associations of Colorado* (CSWCC) (Carsey et al. 2003a; Carsey et al. 2003b) which is based on the U.S. National Vegetation Classification (USNVC) (Anderson et al. 1998), the accepted national standard for vegetation classification. 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 wetland types 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 the study area, or from adjacent locations, are included in this list. Species or plant associations which prefer habitats that are not included in the study area were removed from the list. Elements currently monitored by CNHP with potential to occur in the study area, but currently unrecorded from it were also included on the list and 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 and based on input from the USFWS regarding specific localities of interest to the agency. Areas with potentially high natural values were chosen using aerial photographs, geology maps, vegetation surveys, personal recommendations from knowledgeable local residents, and numerous roadside surveys by our field scientists. Aerial photography is perhaps the most useful tool in this step of the process.

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

The above information was used to delineate **five survey areas** that were believed to have high probability of harboring natural heritage resources of interest to the USFWS.

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.

Although species with lower Natural Heritage ranks were not the main focus of inventory efforts, many of these species occupy similar habitats as the targeted species, and were searched for and documented as they were encountered.

LANDOWNER CONTACTS

Attaining permission to conduct surveys on private property was essential to this project. Once survey sites were chosen, land ownership of these areas was determined using records at the Alamosa County assessor's office and from input from USFWS personnel. 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.

When an element is discovered its precise location and known extent are recorded on 1:24,000 scale topographic maps. Other data recorded at each occurrence includ 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, is 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 qualitative wetland functional evaluation. Indicators of functions were used to conduct this analysis. No quantitative measurement were made to assess functions.

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 provisional and additional information about the site or the element may call for alterations of the boundaries.

RESULTS

TARGETED INVENTORY AREAS

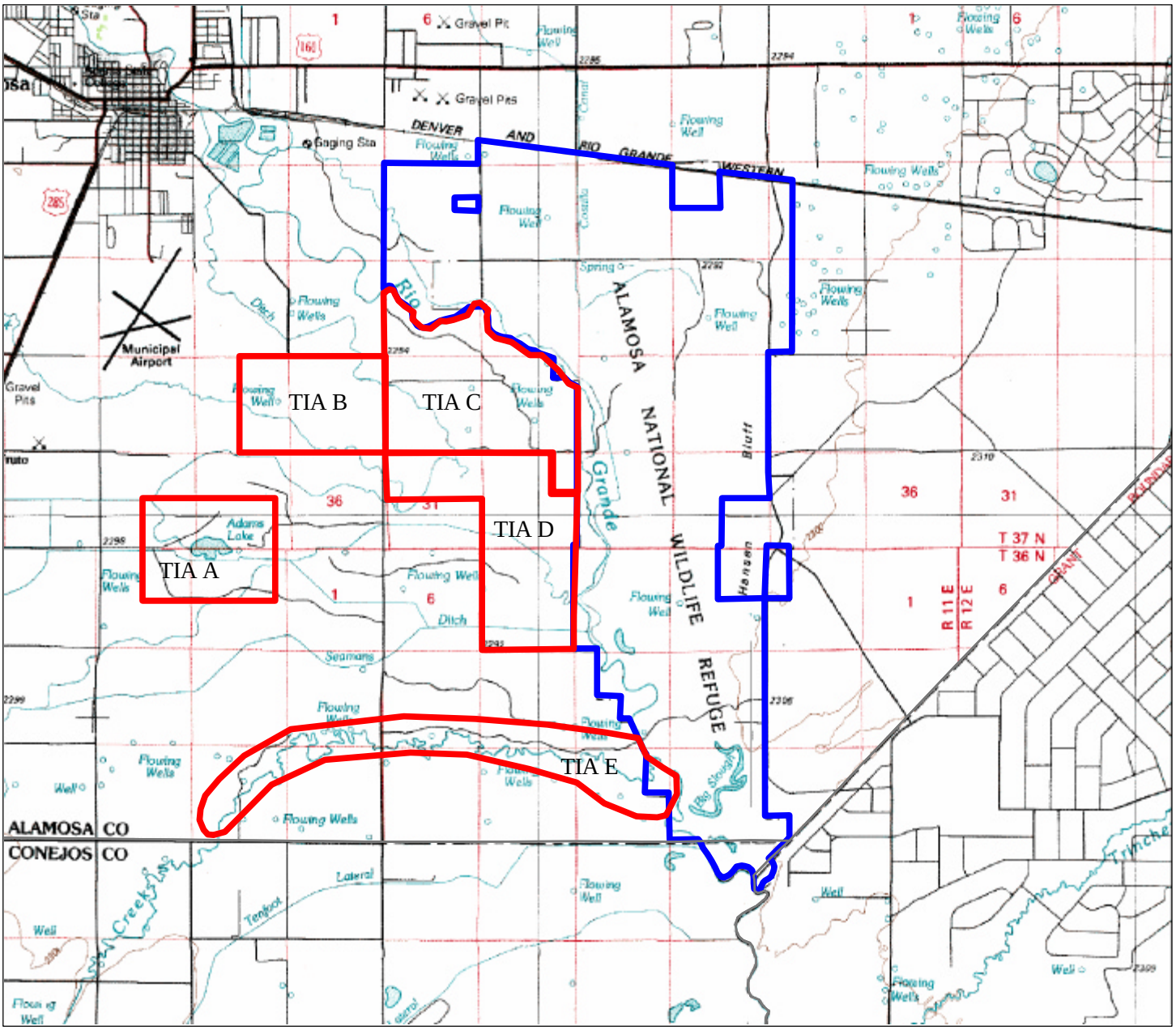
Using available resources and conducting roadside assessment, five Targeted Inventory Areas (TIAs) were identified (Figure 1). CNHP was denied permission to access two of the TIAs (Figure 2).

SIGNIFICANT ELEMENTS ASSOCIATED WITH WETLANDS AND RIPARIAN AREAS

Precipitation near Alamosa in 2002 was the 7th lowest on record at 4.42 inches (National Weather Service 2004). As a result, many of the wetlands in the study area were very dry. Wetland vegetation did not exhibit luxuriant growth in many areas and often was only represented by past year's growth. Thus, many wetland species which may occur in the study area were likely not observed during the 2003 field season (e.g. slender spiderflower (*Cleome multicaulis*)).

Current land management activities, mostly livestock grazing, have also impacted many wetlands in the study area. These impacts have likely been exacerbated by drought conditions as many species may not have the resources to recover from grazing as they would under normal precipitation.

No element occurrences, not already incorporated into CNHP's BCD and BIOTICS databases, were documented in the study area. The White-Faced Ibis, Snowy Egret, and Black-necked Stilt records at Adams Lake were updated with information provided from Rocky Mountain Bird Observatory. Although examples of wetland plant communities tracked by CNHP were observed, their small size, poor condition, and/or the poor condition of the surrounding landscape precluded their incorporatoin into the databases. However, they are included in Table 8 to indicate the diversity of wetland types found in the study area. Short-Eared Owls were observed at Adams Lake and thus are included in Table 8, but these observations are currently not in CNHP's databases due to a lack of detailed data.



0.2 0 0.2 0.4 Miles

Projection: UTM, Zone13, NAD27

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

map created 14 April 2004

Disclaimer

The data contained herein 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.

LEGEND

Targeted Inventory Areas

Alamosa National Wildlife Refuge

QUAD NAME, CODE
7.5 Minute Series OR 30 x 60 Minute Series

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

Location in Study Area

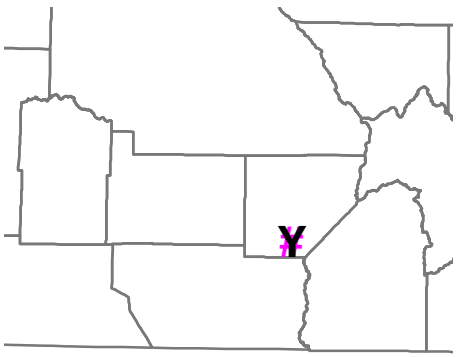
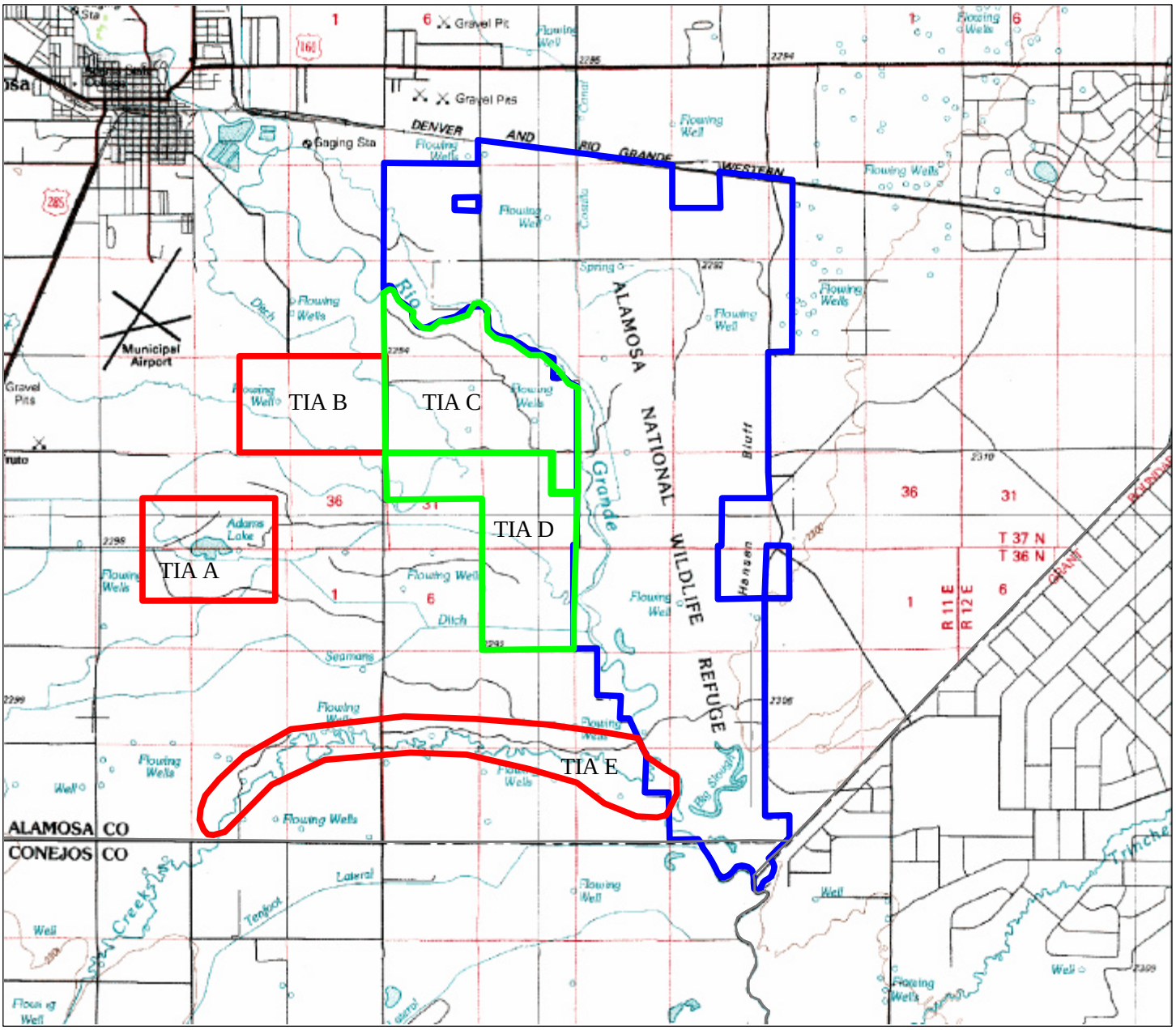


Figure 1. Targeted Inventory Areas



0.2 0 0.2 0.4 Miles

Projection: UTM, Zone13, NAD27

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LEGEND

- Targeted Inventory Area Not Visited
- Targeted Inventory Areas Visited
- Alamosa National Wildlife Refuge

Alamosa 1:100k USGS QUAD

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

Location in Study Area

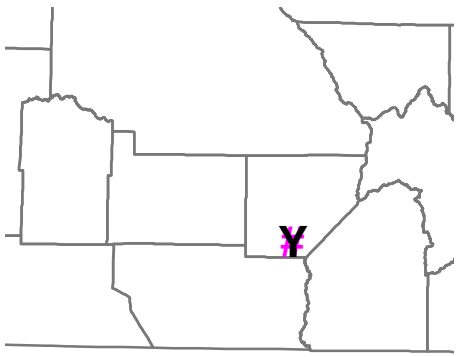


Figure 2. Targeted Inventory Areas Visited

The following table presents CNHP elements of biological significance known to occur in the study area. Note that the elements listed in Table 8 do not match those listed in Tables 11 and 12 which document **all** the elements found in the Potential Conservation Areas in which some of the TIAs occur. Table 8 only list those elements documented in the TIAs while Table 11 and 12 list those found anywhere within the Potential Conservation Areas (outside of the study area).

Table 8. Known elements of concern found within study area, by taxonomic group.
Elements contained in CNHP's BCD and BIOTICS databases are in bold type. **Detailed descriptions of some of the wetland elements listed below can be found in the Appendix.**

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status
Animals				
Asio flammeus	Short-Eared Owl	G5	S2B, SZN	
Egretta thula	**Snowy Egret**	**G5**	**S2B**	
Himantopus mexicanus	**Black-necked Stilt**	**G5**	**S3B**	
Plegadis chihi	**White-faced Ibis**	**G5**	**S2B**	
Plant Communities				
Distichlis spicata	Saline wet meadow	G5	S3	
Eleocharis palustris	Montane wet meadow	G5	S4	
Juncus balticus	Montane wet meadow	G5	S5	
Salix exigua / Mesic graminoid	Montane riparian shrubland	G5	S5	
Sarcobatus vermiculatus / Distichlis spicata	Saline bottomland shrubland	G4	S2?	
Schoenoplectus acutus/ Schoenoplectus tabernaemontani	Freshwater marsh	G5	S2S3	
Schoenoplectus pungens	Montane wet meadows	G3G4	S3	

Slender spiderflower (*Cleome multicaulis*) (G2G3 S2S3)
Slender spiderflower (*Cleome multicaulis*) 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. During the 2003 field survey, many areas in the study area appeared to be potential slender spiderflower habitat. However, slender spiderflower was not observed at any sites. It is unknown if this annual species is present in the seed bank but was unable to germinate due to drought conditions, or is simply not located within the study area. Further survey work should be conducted during a year of average precipitation.

San Luis sandhill skipper (*Polites sabuleti ministigma*) (G5T3 S3)
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. The San Luis sandhill skipper was not observed during the site visits, however its host plant, salt grass, is very abundant in the project area. Future surveys should be conducted for this species.

Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (G5T1T2 S1S2)
Coyote Willow shrublands along the Rio Grande were found to support breeding populations of the Southwestern Willow Flycatcher. Six of these occurrences abut two of the TIAs (C &

D) in this study. Thus, it is likely that this species uses some of the riparian areas and wetlands in the project area.

TARGETED INVENTORY AREA DESCRIPTIONS

It has been speculated that much of the San Luis Valley (SLV), prior to European settlement, was dominated by greasewood (*Sarcobatus vermiculatus*), saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), and rabbitbrush (*Chrysothamnus* spp.). There are still some very large tracts of land dominated by such species within the SLV. Exact species composition varies with the degree of soil moisture and salinity. For example, in areas where seasonal soil moisture is high, salt crusts may develop on the soil surface, limiting species composition to those tolerable of saline and/or alkaline soils. This occurs when the soil solution (soil water and its constituents (nutrients, salts, etc.)) becomes concentrated due to evaporation. This increase in concentration limits the solubility of calcium sulfate, calcium carbonate, and magnesium carbonate, which, as evaporation increases, eventually precipitate out of the soil solution and form salt crusts. This process also increases the proportion of soluble sodium in the soil solution, thus creating a saline soil environment (United States Salinity Laboratory Staff 1954). Often areas with thick salt crusts are void of any vegetation, however pickleweed (*Salicornia rubra*) is sometimes found in these areas and is the most saline tolerant species in the area. However, no pickleweed was located in the study area. Broom seepweed (*Suaeda calceoliformis*), saltgrass, and Nevada bulrush (*Scirpus nevadensis*) occupy slightly less saline areas. Decreasing salinity and moisture allows greasewood (*Sarcobatus vermiculatus*), alkali sacaton (*Sporobolus airoides*), and Baltic rush (*Juncus balticus*) to establish. Thus, a consistent pattern of species distribution is conspicuous on the landscape: the lowest areas of saline bottomland meadows and shrublands are typically void of vegetation; saltgrass occupies bands of slightly less saline soils whereas Baltic rush and greasewood occur on sporadic knolls. Slender spiderflower is sometimes found growing around the base of these knolls, occupying a very narrow band between the more saline saltgrass community and the less saline areas of Baltic rush and greasewood.

Distribution of vegetation within the TIAs mostly followed that described above. A description of each Targeted Inventory Area visited is given below. At least some portion of four of the TIAs are found within two CNHP Potential Conservation Areas (see the Sites of Biodiversity section of this document for more information).

Targeted Inventory Area A:

This TIA occurs within the *Adams Lake Potential Conservation Area*. Please see the profile of the *Adams Lake Potential Conservation Area* within the Sites of Biodiversity section of this document for more information.

Wetland Types Present: Most Cowardin wetland types are either temporarily, seasonal, and semi-permanently flooded palustrine, emergent wetlands. There is also an intermittently exposed Lacustrine, littoral, aquatic bed type.

CNHP plant community types present include: (1) *Schoenoplectus acutus*; (2) *Schoenoplectus pungens*; (3) *Eleocharis palustris*; and (4) *Distichlis spicata*.

Targeted Inventory Area B:

Location: West of the Rio Grande and just west of county road S-112.
U.S.G.S. 7.5-min. quadrangle: Alamosa East
Legal Description: T37N R10E S25, E2 S26.

General Description: Within TIA B, mesic meadows comprised of Baltic rush (*Juncus balticus*), saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), scratchgrass (*Muhlenbergia asperifolia*), and wild iris (*Iris missouriensis*) occupy much of the area. Drier meadows are occupied by rabbitbrush (*Chrysothamnus nauseosus*), Baltic rush, and alkali sacaton. Greasewood (*Sarcobatus vermiculatus*) and saltgrass were also dominant in many locations.

Relict stream channels, which may have been associated with Rock Creek when the creek historically flowed through the area, were dry during the site visits. However, these areas are seasonally wet, as indicated by the presence of hardstem bulrush (*Schoenoplectus acutus*) in these areas. Due to drought conditions, previous year's growth of hardstem bulrush was more prevalent than current year's growth. Foxtail barley (*Hordeum jubatum*), alkali crowfoot (*Halerpestes cymbalaria* subsp. *saximontana*), arrowgrass (*Triglochin maritima*), dock (*Rumex triangularis*), goosefoot (*Chenopodium* sp.), and toad rush (*Juncus bufonius*) were also present in these channels. Soils in these areas were moist and had a thin O-Horizon and a thick, sandy, A-Horizon. No water was observed in soil pits dug to a depth of 24 inches.

Apparently suitable habitat for the slender spiderflower (*Cleome multicaulis*) was observed during the site visit, but slender spiderflower was not present. It is unclear if the species is simply not present at the site or if recent drought conditions did not allow this annual species to germinate.

Cattle graze the entire area. Their impacts were most obvious in the stream channels. Hoof action has created much soil disturbance in the areas. The prevalence of wild iris (*Iris missouriensis*), a species known to increase with overgrazing, and non-native species such as whitetop (*Lepidium latifolium*) and Canada thistle (*Cirsium arvense*) suggest current management may be negatively affecting the floristic integrity of the area. However, current climatic factors may also be influencing species composition at the site.

No wildlife species were observed during the site visit.

Wetland Types Present: Most Cowardin wetland types are palustrine, emergent wetlands with either temporarily, seasonal, intermittent, and semi-permanently hydrological regimes.

CNHP plant community types present include: (1) *Schoenoplectus acutus*; (2) *Schoenoplectus pungens*; (3) *Eleocharis palustris*; (4) *Distichlis spicata*; and (5) *Sarcobatus vermiculatus* / *Distichlis spicata*.

Soils Description: Soils are variable within this TIA. The Alamosa, Arena, La Jara, LaSauses, Nortonville, and Vastine series are all contained within this TIA. 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 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). 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 Nortonville is classified as Fine-loamy, mixed, frigid, Typic Calciaquolls. Nortonville soils are medium-textured, somewhat poorly drained, saline-alkaline soils on low floodplains. They formed in weakly stratified, medium to fine textured alluvium (USDA 1973). 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: Resting some areas from grazing or altering grazing management to allow native vegetation to recover would be beneficial for improving the functional capacity of the wetlands in the area. The geomorphic template (e.g. necessary topographic and hydrological scenarios) for restoration of wetland types such as riparian and wet meadows occurs on site. However, Rock Creek is highly manipulated upstream. Thus, restoring natural hydrology along Rock Creek would require a large-scale restoration project within the Rock Creek drainage on the San Luis Valley floor. NWI maps indicate that the confluence of Rock Creek, La Jara Creek, and the Rio Grande support a very high concentration of wetlands. Thus, such a large-scale project could potentially improve the biological and functional integrity in one of the largest, highly functioning, natural wetland complexes in the San Luis Valley.

Wetland Functional Assessment for TIA B: (riparian areas)
Proposed HGM Class: Riverine **Subclass:** R2
Cowardin System: Palustrine.
CNHP's Wetland Classification: *Schoenoplectus acutus*

Table 9. Wetland Functional Assessment for TIA B.

Function	Ratings	Comments
Overall Functional Integrity	Below Potential	This wetland is functioning below potential due to historical changes in hydrology.
Hydrological Functions		
Flood Attenuation and Storage	Low	Riparian areas rarely flood via overbank or in-channel flow.
Sediment/Shoreline Stabilization	Low	Riparian areas rarely subject to flooding events which could destabilize and/or erode streambanks.
Groundwater Discharge/ Recharge	Moderate	Wetlands on the site are supported by groundwater discharge as indicated by saturated areas during the dry season.
Dynamic Surface Water Storage	Low	There are no extensive areas of open water in these wetlands, most are saturated.
Biogeochemical Functions		
Elemental Cycling	Disrupted	Altered hydrology has disrupted nutrient cycles by eliminating normal flushing cycles and lack of deposition of organic material from floodwaters.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	The wetlands likely receive return water from nearby rangelands and hay meadows, however, some areas are sparsely vegetated and very little ponded water is found in these areas. The latter two limit the capability of these wetlands to perform this function. However, the hardstem bulrush plant community may be able to uptake excess nutrients within the stream channels.
Biological Functions		
Habitat Diversity	Low	The site consists of salt meadows, saline bottomland shrublands, and small amounts of riparian vegetation, with no open water.
General Wildlife Habitat	Moderate	No wildlife species were observed. However, when water is present, the oxbows and sloughs may provide open water for waterbirds and food and cover for many other avian species. However, livestock activities have impacted some wildlife habitat in the area by removing aboveground vegetation.
General Fish/Aquatic Habitat	N/A	Doesn't occur along a natural surface drainage.
Production Export/Food Chain Support	Low	Sparse growth of vegetation (due to saline/alkaline soils), low habitat and species diversity, and ephemeral surface water limits the export of organic matter and nutrients. The site provides food chain support for some species (i.e. potentially the San Luis Valley sand hills skipper (*Polites sabuleti ministigma*), which uses saltgrass as a host plant).
Uniqueness	Moderate	Historically, riparian areas associated with Rock Creek were likely more numerous as irrigation and groundwater withdrawal have decreased the flow in these area and thereby have eliminated much of this habitat.

Targeted Inventory Area C:

Location: West of the Rio Grande and east of county road S-112.
U.S.G.S. 7.5-min. quadrangle: Alamosa East
Legal Description: T37N R11E portions of S19, 20, 29, 32, and all of S30.

General Description: CNHP did not receive permission to access this TIA. However, a portion of this site is incorporated into the Rio Grande at Alamosa National Wildlife Refuge Potential Conservation Area (see Sites of Biodiversity section of this document) due to the site's proximity to the Rio Grande floodplain. Thus, the ecological processes associated with the Rio Grande likely affect many portions of this area. Future surveys are needed to determine if any elements occur in this area.

Wetland Types Present: Cowardin wetland types include temporarily and seasonally flooded palustrine, emergent wetlands, seasonally flooded palustrine, scrub-shrub, and semi-permanently flooded palustrine, aquatic bed.

CNHP plant community types present include: Unknown.

Targeted Inventory Area D:

Location: West of the Rio Grande and east of county road S-112.
U.S.G.S. 7.5-min. quadrangle: Alamosa East
Legal Description: T37N R11E portions of S31 and 32;
T36N R11E S5

General Description: CNHP did not receive permission to access this TIA. However, a portion of this site is incorporated into the Rio Grande at Alamosa National Wildlife Refuge Potential Conservation Area (see Sites of Biodiversity section of this document) due to the site's proximity to the Rio Grande floodplain. Thus, the ecological processes associated with the Rio Grande likely affect many portions of this area. Future surveys are needed to determine if any elements occur in this area.

Wetland Types Present: Cowardin wetland types include temporarily and seasonally flooded palustrine, emergent wetlands and permanently flooded riverine, lower perennial, unconsolidated, types.

CNHP plant community types present include: Unknown.

Targeted Inventory Area E:

A portion of this site is incorporated into the Rio Grande at Alamosa National Wildlife Refuge Potential Conservation Area (see Sites of Biodiversity section of this document) due to the site's proximity to the Rio Grande floodplain.

Location: West of the Rio Grande along the Alamosa and Conjeos county line.
U.S.G.S. 7.5-min. quadrangle: Pikes Stockade
Legal Description: Portion Visited: T36N R11E portions of S7, 8, 8, 16, 17, and 18;
Portion Not Visited: T36N R10E portions of S11-14.

General Description: La Jara Creek meanders through extensive mesic and dry meadows within this area. Numerous oxbows and old stream channels are also scattered throughout the site.

Coyote willow (*Salix exigua*), mountain willow (*S. monticola*), and wild rose (*Rosa woodsii*) dominate along the banks of La Jara Creek. However, excessive grazing has resulted in "mushroom" shaped willows and a plethora of non-native species, such as Canada thistle (*Cirsium arvense*) and whitetop (*Lepidium latifolium*), occurring along La Jara Creek. Livestock trampling has also resulted in numerous soil "pits" which may disrupt hydrological patterns within the riparian area. It is unclear how much streamflow typically occurs along this reach of La Jara Creek, however there was no surface water present during the site visit. Hydric soil indicators, such as a depleted matrix and oxidized ped faces and root channels, suggest that the area is periodically or seasonally saturated in most years (NRCS 2003).

Greasewood (*Sarcobatus vermiculatus*), saltgrass (*Distichlis spicata*), Baltic rush (*Juncus balticus*), and alkali sacaton (*Sporobolus airoides*) are dominant throughout most of the surrounding landscape. Russian knapweed (*Acroptilon repens*) is prevalent throughout these areas.

Oxbows and stream channels were very dry during the site visit. Some had current year's growth of hardstem bulrush (*Schoenoplectus acutus*) although many only exhibited previous year's growth of this species. Foxtail barley (*Hordeum jubatum*) was present in most channels. A portion of this TIA abuts the western side of the Rio Grande. This area is dominated by coyote willow and a diversity of forbs and graminoids. Species such as hardstem bulrush, foxtail barley, owl-clover (*Orthocarpus luteus*), Kentucky bluegrass (*Poa pratensis*), silverweed (*Argentea anserina*), cocklebur (*Xanthium strumarium*), black medic (*Medicago lupulina*), rabbitfoot grass (*Polypogon monspeliensis*), small-fruited bulrush (*Scirpus microcarpus*), sloughgrass (*Beckmannia syzigachne*), common plantain (*Plantago major*), and dock (*Rumex triangularis*) comprised the understory.

The area is grazed by cattle, which have most impacted the riparian areas near La Jara Creek. Hoof action has created much soil disturbance in these areas. The prevalence of wild iris (*Iris missouriensis*), a species known to increase with overgrazing, and non-native species such as whitetop (*Lepidium latifolium*) and Canada thistle (*Cirsium arvense*) suggest current management may be negatively affecting the floristic integrity of the area. However, current climatic factors may also be influencing species composition at the site.

Wetland Types Present: Cowardin wetland types include temporarily, seasonally, and semi-permanently flooded palustrine, emergent wetlands, seasonally flooded palustrine, scrub-shrub types.

CNHP plant community types present include: (1) *Salix exigua* / Mesic graminoid; (2) *Schoenoplectus acutus*; and (3) *Distichlis spicata.*

Soils Description: Most of the soils near La Jara creek are mapped as the La Jara series. Pockets of the Nortonville series are also found in the area. 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). The Nortonville is classified as Fine-loamy, mixed, frigid, Typic Calciaquolls. Nortonville soils are medium-textured, somewhat poorly drained, saline-alkaline soils on low floodplains. They formed in weakly stratified, medium to fine textured alluvium (USDA 1973).

Restoration Potential: Resting some areas from grazing or altering grazing management to allow native vegetation to recover would be beneficial for improving the functional capacity of the wetlands in the area. Any effort to increase streamflow in La Jara Creek would also improve the biological and functional integrity of the riparian wetlands.

Wetland Functional Assessment for TIA E: (riparian areas)
Proposed HGM Class: Riverine/Slope **Subclass:** RS2
Cowardin System: Palustrine
CNHP's Wetland Classification: *Schoenoplectus acutus* and willow (*Salix* sp.)

Table 10. Wetland Functional Assessment for TIA E.

Function	Ratings	Comments
Overall Functional Integrity	Below Potential	This wetland is functioning below potential due to historical changes in hydrology.
Hydrological Functions		
Flood Attenuation and Storage	Low	Riparian areas rarely flood via overbank or in-channel flow.
Sediment/Shoreline Stabilization	Low	Riparian areas rarely subject to flooding events which could destabilize and/or erode streambanks. In addition, current grazing activities are destabilizing streambanks.
Groundwater Discharge/ Recharge	Moderate	Many of the wetlands on the site are supported by groundwater discharge as indicated by saturated areas during the dry season.
Dynamic Surface Water Storage	Low	There are no extensive areas of open water in these wetlands, most are saturated.
Biogeochemical Functions		
Elemental Cycling	Disrupted	Altered hydrology has disrupted nutrient cycles by eliminating normal flushing cycles and lack of deposition of organic material from floodwaters.
Removal of Imported Nutrients, Toxicants, and Sediments.	Moderate	The wetlands likely receive runoff from nearby rangelands and hay meadows, however, some areas are sparsely vegetated and very little ponded water is found in these areas. The latter two limit the capability of these wetlands to perform this function. However, the hardstem bulrush plant community may be able to uptake excess nutrients within the stream channels.
Biological Functions		
Habitat Diversity	Low	The site consists of salt meadows, saline bottomland shrublands, and small amounts of riparian vegetation, with no open water.
General Wildlife Habitat	Moderate	No wildlife species were observed. However, when water is present, the oxbows and sloughs may provide open water for waterbirds and food and cover for many other avian species. However, livestock activities have impacted some wildlife habitat in the area by removing aboveground vegetation.
General Fish/Aquatic Habitat	N/A	Doesn't occur along a natural surface drainage.
Production Export/Food Chain Support	Low	Sparse growth of vegetation (due to saline/alkaline soils), low habitat and species diversity, and ephemeral surface water limits the export of organic matter and nutrients. The site does, however provide food chain support for some species (i.e. potentially the San Luis Valley sand hills skipper (*Polites sabuleti ministigma*), which uses saltgrass as a host plant).
Uniqueness	Moderate	However, riparian areas associated with Rock Creek were likely more numerous as irrigation and groundwater withdrawal have decreased the flow in these area and thereby have eliminated much of this habitat.

SITES OF BIODIVERSITY SIGNIFICANCE

The two most important wetland sites in the study area are profiled in this section as Potential Conservation Areas (PCAs) with biodiversity ranks (Figure 3). 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.

Each Potential Conservation Area (PCA) is described in a standard PCA profile report that reflects data fields in CNHP's BIOTICS database. 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, animals, 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.

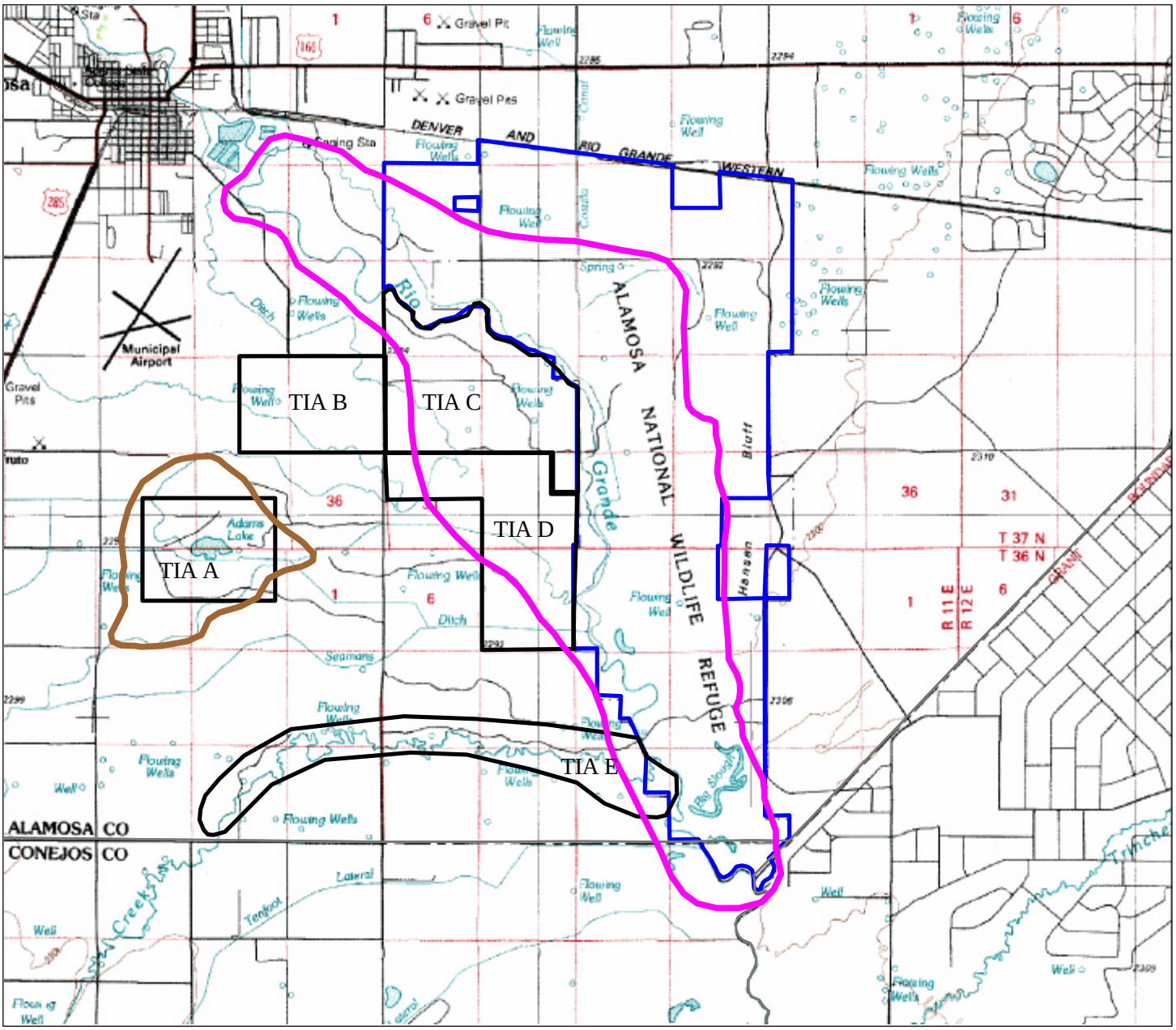
Protection Rank Comments: Discussion of major land ownership issues that may affect the long-term viability of the PCA and the element(s).

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.

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



0.2 0 0.2 0.4 Miles

Projection: UTM, Zone13, NAD27

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

map created 14 April 2004

Disclaimer

The data contained herein 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.

LEGEND

- Rio Grande at Alamosa National Wildlife Refuge Potential Conservation Area
- Adams Lake Potential Conservation Area
- Targeted Inventory Areas
- Alamosa National Wildlife Refuge

Alamosa 1:100k USGS QUAD

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

Location in Study Area

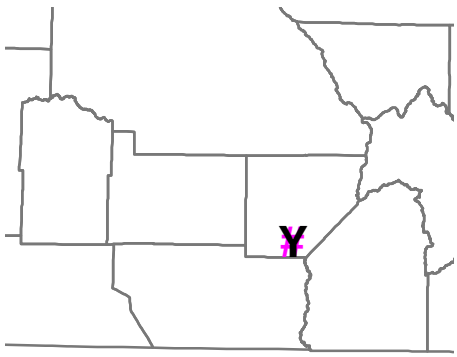


Figure 3. Potential Conservation Areas in the Study Area

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 Owl (*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 (*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 latifolia*), 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, Inc. 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 (see Appendix B for notes regarding the vegetation of these areas) and all locations occurred within the coyote willow-mesic graminoid riparian shrubland (*Salix exigua* / mesic graminoid) plant community (Carsey et al. 2003b).

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 latifolia*), 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 common reed (*Phragmites australis*) and sandbar willow communities are very common. 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 11. 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					
Phragmites australis	Common reed wet meadows	G5	S3		C
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 and education/bird watching) is the dominant use of the Refuge. Livestock grazing and hay production occurs 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 a concern 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 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 12. 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 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

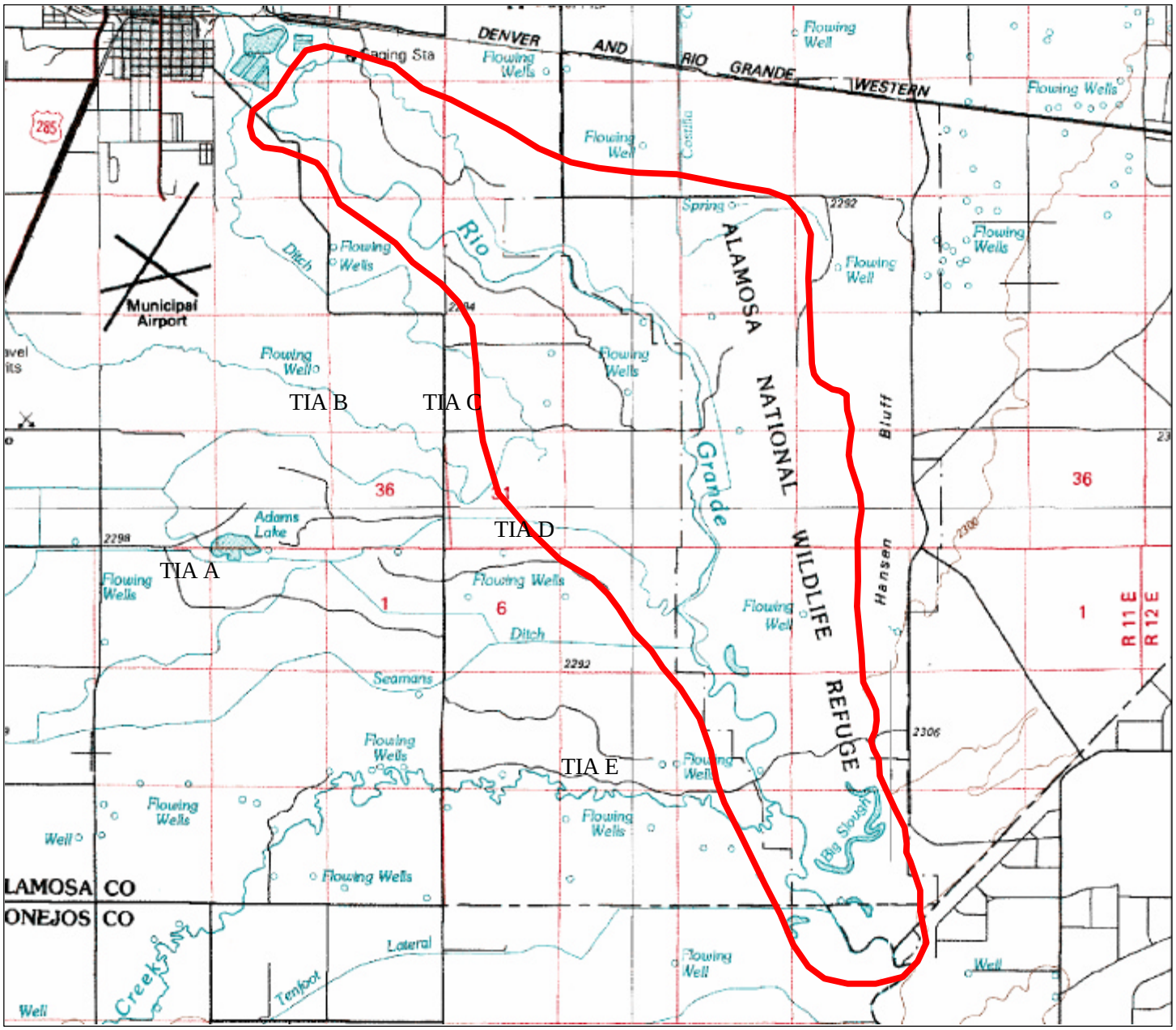
		riparian area provide important habitat for the Federally Endangered Southwestern Willow Flycatcher. Wet meadows, emergent wetlands, and open water wetlands provide nesting and migratory habitat for numerous species of birds and mammals, which in turn provide forage for birds of prey such as eagles, 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 13. 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 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



0.2 0 0.20.4 Miles

Projection: UTM, Zone13, NAD27

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map created 14 April 2004

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LEGEND

Rio Grande at Alamosa National Wildlife Refuge Potential Conservation Area

Alamosa 1:100k USGS QUAD

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

Location in Study Area

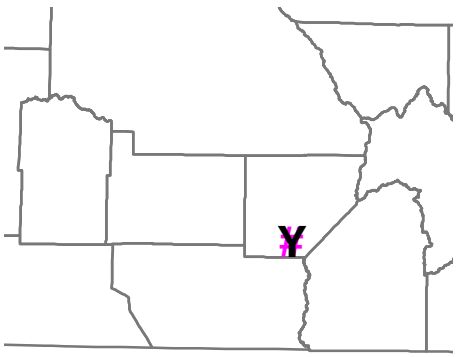


Figure 4. Rio Grande at Alamosa National Wildlife Refuge Potential Conservation Area

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: 1,665 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 14. Natural Heritage element occurrences at Adams Lake PCA.

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

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).

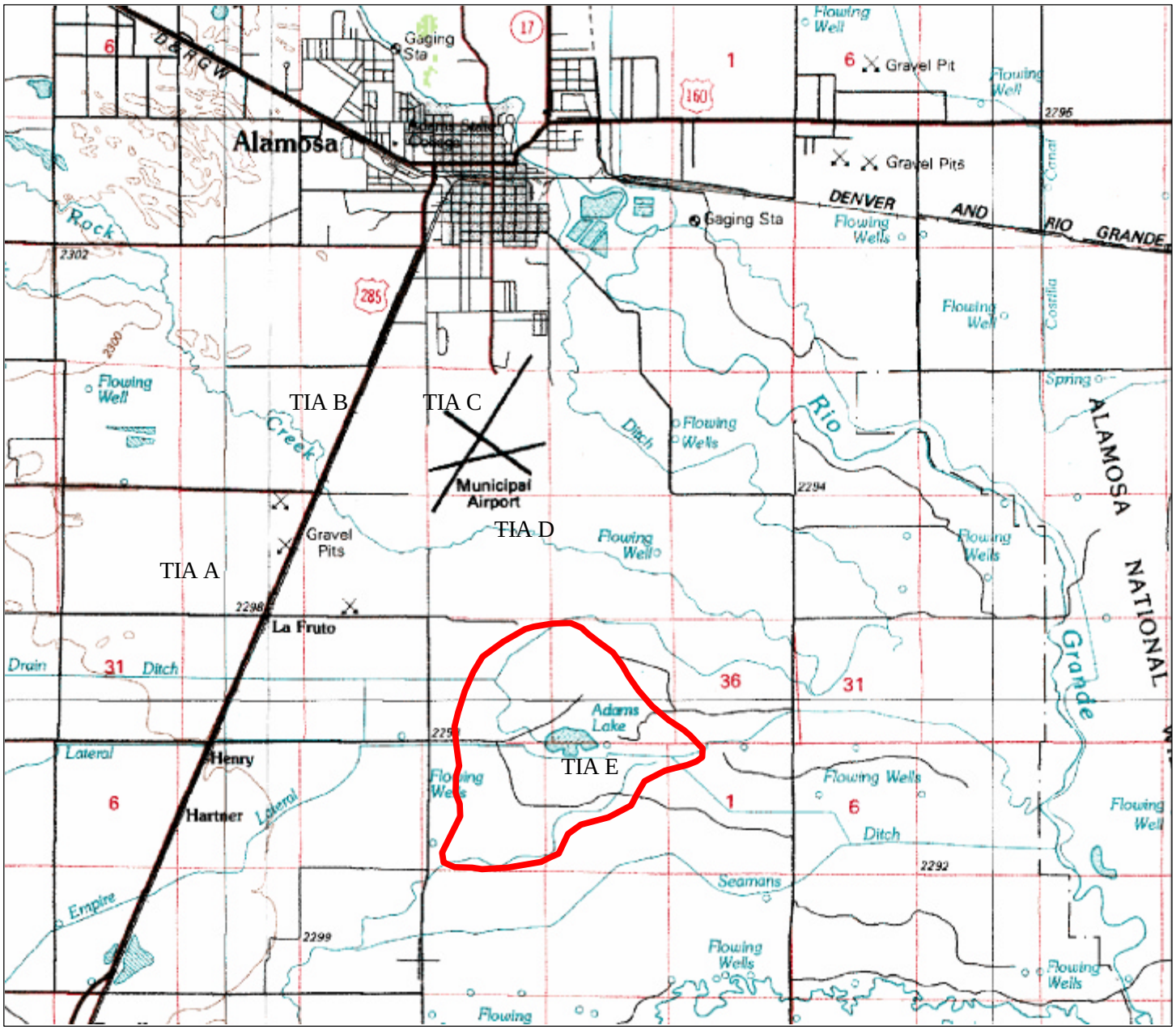
Restoration Potential: Restoration should focus on upstream water use. Restoration of natural hydrologic processes would require an immense collaboration with upstream water users, local landowners, municipalities, etc. Wetland functions such as biogeochemical functions, have likely been impacted by 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 15. 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	High	Dense wet meadow and emergent vegetation and open water

Chain Support		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.



0.2 0 0.2 0.4 Miles

Projection: UTM, Zone13, NAD27

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LEGEND

Adams Lake
Potential Conservation Area

Alamosa 1:100k USGS QUAD

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

Location in Study Area

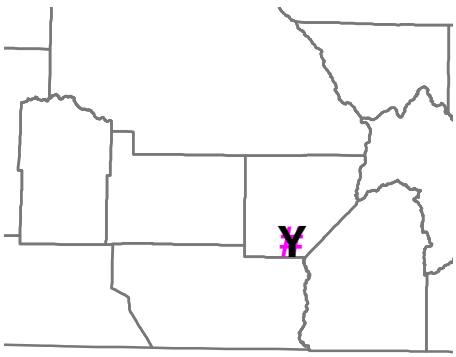

Figure 5. Adams Lake Potential Conservation Area

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APPENDIX A: Natural History Information of Selected Elements

Animals

Asio flammeus (Short-Eared Owl)

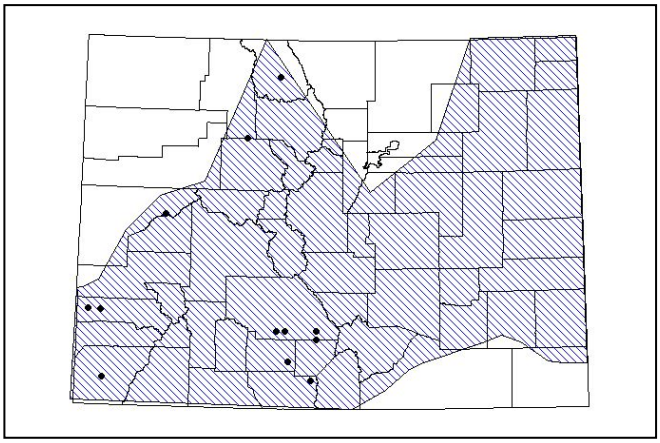
Taxonomy:
Class: Aves
Order: Strigiformes
Family: Tytonidae
Genus: *Asio*

Taxonomic Comments:

CNHP Ranking: G5 S2B, SZN

State/Federal Status: None

Habitat Comments: The Short-eared Owl inhabits open fields, marshes, dunes, and grasslands, as well as shrub-steppes and agricultural lands (CBBA1998). 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).

Location in Project Area in which it occurs: Adams Lake Potential Conservation Area. Likely elsewhere.

Empidonax traillii extimus **(Southwestern Willow Flycatcher)**

(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: Thickets, scrubby and brushy areas, open second growth, swamps, and open woodland (AOU 1983). Restricted to riparian habitat in Arizona (Brown 1988). 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

Nests in fork or on horizontal limb of small tree, shrub, or vine, 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 immigration from nearby populations and their isolated nature increases the risk of local extirpation (USFWS 2002). The vulnerability of the few relatively large populations (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 replaced 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).

Location in Project Area in which it occurs: Rio Grande at Alamosa National Wildlife Refuge (near TIA C & D.

Himantopus mexicanus **(Black-necked Stilt)**

(text from NatureServe www.natureserve.org)

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

Taxonomic Comments:

CNHP Ranking: G5 S3B

State/Federal Status: None

Photo from www.natureserve.org

Habitat Comments: 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).

Nests along shallow water of ponds, lakes, swamps, or lagoons. May nest on the ground or in shallow water on a plant tussock.

Feeds actively in shallow water; plucks food from surface of water or mud, or probes 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. These birds are social; usually occurring 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.

Location in Project Area in which it occurs: Adams Lake Potential Conservation Area.

Plegadis chihi **(White-faced Ibis)**

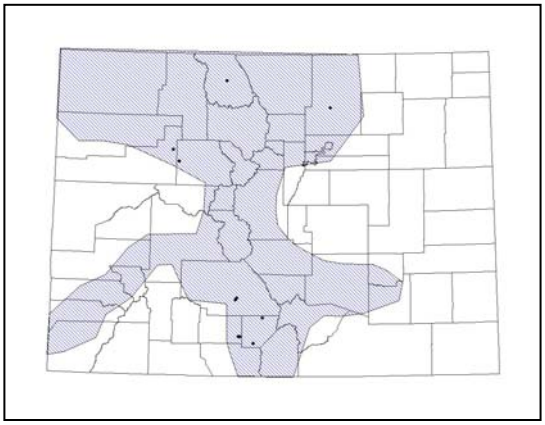
Taxonomy:
Class: Aves
Order: Ardeidae
Family: Threskiornithidae
Genus: *Plegadis*

Taxonomic Comments:

CNHP Ranking: G5 S2B

State/Federal Status: None

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).



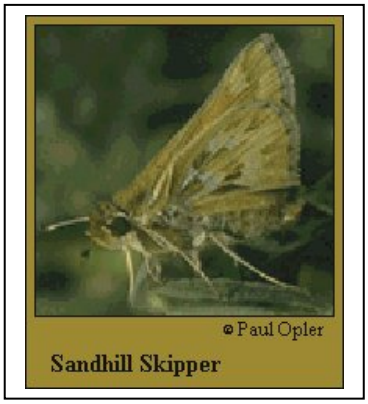
Distribution: In North America the White-faced Ibis nests from central Mexico to Louisiana and Texas (mainly coastal) and throughout the Great Basin. In Colorado, this species mainly nests in the San Luis Valley (Ryder 1998).

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).

Location in Project Area in which it occurs: Adams Lake Potential Conservation Area.

Polites sabuleti ministigma (San Luis sandhill skipper)



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 1998, Rondeau et al. 1998, Scott 1986).

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*).

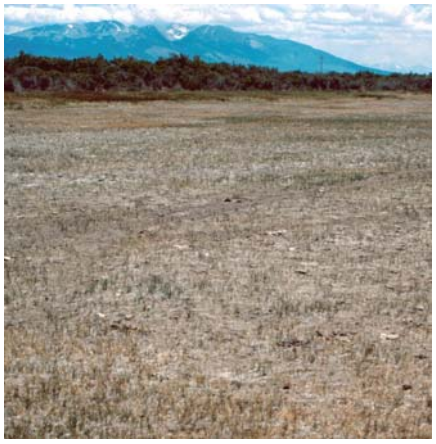
Known Threats and Management Issues: Continued surveys are encouraged to further determine range of this species within the San Luis Valley and the Arkansas River watershed. Additionally, as this species is considered to be an isolated and endemic subspecies (Scott 1986), research to determine the validity 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).

Location in Project Area in which it occurs: Not documented but may occur in the study area.

Plant Communities

INLAND SALTGRASS HERBACEOUS VEGETATION

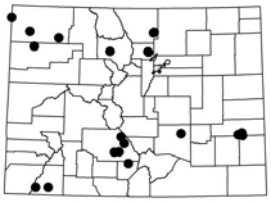
Distichlis spicata



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.

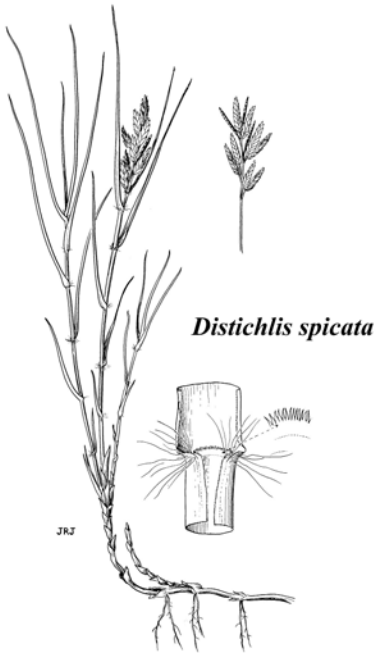
Ecological Processes

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.

Location in Project Area in which it occurs: Know throughout the project 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%).



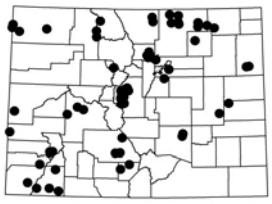
Common spikerush Herbaceous Vegetation (*Eleocharis palustris*)

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.

Location in Project Area in which it occurs: TIA A and likely throughout the project 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%).

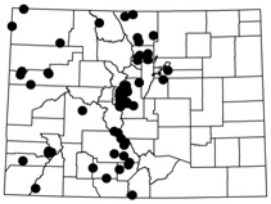
MOUNTAIN RUSH HERBACEOUS VEGETATION

Juncus balticus var. *montanus*

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.

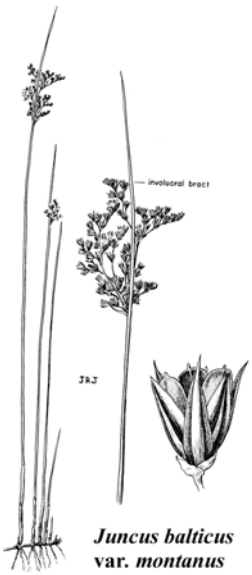
Adjacent stream channels are highly variable and can be narrow and deeply entrenched, moderately wide and moderately sinuous, moderately wide and very sinuous, narrow and very sinuous, or braided. Soil textures are also variable. They range from sandy and well drained, to silty clay loams, to pure organic 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).

Location in Project Area in which it occurs: Know throughout the project area



Juncus balticus* var. *montanus

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.

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%).

Sandbar willow / Mesic graminoid Shrubland
(*Salix exigua* / Mesic graminoid)

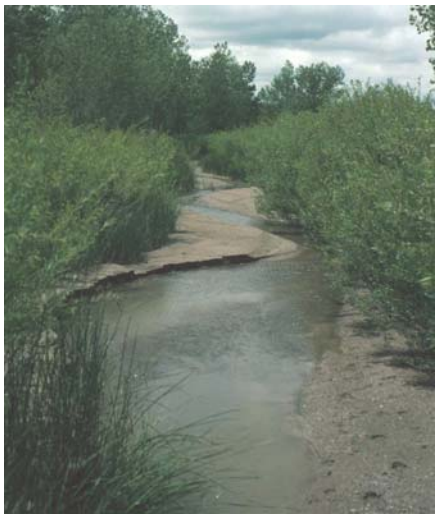
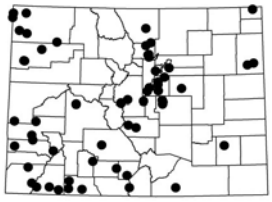


Photo from CNHP Photo database

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.

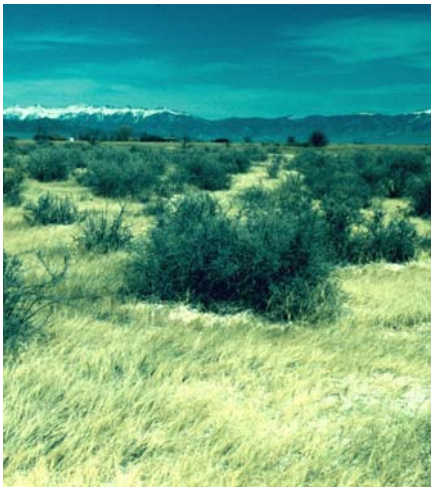
Location in Project Area in which it occurs: TIA C & D.

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%).

BLACK GREASEWOOD / INLAND SALTGRASS SHRUBLAND

Sarcobatus vermiculatus / Distichlis spicata



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.

Location in Project Area in which it occurs: Known throughout the project area.

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%).

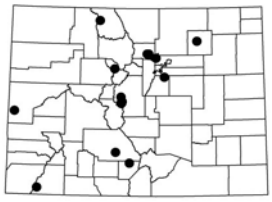
HARDSTEM BULRUSH - SOFTSTEM BULRUSH HERBACEOUS VEGETATION

Schoenoplectus acutus var. *acutus* - *Schoenoplectus tabernaemontani*

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

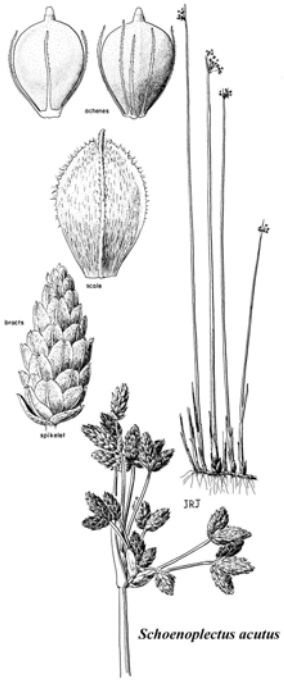
Schoenoplectus spp. (bulrush) stands are generally considered permanent wetland communities. They will remain in place unless the hydrologic regime is severely altered. Stands of *Schoenoplectus* are important to wildlife species, especially birds, for cover and nesting habitat.

Location in Project Area in which it occurs: Known throughout the project area.

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%).



Schoenoplectus acutus

Common threesquare Herbaceous Vegetation
(*Schoenoplectus pungens*)

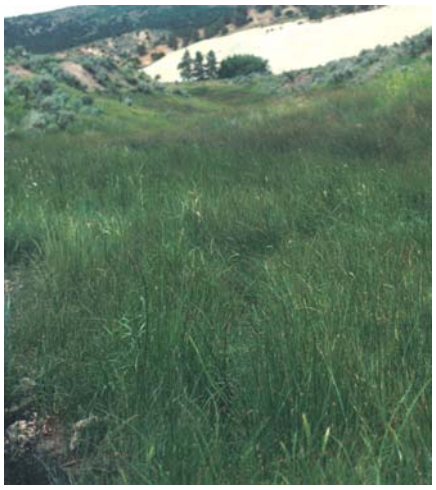
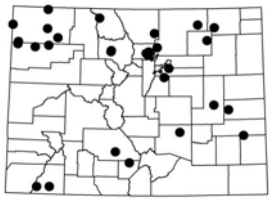


Photo from CNHP Photo database

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.

Location in Project Area in which it occurs: TIA A & D.

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%).

APPENDIX B: Summary of Vegetation at Southwestern Willow Flycatcher Locations at Higel State Wildlife Area and the Alamosa National Wildlife Refuge

CNHP visited areas within Higel State Wildlife Area and the Alamosa National Wildlife Refuge at which HawksAloft, Inc. (2003) detected Southwestern Willow Flycatchers (*Empidonax traillii extimus*). Site numbers are referenced on Figures 6 and 7. These maps can be compared to the figures within HawksAloft (2003) to crosswalk the data. CNHP's purpose was to provide a rapid assessment of the vegetation composition at each site. Other pertinent vegetation information was noted, such as vegetation structure and density. No quantitative data were collected. Observations are simply based on professional judgement and ocular estimates. CNHP plant community types are defined in Carsey et al. (2003).

Higel State Wildlife Area

Site # 1: General Description: Dense, relatively narrow stand of coyote willow (*Salix exigua*) on both sides of the river. Lots of non-native plant species are present. Vegetation structure is dense and consists of 3-8ft. willows of various age classes. Foliage and stem density are high. Large cottonwoods (*Populus angustifolia*) occur behind the willow stands. There are wooly sedge (*Carex pellita*) meadows nearby.

Plant composition: Coyote willow (*Salix exigua*), strapleaf willow (*S. ligulifolia*), western wheatgrass (*Pascopyrum smithii*), milkweed (*Asclepias speciosa*), horsetail (*Equisetum arvense*), Baltic rush (*Juncus balticus*), goosefoot (*Chenopodium* sp.), and silverweed (*Argentea anserina*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Canada thistle (*Cirsium arvense*), reed canarygrass (*Phalaris arundinacea*), Kentucky bluegrass (*Poa pratensis*), and beggar's tick (*Bidens cernua*).

Site # 2: General Description: Dense stand, moderately wide stand of coyote willow (*Salix exigua*) on north/west side of the river. Vegetation structure is dense and consists of 3-8ft. willows of various age classes.

Plant composition: Coyote willow (*Salix exigua*), western wheatgrass (*Pascopyrum smithii*), and foxtail barley (*Hordeum jubatum*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Reed canarygrass (*Phalaris arundinacea*), Kentucky bluegrass (*Poa pratensis*), and beggar's tick (*Bidens cernua*).

Site # 3: General Description: Large stand of coyote willow (*Salix exigua*) mostly over six ft. tall (ranges from 3-8ft.). A stand of cattail (*Typha latifolia*) occurs within and to the south of the willow stand. The stand is very lush. Canada thistle (*Cirsium arvense*) is prevalent. Foliage and stem density are high.

Plant composition: Coyote willow (*Salix exigua*), milkweed (*Asclepias speciosa*), goosefoot (*Chenopodium* sp.), wooly sedge (*Carex pellita*), wild licorice (*Glycyrrhiza lepidota*), cattail (*Typha latifolia*), and scarlet smartweed (*Polygonum coccinea*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Canada thistle (*Cirsium arvense*).

Sites 4, 5, and 6: General Description: These sites contain large, dense, stands of coyote willow (*Salix exigua*) of various age classes with high foliage and stem density. There is a western wheatgrass (*Pascopyrum smithii*) meadow on the south side of the stand which grades into large hayed, sedge (*Carex* sp.) meadows. Large cottonwoods (*Populus angustifolia*) are nearby.

Plant composition: Coyote willow (*Salix exigua*), wooly sedge (*Carex pellita*), wild licorice (*Glycyrrhiza lepidota*), wild rose (*Rosa woodsii*), and western wheatgrass (*Pascopyrum smithii*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Canada thistle (*Cirsium arvense*) and Kentucky bluegrass (*Poa pratensis*).

Alamosa National Wildlife Refuge

Site #7: General Description: This site (Lil Pop Ranch) has a dense stand of coyote willow (*Salix exigua*) with patches of slough sedge (*Carex atherodes*) in the understory. Some of the willows are up to 12 ft. tall. The understory in these areas is sparse and not as diverse as smaller stature willow stands. Wild rose (*Rosa woodsii*) is common in the understory of the taller stands. Overall, the willow stand is about 10-15 meters in width and occurs on the north side of the sewage treatment pond. Cattial stands (*Typha latifolia*) and beaked sedge meadows (*Carex utriculata*) occur nearby in wetter locations. Slough sedge also occurs in open meadows. Vegetation structure in the willow stands consists of two stratums (shrub and herbaceous) although scattered cottonwood (*Populus angustifolia*) trees occur nearby. Foliage and stem density are higher in smaller stature stands than tall ones. Overall, habitat diversity is high in this location.

Plant composition: Coyote willow (*Salix exigua*), strapleaf willow (*S. ligulifolia*), Pacific willow (*Salix lasiandra* ssp. *lasiandra*), narrowleaf cottonwood (*Populus angustifolia*), foxtail barley (*Hordeum jubatum*), slough sedge (*Carex atherodes*), beaked sedge (*C. utriculata*), wooly sedge (*C. pellita*), Baltic rush (*Juncus balticus*), white-panicle aster (*Aster lanceolatus* ssp. *hesperius*), silverweed (*Argentea anserina*), bugleweed (*Lycopus asper*), dock (*Rumex ste*nophyllus), hardstem bulrush (*Schoenoplectus acutus*), Indian hemp (*Apocynum cannabinum*), horsetail (*Equisetum arvense*), wild mint (*Mentha arvense*), bluejoint reedgrass (*Calamagrostis canadensis*), wild licorice (*Glycyrrhiza lepidota*), wild rose (*Rosa woodsii*), and western wheatgrass (*Pascopyrum smithii*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Canada thistle (*Cirsium arvense*) and Kentucky bluegrass (*Poa pratensis*). Whitetop (*Lepidium latifolium*) is present nearby.

Site #8: General Description: A narrow, low volume/density, and species poor strip of coyote willow (*Salix exigua*) occurs along the riverbank. Willows are much more dense surrounding a nearby overflow channel. This channel is separated from the river by a sandbar comprised of a mesic Baltic rush (*Juncus balticus*) meadow. This meadow has sparse, low stature coyote willows and a few scattered, young cottonwoods (*Populus angustifolia*) within it. Canada thistle (*Cirsium arvense*) is abundant here. The overflow channel is dominated by diversity of wet forbs and graminoids in the interior while a dense, high volume coyote willow stands occurs along the periphery of the channel.

Grazing has occurred somewhat recently on the sandbar as indicated by numerous "cow patties" in the area.

Plant composition: Coyote willow (*Salix exigua*), strapleaf willow (*S. ligulifolia*), peach leaf willow (*S. amygdaloides*), Pacific willow (*Salix lasiandra* ssp. *lasiandra*), golden currant (*Ribes aureum*), American mannagrass (*Glyceria grandis*), broadfruit bur-reed (*Sparganium emersum*), small-fruited bulrush (*Scirpus microcarpus*), common spikerush (*Eleocharis palustris*), narrowleaf cottonwood (*Populus angustifolia*), slough sedge (*Carex atherodes*), silverweed (*Argentea anserina*), hardstem bulrush (*Schoenoplectus acutus*), wild mint (*Mentha arvense*), bluejoint reedgrass (*Calamagrostis canadensis*), wild rose (*Rosa woodsii*), and western wheatgrass (*Pascopyrum smithii*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Canada thistle (*Cirsium arvense*) and Kentucky bluegrass (*Poa pratensis*).

Site #9: General Description: Coyote willow (*Salix exigua*) cover is much greater on the west side of river, however species composition data was collected from the east side. Streambanks on the west side of the river are more connected to the river's bankful flood stage than the east side where streambanks are much steeper and higher above the river. As a consequence, vegetation on the west side appeared more lush, had greater foliage and stem density, and more structural diversity. Grazing has occurred somewhat recently, at least on the east side, as indicated by numerous "cow patties" in the area.

Plant composition: Coyote willow (*Salix exigua*), Baltic rush (*Juncus balticus*), scouring rush (*Hippochaete hyemalis*), Indian hemp (*Apocynum cannabinum*), gumweed (*Grindelia* sp.), and western wheatgrass (*Pascopyrum smithii*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Kentucky bluegrass (*Poa pratensis*).

Site #10: General Description: Coyote willow (*Salix exigua*) lines the riverbanks. A Baltic rush (*Juncus balticus*) meadow occurs between the service road and the willow stand. The stand of willows has moderate density. Cow patties and livestock trails indicate that grazing has occurred recently. The understory is mostly dominated non-native (Canada thistle) and native increasers (wild iris) indicating that the area has been overgrazed. Willows are between 5-7 ft. tall. An overflow channel, dominated mostly by American mannagrass (*Glyceria grandis*) and small-fruited bulrush (*Scirpus microcarpus*) also occurs in the area. Streambanks on the west side of the river are more connected to the river's bankful flood area than the east side where streambanks are much steeper and higher above the river. As a consequence, vegetation on the west side appeared more lush, had greater foliage and stem density, and more structural diversity.

Plant composition: Coyote willow (*Salix exigua*), strapleaf willow (*S. ligulifolia*), Pacific willow (*Salix lasiandra* ssp. *lasiandra*), peach leaf willow (*S. amygdaloides*), narrowleaf cottonwood (*Populus angustifolia*), golden currant (*Ribes aureum*), foxtail barley (*Hordeum jubatum*), American mannagrass (*Glyceria grandis*), slough sedge (*Carex atherodes*), beaked sedge (*C. utriculata*), wooly sedge (*C. pellita*), Nebraska sedge (*C. nebrascensis*), small-fruited bulrush (*Scirpus microcarpus*), common spikerush (*Eleocharis palustris*), water parsnip (*Sium suave*), Baltic rush (*Juncus balticus*), cattail (*Typha latifolia*), slough grass (*Beckmannia syzigachne*), wild iris (*Iris missouriensis*), goosefoot (*Chenopodium* sp.), silverweed (*Argentea anserina*), bugleweed (*Lycopus asper*), hardstem bulrush (*Schoenoplectus acutus*), Indian hemp (*Apocynum cannabinum*), horsetail (*Equisetum*

arvense), wild mint (*Mentha arvense*), bluejoint reedgrass (*Calamagrostis canadensis*), wild rose (*Rosa woodsii*), and western wheatgrass (*Pascopyrum smithii*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Canada thistle (*Cirsium arvense*), Beggar's tick (*Bidens cernua*), Kentucky bluegrass (*Poa pratensis*), and whitetop (*Lepidium latifolium*).

Site #11: General Description: There are a lot of dead coyote willow (*Salix exigua*) individuals here. Both sides of the riverbank are well above the river, thus the downcutting of the river may be lowering water tables beyond the reach of the willow's roots. There is a small stand of willows near the riverbank which is void of understory species and is between 3-6 ft. tall. Vegetation structure is simple and foliage and stem density are low. There are a few cottonwood (*Populus angustifolia*) and peach leaf willows (*Salix amygdaloides*) trees on both sides of the river. Signs of recent grazing are present. Canada thistle (*Cirsium arvense*) is prevalent.

Plant composition: Coyote willow (*Salix exigua*), peach leaf willow (*S. amygdaloides*), narrowleaf cottonwood (*Populus angustifolia*), Nebraska sedge (*C. nebrascensis*), and silverweed (*Argentea anserina*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Canada thistle (*Cirsium arvense*) and Kentucky bluegrass (*Poa pratensis*).

Site #12: General Description: The stand of coyote willow (*Salix exigua*) occurs on the west side of the river, thus CNHP was not able to walk through the stand. That stand appears to have moderately diverse structure and the density of foliage and stems looks high. The stand is tall with a diversity of age classes. There are a few peach leaf willow (*Salix amygdaloides*) trees behind the willow stand.

Plant composition: Did not walk through stand but using binoculars, the following were observed: Coyote willow (*Salix exigua*) and peach leaf willow (*S. amygdaloides*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Unknown.

Site #13: General Description: The stand of coyote willow (*Salix exigua*) here are small (between 3-6 ft. tall) although foliage and stem density are high. Canada thistle (*Cirsium arvense*) is abundant. A mesic, weedy meadow sits to the east of the willow stand. Whitetop (*Lepidium latifolium*) is present here.

Plant composition: Coyote willow (*Salix exigua*), scratchgrass (*Muhlenbergia asperifolia*), meadow foxtail (*Alopecurus pratensis*), silverweed (*Argentea anserina*), western wheatgrass (*Pascopyrum smithii*), gumweed (*Grindelia* sp.), aster (*Aster foliaceus*), Baltic rush (*Juncus balticus*), sedge (*Carex* sp.), and foxtail barley (*Hordeum jubatum*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Canada thistle (*Cirsium arvense*), smooth brome (*Bromus inermis*), and Kentucky bluegrass (*Poa pratensis*).

Site #14: General Description: A narrow band of coyote willow (*Salix exigua*) occurs on both sides of the river. The stand on the east side is sparse, as it is higher above the river than the west bank. Indications of grazing are present.

Plant composition: Coyote willow (*Salix exigua*), Nebraska sedge (*Carex nebrascensis*), silverweed (*Argentea anserina*), western wheatgrass (*Pascopyrum smithii*), scouring rush (*Hippochaete hyemalis*), and a few cottonwoods (*Populus angustifolia*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Canada thistle (*Cirsium arvense*) and whitetop (*Lepidium latifolia*).

Site #15: General Description: The stand of coyote willow (*Salix exigua*) occurs on the west side of the river, thus CNHP was not able to walk through the stand. That stand appears to have moderately diverse structure and the density of foliage and stems looks high. The stand is tall, has a diversity of age classes, and appears extensive.

Plant composition: Did not walk through stand but using binoculars, the following were observed: Coyote willow (*Salix exigua*) and cottonwood (*Populus angustifolia*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Unknown.

Site #16: General Description: The stand of coyote willow (*Salix exigua*) here is dense, has multiple canopy layers (diversity of age classes), high foliage and stem density, and a moderately diverse understory. Non-native species are present. Adjacent riverbank and nearby meadow are weedy.

Plant composition: Coyote willow (*Salix exigua*), narrowleaf cottonwood (*Populus angustifolia*), silverweed (*Argentea anserina*), sedges (*Carex* sp.), foxtail barley (*Hordeum jubatum*), bugleweed (*Lycopus asper*), and Hooker's evening primrose (*Oenothera elata* ssp. *hirsutissima*)

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Canada thistle (*Cirsium arvense*), Kentucky bluegrass (*Poa pratensis*), and reed canarygrass (*Phalaris arundinacea*).

Site #17: General Description: An extensive stand of coyote willow (*Salix exigua*), mostly on the west side of the river, occurs here. Multiple age classes and dense foliage and stems characterize the stand. An overflow channel passes through the west side stand.

Plant composition: Coyote willow (*Salix exigua*), wild mint (*Mentha arvense*), foxtail barley (*Hordeum jubatum*), Hooker's evening primrose (*Oenothera elata* ssp. *hirsutissima*), and white-panicle aster (*Aster lanceolatus* ssp. *hesperius*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Canada thistle (*Cirsium arvense*), Kentucky bluegrass (*Poa pratensis*), dandelion (*Taraxacum officinale*), and whitetop (*Lepidium latifolium*).

Site #18: General Description: The stand of coyote willow (*Salix exigua*) occurs on the west side of the river, thus CNHP was not able to walk through the stand. There appear to be a few peach leaf willow (*Salix amygdaloides*) or cottonwood (*Populus angustifolia*) trees behind the willow stand. The stand has a diversity of age classes and is long but narrow.

Plant composition: Did not walk through stand but using binoculars, the following were observed: Coyote willow (*Salix exigua*), peach leaf willow (*S. amygdaloides*) and cottonwood (*Populus angustifolia*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Unknown.

Site #19: General Description: The stand of coyote willow (*Salix exigua*) here is large and wide. Much of it is sandy and dry with a sparse understory. Strapleaf willow (*S. ligulifolia*), peach leaf willow (*S. amygdaloides*), and cottonwood (*Populus angustifolia*) occur in a patch within the coyote willow stand. Multiple age classes of willows are present as well as moderate density of foliage and stems.

Plant composition: Coyote willow (*Salix exigua*), golden currant (*Ribes aureum*), western wheatgrass (*Pascopyrum smithii*), sedges (*Carex* sp.), silverweed (*Argentea anserina*), Baltic rush (*Juncus balticus*), and foxtail barley (*Hordeum jubatum*).

CNHP Plant Community Type: *Salix exigua*/mesic graminoid

Non-native species: Canada thistle (*Cirsium arvense*) and Kentucky bluegrass (*Poa pratensis*).

Projection: UTM, Zone13, NAD27

Colorado Natural Heritage Program
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College of Natural Resources
254 General Services Building
Fort Collins, CO 80523

map created 19 April 2004

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LEGEND

Y Southwestern Willow Flycatcher sites

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

Location in Study Area

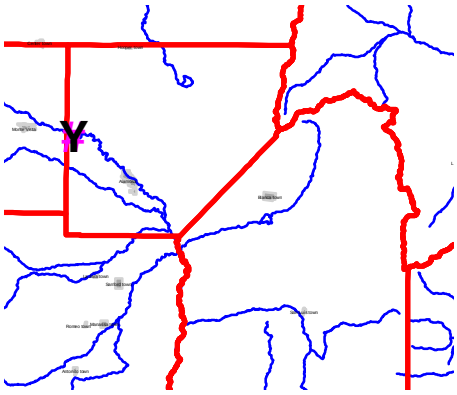
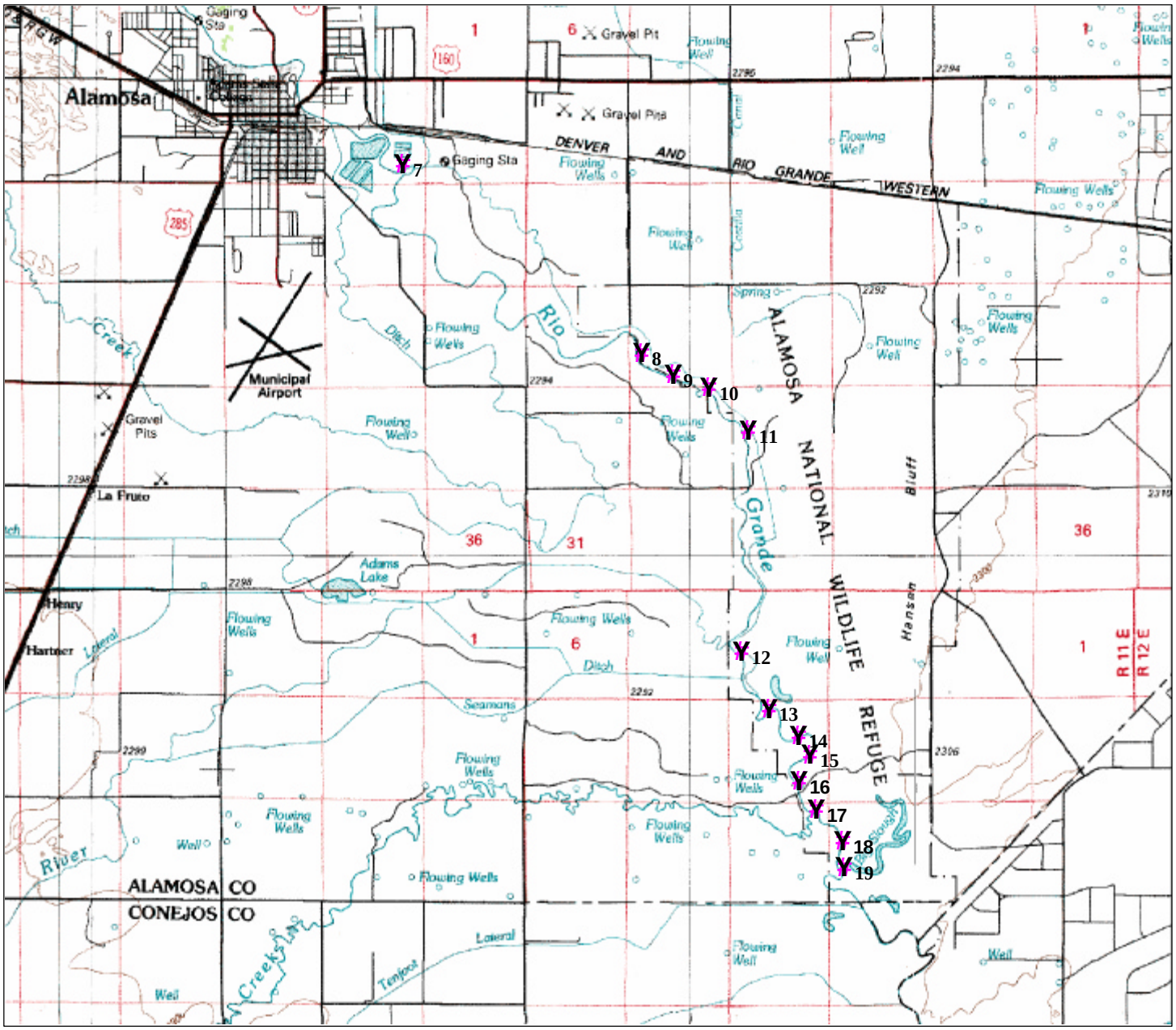


Figure 6. Southwestern Willow Flycatcher Sites within Higel State Wildlife Area



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Y Southwestern Willow Flycatcher sites

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

Location in Study Area

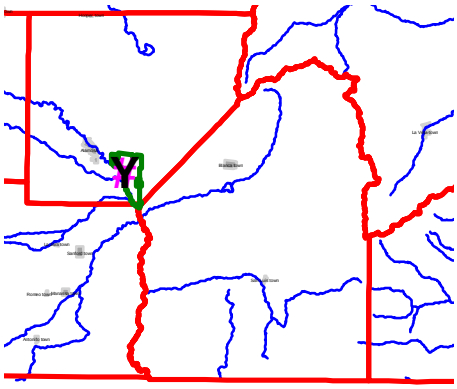

Figure 7. Southwestern Willow Flycatcher Sites within Alamosa National Wildlife Refuge.