Ecologically Significant Wetlands in the Upper Yellowstone River Watershed

including the Boulder, Clarks Fork Yellowstone, Shields, and Stillwater River Drainages

Prepared for the
Montana Department of Environmental Quality

By
W. Marc Jones

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MONTANA
Natural Heritage
Program

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Summary

The Montana Natural Heritage Program, in partnership with the Montana Department of Environmental Quality, has completed an inventory of ecologically significant wetlands in the watersheds of the upper Yellowstone River in south central Montana. This project identified high quality wetlands in the study area and evaluated their diversity and integrity. Building on previous watershed inventories, this work creates a consistent and comprehensive source of wetland information that can form the basis for effective prioritization of wetland protection and restoration efforts.

This inventory targeted wetlands with intact hydrological functions, representative native plant communities, outstanding wildlife values, and/or rare plant and animal species. Inventory priorities were also influenced by degree of threat. Therefore highly protected alpine wetlands in the Absaroka-Beartooth Wilderness Area and the proposed Line Creek Plateau Research Natural Area were not inventoried, despite the ecological importance of these wetlands. Instead, greater priority was placed on inventorying wetlands on private land because of the greater development potential at these sites. Important sources for locating significant wetlands were local expert opinion and aerial photographs.

We used standard Heritage Program methodologies to inventory wetlands and to assess site condition, catalog community types, and document rare plant and animal occurrences. Five criteria were used to evaluate each site's ecological significance: (1) condition, which includes degree of hydrologic or geomorphic alteration, quality of native plant communities, and presence of exotic species, (2) landscape context, which includes condition of uplands and hydrologic connectivity between wetland and uplands, (3) diversity, which includes the number of plant communities, structural vegetation types, and hydrologic classes, (4) rarity, which includes the number and condition of rare plants, animals, or communities, and (5) size of wetland. We then placed sites into one of four categories, ranging from highest quality (A-ranked) to poorest quality (D-ranked).

Forty-six ecologically significant wetlands were inventoried for this study. Of these sites, eight rated as A-ranked wetlands, 16 as B-ranked wetlands, 20 as C-ranked wetlands, and two sites were not ranked. A-ranked sites were relatively undisturbed to pristine. In general, their natural hydrologic regimes were intact, they supported high quality examples of native plant communities, and they had no or only minor weed populations. The uplands surrounding these sites were largely undisturbed, with minimal human alterations. These wetlands included diverse beaver-influenced wetlands and several poor fens, which are a regionally rare wetland type. In contrast, B-ranked sites had been impacted by both on- and off-site human disturbances, although many sites still maintained high functional capacity and supported high quality plant communities. This category included riverine and depressional montane wetlands along the Beartooth Front and low-elevation riverine and slope wetlands. Grove Creek Aspens, a unique spring-fed aspen stand in the arid Bighorn Basin, was included in this category. The remaining sites were rated as C-ranked wetlands. These wetlands have been functionally impaired through hydrologic or geomorphic alterations or through land use disturbances in the wetlands or adjacent uplands. Exotic species were widespread and abundant at many of these sites. In contrast, some of these wetlands were in good condition, but were comprised of a few common, structurally simple communities, and therefore had low diversity and rarity scores. C-ranked sites included low-elevation riverine wetlands as well as three large alkaline lake systems.

Acknowledgements

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Introduction

Historically, wetlands have been considered unproductive lands with little value to society (Mitsch and Gosselink 1993). Consequently, wetlands have long been drained, filled, or otherwise manipulated to produce goods and services valued by society. This has resulted in significant wetland destruction and degradation in the United States. Dahl (1990) estimated that over half of the wetland acres in the conterminous United States have been lost since 1780, and that approximately 25% of Montana's wetland acres have been lost in the same period.

In the last 20 years, as awareness of the cumulative loss and damage to wetlands in the United States has grown, so too has society's appreciation of the ecological importance and economic benefits of wetlands. This recognition has expanded opportunities to prevent wetland loss and restore the condition of remaining wetlands. In Montana, there are numerous regulatory and incentive-based programs at the private, state, and federal level dedicated to wetland conservation (see Kyle [1998] for an overview of these programs). Wetland inventories, by identifying and assessing the condition of biologically significant wetlands, can improve the effectiveness of these programs and are an important first step in wetland conservation.

In 1998 the Montana Natural Heritage Program (MTNHP), in partnership with the Montana Department of Environmental Quality, began to systematically evaluate the diversity, integrity, and significance of Montana wetlands through watershed inventories. The goal of these inventories is to produce a consistent and comprehensive source of wetland information to help ensure that protection, restoration, and mitigation efforts target the full range of wetland diversity, including those wetlands that are outstanding, irreplaceable, or which contribute most to watershed integrity. It provides local landowners, county planners, land trusts, conservation districts, government agencies, and others access to reliable information on the diversity of wetland types as well as the location and relative significance of specific wetland sites within target watersheds. This creates a basis for effectively prioritizing wetland protection and restoration efforts.

The initial MTNHP inventories were conducted in the Flathead River watershed and are summarized in Greenlee (1999) and Cooper et al. (2000). This current project, which inventoried wetlands in the watersheds of the upper Yellowstone River, builds on this previous work. Taken together, these inventories document ecologically significant wetlands in these important watersheds and contribute to our understanding of wetlands and their associated biological diversity in Montana. Figure 1 displays the status of MTNHP wetland inventories conducted to date in the state, as well as the watersheds proposed for inventory in 2001.

MTNHP inventories use standard methods both to identify ecologically significant wetlands at a watershed scale and to prioritize their importance for wetland conservation. This approach considers biological composition and condition as well as the functional integrity of wetland sites with respect to hydrology and landscape setting. The conservation significance of each wetland is evaluated based on standardized criteria developed for the state (Appendix B).

The wetland sites examined in this inventory fall within the wetland definition used by Cowardin et al. (1979), and all had at least one of the following attributes: hydrophytic vegetation, hydric soils, and/or wetland hydrology. This definition includes riparian areas, wet meadows, and vernal pools. Wetland terminology in this report follows definitions presented in Chadde et al. (1998) and Keddy (2000).

Wetlands can be divided into several different categories depending on the amount and type of water they receive, whether herbaceous or woody vegetation is dominant, and whether the substrate is organic or mineral. **Swamps** are temporarily to seasonally flooded wetlands that are dominated by woody vegetation that is rooted in hydric soils, but not in peat or muck (organic soils composed of partially or wholly decomposed plant matter). **Riparian forests**, such as cottonwood gallery forests, receive less water than swamps and are usually temporarily or less frequently flooded. **Marshes** are seasonally to permanently flooded wetlands dominated by emergent herbaceous vegetation. Although marshes form on mineral soil, some peat accumulation can occur because of the

tremendous productivity of marsh vegetation. In contrast, **peatlands** are wetlands with saturated substrates that have accumulated a layer of peat at least 30 cm deep in the upper soil horizon (Chadde et al. 1998). Peatlands in Montana are either **fens**, dominated by herbaceous species, or **carrs**, dominated by shrubs. The water source for fens and carrs is groundwater that has been in contact with mineral soil (and thus may be high in nutrients), as opposed to **bogs**, whose water source is precipitation and therefore very nutrient poor. True bogs do not occur in Montana, although some fens are **mixed mires** that support bog-like microsites, such as raised mounds dominated by *Sphagnum* mosses. **Wet meadows** are dominated by herbaceous plant communities that are temporarily to seasonally flooded and have limited peat development because they usually dry down for part of the growing season. Wet meadows are often exceptionally species rich. The terms **slope, riverine, depressional,** and **lacustrine fringe** wetlands are all used as defined by Smith et al. (1995).

Study Area

Physical Setting

The study area is located within the upper Yellowstone River watershed in south central Montana (Figure 2). This area encompasses the Yellowstone River downstream of the Park County line to the city of Billings and includes the Shields, Boulder, Stillwater, and Clark's Fork Yellowstone River drainages. These watersheds correspond to the following U.S. Geological Survey fourth code hydrologic units (HUCs): Clark's Fork Yellowstone (HUC 10070006), Shields (HUC 10070003), Stillwater (HUC 10070005), Upper Yellowstone Lake Basin (HUC 10070004), and the portion of the Upper Yellowstone downstream from Park County (HUC 10070002). The study area contains most of Sweet Grass and Stillwater Counties, the western two-thirds of Carbon County, and the southwestern portion of Yellowstone County.

The upper Yellowstone River watershed lies at the intersection of the Rocky Mountains and the Great Plains, and it supports a correspondingly diverse physiography, climate, and vegetation. This region includes portions of four Bailey ecoregion provinces: the Southern Rocky Mountains Province, represented in the study area by the Beartooth Front, Beartooth Mountains, and Absaroka/Gallatin Mountains Subsections, the Middle Rocky Mountains Province, represented by the Crazy Mountains and Central Montana Broad Valleys Subsections, the Great Plains-Palouse Province, represented by the Montana High Plains and Foothills and Montana Sedimentary Plains Subsections, and the Intermountain Semi-Desert Province, represented by the Bighorn Intermontane Basin Subsection (Nesser et al. 1997).

The mountainous portion of the study area includes the Beartooth, Absaroka, and Crazy Mountains. The Beartooth Mountains are a broad, fault-bounded uplift of Precambrian crystalline rocks, such as granitic gneiss and schist (Zelt et al. 1999), and the high Beartooth Plateau supports extensive alpine areas with many lakes. The Absaroka Range is a large Tertiary age volcanic field composed largely of andesite, dacite, and rhyolite that was laid down in volcanic flows and eruptions (Woods et al. 1999, Zelt et al. 1999). The Crazy Mountains consist of a core of Tertiary age coarse-grained alkaline intrusive rock surrounded by a mantle of Quaternary drift and colluvium (Alt and Hyndman 1986, Woods et al. 1999). All these ranges were extensively glaciated and are very rugged.

In contrast, the non-mountainous portion of the study area – the Great Plains and Bighorn Basin – are primarily underlain with Cretaceous age sedimentary rocks, such as sandstone and shale, with localized deposits of volcanic debris, as in the Crazy Mountain Basin (Alt and Hyndman 1986). Unconsolidated Quaternary deposits, such as glacial outwash terraces and alluvium, are common along stream courses.

The climate in the study area is largely continental and can be extremely variable. The region's seasonality is the product of interactions among air masses originating in the northern Pacific Ocean, the Gulf of Mexico, and the Arctic, with Gulf systems dominant in the spring and early summer and Arctic air dominant in the winter (Zelt at al. 1999). Climate ranges from cold and moist in the mountains to temperate and semiarid in the plains (Zelt at al. 1999). Average annual temperatures range from 34ºF at Cooke City to 47ºF at Billings (Western Regional Climate Center 2001). Precipitation varies from 40 to 110 inches per year in the

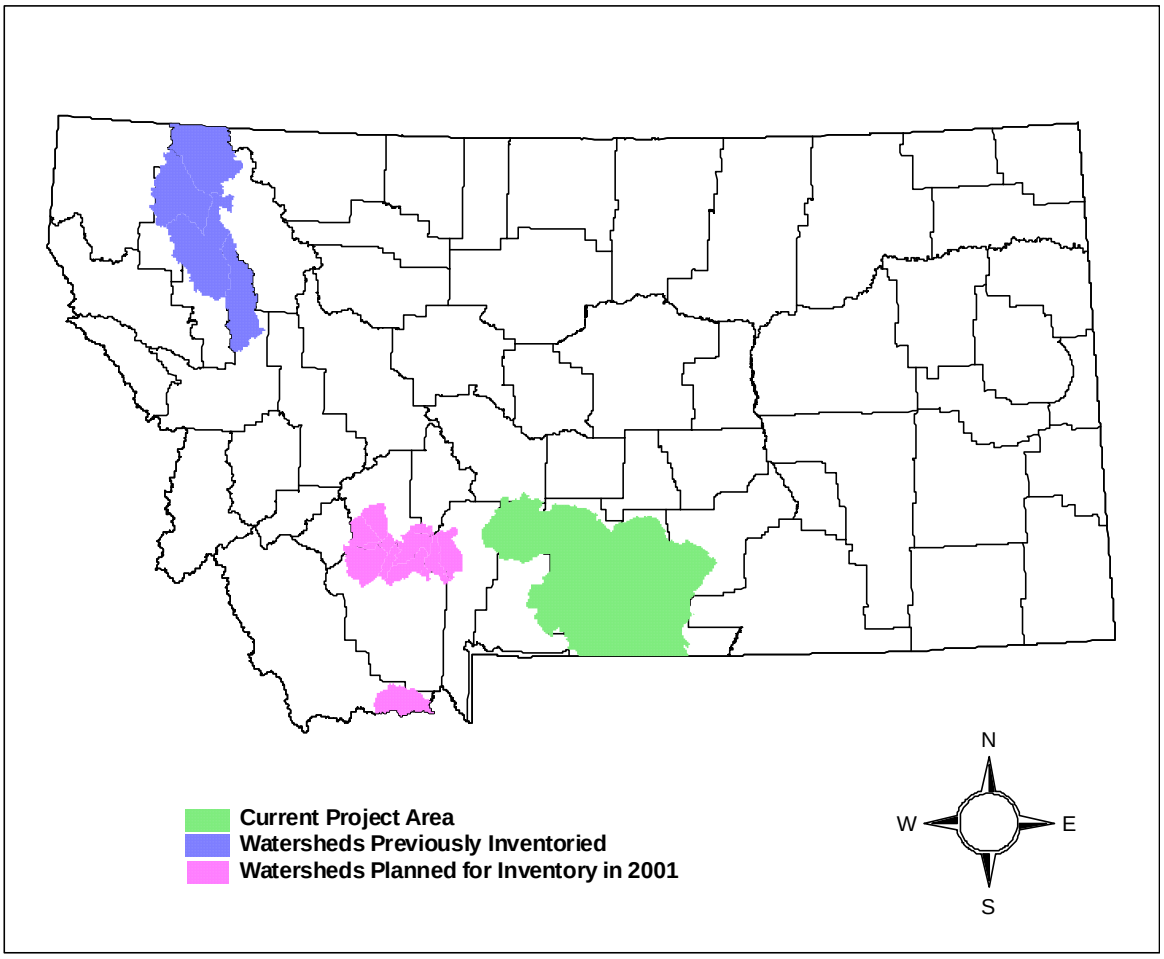


Figure 1. Status of Montana Natural Heritage Program wetland inventories.

Absaroka and Beartooth Mountains to 10 to 20 inches in the Great Plains (Nesser et al. 1997). The arid Bighorn Basin, which lies in the rain shadow of the Beartooth Mountains, receives only 5 to 12 inches of precipitation per year (Nesser et al. 1997). Elevations in the study area range from over 12,000 feet in the Beartooth Mountains to just over 3,000 feet at Billings in the Great Plains.

Vegetation

The Beartooth Mountains support extensive areas of **alpine tundra**. The range's high plateaus and many peaks contain the largest extent of alpine tundra in Montana (Lesica 1993). Associated with the splendor of the alpine vegetation is the greatest variety and extent of cryopedogenic features observed anywhere in Montana, including solifluction terraces, sorted nets and stripes, sorted and unsorted polygons, and frost hummocks (Johnson and Billings 1961). The vegetation on the Line Creek Plateau is more similar to the high ranges of Wyoming, Utah, and Colorado than any other mountain range in Montana. Line Creek Plateau is a gently rolling alpine tundra landscape with extensive areas of moist snowbed vegetation. The plateau contains hundreds of glacial lakes and potholes although wetland features are rare (Lesica 1993).

Vegetation of these alpine environments is characterized by turf vegetation dominated by Ross' avens (*Geum rossii*), curly sedge (*Carex rupestris*), Bellardi bog sedge (*Kobresia myosauroides*) and blackroot sedge (*Carex elynoides*), cushion plant communities dominated by curly sedge, moss campion (*Silene acaulis*), dwarf clover (*Trifolium nanum*), and twinflower sandwort (*Minuartia obtusiloba*), and moist grasslands to wet meadows dominated by tufted hairgrass (*Deschampsia caespitosa*), alpine bluegrass (*Poa alpina*), and Parry's clover (*Trifolium parryi*). The transition from wet meadow to marsh and fen is characterized by the increasing presence of mountain sedge (*Carex scopulorum*).

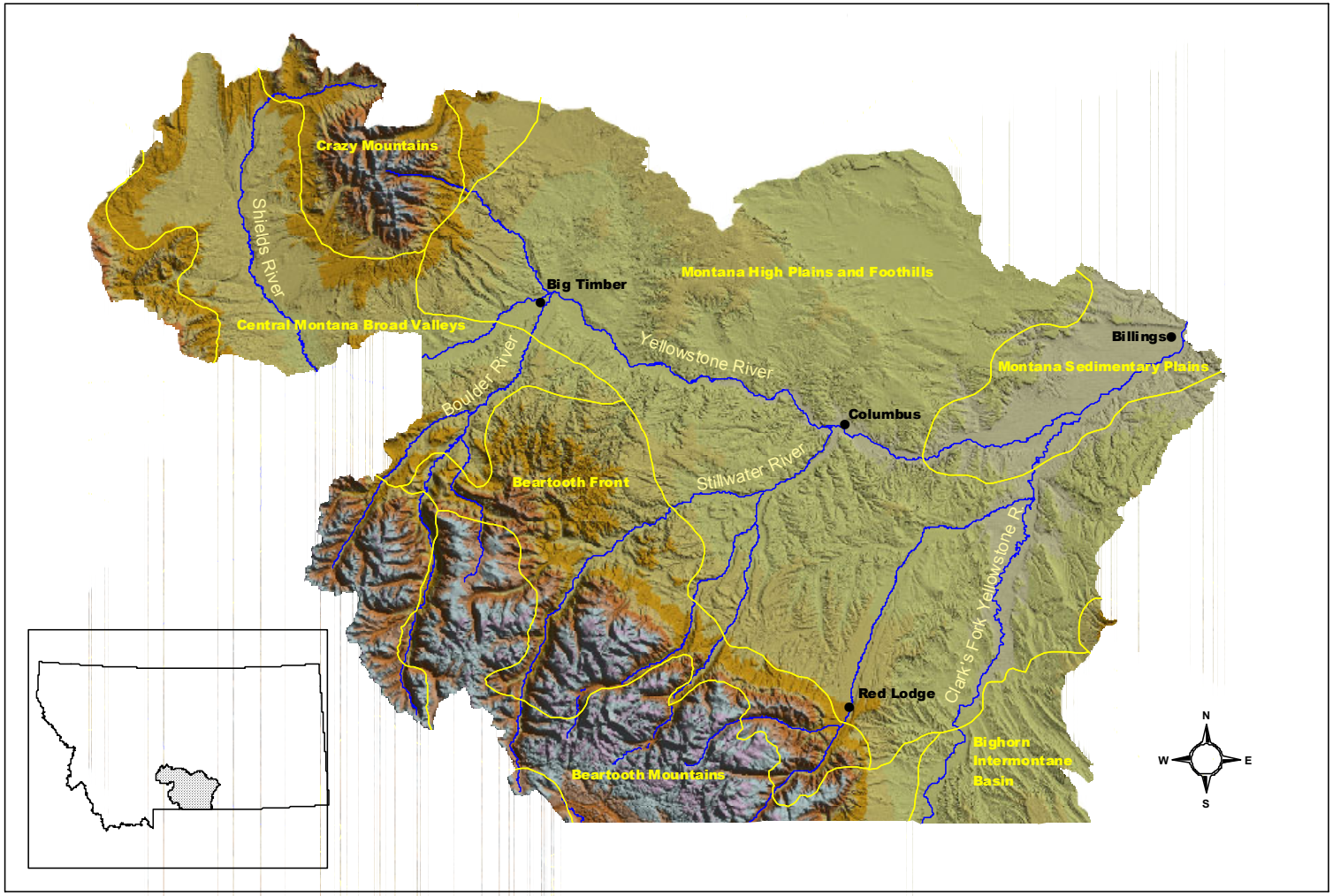


Figure 2. The project study area, showing physiography, rivers, cities, and Bailey ecoregions (Nesser et al. 1997).

Coniferous forests dominate the mountainous portion of the study area. The composition of these forests varies greatly by elevation. In high-elevation subalpine forests, the dominant species are whitebark pine (*Pinus albicaulis*), subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), and lodgepole pine (*Pinus contorta*). While whitebark pine is found only in the upper subalpine zone, the other species are also dominant at mid-elevations. Low- and mid-elevation montane areas are dominated by Douglas-fir (*Pseudotsuga menziesii*) and lodgepole pine. At the lower treeline, ponderosa pine (*Pinus ponderosa*) becomes the dominant species, with limber pine (*Pinus flexilis*) and Rocky Mountain juniper (*Juniperus scopulorum*) filling this roll on calcareous substrates.

Deciduous forests of aspen (*Populus tremuloides*) or cottonwood are relatively uncommon but occur locally in the mid- to low-montane zone where adequate soil moisture is available. Aspen forms large stands on toe slope positions and subirrigated slopes, especially along the base of the Beartooth Front at Grove Creek (east slope) and west of Red Lodge (north slope). Seasonally flooded aspen stands are restricted to sites saturated by seepage from springs or from high stream flow such as below seeps on gentle slopes, wet draws and flats, and in depressions along stream bank terraces. The major streams and rivers in the Great Plains support locally extensive riparian forests, dominated by black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), narrowleaf cottonwood (*Populus angustifolia*), and plains cottonwood (*Populus deltoides*).

Grasslands and shrublands dominate broad valleys and sedimentary plains. The primary exception is where ponderosa pine woodlands are locally abundant on exposed sandstone ridges and benches. Grasslands are composed chiefly of Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and needle-and-thread (*Hesperostipa comata*), with blue grama (*Bouteloua gracilis*) becoming an important dominant on the lower plains. Sagebrush communities typically are found in upland sites such as flat to rolling plains, plateaus and hills, benches and terraces above valley floors, alluvial fans and toeslopes, mountain parks and ridges, as well as well-drained alluvial bottomlands (ABI 2001). Mountain sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is found with Idaho fescue, bluebunch wheatgrass, or western wheatgrass (*Pascopyrum smithii*). In the more arid Big Horn Basin, Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) replaces mountain sagebrush as the dominant sagebrush species. Black sagebrush (*Artemisia nova*) communities with bluebunch wheatgrass are dominant on areas underlain by calcareous substrate.

Wetlands in the study area have formed through various processes. In and near the mountains, many wetlands were created by glacial processes. Many depressional wetlands are associated with glacial landforms, such as cirques, terminal and recessional moraines, and kettle ponds. Broad, U-shaped glaciated valleys and outwash plains are also conducive to wetland development. Many rivers in glaciated valleys and on the plains have well developed floodplains that support extensive riparian wetlands. Additionally, some depressional wetlands on the plains are associated with wind-eroded deflation basins (Woods et al. 1999).

Cultural Characteristics and Land Use

Population in the watershed is sparse, in most areas averaging 2 to 6 persons per square mile. The exception is Yellowstone County, where Billings (Montana's largest city and the only one of over 15,000 in the watershed) accounts for an average population of nearly 50 persons per square mile in the county. The region's population was relatively stable until the 1990's, but increased between the 1990 and 2000 census from 14 percent in Yellowstone County to 25 percent in Stillwater County (U.S. Census Bureau 2001). Most of the growth is concentrated in the Billings area and in desirable recreational/resort areas, the latter driven primarily by conversion of ranches to low-density residential use (Zelt et al. 1999).

Most of the study area is in private ownership. Large blocks of public land are restricted to National Forest lands in the Beartooth, Absaroka, and Crazy Mountains and portions of the upper Clark's Fork River watershed managed by the Bureau of Land Management. State school trust lands, managed by the Department of Natural Resources

and Conservation, are interspersed throughout privately owned lands.

Land use varies dramatically between the lower and upper watershed and by elevation. In the non-forested Great Plains and intermountain valleys, grazing and, to a lesser extent, crop production (both dryland and irrigated) represent the major land uses by acreage. Although overstocking and concentration of stock along watercourses can impact habitat, grazing can be among the lowest-impact land uses and is important to the health of grasslands. Ranches with rangelands are increasingly being converted to low-density residential development, resulting in habitat loss and fragmentation. Land trusts dedicated to open space have secured many agricultural easements in valley locations helping to prevent habitat fragmentation in the watershed.

Development and intensive human use is concentrated along rivers, with major impacts on habitat and species diversity. Riparian habitats support a diverse array of species, many of them dependent on riparian or wetland habitats for all or a portion of their habitat requirements. Riparian habitat, especially along the Yellowstone River, has also been heavily impacted by bank hardening, which suppresses the flooding required for cottonwood regeneration. Riparian areas are also particularly susceptible to invasion by exotic weeds, especially those that rely on elevated moisture levels or that invade where soils are disturbed. Grazing animals tend to concentrate in riparian areas because of the highly productive forage, available water, and shade. Recreation activities frequently take place in riparian settings. Grazing animals and humans can also accidentally spread weeds into riparian areas.

In the mountainous portion of the watershed, dominant land uses are recreation, forestry, and mining. The principle human impact in forested zones has probably been fire suppression (Arno 2000). Major mining activity is concentrated at the Stillwater drainage. Stillwater Mining Company is the only U.S. producer of platinum and palladium. Recreational impacts are concentrated in areas of higher tourism development (e.g., near Red Lodge, Gardiner, and Livingston), but are also widely dispersed throughout mid- and high-elevation areas, where there is extensive camping, fishing, and hiking use. These activities can damage fragile alpine vegetation in areas of heavy use.

Methods

Site Identification and Selection

The principle criteria used to initially select wetlands for inventory were ecological integrity and conservation significance. Specifically, we sought wetlands without hydrologic or geomorphic modification that had intact, representative native plant communities and that supported rare species or communities or had outstanding wildlife habitat. We consulted several sources of information to identify potential high quality wetlands. Expert opinion from local resource managers, biologists, and hydrologists provided the best site-specific information and most promising leads for follow-up. Agencies and organizations consulted included the U.S. Forest Service, U.S. Bureau of Reclamation, Bureau of Land Management, local Conservation Districts, Montana Department of Fish, Wildlife & Parks, The Nature Conservancy, Montana Land Reliance, University of Montana Riparian and Wetland Research Program, and ecological consultants. We also checked Heritage databases for known occurrences of wetland-dependent special status plants and animals and inspected U.S. Geological Survey topographic quad maps and aerial photographs to identify potentially important wetlands. In all, these data sources revealed about 100 potential high quality wetland sites.

Once potential sites were identified, we used the above criteria to prioritize our inventory efforts. We emphasized wetlands with intact hydrologic regimes and geomorphology that support high quality native plant communities and/or populations of rare plants or animals. We also considered landscape context, ownership, and management. For example, because of the greater potential for development, wetlands and riparian areas on private lands received greater inventory attention than those on state or federal lands. Similarly, because of their highly protected status, we did not inventory alpine wetlands within the Absaroka-Beartooth Wilderness Area or the proposed Line Creek Plateau Research Natural Area, despite the ecological importance of these wetlands. Where potential inventory sites were partly or wholly in

private ownership, we requested landowner permission for access. In cases where permission was denied, the site was dropped from the priority list.

Data Collection

Wetlands were surveyed during the summers of 1999 and 2000, except for two sites that were inventoried in May 2001. Montana Natural Heritage Program ecologists used a standardized methodology based on Bourgeron et al. (1992) to assess site condition, catalog community types, and document rare plant and animal occurrences. Specifically, we attempted to walk through all wetland plant communities at any given site, except where prevented by deep water or denial of landowner permission. We noted dominant species in each stratum, made ocular estimates of their canopy coverage, and estimated the acreage of each community. Where applicable, we classified each wetland plant community using Hansen et al. (1995) and ABI (2001). The condition of each community was assessed using criteria such as the presence of exotic species, evidence of logging, hummocking or pugging, presence of ditches, dikes, riprap, and other geomorphic and hydrologic modifications. We also noted the depth of standing water and presence of beaver activity. For plant communities not previously described in Hansen et al. (1995) or ABI (2001) or which were deemed uncommon, we collected detailed plot data.

At each site, elevation, aspect, slope, and the hydrogeomorphic (HGM) class and subclass (Smith et al. 1995) were noted, as were the Cowardin system/subsystem, class/subclass, and hydrologic regime (Cowardin et al. 1979). We also recorded offsite land uses and spoke to landowners/managers about land use history whenever possible. A cursory search for rare plants was conducted during the walk-through of each wetland. Bryophytes were collected at a few sites and identified by J.C. Elliott. Montana Natural Heritage Program zoologists conducted faunal surveys of selected wetlands. These surveys focused on animal groups that are ecologically important in wetlands, such as amphibians and snails.

Although no formal wetland delineations or functional assessments were conducted as part of this project, Heritage Program ecologists did use two regional HGM models developed by researchers at the Flathead Lake Biological Station (Hauer et al. 2000a, 2000b). For example, we measured the depth of the O and A soil horizons at some sites. This variable is measured in the intermontane pothole HGM model; it represents the long-term store of nutrients in the soil and acts as an index of the characteristic decomposer community in the wetland (Hauer et al. 2000a). For instance, a very thick A horizon can indicate an excessive amount of upland erosion is taking place.

About one-third of the wetlands inventoried included lands under private ownership. Landowners were contacted for permission to gain access to their property prior to site visits. Users of this report should note that they, too, would need to obtain landowner permission before entering private lands.

Data Management

The Montana Natural Heritage Program maintains four types of database records for information gathered in the wetland inventory: community plot records, community and species occurrence records, site records, and community abstracts. Wetland community plot information (i.e., species composition and cover and environmental data) was entered into a relational database that is similar to the U.S. Forest Service Ecodata system used for managing ecological data (Jensen et al. 1993).

We created a community occurrence record for each wetland community ranked as having outstanding quality or considered rare or imperiled. Community occurrence information (e.g., HGM class, Cowardin class/subclass, dominant species, hydrology, landscape setting) was summarized and entered in the Biological and Conservation Data System (BCD), a database developed by The Nature Conservancy and used by programs throughout the Natural Heritage Network.

Summary information about each site as a whole (e.g., general site descriptions, ecological diversity, on- and offsite land uses, management needs) was also entered into a site file in BCD. Detailed plant community abstracts were created to characterize both common and uncommon wetland plant communities. These include information from a variety of sources documenting community range, typical landscape setting, typical species composi-

tion, succession, and management. This information is being stored temporarily in a word processing template, for later uploading into a BCD file under development. The boundaries of each wetland site were digitized as polygons and stored in a Geographic Information System.

Site and Community Ranking

Community Rarity Ranks (State and Global Ranks)

We ranked the rarity and conservation significance of individual plant community types using criteria analogous to those used for ranking plant and animal species. This ranking system is intended to help managers identify elements at risk and determine management and conservation priorities. Community ranks are based primarily on the total number of occurrences and area occupied by the community type, either rangewide (for global or G ranks) or statewide (for state or S ranks). In addition, information on condition, threats, trend, and fragility are considered when known. The ranks are scaled from 1 to 5, with G1 indicating that the community is critically imperiled rangewide and G5 indicating no risk of extinction. Guidelines used to assign community ranks are included in Appendix A.

Community Viability Ranks

Each individual wetland community occurrence was also quality-ranked using criteria developed by The Nature Conservancy and the Natural Heritage Network (TNC and ABI 1999). For each community, we evaluated its condition, landscape context, and size. We then assigned an overall rank of A – D, with A being excellent and D being poor. Wetland and riparian communities usually occur as small patches or linear stringers in the landscape, and they are highly dependent on external factors, such as flooding and upland condition. Therefore, when evaluating a community's overall quality, we considered condition and landscape context to be of primary importance and size secondary.

Site Ranks

We evaluated wetland sites using similar criteria. In addition to condition, landscape context, and size, two other factors important for assessing conservation significance were considered: diversity and rarity. We developed these criteria in conjunction with regional wetland assessment protocols (Washington State Department of Ecology 1991, Chadde et al. 1998, Jankovsky-Jones 1999, Greenlee 1999), regional hydrogeomorphic functional assessments (Hruby et al. 1999, Jankovsky-Jones et al. 1999a, 1999b, Hauer et al. 2000a, 2000b, Hruby et al. 2000), and plant community ranking specifications developed by other Natural Heritage Programs (Chappell and Christy 2000, Rondeau and Sanderson 2000).

Table 1 shows the indicators for and relative importance of each factor; the complete criteria are presented in Appendix B. Similar to community viability ranks, each site was evaluated by the five factors and assigned an overall rank of A – D. Each factor was weigthed by its relative importance in assessing a site's overall ecological and conservation significance. Condition and landscape context were of primary importance and each factor accounted for 25% of a site's overall rank. Diversity and rarity were secondary factors, each accounting for 20% of the site rank, and the tertiary factor was size, which accounts for 10% of the overall site rank. The general characteristics of A – D sites are described below.

A-ranked Sites

These wetlands have the greatest ecological and conservation significance. A-ranked sites are in good to excellent condition with intact, high quality examples of native plant communities, and there are few to no exotic species. There are minimal anthropogenic influences at these sites or in their surrounding uplands; therefore, wetland functions are largely intact and will most likely fall within the range of natural variation. These sites often support a diverse array of plant communities and other important wetland features, including peatlands, beaver ponds, and springs. They also may provide habitat for numerous state and/or globally rare plant and animal species. Impacts to these sites cannot be fully mitigated, and any alterations could lead to significant loss of their distinctive characteristics and value.

B-ranked Sites

Wetland sites in this category generally support diverse, high quality plant communities, but they are distinguished from A-ranked wetlands by having a greater degree of anthropogenic distur-

Table 1. Indicators and relative importance of criteria used to rank the ecological and conservation significance of wetland sites.

Factor	% of Overall Rank	Indicators
Condition	25%	• Alteration of hydrologic, geomorphic, or biogeochemical processes. • Presence of intact, representative native plant communities with character structure and composition. • Presence of exotic species or cultural vegetation.
Landscape Context	25%	Extent of land uses in the surrounding uplands that disrupt hydrologic and hat connectivity among the site, uplands, and adjacent wetlands.
Diversity	20%	Number of plant communities, number of structural vegetation types, number hydrologic classes.
Rarity	20%	Number and condition of rare plants, animals, or plant communities present at
Size	10%	Size of site.

bance either on- or off-site (e.g., logging in the uplands near the site, grazing on a portion of the site, etc.). These disturbances are localized or minimal and may be restorable. B-ranked sites may support a number of state rare plant or animal species. Most of the wetland plant communities at these sites are in excellent condition, but a few may have moderate impacts. Improvement in resource management at these sites, such as changing grazing management plans or reducing trapping pressure on beaver, may improve the overall suite of wetland functions at these sites.

C-ranked Sites

Generally, C-ranked wetlands have been degraded by systematic hydrologic or geomorphic modifications or by disruptive land uses in the wetland or its surrounding uplands. These sites may still support high quality native plant communities, but exotic species are often widespread. Alternatively, these sites may be homogenous wetlands in good condition dominated by structurally simple, common communities, such as broadleaf cattail (*Typha latifolia*) monocultures. Although these wetlands are often degraded, they still provide important functional values, such moderating flood flows or removing particulates or nutrients, as well as habitat for wetland-dependent wildlife, such as waterfowl. These sites may also support populations of rare species or communities.

D-ranked Sites

D-ranked sites have been significantly affected by hydrologic or geomorphic alterations and often provide poor functional or habitat values. Vegetation at these sites is often degraded with little to no regeneration and exotic weeds or cultural vegetation may be widespread. The uplands may have been converted from native vegetation to agricultural or residential land uses, and the site may suffer from excessive sedimentation, erosion, and nutrient loading or may have become hydrologically isolated. Generally, D-ranked sites are not considered ecologically significant for the purposes of this report. However, these sites may provide locally important habitat values in areas where natural habitats have been largely converted to urban or agricultural land uses.

Plant Community Classification

We defined plant associations based on the International Classification of Ecological Communities (ABI 2001). This database, developed by The Nature Conservancy and Association for Biodiversity Information, forms the basis for a standardized National Vegetation Classification. This classification is currently being developed by the Association for Biodiversity Information, Ecological Society of America, and U.S. Geological Survey, among others. It incorporates and expands on published state and regional plant community classifications, such as Pfister et al. (1977), Mueggler and Stewart (1980), and Hansen

et al. (1995). For aquatic communities, we also referred to Pierce's classification of aquatic vegetation in western Montana and northern Idaho (Pierce 1999).

ABI (2001) recognizes many of the wetland and riparian communities described in Hansen et al. (1995), with several exceptions. Hansen et al. (1995) was designed as a management tool and not specifically to address biological diversity. Therefore, it lumps together several dominant and indicator species with similar ecological requirements. In general, we do not follow Hansen et al.'s ecological equivalents. Therefore, we recognize Booth's willow (*Salix boothii*) distinct from Geyer's willow (*Salix geyeriana*), inflated sedge (*Carex vesicaria*) distinct from beaked sedge (*Carex utriculata*), woolly sedge (*Carex pellita*) and Buxbaum's sedge (*Carex buxbaumii*) distinct from slender sedge (*Carex lasiocarpa*), narrow-spiked reedgrass (*Calamagrostis stricta*) distinct from bluejoint reedgrass (*Calamagrostis canadensis*), softstem bulrush (*Schoenoplectus tabernaemontani*) distinct from hardstem bulrush (*Schoenoplectus acutus*), black hawthorn (*Crataegus douglasii*) distinct from succulent hawthorn (*Crataegus succulenta*), prickly rose (*Rosa acicularis*) distinct from Wood rose (*Rosa woodsii*), and the native ticklegrass (*Agrostis scabra*) distinct from the exotic redtop (*Agrostis stolonifera*).

Nomenclature

We used Hitchcock et al. (1955-1969) and Dorn (1984) to identify plant species in the study area. In keeping with International Classification of Ecological Communities (ABI 2001), we followed the nomenclature presented in Kartesz and Meacham (1999) for vascular plants, except for bog birch (*Betula glandulosa*), where we used the Flora of North America (Flora of North America Editorial Committee 1997). For mosses we followed Anderson (1990) and Anderson et al. (1990). There are two other taxonomic considerations worth noting. The first concerns a common wetland sedge, often called beaked sedge, which has been erroneously called *Carex rostrata* in previous studies. While *Carex rostrata* does occur in northwestern Montana, it is very rare. In this report, we refer to beaked sedge as *Carex utriculata* (Griffiths 1989). Secondly, we use *Picea engelmannii* (Engelmann spruce) to include *Picea engelmannii*, *Picea glauca* (white spruce), and their hybrids (Daubenmire 1974). Table 2 presents the synonymy among Hitchcock and Cronquist (1973), Dorn (1984), and Kartesz and Meacham (1999) for common and indicator species.

Results and Discussion

Wetland Status

Nationally, 58,500 acres of wetlands were lost each year from 1986 to 1997 (Dahl 2000). Although still a substantial rate of loss, this is an 80% reduction in the average annual rate from the period of the mid-1970's to mid-1980's (Dahl 2000). In the Northern Plains region, which includes Montana, agriculture was the greatest cause of wetland loss (NRCS 1999). In the study area, development and agriculture appear to be the primary causes of wetland loss.

In addition to the outright loss of wetlands, the degradation of wetland condition and functional capacity are also causes for concern. Human activities, such as livestock grazing, mining, timbering, agriculture, and development, can impair wetlands by altering their hydrology, geomorphology, and vegetation and by fragmenting hydrologic and habitat connectivity between wetlands and between wetlands and their surrounding uplands. The upper Yellowstone River watershed is unusual in that its rivers contain no large hydropower or flood control dams. Thus many aspects of these rivers' hydrologic regime are intact, such as spring flooding. However, the hydrology of some wetlands has been significantly altered by irrigation practices and bank revetment.

Exotic species are a widespread cause of impairment, and most wetlands in the study area have experienced some shift in species composition due to invasion by exotic species. The presence of exotic species in a wetland may be indicative of past livestock grazing or other ground disturbance, although some wetlands, such as riparian areas frequently disturbed by flooding, are highly susceptible to invasion by exotics. Flooding creates bare substrate that can be easily colonized by seeds of exotic species washed downstream from infestations higher in the watershed. Leafy spurge (*Euphorbia esula*) and reed canarygrass

Table 2. Synonymy of dominant and indicator plant species.

Kartesz and Meacham (1999)	**Dorn (1984)**	**Hitchcock and Cronquist (1973)**	**Common Name**
		Trees	
Populus balsamifera ssp. *trichocarpa*	*Populus balsamifera*	*Populus trichocarpa*	Black cottonwood
		Shrubs	
Betula nana	*Betula glandulosa*	*Betula glandulosa*	Bog birch
Cornus sericea	*Cornus stolonifera*	*Cornus stolonifera*	Red-osier dogwood
Dasiphora fruticosa ssp. *floribunda*	*Pentaphylloides floribunda*	*Potentilla fruticosa*	Shrubby cinquefoil
Salix boothii	*Salix boothii*	*Salix myrtillifolia*	Booth's willow
Salix lucida ssp. *caudata*	*Salix lasiandra*	*Salix lasiandra*	Shining willow
		Graminoids	
Agrostis stolonifera	*Agrostis stolonifera*	*Agrostis alba*	Redtop
Carex pellita	*Carex lanuginosa*	*Carex lanuginosa*	Woolly sedge
Carex utriculata	*Carex rostrata*	*Carex rostrata*	Beaked sedge
Deschampsia caespitosa	*Deschampsia cespitosa*	*Deschampsia cespitosa*	Tufted hairgrass
Elymus repens	*Elymus repens*	*Agropyron repens*	Quackgrass
Elymus trachycaulus	*Elymus trachycaulus*	*Agropyron caninum*	Slender wheatgrass
Hesperostipa comata	*Stipa comata*	*Stipa comata*	Needle-and-thread
Pascopyrum smithii	*Elymus smithii*	*Agropyron smithii*	Western wheatgrass
Pseudoroegneria spicata	*Elymus spicatus*	*Agropyron spicatum*	Bluebunch wheatgrass
Schoenoplectus acutus	*Scirpus acutus*	*Scirpus acutus*	Hardstem bulrush
Schoenoplectus maritimus	*Scirpus maritimus*	*Scirpus maritimus*	Saltmarsh clubrush
Schoenoplectus pungens	*Scirpus pungens*	*Scirpus pungens*	Threesquare
Schoenoplectus tabernaemontani	*Scirpus validus*	*Scirpus validus*	Softstem bulrush
Thinopyrum intermedium	*Elymus hispidus*	*Agropyron intermedium*	Intermediate wheatgrass
		Forbs	
Maianthemum stellatum	*Smilacina stellata*	*Smilacina stellata*	Starry false Solomon's seal
Nuphar lutea ssp. *polysepala*	*Nuphar polysepalum*	*Nuphar polysepalum*	Yellow pond-lily
Stuckenia pectinata	*Potamogeton pectinatus*	*Potamogeton pectinatus*	Sago pondweed
Symphotrichum foliaceum	*Aster foliaceus*	*Aster foliaceus*	Leafy aster

(Phalaris arundinacea) are exotic species that can dominate these early successional habitats. Merigliano and Lesica (1998) hypothesize that both native and exotic genotypes of reed canarygrass exist in Montana, with the exotic genotypes being responsible for the dense monocultures of this grass in some wetlands. Populations of exotic origin may be responsible for the aggressive spread of reed canarygrass in Montana wetlands.

For the most part, however, exotic species are better established in "drier" wetland communities, such as mature cottonwood stands, wet meadows, mesic aspen stands, and willow / bluejoint reedgrass (*Calamagrostis canadensis*) communities. Long-term grazing pressure and other land uses in these communities (and direct seeding in some cases) have facilitated the spread of exotic pasture grasses, such as smooth brome (*Bromus inermis*), redtop (*Agrostis stolonifera*), Kentucky bluegrass (*Poa pratensis*), and common timothy (*Phleum pratense*), and noxious weeds, including leafy spurge, Canada thistle (*Cirsium arvense*), spotted knapweed (*Centaurea maculosa*), and hound's tongue (*Cynoglossum officinale*).

Another exotic species that may significantly affect biological diversity and native habitats is Russian olive (*Elaeagnus angustifolia*). This species was and still is widely planted as a windbreak, but it has invaded many riparian areas throughout the western United States (Olson and Knopf 1986). In the study area, it is a mid-canopy dominant in many cottonwood stands along the lower portion of the Yellowstone River. As cottonwoods die, Russian olive will come to dominate many floodplain and terrace sites (Shafroth et al. 1995, Lesica and Miles 2001). Although Russian olive is beneficial to some wildlife species, conversion of cottonwood stands to stands dominated by Russian olive will be detrimental to many species of cavity-nesting and insectivorous birds (Knopf and Olson 1984, Olson and Knopf 1986). Russian olive is able to reproduce under its own canopy and occurs as multiple-age stands; therefore, in the absence of flood disturbance, it may be able to perpetually hold riparian terraces and limit the establishment of native late-successional communities, such as western wheatgrass (*Pascopyrum smithii*), western snowberry (*Symphoricarpos occidentalis*), and green ash (*Fraxinus pennsylvanica*) (Lesica and Miles 2001). It also may limit future cottonwood establishment on regulated rivers (Lesica and Miles 2001).

Plant Communities

Eighty-four wetland and riparian plant communities were documented in the study area. These communities, with another 47 communities known or suspected to occur in the upper Yellowstone River watershed, are presented in Table 3. Community names and conservation ranks are from ABI (2001). Appendix C contains detailed descriptions of some of the more common plant associations documented from the study area.

For the most part, there are few intrinsically rare plant communities in the study area. An exception is the beaked sedge (*Eleocharis rostellata*) herbaceous community. In the study area, this community is known only from thermal springs, where it forms near-monospecific stands on wet mineral soils directly in contact with thermal waters (Lesica 1990). Bluewater Springs support an example of this community. Other wetland communities are common, but have been widely degraded by human activities such that high quality occurrences are relatively rare. As previously mentioned, this phenomenon is prevalent with many drier wetland communities that are accessible to livestock. For example, on the Yellowstone River, high quality cottonwood stands with well-developed native shrub understories, especially mesic floodplain communities with abundant red-osier dogwood (*Cornus sericea*), are regionally very rare. In many cases, the native shrub component has been converted to an understory dominated by exotic pasture grasses.

The following discussion, organized by Cowardin et al.'s (1979) palustrine subclass, provides general descriptions for the major wetland plant communities found in the study area.

Forested Vegetation

Forested wetland communities in the study area are mainly associated with riverine systems. At mid to low elevations, floodplains along low-gradient streams and rivers are often dominated by well-developed stands of cottonwood. There are three species of cottonwood in the study area: plains cottonwood (*Populus deltoides*), narrowleaf

Table 3. Wetland and riparian plant communities and their conservation ranks for communities that occur or are likely to occur in the upper Yellowstone River watershed, arranged by Cowardin system, class, and sub-class.

Scientific Name	Common Name	State Rank	Global Rank
PALUSTRINE FORESTED COMMUNITIES, NEEDLE-LEAVED EVERGREEN			
Abies lasiocarpa / *Actaea rubra*	Subalpine fir / Baneberry	S2	G4?
Abies lasiocarpa / *Calamagrostis canadensis*	Subalpine fir / Bluejoint reedgrass	S5	G5
Abies lasiocarpa / *Galium triflorum*	Subalpine fir / Sweet-scented bedstraw	S4	G4
Abies lasiocarpa / *Streptopus amplexifolius*	Subalpine fir / Clasping twisted stalk	S3	G4
Juniperus scopulorum / *Cornus sericea*	Rocky Mountain juniper / Red-osier dogwood	S4	G4
Picea engelmannii / *Calamagrostis canadensis*	Engelmann spruce / Bluejoint reedgrass	S4	G4
Picea engelmannii / *Caltha leptosepala*	Engelmann spruce / White marsh-marigold	SP	G3?
Picea engelmannii / *Carex disperma*	Engelmann spruce / Softleaf sedge	S2?	G2Q
Picea engelmannii / *Cornus sericea*	Engelmann spruce / Red-osier dogwood	S3	G3
Picea engelmannii / *Equisetum arvense*	Engelmann spruce / Field horsetail	S4	G4
Picea engelmannii / *Galium triflorum*	Engelmann spruce / Sweet-scented bedstraw	S4	G4
Pinus ponderosa / *Cornus sericea*	Ponderosa pine / Red-osier dogwood	S3	G3
Pseudotsuga menziesii / *Cornus sericea*	Douglas-fir / Red-osier dogwood	S3	G4
PALUSTRINE FORESTED COMMUNITIES, BROAD-LEAVED DECIDUOUS			
Acer negundo / *Prunus virginiana*	Box elder / Chokecherry	S3	G3
Fraxinus pennsylvanica / *Prunus virginiana*	Green ash / Chokecherry	S2S3	G3?
Populus angustifolia / *Cornus sericea*	Narrowleaf cottonwood / Red-osier dogwood	S3	G4
Populus angustifolia / Recent Alluvial Bar	Narrowleaf cottonwood / Recent Alluvial Bar	S?	G?
Populus angustifolia / Mesic Graminoids	Narrowleaf cottonwood / Mesic Graminoids	SM	G?
Populua angustifolia / *Rhus trilobata*	Narrowleaf cottonwood / Skunkbush sumac	S?	G3
Populus angustifolia / *Symphoricarpos occidentalis*	Narrowleaf cottonwood / Western snowberry	S?	G?
Populus balsamifera ssp. *trichocarpa* / *Cornus sericea*	Black cottonwood / Red-osier dogwood	S3?	G3?
Populus balsamifera ssp. *trichocarpa* / Mesic Graminoids	Black cottonwood / Mesic Graminoids	SM	G?
Populus balsamifera ssp. *trichocarpa* / Recent Alluvial Bar	Black cottonwood / Recent Alluvial Bar	S3	G?
Populus balsamifera ssp. *trichocarpa* / *Symphoricarpos albus*	Black cottonwood / Common snowberry	S4	G2?
Populus balsamifera ssp. *trichocarpa* / *Symphoricarpos occidentalis*	Black cottonwood / Western Snowberry	S3?	G?
Populus deltoides / *Cornus sericea*	Plains cottonwood / Red-osier dogwood	S2S3	G2G3
Populus deltoides / Mesic Graminoids	Plains cottonwood / Mesic Graminoids	SM	G?
Populus deltoides / Recent Alluvial Bar	Plains cottonwood / Recent Alluvial Bar	S3	G?
Populus deltoides / *Symphoricarpos occidentalis*	Plains cottonwood / Western snowberry	S?	G2G3
Populus tremuloides / *Calamagrostis canadensis*	Quaking aspen / Bluejoint reedgrass	S2	G3
Populus tremuloides / *Cornus sericea*	Quaking aspen / Red-osier dogwood	S3	G4
Populus tremuloides / *Heracleum maximum*	Quaking aspen / Cow-parsnip	S2?	G4Q
Populus tremuloides / *Osmorhiza occidentalis*	Quaking aspen / Western sweet cicely	S3?	G3?
Populus tremuloides / *Poa pratensis*	Quaking aspen / Kentucky bluegrass	SM	G?
Populus tremuloides / *Prunus virginiana*	Quaking aspen / Chokecherry	SQ	G3?Q
Populus tremuloides / *Symphoricarpos albus*	Quaking aspen / Common snowberry	S3?	G3?
Salix amygdaloides	Peachleaf willow	S3	G3
PALUSTRINE SCRUB-SHRUB COMMUNITIES			
Alnus incana	Mountain alder	S3	G?Q
Alnus incana – Betula occidentalis	Mountain alder – Water birch	SP	G2G3
Alnus incana / *Calamagrostis canadensis*	Mountain alder / Bluejoint reedgrass	S3Q	G3Q
Alnus incana / *Carex* spp.	Mountain alder / Sedge	S?	G3
Alnus incana / *Cornus sericea*	Mountain alder / Red-osier dogwood	SP	G3Q
Alnus incana / *Equisetum arvense*	Mountian alder / Field horsetail	S?	G3
Alnus incana / Mesic Forbs	Mountain alder / Mesic Forbs	SP	G3G4
Artemisia cana / *Pascopyrum smithii*	Silver sage / Western wheatgrass	S4	G4
Atriplex gardneri / *Pascopyrum smithii*	Gardner's saltbush / Western wheatgrass	S3	G3
Betula glandulosa / *Carex utriculata*	Bog birch / Beaked sedge	S4	G4?
Betula occidentalis	Water birch	S3	G3Q
Betula occidentalis – Cornus sericea	Water birch – Red-osier dogwood	SP	G3?
Cornus sericea	Red-osier dogwood	S3	G4Q
Crataegus douglasii	Black hawthorn	S2	G2Q
Dasiphora fruticosa ssp. *floribunda* / *Carex* spp.	Shrubby cinquefoil / Sedge	S3	G3?

Table 3 continued

Scientific Name	Common Name	State Rank	Global Rank
	PALUSTRINE SCRUB-SHRUB COMMUNITIES		
Dasiphora fruticosa ssp. *floribunda* / *Deschampsia caespitosa*	Shrubby cinquefoil / Tufted hairgrass	S4	G4
Elaeagnus commutata / *Pascopyrum smithii*	Silverberry / Western wheatgrass	S2	G3?
Prunus virginiana	Chokecherry	S4	G4Q
Rosa woodsii	Wood's rose	S5	G5
Salix bebbiana	Bebb willow	S3?	G3?
Salix boothii / *Calamagrostis canadensis*	Booth's willow / Bluejoint reedgrass	S3	G3G4Q
Salix boothii / *Carex utriculata*	Booth's willow / Beaked sedge	S4	G4
Salix boothii / Mesic Graminoids	Booth's willow / Mesic Graminoids	S?	G3?
Salix drummondiana / *Calamagrostis canadensis*	Drummond's willow / Bluejoint reedgrass	S2S3	G3
Salix exigua	Sandbar willow	S5	G5
Salix geyeriana / *Calamagrostis canadensis*	Geyer's willow / Bluejoint reedgrass	S4	G5
Salix geyeriana / *Carex utriculata*	Geyer's willow / Beaked sedge	S5	G5
Salix glauca	Grayleaf willow	S2	G3?
Salix lucida ssp. *caudata*	Shining willow	S3	G3Q
Salix lutea / *Calamagrostis canadensis*	Yellow willow / Bluejoint reedgrass	S3?	G3?
Salix lutea / *Carex utriculata*	Yellow willow / Beaked sedge	S4	G4
Salix lutea / *Rosa woodsii*	Yellow willow / Wood's rose	S?	G3
Salix planifolia / *Calamagrostis canadensis*	Planeleaf willow / Bluejoint reedgrass	S?	G3
Salix planifolia / *Carex aquatilis*	Planeleaf willow / Water sedge	S3	G5
Salix planifolia / *Carex scopulorum*	Planeleaf willow / Holm's Rocky Mountain sedge	S?	G4
Salix planifolia / *Carex utriculata*	Planeleaf willow / Beaked sedge	S?	G3
Salix reticulata / *Caltha leptosepala*	Netleaf willow / White marsh marigold	S2	G3
Salix wolfii / *Carex aquatilis*	Wolf's willow / Water sedge	S3	G4
Salix wolfii / *Deschampsia caespitosa*	Wolf's willow / Tufted hairgrass	S3	G3
Sarcobatus vermiculatus / *Atriplex gardneri*	Black greasewood / Gardner's saltbush	S3	G4?
Sarcobatus vermiculatus / *Leymus cinereus*	Black greasewood / Basin wildrye	S2S3	G3
Sarcobatus vermiculatus / *Pascopyrum smithii*	Black greasewood / Western wheatgrass	S4	G4
Shepherdia argentea	Silver buffaloberry	S3?	G3G4
Symphoricarpos occidentalis	Western snowberry	S4S5	G4G5
	PALUSTRINE EMERGENT COMMUNITIES		
Agrostis stolonifera	Redtop	S5	GM
Calamagrostis canadensis	Bluejoint reedgrass	S4	G4
Carex aquatilis	Water sedge	S4	G5
Carex aquatilis – Carex utriculata	Water sedge – Beaked sedge	S?	G4
Carex buxbaumii	Buxbaum's sedge	S3	G3
Carex lasiocarpa	Slender sedge	S4	G4?
Carex limosa	Mud sedge	S3	G3
Carex nebrascensis	Nebraska sedge	S4	G4
Carex nigricans	Black alpine sedge	S3	G4
Carex pellita	Woolly sedge	SP	G5?
Carex praegracilis	Clustered field sedge	S?	G3
Carex scopulorum	Holm's Rocky Mountain sedge	S4	G5
Carex scopulorum – Caltha leptosepala	Holm's Rocky Mountain sedge – White marsh marigold	S3	G4
Carex simulata	Analogue sedge	S3	G4
Carex utriculata	Beaked sedge	S5	G5
Carex vesicaria	Inflated sedge	S4	G4Q
Deschampsia caespitosa	Tufted hairgrass	S4	G4
Deschampsia caespitosa – Carex spp.	Tufted hairgrass – Sedge	S4Q	G4Q
Deschampsia caespitosa – Potentilla diversifolia	Tufted hairgrass – Varileaf cinquefoil	S2	G5
Distichlis spicata	Saltgrass	S4	G5
Eleocharis palustris	Common spikerush	S5	G5
Eleocharis quinqueflora	Fewflower spikerush	S3	G4
Eleocharis rostellata	Beaked spikerush	S1	G?
Equisetum fluviatile	Water horsetail	S4	G4
Festuca idahoensis – Deschampsia cespitosa	Idaho fescue – Tufted hairgrass	S3	G3G4
Glyceria borealis	Northern mannagrass	S3	G4
Glycyrrhiza lepidota	American licorice	S?	G?

Table 3 continued

Scientific Name	Common Name	State Rank	Global Rank
	PALUSTRINE EMERGENT COMMUNITIES		
Hordeum jubatum	Foxtail barley	S4	G4
Juncus balticus	Baltic rush	S5	G5
Pascopyrum smithii	Western wheatgrass	S4	G3G5Q
Phalaris arundinacea	Reed canarygrass	S4	G5
Phleum alpinum – Carex microptera	Alpine timothy – Smallwing sedge	S?	G3?
Phragmites australis	Common reed	S2	G5
Poa palustris	Fowl bluegrass	S4	GW
Poa pratensis	Kentucky bluegrass	SW	GW
Puccinellia nuttalliana	Nuttall's alkaligrass	S?	G3?
Salicornia rubra	Red glasswort	S2?	G2G3
Schoenoplectus acutus	Hardstem bulrush	S5	G5
Schoenoplectus maritimus	Saltmarsh clubrush	S4	G4
Schoenoplectus pungens	Threesquare	S3	G3G4
Schoenoplectus tabernaemontani	Softstem bulrush	S3	G5
Spartina gracilis	Alkali cordgrass	SP	GU
Spartina pectinata	Prairie cordgrass	S3?	G3?
Spartina pectinata – Carex spp.	Prairie cordgrass – Sedge	S3	G3?
Spartina pectinata – Scirpus pungens	Prairie cordgrass – Threesquare	S3	G3Q
Typha latifolia	Broadleaf cattail	S5	G5
	PALUSTRINE AQUATIC BED COMMUNITIES, ROOTED AND FLOATING VASCULAR		
Nuphar lutea ssp. *polysepala*	Yellow pond-lily	S?	G5
Polygonum amphibium	Water knotweed	S?	G5
Potamogeton richardsonii – Myriophyllum spicatum	Red-head pondweed – Water milfoil	S2Q	G2Q
Sparganium angustifolium	Narrowleaf bur-reed	S?	G4
Stuckenia pectinata – Myriophyllum spicatum	Sago pondweed – Water milfoil	S1Q	G3G4

cottonwood (*Populus angustifolia*), and black cottonwood (*Populus balsamifera* ssp. *trichocarpa*). These species have different elevational ranges, though they often overlap and may be co-dominants at the same site. Plains cottonwood is abundant at lower elevation sites in the Great Plains and is the dominant cottonwood along the Yellowstone River downstream from Columbus. Narrowleaf cottonwood is dominant at somewhat higher elevations, and is abundant on the Yellowstone River upstream of Columbus. Black cottonwood is most abundant at higher elevations and is the dominant cottonwood along the Yellowstone River's tributaries. Where species of cottonwood do overlap, they often show different environmental tolerances. For example, in the plains, narrowleaf cottonwood survives better on elevated gravel bars while plains cottonwood shows greater vigor in depressions with fine sediments (Patten 1998). Cottonwoods often hybridize, and Rydberg's cottonwood, (*Populus* x *acuminata*), a hybrid between narrowleaf and plains cottonwood, is common along the Yellowstone River immediately downstream from Columbus (P. Lesica, pers. comm.).

Fluvial processes that lead to the development of cottonwood communities, such as flooding and sediment deposition, are largely intact in the upper Yellowstone River watershed. However, many of these valley bottoms have received significant long-term grazing pressure, and many stands have shifted from shrub-dominated understories to understories dominated by exotic pasture grasses. Intact valley bottom cottonwood forests have declined regionally, from conversion to agricultural uses, rural expansion, bank stabilization, and dams.

Other floodplain forest dominants include green ash and box-elder (*Acer negundo*) in the Great Plains along the lower portion of the Yellowstone River and Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*) in the foothills and lower montane zone. Quaking aspen (*Populus tremuloides*) can also dominate floodplain forests in the foothills and lower montane zone, often forming co-dominant stands with black cottonwood.

Aspen is also common in draws and toeslopes that receive subirrigation from groundwater and around the margins of morainal potholes. At higher elevations, Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) become common floodplain forest dominants. Engelmann spruce is also sometimes dominant on poorly drained sites on the margins of fens, beaver ponds, or toeslope seeps.

Scrub-Shrub Vegetation

Riparian and wetland shrublands in the study area occur on terraces, active floodplain zones of low and high gradient streams and rivers, around beaver ponds, in peatlands, and on the edge of marshes, potholes, and lakes. Willow communities often dominate these shrublands. At higher elevations, planeleaf willow (*Salix planifolia*) and Wolf willow (*Salix wolfii*) are dominant, occurring in small slope and depressional wetlands and on the margins of subalpine lakes and beaver ponds. Booth's willow (*Salix boothii*) is the most common willow at mid elevations. Stands of Booth's willow occur on terraces and in swales along low-gradient streams and rivers and as a mosaic with marsh vegetation in wet meadow complexes (often with some beaver influence). Bebb willow (*Salix bebbiana*) and Geyer's willow (*Salix geyeriana*) are common co-dominants in this zone. Yellow willow (*Salix lutea*) is common in riverine floodplains at lower elevations. Sandbar willow (*Salix exigua*) stands dominate active and recently stabilized gravel and sandbars at low to mid elevations.

Several non-willow communities are common in the study area. Mountain alder (*Alnus incana*) and water birch (*Betula occidentalis*) are dominant in springs and seeps and along high gradient streams. Western snowberry, silver sage (*Artemisia cana*), chokecherry (*Prunus virginiana*), and red-osier dogwood are common and locally dominant in riverine floodplains and terraces. Black greasewood (*Sarcobatus vermiculatus*) is a common dominant around alkali lakebeds.

Several shrub communities are also associated with fens. Fens are rare in the study area, and occur as slope or depressional wetlands, sometimes associated with beaver activity. Bog birch (*Betula glandulosa*), planeleaf willow, gray-leaf willow (*Salix glauca*), and shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*) are common species in carrs.

Emergent Vegetation

Native herbaceous emergent vegetation is common in a variety of settings, including peatlands, marshes, potholes, beaver ponds, wet meadows, lake edges, oxbows, and sloughs. Herbaceous wetland vegetation is usually a complex mosaic of monocultures, due to the rhizomatous habit of many of the constituent species. Common dominant marsh species include beaked sedge (*Carex utriculata*), woolly sedge (*Carex pellita*), common spikerush (*Eleocharis palustris*), water horsetail (*Equisetum fluviatile*), hardstem bulrush (*Schoenoplectus acutus*), and broadleaf cattail (*Typha latifolia*). In addition to being highly competitive, cattail also increases with nutrient inputs, especially nitrogen (Neill 1990). Fertilizer run-off and discharge of septic effluent to water bodies can cause rapid nutrient increases and can lead to increased dominance of this species.

Marsh communities in the study area are still largely intact. In contrast, drier herbaceous-dominated wetlands, such as wet meadows and riparian terrace grasslands, have been greatly affected by grazing and other land uses and by invasive exotic species. Although intact wet meadow communities are still relatively common at higher elevations, many valley bottoms that once supported tufted hairgrass (*Deschampsia caespitosa*) and bluejoint reedgrass (*Calamagrostis canadensis*) communities are now dominated by exotics like redtop, Kentucky bluegrass, smooth brome, common timothy, and reed canarygrass. This conversion has also affected western wheatgrass communities on riparian floodplains and terraces.

Two other wetland habitats should be mentioned: alkali lake margins and fens. Alkali areas support herbaceous communities dominated by saltgrass (*Distichlis spicata*), Nuttall's alkaligrass (*Puccinellia nuttalliana*), red glasswort (*Salicornia rubra*), and saltmarsh clubrush (*Schoenoplectus maritimus*). Common herbaceous dominants in fens include Buxbaum's sedge (*Carex buxbaumii*) and water sedge (*Carex aquatilis*). Fens in the study area are for the most part very nutrient poor, and species of *Sphagnum* moss are an important

and often dominant component of fen communities.

Herbaceous wet meadows that have been converted from native vegetation represent a major restoration challenge. In addition to exotic pasture grasses, noxious weeds were most common in herbaceous vegetation types. Among the most widespread are Canada thistle, spotted knapweed, hound's tongue, and leafy spurge.

Aquatic Bed Vegetation

Aquatic communities occur in the littoral (less than 2-m deep) and limnetic (more than 2-m deep) zones of ponds and lakes or on the beds of low-gradient, slow-moving perennial streams. Yellow pond-lily (*Nuphar lutea* ssp. *polysepala*), a floating-leaved species, is a common dominant aquatic species. Other common dominants, which range from completely to partly submersed, include narrowleaf bur-reed (*Sparganium angustifolium*), water milfoil (*Myriophyllum* spp.), common mare's tail (*Hippuris vulgaris*), grassy pondweed (*Potamogeton gramineus*), red-head pondweed (*Potamogeton richardsonii*), sago pondweed (*Stuckenia pectinatus*), and the alga *Chara*.

Plant Species of Concern

Forty plant species in the watershed are recognized as Montana plant species of concern, in addition to seven species of potential concern that are of limited distribution or whose status is under review (Table 4). They are all vascular plants, except for two mosses. Five of these are regional endemics that are potentially globally vulnerable (G3), including Nelson's sedge (*Carex nelsonii*), slender Indian paintbrush (*Castilleja gracillima*), fan-leaved fleabane (*Erigeron flabellifolius*), persistent-sepal yellowcress (*Rorippa calycina*) and tiny swamp saxifrage (*Saxifraga apetala*). For most of these species, the upper Yellowstone River watershed represents most of their known range in Montana.

Thirteen of the plant species of concern and six of the seven species of potential concern are in the alpine zone. They represent the highest concentration of rare wetland alpine species in Montana, reflecting the fact that the Beartooth Mountains have the most extensive alpine wetlands system in the state (Anderson 1994). Eight of the thirteen alpine plant species of concern are known only in the state from the study area. Three of the four regional endemics that are potentially globally vulnerable are alpine species.

The rest of the plant species of concern in the upper Yellowstone River watershed are in a variety of habitats reflecting the diversity of wetland settings. Their habitats include seeps, cold- and hot-springs, alkaline and other wet meadows, ephemeral desert washes, peatlands, temporary wetlands, riparian forest, open water, and damp cold-air drainages, all variously linked to different elevation zones and riverine or palustrine settings.

We sought to relocate two of the species known only from low-elevation historic records in the study area, persistent-sepal yellowcress (*Rorippa calycina*) and Drummond's hemicarpha (*Hemicarpha drummondii*). They had vague location information, and we were not successful in documenting extant populations. Incidental to these efforts, three new records were acquired for tracked or watch species, and records for six species were added from secondary sources, most of which are the first records for these species in the study area.

Animal Species of Concern

The watersheds of the upper Yellowstone River provide habitat for a number of animals listed as species of concern by the Montana Natural Heritage Program and the Montana Department of Fish, Wildlife & Parks (Table 5). Thirty-one bird species of concern are found within the watershed, 32 percent of which are associated with riparian habitats. Most of the species are tied to the water, although the red-headed woodpecker (*Melanerpes erythrocephalus*), Lewis' woodpecker (*Melanerpes lewis*), and black-billed cuckoo (*Coccyzus erythropthalmus*) inhabit associated riparian habitats. The harlequin duck (*Histrionicus histrionicus*) is associated with mountainous riverine and riparian habitats, and the bald eagle (*Haliaeetus leucocephalus*), which is listed as a threatened species, occurs throughout the watershed but breeds in the riparian forests along the major waterways. Mammal species of concern that utilize wetland habitats in the study area are limited to three bat species. Wetlands provide valuable foraging areas for these species. The spotted bat (*Euderma maculatum*) and Townsend's big-eared

Table 4. Rare wetland and riparian plants and their conservation ranks for plants that occur or are likely to occur in the upper Yellowstone River watershed.

Scientific Name	Common Name	Conservation Rank		Management Status*	
		State	Global	USFS	BLM
Vascular Plants					
Adoxa moschatellina	Musk-Root	S1	G5	S	W
Agoseris lackschewitzii	Pink Agoseris	S3	G4		
Aquilegia brevistyla	Short-Styled Columbine	S2	G5	S	
Asclepias incarnata	Swamp Milkweed	S1	G5		
Atriplex truncata	Wedge-Leaved Saltbush	SH	G5		W
Camissonia andina	Obscure Evening-Primrose	S1	G4		S
Carex multicostata	Many-Ribbed Sedge	S1	G5		W
Carex nelsonii	Nelson's Sedge	SU	G3?		
Carex neurophora	Alpine Nerved Sedge	S3	G4		
Carex norvegica ssp. *inserrulata*	Toothed Scandinavian Sedge	S1	G5T?Q		
Carex tenera	Slender Sedge	SU	G5		
Carex tincta	Slender Sedge	SU	G4G5		
Castilleja exilis	Annual Indian Paintbrush	S2	G5		
Castilleja gracillima	Slender Indian Paintbrush	S2	G3G4	S	W
Cleome lutea	Yellow Bee Plant	S1	G5		W
Cypripedium parviflorum	Small Yellow Lady's-Slipper	S3	G5	S	W
Drosera anglica	English Sundew	S2	G5	S	
Eleocharis rostellata	Beaked Spikerush	S2	G5	S	W
Elodea longivaginata	Long Sheath Waterweed	S1	G4G5		W
Epipactis gigantea	Giant Helleborine	S2	G4	S	W
Erigeron flabellifolius	Fan-leaved fleabane	S3	G3		
Eriophorum callitrix	Sheathed Cotton-Grass	S1	G5		
Eupatorium maculatum var. *bruneri*	Joe-Pye Weed	S2	G5TU		W
Gentiana prostrata	Pygmy Gentian	SU	G5		
Gentianella tenella	Slender Gentian	SU	G4G5		
Gentianopsis simplex	Hiker's Gentian	S1	G4	S	W
Gratiola ebracteata	Bractless Hedge-Hyssop	S1	G4		
Hemicarpha drummondii	Drummond's Hemicarpha	SH	G4G5		
Hutchinsia procumbens	Hutchinsia	S1	G5		W
Juncus triglumis	Three-Flowered Rush	SU	G5		
Kobresia macrocarpa	Large-Fruited Kobresia	S1	G5		
Kobresia simpliciuscula	Simple Kobresia	S2	G5		
Koenigia islandica	Island Koenigia	S1	G4		
Phippsia algida	Ice Grass	S2	G5		
Potentilla plattensis	Platte Cinquefoil	S1	G4		W
Primula incana	Mealy Primrose	S2	G4G5		W
Ranunculus cardiophyllus	Heart-Leaved Buttercup	S2	G4G5		W
Ranunculus gelidus	Arctic Buttercup	S1	G4		
Ranunculus jovis	Jove's Buttercup	S2	G4	S	
Rorippa calycina	Persistent-sepal yellowcress	S1	G3		W
Salix barrattiana	Barratt's Willow	S1	G5	S	
Saxifraga apetala	Tiny Swamp Saxifrage	S2	G3Q		
Saxifraga hirculus	Yellow Marsh Saxifrage	S1	G5		
Senecio amplectens	Clasping Groundsel	S1	G4T?		
Senecio eremophilus var. *eremophilus*	Desert Groundsel	S1	G5T5		
Stellaria crassifolia	Fleshy Stitchwort	S1	G5		W
Non-vascular Plants					
Meesia triquetra		S2	G5	S	
Paludella squarrosa		S1	G3G5		

* BLM = Bureau of Land Management, USFS = U.S. Forest Service; S = sensitive, W = watch

Table 5. Rare wetland and riparian animals associated with wetland and riparian areas in the Upper Yellowstone watersheds, as well as their conservation and management status.

		Heritage Rank		Management Status*		
Scientific Name	**Common Name**	**State**	**Global**	**USFWS**	**USFS**	**BLM**
Amphibians						
Bufo cognatus	Great Plains toad	S3	G5			
Spea bombifrons	Plains spadefoot toad	SU	G5			
Rana pipiens	Northern leopard frog	S3	G5			
Birds						
Gavia immer	Common loon	S1S2B,SZN	G5		S	SS
Pelecanus erythrorhynchos	American white pelican	S3B,SZN	G3			
Nycticorax nycticorax	Black-crowned night-heron	S3B?,SZN	G5			
Histrionicus histrionicus	Harlequin duck	S2B,SZN	G4		S	
Haliaeetus leucocephalus	Bald eagle	S3B,S3N	G4	T		
Falco peregrinus	Peregrine falcon	S2B,SZN	G4		S	
Sterna caspia	Caspian tern	S2B,SZN	G5			
Chlidonias niger	Black tern	S3B,SZN	G4			
Coccyzus erythropthalmus	Black-billed cuckoo	SU	G5			
Melanerpes lewis	Lewis' woodpecker	S3S4B,SZN	G5			
Melanerpes erythrocephalus	Red-headed woodpecker	S3S4B,SZN	G5			
Fish						
Oncorhynchus clarki bouvieri	Yellowstone cutthroat trout	S2	G4		S	SS
Stizostedion canadense	Sauger	S2	G5			
Mammals						
Euderma maculatum	Spotted bat	S1	G4			
Corynorhinus townsendii	Townsend's big- eared bat	S2S3	G4		S	SS
Antrozous pallidus	Pallid bat	S1	G5		S	
Reptiles						
Chelydra serpentina	Snapping turtle	S3	G5			
Trionyx spiniferus	Spiny softshell	S3	G5			

* BLM = Bureau of Land Management, USFWS = U.S. Fish and Wildlife Service, USFS = U.S. Forest Service; T = listed as threatened, S = sensitive, SS = special status

bat (*Plecotus townsendii*) are found in south-central Montana and utilize cliff habitat found along the river and upland wetlands. Fish species of concern are the Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*) and the sauger (*Stizostedion canadense*), both of which have experienced recent declines in numbers and are intimately tied to the management of the Yellowstone River. The trout inhabits the upstream areas of the watershed characterized by clear cold water while the sauger inhabits lower stretches of the study area in portions of the river characterized by more sluggish and turbid waters. Reptiles of concern include the snapping turtle (*Chelydra serpentina*) and spiny softshell (*Trionyx spiniferus*), both of which are directly tied to the riverine system in the downstream portion of the study area. Two toad and one frog species are listed as amphibian species of concern. The northern leopard frog (*Rana pipiens*) is associated with wetland and riparian habitats. The Great Plains toad (*Bufo cognatus*) and Plains spadefoot (*Spea bombifrons*) are found in associated upland areas and utilize temporary wetland areas to breed.

Wetland Conservation

We identified 46 ecologically significant wetlands in the course of this study, 17 of which occurred on private land (Table 6). Because of land access and other issues, two of these sites, Bluewater Springs and Edgar Oxbow, did not receive full ecological inventories and were not ranked. Twelve additional sites were inventoried or received site visits, but either did not meet significance criteria or were lacking in true wetland characteristics.

Table 6. Site ranks and ownership of upper Yellowstone wetland sites inventoried in 1999 and 2000.

		Site Rank					
	Weight factor =	0.25	0.25	0.20	0.20	0.10	(1.00)
Site Name	**Ownership***	**Condition**	**Landscape Context**	**Diversity**	**Rarity**	**Size**	**Overall Rank**
A-RANKED SITES							
Crater Fen	USFS	A	A	C	A	B	**A**
East Rosebud Complex	USFS	A	B	A	B	A	**A**
Basin Lakes	USFS	A	A	B	B	B	**A**
East Rosebud Lake	USFS, Pri	A	A	B	B	C	**A**
Chrome Lake	USFS, Pri	B	A	C	A	A	**A**
Big Beaver	USFS	B	A	A	B	C	**A**
West Rosebud Complex	USFS, Pri	B	A	A	C	A	**A**
West Fork Rock Fens	USFS	A	B	C	A	B	**A**
B-RANKED SITES							
Twin Lakes	USFS	A	A	B	C	B	**B**
West Boulder Meadows	USFS	B	A	B	C	A	**B**
Main Boulder	Pri	B/C	A	B	B	B	**B**
McDonald Basin	USFS	B	B	B	B	A	**B**
Dry Fork Creek Marshes	USFS	B	A	B	B	C	**B**
East Rosebud Floodplain Subdivision	Pri	B	A	B	C	A	**B**
East Fork Fiddler Creek Complex	DNRC	B	A	B	C	B	**B**
Water Birch	FWP	B	B	B	B	A	**B**
Grove Creek Aspens	BLM, Pri	B	B	B	B	A	**B**
West Rosebud Moraine	Pri	B	B	A	C	B	**B**
Horsethief Station	FWP	B	B	B	C	A	**B**
Yellowstone River-Stillwater River	Pri	B	A	D	B	C	**B**
Buffalo Mirage	DNRC, Pri	B/C	B	C	C	A	**B**
Hell's Canyon	USFS	B	B	C	C	C	**B**
Pruit Park	Pri	B	A	D	C	C	**B**
Stillwater River-Flume Creek	USFS	B	B	B	D	C	**B**
C-RANKED SITES							
Riverfront Park	YCo	C	B	B	D	A	**C**
Mud Lake-Boulder River	USFS	B	B	B	D	C	**C**
West Rosebud Trailhead	USFS	B	B	B	D	C	**C**
Sage Creek	BLM	B	C	C	C	B	**C**
Boulder Forks	FWP, Pri	C	B	A	D	C	**C**
Lost Lakes	USFS	B	A	C	0	C	**C**
East Rosebud Oxbow	DNRC	C	B	C	C	D	**C**
Big Lake	FWP, DNRC	B	D	B	C	A	**C**
Bull Springs	FWP	C	B	C	D	A	**C**
Beaver Lodge	FWP	C	B	C	D	A	**C**
Nurses Lakes	USFS, Pri	B	B	C	0	B	**C**
Young's Point	Pri	C	B	B	0	A	**C**
Halfbreed National Wildlife Refuge	FWS, DNRC, Pri	B	D	B	D	A	**C**
Two Moon Park	City	C	C	B	D	A	**C**
Clark's Fork Waterfowl Production Area	FWS	C	C	A	0	A	**C**
Wyoming Line	BLM, Pri	B	B	D	0	B	**C**
Meyers Creek	USFS	C	B	C	D	C	**C**

Table 6 continued

Site Name	Ownership*	Site Rank: Condition	Landscape Context	Diversity	Rarity	Size
Weight factor =		0.25	0.25	0.20	0.20	0.10
C-RANKED SITES						
White Bird	FWP	C	C	C	D	C
Yellowstone River-Work Creek	Pri	B	C	D	D	D
Hailstone National Wildlife Refuge	FWS	C	D	C	D	A

* BLM = Bureau of Land Management, City = City of Billings, DNRC = Montana Department of Natural Resources, FWP = Montana Department of Fish, Wildlife & Parks, FWS = U.S. Fish and Wildlife Service, Pri = Private, USFS = U.S. Forest Service, YCo = Yellowstone County

These sites range from pristine wetlands of statewide conservation significance to highly impacted wetlands that still provide important wildlife habitat. Appendix D provides detailed information for each wetland and riparian area inventoried. Site locations are presented in Figure 3. Please note that about one third of the sites described occur wholly or in part on private land, and landowner permission is needed to access these sites.

A-ranked Wetlands

Eight of the sites inventoried qualify as A-rank wetlands. These sites are in good to excellent condition. In general, their natural hydrologic regimes are intact, they support high quality examples of native plant communities, and they have no or only minor weed populations. The uplands surrounding these sites are largely pristine, with minimal human disturbances. Many of these wetlands encompass a broad array of physical environments and thus contain a high diversity of plant communities and structural types.

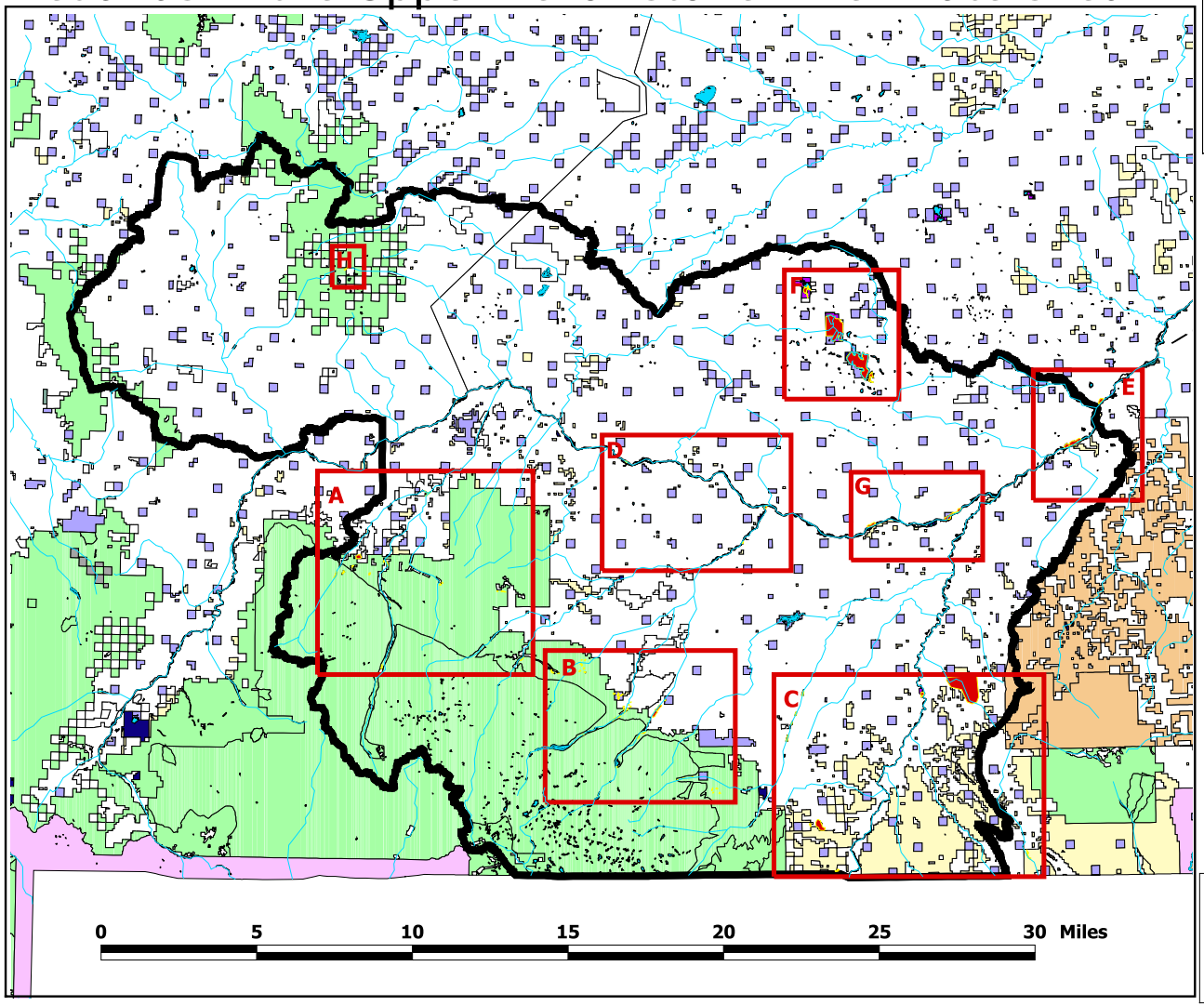
A-ranked sites include fens as well as slope, lacustrine fringe, and beaver-influenced riparian wetlands. Three of these sites, Crater Fen, Chrome Lake, and West Fork Rock Creek Fens, are nutrient-poor fens. This is a rare wetland type statewide and is very uncommon in the study area. Chrome Lake is especially interesting, as it is only the fourth patterned fen known from the state. In addition, there is some fen development at the Basin Lakes site. Three of the remaining sites are slope and riparian wetlands influenced by past and current beaver activity. East Rosebud Complex, Big Beaver, and West Rosebud Complex are all extremely diverse sites that include aquatic communities, sedge meadows, willow bottoms, stands of cottonwood and wet aspen, and climax riparian spruce forests. These sites support outstanding examples of beaked sedge, Booth's willow / bluejoint reedgrass, and Engelmann spruce / bluejoint reedgrass communities. The final site, East Rosebud Lake, is a riparian and lacustrine fringe site that supports excellent examples of beaked sedge and planeleaf willow / bluejoint reedgrass communities.

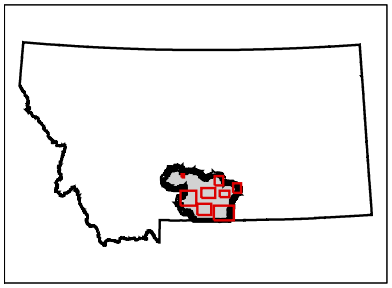
All of these sites are wholly or in part on National Forest land. Three sites are partially in private ownership. None of these sites has any formal protection, except for the privately owned section of the West Rosebud Complex, which is under conservation easement. To protect the outstanding character of these sites, conservation easements should be acquired on the portions of the sites under private ownership. For sites on public land, they should be managed to maintain their condition and hydrological connectivity to adjacent wetlands and the surrounding uplands. In some cases, Research Natural Area or Special Interest Area designation would be appropriate. ATV access to and use of the Chrome Lake site should be eliminated immediately.

B-ranked Wetlands

Sixteen wetlands were rated as B-ranked sites. In general, these sites have greater human-caused disturbance both on- and off-site. However, these

Figure 3. Locations of ecologically significant wetlands in the Upper Yellowstone River watershed





OWNERSHIP
- BLM
- USFS
- USFWS
- BIA Trust
- State Trust
- DFWP
- Other private
- Water

N

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Figure 3. Inset A

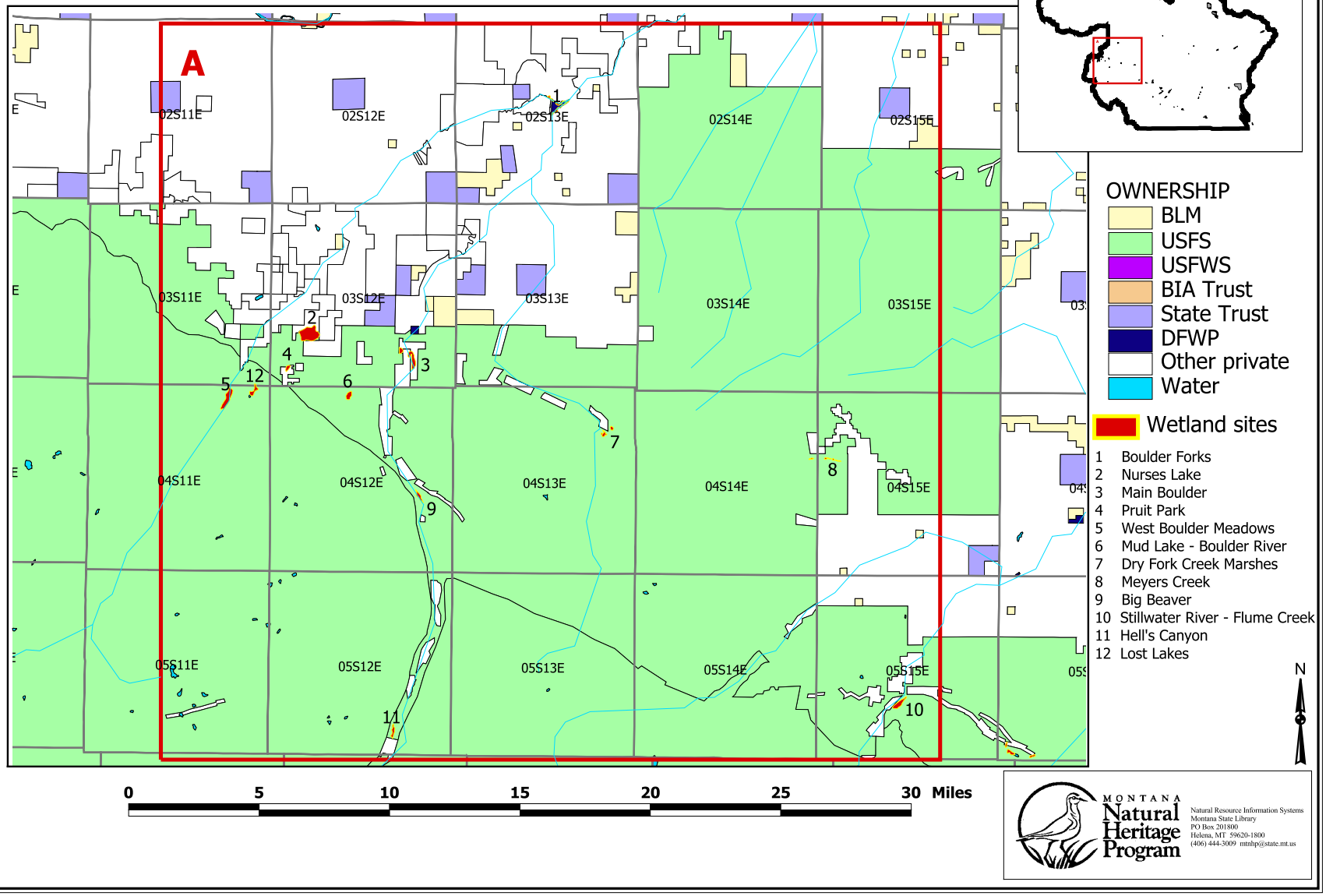

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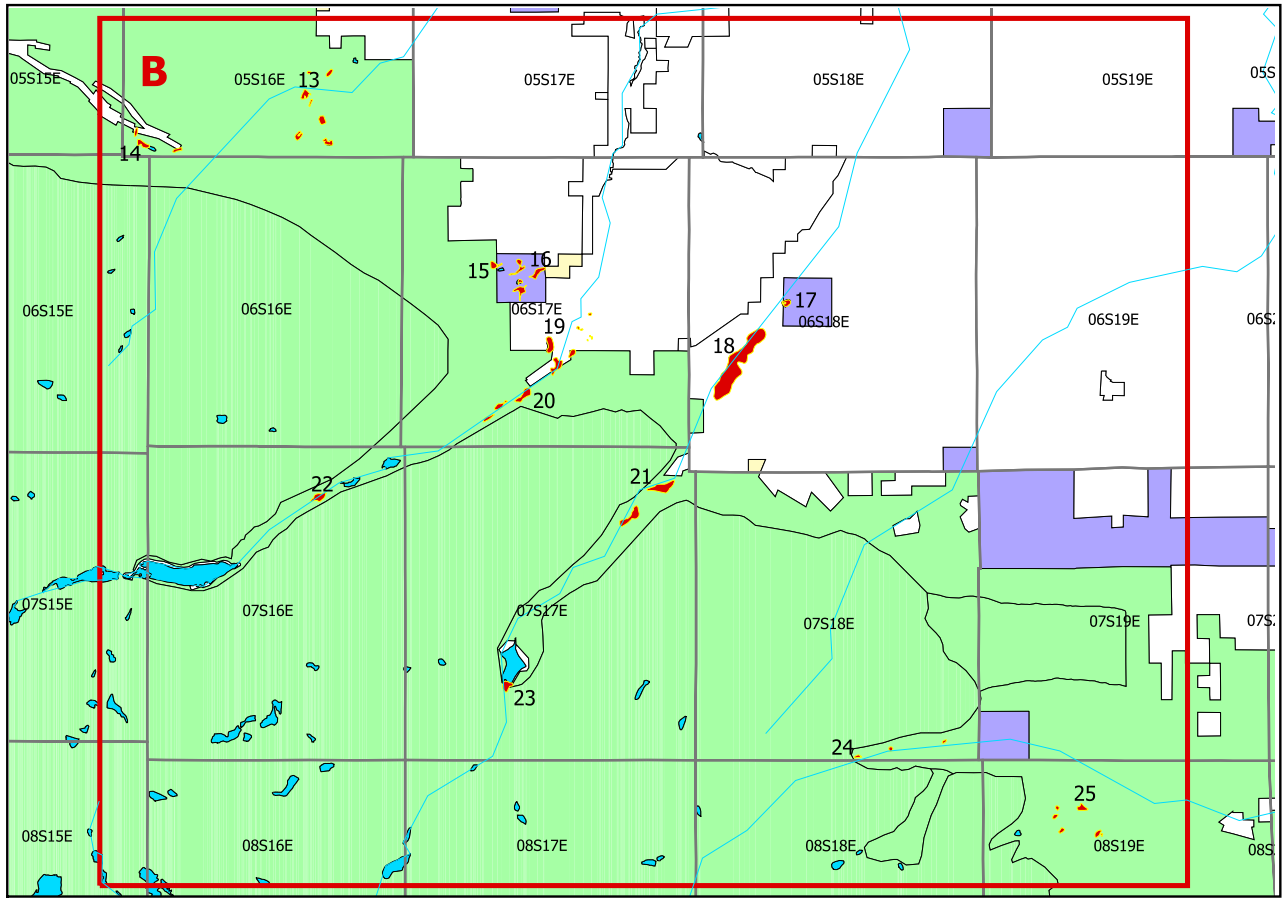
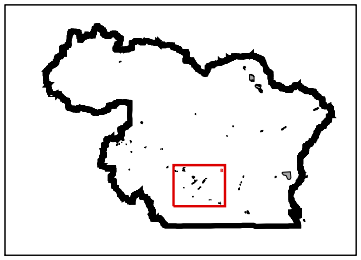
Figure 3. Inset B





OWNERSHIP
- BLM
- USFS
- USFWS
- BIA Trust
- State Trust
- DFWP
- Other private
- Water

Wetland sites
13 McDonald Basin
14 Chrome Lake
15 Crater Fen
16 E Fork Fiddler Creek Complex
17 E Rosebud Oxbow
18 E Rosebud Floodplain Subdivision
19 W Rosebud Moraine
20 W Rosebud Complex
21 E Rosebud Complex
22 W Rosebud Trailhead
23 E Rosebud Lake
24 W Fork Rock Creek Fens
25 Basin Lakes

N

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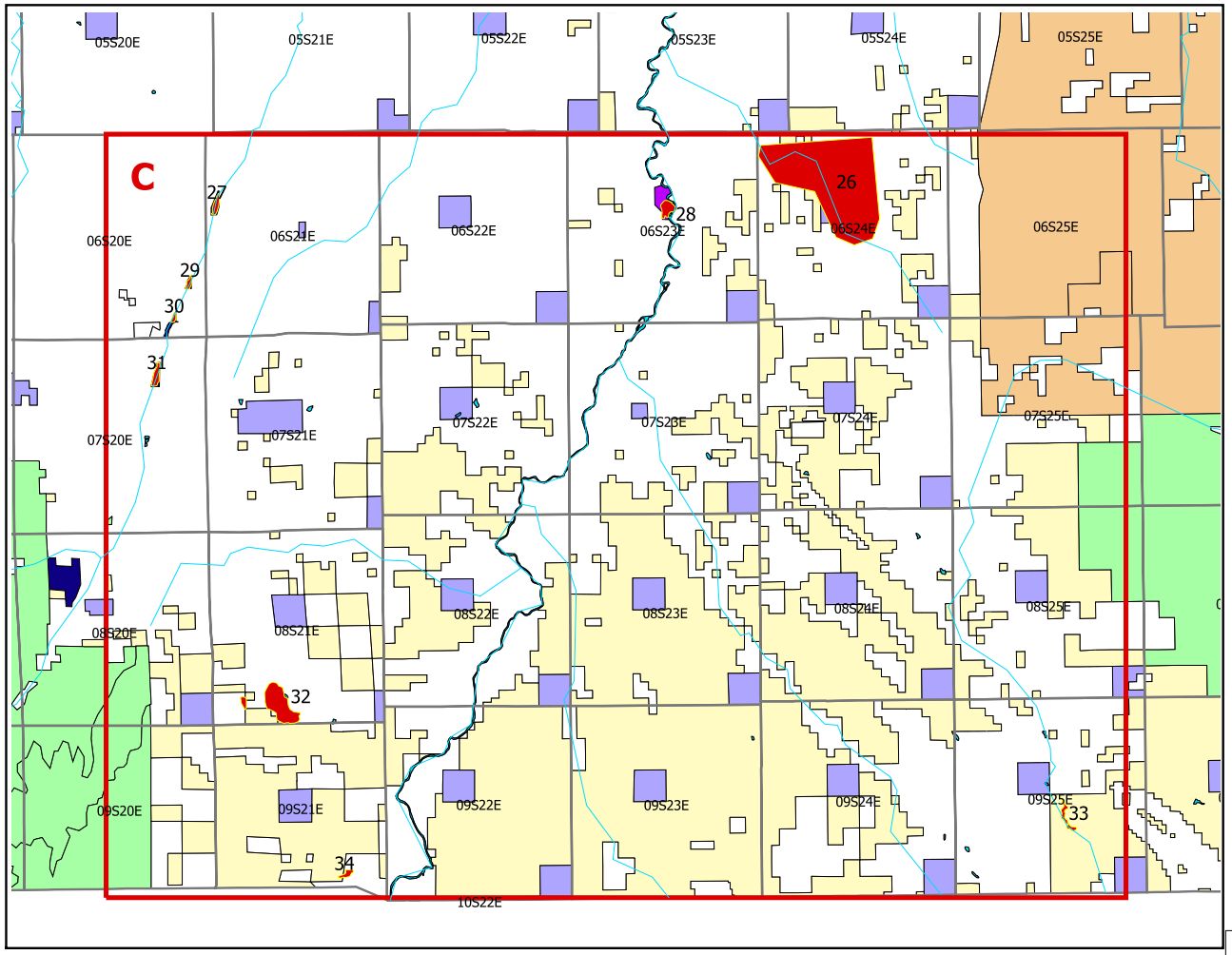
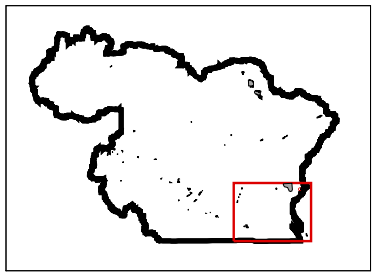
Figure 3. Inset C





OWNERSHIP

- BLM
- USFS
- USFWS
- BIA Trust
- State Trust
- DFWP
- Other private
- Water

Wetland sites

26 Bluewater Springs
27 Water Birch
28 Clark's Fork Waterfowl PA
29 Bull Springs
30 Beaver Lodge
31 Horsethief Station
32 Grove Creek Aspens
33 Sage Creek
34 Wyoming Line

N

0 5 10 15 20 25 30 Miles

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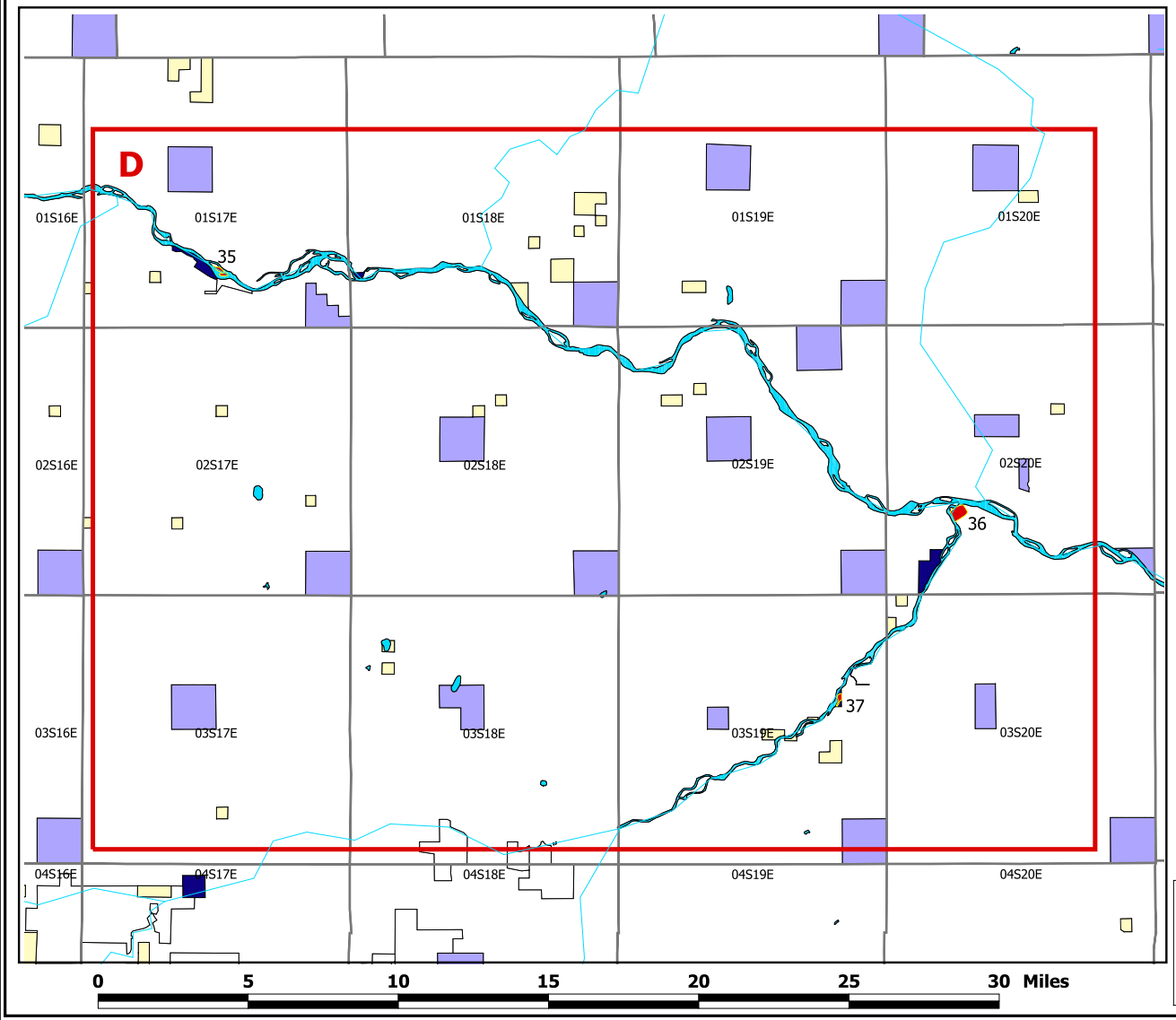
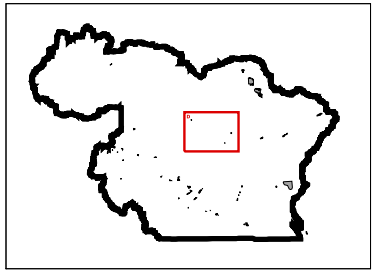
Figure 3. Inset D





OWNERSHIP
- BLM
- USFS
- USFWS
- BIA Trust
- State Trust
- DFWP
- Other private
- Water

Wetland sites

35 Yellowstone R - Work Creek
36 Yellowstone R - Stillwater R
37 White Bird

N

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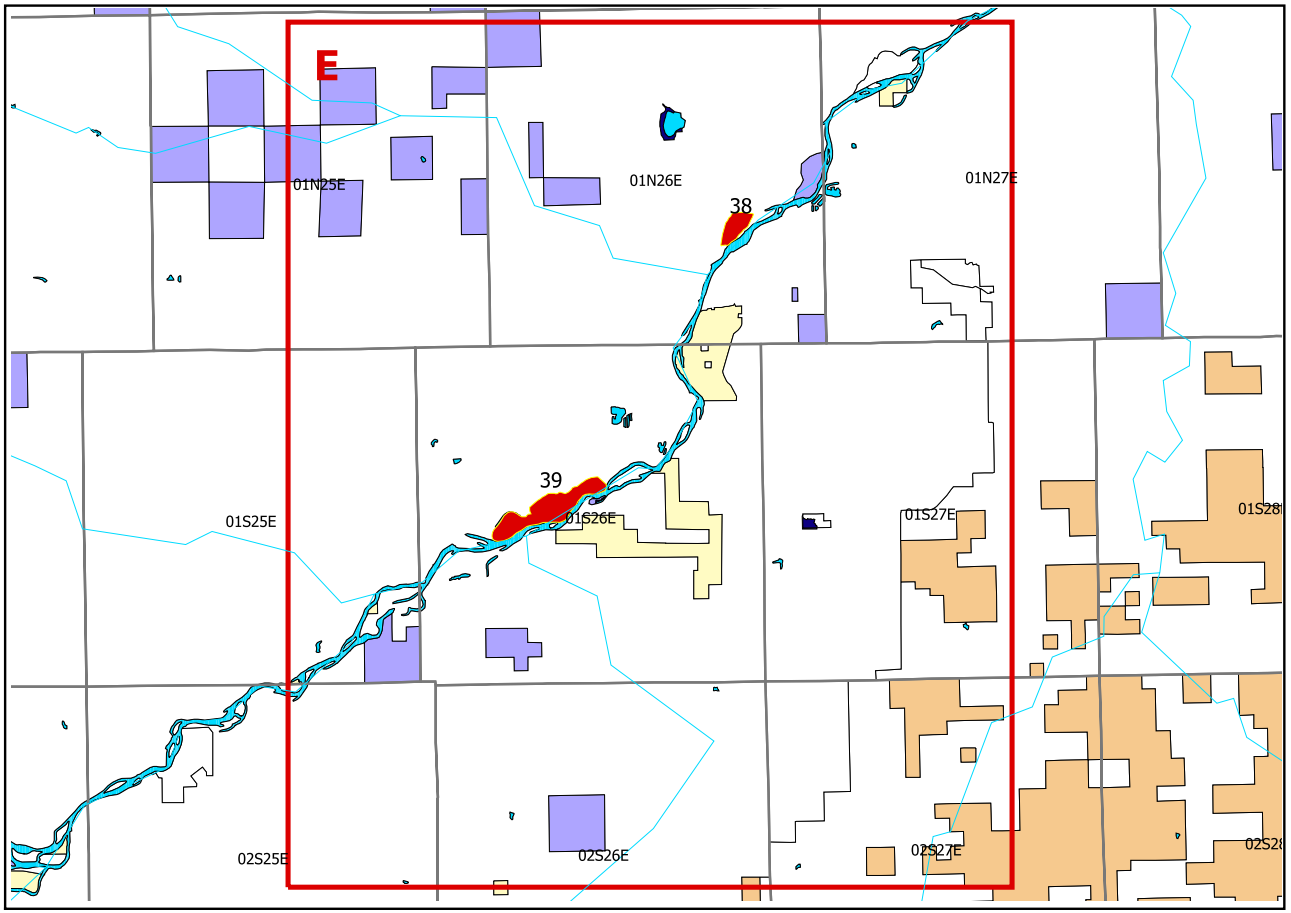
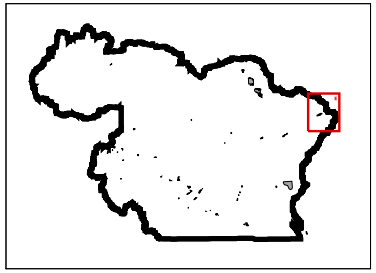
Helena, MT 59620-1800
(406) 444-3009 mtnhp@state.mt.us

Figure 3. Inset E





OWNERSHIP
- BLM
- USFS
- USFWS
- BIA Trust
- State Trust
- DFWP
- Other private
- Water

Wetland sites

38 Two Moon Park
39 Riverfront Park

N

0 5 10 15 20 25 30 Miles

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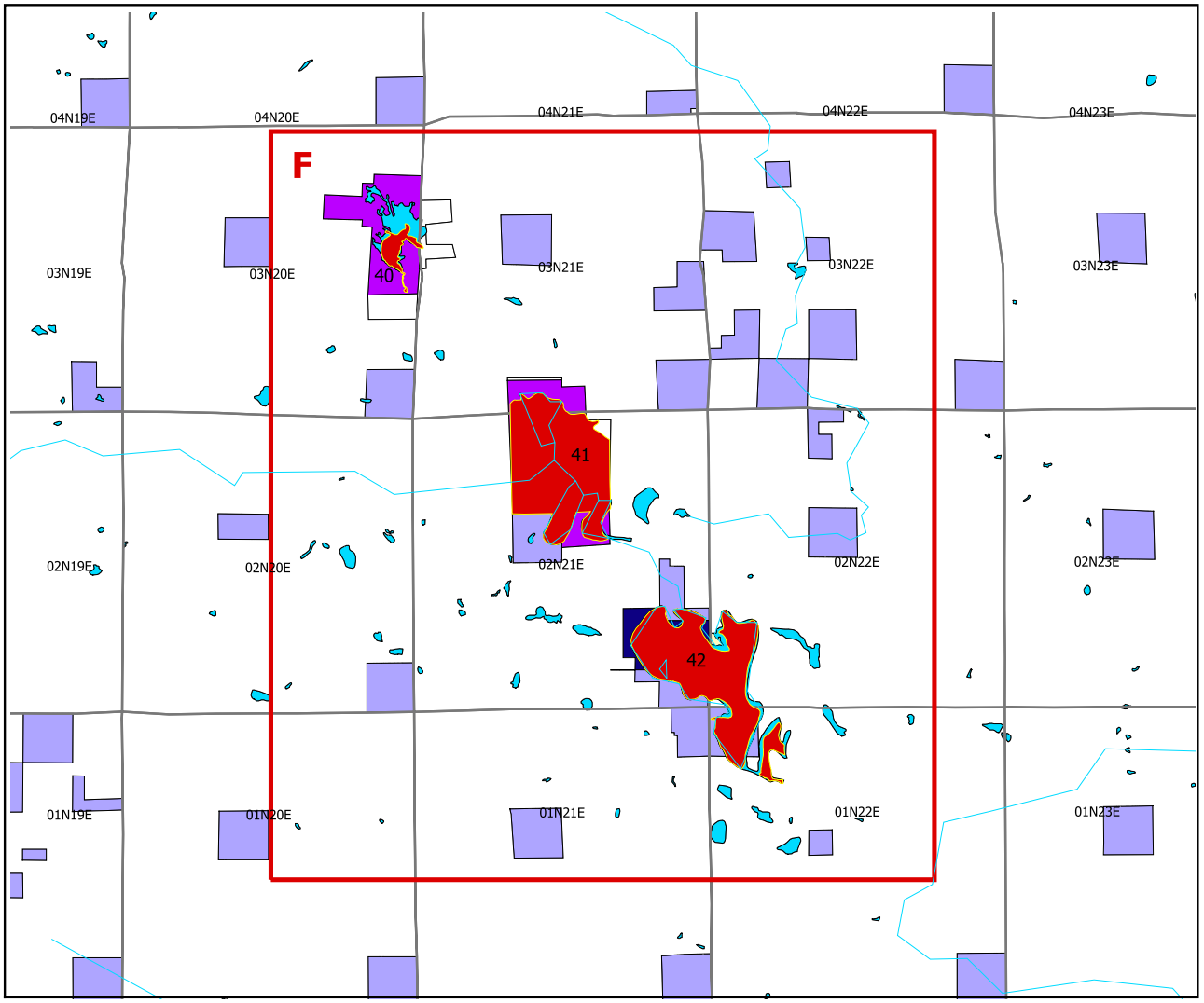
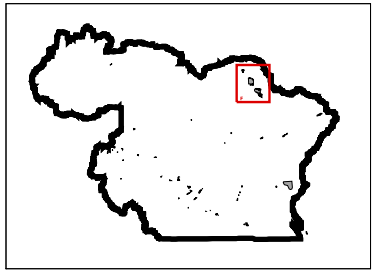
Figure 3. Inset F





OWNERSHIP

- BLM
- USFS
- USFWS
- BIA Trust
- State Trust
- DFWP
- Other private
- Water

Wetland sites

40 Hailstone NWR
41 Halfbreed NWR
42 Big Lake

N

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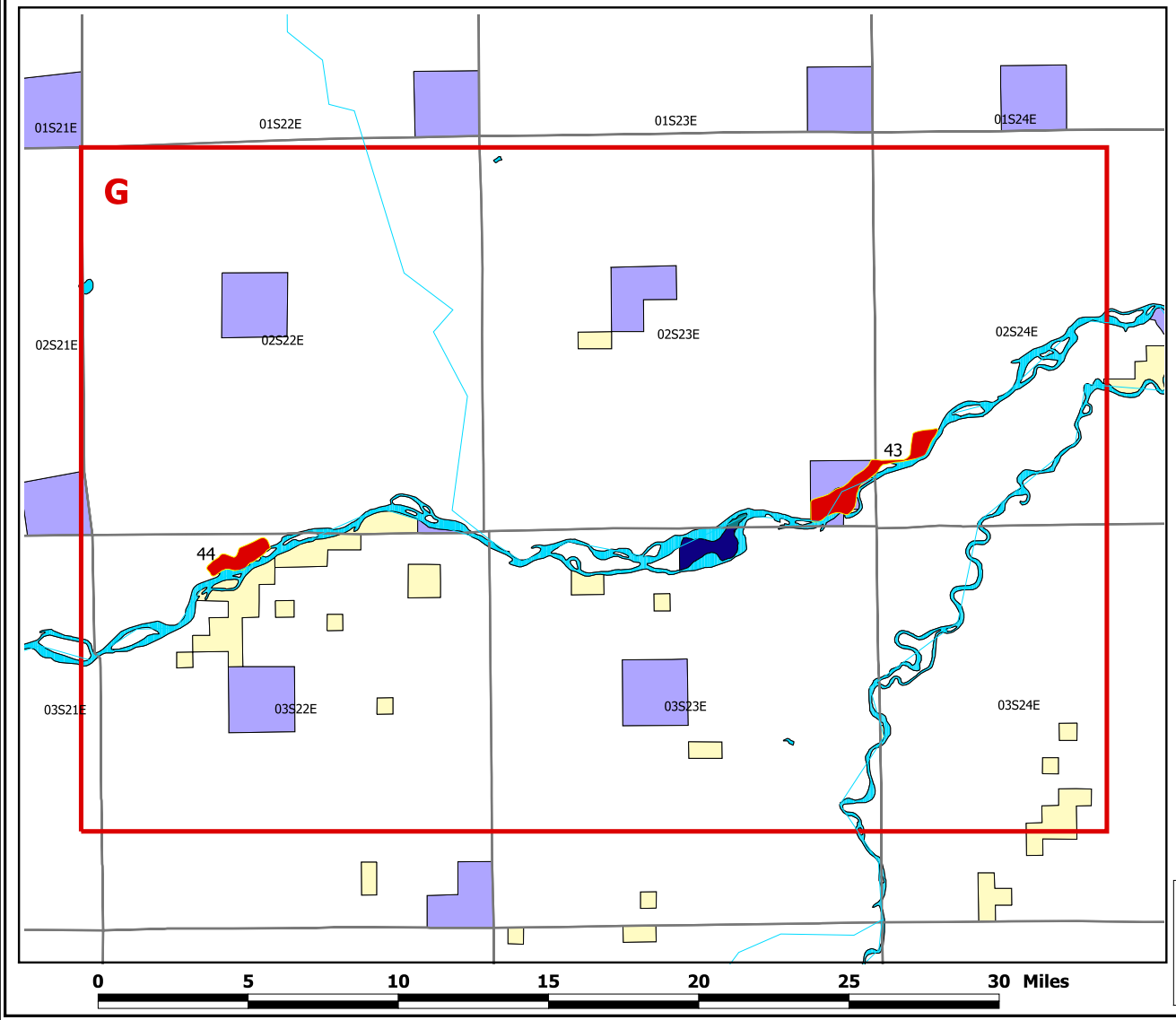
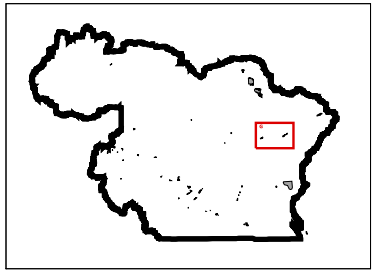
Figure 3. Inset G





OWNERSHIP
- BLM
- USFS
- USFWS
- BIA Trust
- State Trust
- DFWP
- Other private
- Water

Wetland sites
43 Buffalo Mirage
44 Youngs Point

N

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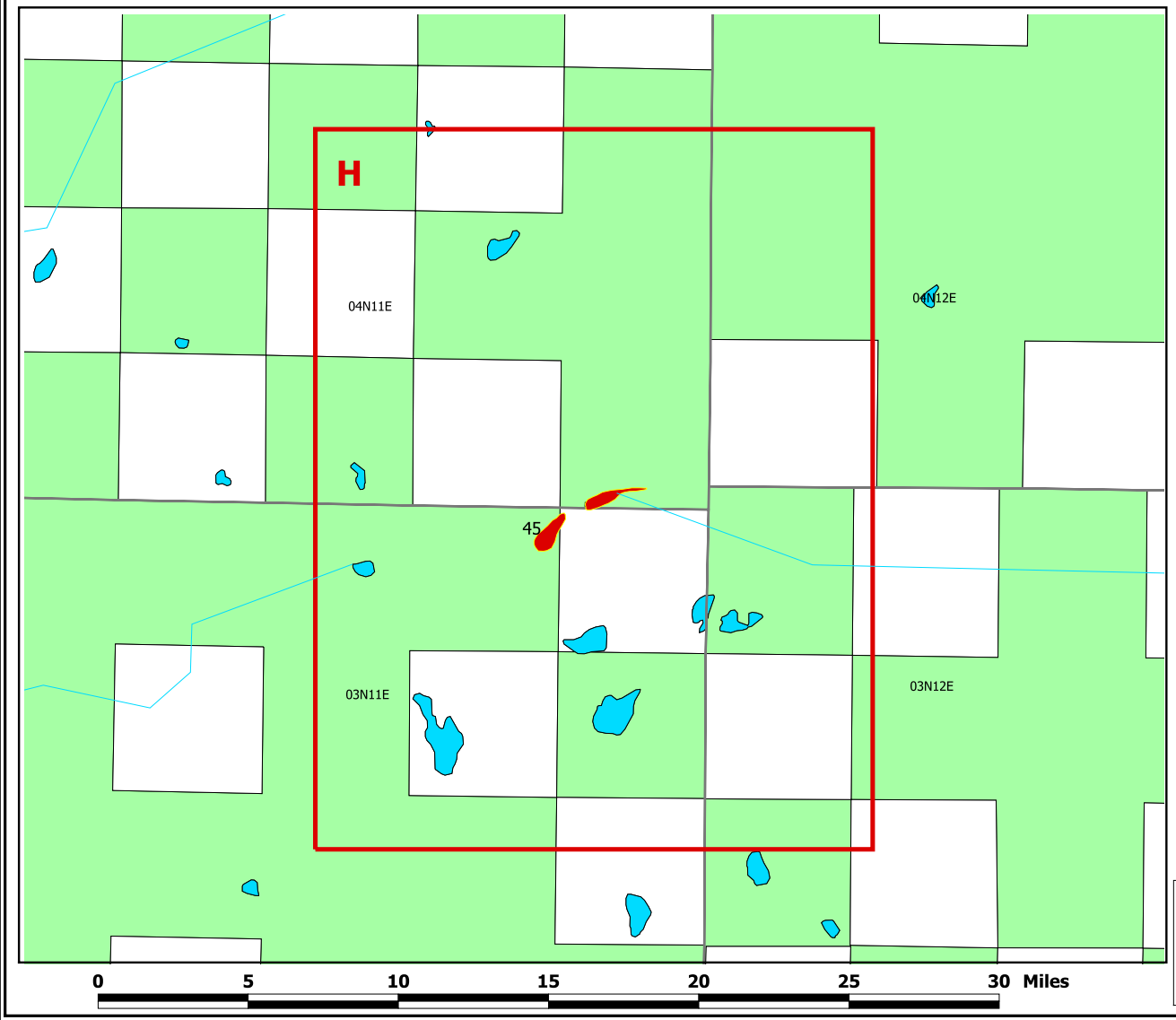
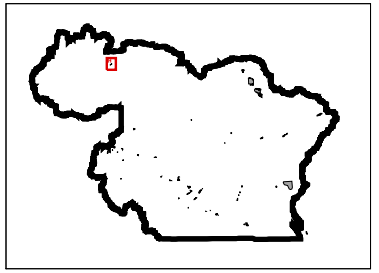
Figure 3. Inset H





OWNERSHIP
- BLM
- USFS
- USFWS
- BIA Trust
- State Trust
- DFWP
- Other private
- Water

Wetland sites

45 Twin Lakes

N

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sites are still relatively diverse, have high functional capacity, and support high quality plant communities as well as good examples of rare communities.

The majority of these wetlands occur in the montane zone along the Beartooth Front. Many of these sites are riparian, often beaver-influenced, wetlands. These sites include East Fork Fiddler Creek Complex, East Rosebud Floodplain Subdivision, Hell's Canyon, Main Boulder, Stillwater River-Flume Creek, and West Boulder Meadows. While these sites have intact hydrologic regimes and geomorphology, they have been disturbed by past and current land uses, such as grazing, and populations of weedy species are locally abundant. Nonetheless, they still support high quality examples of native plant communities, such as East Fork Fiddler Creek Complex's wet aspen draws and Stillwater River-Flume Creek's quaking aspen / red-osier dogwood community. In fact, the Main Boulder site contains the best example of a black cottonwood / red-osier dogwood community documented in the study area.

Other montane sites are non-riverine. Dry Fork Creek Marshes, McDonald Basin, and West Rosebud Moraine are all depressional wetlands that were formed by past glaciation, and McDonald Basin has some fen development. Twin Lakes is a high-elevation slope and lacustrine fringe wetland in a subalpine lake basin, and Pruit Park is a slope wetland on an elevated glacial terrace. Hydrologic processes are largely intact at these sites, but, except for Twin Lakes, they have been influenced by disruptive land uses and by encroachment of exotic species. Twin Lakes is largely pristine, but lacked the diversity and rarity scores to qualify as an A-ranked site.

The five remaining sites occur at low elevations. Yellowstone River-Stillwater River, Buffalo Mirage, Horsethief Station, and Water Birch are riverine wetlands. The first two occur along the Yellowstone River and support cottonwood stands in good condition with intact native shrub communities. The latter two occur along Rock Creek, which has been hydrologically modified by irrigation withdrawals. Grove Creek Aspens is a unique spring/seep-fed mosaic of aspen stands and alkaline meadows in the Bighorn Basin. These sites have all been influenced by land use and exotic species. Six of the B-ranked sites occur on National Forest land, three occur on state land, five are in private ownership, and two are in mixed public/private ownership. Of the sites on public land, none enjoy protected status, except for West Boulder Meadows, which is in the Absaroka-Beartooth Wilderness Area. Water Birch, Horsethief Station, and a portion of Buffalo Mirage enjoy some protection as Fishing Access sites administered by the Department of Fish, Wildlife & Parks. Sites on public land should be managed to maintain and enhance the existing hydrological and habitat connectivity to adjacent wetlands and the surrounding uplands. Three of the sites in private ownership (Main Boulder, West Rosebud Moraine, and Pruit Park) are under conservation easement. Conservation easements or other cooperative agreements that would protect the other four private land sites from habitat fragmentation or hydrologic isolation should be pursued.

Most of these sites would benefit from noxious weed plans. Canada thistle, hound's tongue, leafy spurge, and other noxious weeds are currently present at many sites as small populations, and as such are more amenable to control or eradication measures. Perhaps a more intractable problem is the abundance of exotic pasture grasses in drier wetland habitats and across the transition zone between wetland and uplands. At several sites, including Main Boulder, East Fork Fiddler Creek Complex, Ease Rosebud Floodplain Subdivision, Stillwater River-Flume Creek, West Boulder Meadows, Buffalo Mirage, and Yellowstone River-Stillwater River, the herbaceous layer of some communities is dominated by these pasture grasses. It will be extremely difficult to restore these areas, especially when it is unclear what the pre-disturbance native dominants were.

C-ranked Wetlands

The remaining 20 wetlands all rated as C-ranked sites. Most of these wetlands have been functionally impaired through hydrologic or geomorphic alterations or through land use disturbances in the wetlands or adjacent uplands. Exotic species are widespread and abundant at many of these sites. In contrast, some of these wetlands are in good condition, but are comprised of a few common, structurally simple communities, and therefore had low diversity and rarity scores.

The majority of these sites are riverine wetlands, at least in part. Boulder Forks, East Rosebud Oxbow, and West Rosebud Trailhead occur in bottomlands along large streams in the lower montane zone. Meyers Creek is a lower montane site along an intermittent creek. Lower-elevation riparian sites include Beaver Lodge and Bull Springs along Rock Creek, White Bird along the lower Stillwater River, Yellowstone River-Work Creek, Young's Point, Riverfront Park, and Two Moon Park along the Yellowstone River, Sage Creek in the arid Bighorn Basin, and a created wetland at the Clark's Fork Waterfowl Production Area. Young's Point also contains a wet meadow supported by seepage from an irrigation ditch. All these sites have well-established populations of weedy species. Some sites, such as Riverfront and Two Moon Park, face the possibility of the permanent conversion of native cottonwood stands to exotic-dominated Russian olive communities.

Other low-elevation sites are depressional wetlands. Hailstone and Halfbreed National Wildlife Refuges and Big Lake occur around alkaline lakebeds in central Montana's Lake Basin. These sites support many salt-tolerant communities and provide important waterfowl habitat. Wyoming Line is a spring/seep wetland in the Bighorn Basin.

The remaining three sites are montane depressional wetlands. Lost Lakes, Nurses Lakes, and Mud Lake-Boulder River are in good condition within relatively undisturbed landscapes and are generally less impacted than low-elevation C-ranked sites. However, these sites are less diverse and support few or no rare species or communities.

Most of these sites occur at least in part on public land. Several of these sites enjoy some protected status or are managed for wildlife values. These include Riverfront and Two Moon Parks, Hailstone and Halfbreed National Wildlife Refuges, and several Fishing Accesses. Additionally, the private land portions of two sites, Boulder Forks and Halfbreed National Wildlife Refuge, have conservation easements on them. All these sites should be managed to maintain, and where possible, to restore wetland functions and habitat values.

Although noxious weeds and other exotic species are widespread at many of these wetlands, these sites would still benefit from comprehensive weed management plans. Well-established populations of Russian olive are present along the Yellowstone River below the confluence with the Clark's Fork. This is especially troubling as it is likely that this species will come to dominate many parts of the floodplain as the native cottonwood stands die out.

Wetlands Not Inventoried

There are a number of wetlands in the upper Yellowstone River watershed that were not surveyed as part of this inventory project. Readers should not infer that these uninventoried wetlands are in poor condition or have low functional integrity. Indeed, several potential high quality wetlands identified during the site selection process were not inventoried. These include alpine wetlands in the Beartooth Plateau, which were not inventoried because of their high level of protection, and wetlands in private ownership where landowners did not grant access permission. Lack of access has resulted in some portions of the study area, such as the Shields River and other Crazy Mountain drainages, being under-represented in this study.

Many other wetlands did not meet our initial selection criteria and were not prioritized for inventory. However, most of these wetlands do provide important wetland functions and are valuable for that reason alone. Except as noted above, we expect that most wetlands not inventoried as part of this project would qualify as B- or C-ranked wetlands. Many wetlands in the watershed have been fragmented by roads or have had their native wetland plant communities degraded by a variety of land uses. Others are pristine, but very small and dominated by just one or two plant communities. We believe that the B- and C-ranked sites that were inventoried represent a fairly representative sample of these types of wetlands.

Because we focused where possible on large, fairly discrete wetlands, some types of wetlands and processes were likely under-emphasized during the inventory. Examples include small spring/seeps or just smaller wetlands that by chance could have harbored rare species. In addition, some fluvial processes (like deposition, channel migration, and flooding) occur at a larger scale than our assessments methods were designed to address. Riparian

cottonwood communities are inextricably tied to such processes, and simply protecting existing patches of mature cottonwood forest cannot conserve these communities. Areas where deposition is occurring (where future cottonwood stands will be recruited) need to be conserved as well (Merigliano 1996).

How This Information Can Be Used

The purpose of this wetland inventory is to provide information that will assist in the conservation of wetland diversity and quality. The resulting information can be used to:

* **Prioritize wetlands for conservation**

This inventory provides a list of wetland sites ranked by ecological significance. This list can be used to efficiently prioritize how limited wetland protection funds are spent by land trusts considering conservation easements, or by state/federal agencies and corporate owners considering easements or land exchanges.

* **Identify irreplaceable wetlands**

This list of significant wetland sites identifies resources that are essentially irreplaceable. Some A-and B-ranked sites contain wetland features like peatlands, spruce swamps, and rare plants which could not realistically be mitigated if lost.

* **Identify potential Special Management Areas**

High ranking sites on Forest Service or Bureau of Land Management lands may be good candidates for designation as Research Natural Areas, Botanical Special Interest Areas, or Areas of Critical Environmental Concern. Likewise, similar sites on state land merit management to maintain significant natural values.

* **Identify reference wetlands**

Consultants, wetland scientists, watershed groups, and government agencies can use these results to identify reference wetlands. Such sites can serve as models of wetland plant community structure/ composition for comparison/evaluation of other sites, for restoration projects, or as seed sources for plant materials. Reference wetlands are also extremely useful for inferring the impacts of certain land use activities.

* **Identify potential mitigation sites**

Some wetlands identified in this report could serve as mitigation sites to help offset losses of wetlands at other locations, in compliance with Section 404 of the Clean Water Act. At some sites, restoring hydrology by blocking peripheral drainage would improve wetland function.

* **Provide context for wetland permit review**

This list of significant wetlands and wetland communities can help regulators ascertain the relative scarcity of a particular wetland type or community within a watershed or region, and provide perspective on the biological importance of wetlands resources that may be impacted.

* **Provide information for land use decisions**

County planners, regulators, and others can use this list as a tool by to help inform decisions about planning, growth, and development.

* **Assist HGM modeling efforts**

Some of these wetlands identified by this inventory could serve as reference sites for the regional guidebook being developed for slope wetlands.

Future Needs

This report completes our wetland inventory in the drainages of the upper Yellowstone River. However, a tremendous need remains for better information on Montana wetlands. One of these is to complete the National Wetland Inventory for Montana. NWI provides valuable basic information on the distribution, size, and types of wetlands found across the state. Another priority is to continue the inventory of ecologically significant wetlands on a watershed basis throughout the state. Appendix E provides a list of Montana watersheds with a preliminary prioritization by biodiversity value and level of threat, to help direct future wetland inventory efforts.

How To Request Additional Information

Additional wetland data is available for watershed-wide or site specific projects. Digitized National Wetland Inventory maps for some USGS quads in Montana can be viewed on the web at the Natural Resource Information System's Wetland Clearing

house web page (http://www.nris.state.mt.us/wis/wis1.html). Hard copy maps are available for inspection at U.S. Fish and Wildlife Service offices or for purchase from the NWI Regional Distribution Center (605-688-5890).

The following wetland information is available from MTNHP:

- Occurrence information for rare plants, animals, and natural communities
- Site-specific community information for wetland sites surveyed
- Information on ecologically significant wetland sites currently not under conservation management
- Information on ecologically significant wetland sites currently protected

This report and previous wetland inventory reports are also available on the MTNHP website. Requests for additional information can be submitted through the Montana Natural Heritage Program website at http://nhp.nris.state.mt.us, or by contacting the Montana Natural Heritage Program.

Finally, MTNHP databases will be updated if and when any additional inventory work is conducted in the study area. Any new site records resulting from future work will be available by contacting the Montana Natural Heritage Program.

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Appendix A – Global and State Rank Guidelines

For state ranks, substitute S for G in these definitions

G1 = Critically imperiled globally because of extreme rarity (typically five or fewer occurrences or very few remaining acres) or because of some factor(s) making it extremely vulnerable to exptirpation.

G2 = Imperiled globally because of extreme rarity (typically six to 20 occurrences or few remaining acres) or because of some factor(s) making it very vulnerable to extirpation.

G3 = Vulnerable; either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g. a single Great Plains state, a single physiographic or ecoregional unit) or because of other factors making it vulnerable to extirpation throughout it's range.

G4 = Apparently Secure; Uncommon, but not rare (although it may be quite rare in parts of its range, especially at the periphery). Apparently not vulnerable in most of its range.

G5 = Secure; Common, widespread, and abundant (though it may be quite rare in parts of its range, especially at the periphery). Not vulnerable in most of its range.

GU = Unrankable; Status cannot be determined at this time.

G? = Unranked; Status has not yet been assessed.

GM/GW = Designates a community that is modified and dominated by cultivated or weedy species.

<u>Modifiers and Rank Ranges</u>

? A question mark added to a rank expresses an uncertainty about the rank in the range of 1 either way on the 1-5 scale.

G#G# Greater uncertainty about a rank is expressed by indicating the full range of ranks which may be appropriate.

Q A "Q" added to a rank denotes questionable taxonomy. It modifies the degree of imperilment and is only used in cases where the type would have a less imperiled rank if it were not recognized as a valid name (i.e. if it were combined with a more common type).

P Assigned at the state level. There is potential that the element occurs in the state, but no extant or historic occurrences are accepted.

R Assigned at the state level. Element is reported as occurring in the state but without a basis for either accepting or rejecting the report.

CRITERIA USED FOR RANKING

The criteria for ranking are based on a set of quantitative and qualitative factors. These factors are listed below in order of their general importance:

a. Number of Element Occurrences (EOs):
the estimated number of EOs throughout the Element's global range;

b. Abundance:
the estimated global abundance of the Element (measured by number of individuals, or area, or stream length covered);

c. Size of Range:
the estimated size of the Element's global range;

d. Distribution trend:
the trend in the Element's distribution over it's global range;

e. Number of protected EOs:
the estimated number of adequately protected EOs throughout the Element's global range;

f. Degree of threat:
the degree to which the Element is threatened globally;

g. Fragility:
the fragility or susceptibility of the Element to intrusion;

h. Other global considerations:
for example, the quality or condition of EOs that affect or may affect endangerment status; unexplained population fluctuations; reproductive strategies that are dependent on specific habitat; etc.

Appendix B – Site Rank Criteria for Wetlands and Riparian Areas

Minimum Site Size: 1 acre (0.5 acre for peatlands)

Rank Procedure: The following site ranking specifications have been modified from and informed by criteria presented in regional wetland assessment protocols (Washington State Department of Ecology 1991, Chadde et al. 1998, Greenlee 1999, Jankovsky-Jones 1999), hydrogeomorphic functional assessments (Hruby et al. 1999, Jankovsky-Jones et al. 1999a, 1999b, Hauer et al. 2000a, 2000b, Hruby et al. 2000), and plant community ranking specifications developed by other Natural Heritage programs (Chappell and Christy 2000, Rondeau and Sanderson 2000). This ranking procedure has been developed to be consistent with standard Heritage methodology described in the Draft Element Occurrence Data Standard (TNC and ABI 1999). The data standard was developed for ranking an element occurrence's viability by evaluating its condition, landscape context, and size. We propose similar criteria to evaluate a wetland site's viability. In addition to condition, context, and size, two other factors important in determining a site's conservation significance, diversity and rarity, are considered.

In the Rocky Mountains and Great Plains of Montana, wetlands occur as small patch and linear systems on the landscape (although there may be localized large patch occurrences, as in the Centennial Valley). Because of their small size and high dependence on external processes, the primary factors affecting site viability and significance are condition and context. Secondary factors are diversity and rarity, and the tertiary factor is size. These variables, their weighting factors, and rank thresholds are described below.

Condition Specifications (weight factor = .25): This factor is a combination of environmental factors (hydrologic, geomorphic, and biogeochemical) and vegetation and habitat parameters. A site's condition should be representative of the overall condition of individual plant associations present at the site. In addition to the condition of native plant associations, the presence of exotic-dominated communities is an important factor. The presence of weedy, modified, or cultural vegetation types should reduce the site condition rank, even where native associations are in pristine condition. An important point to consider in this case is the potential for the exotic species to spread. Note: not all of the factors listed below are applicable to all wetland systems (e.g., surface flooding is primarily a process associated with riverine systems, whereas subsurface flooding/saturation is important for all wetland types).

The following rank thresholds are not mutually exclusive. It is possible to have a site with minor hydrologic or geomorphic modification with highly degraded plant communities. For example, a cottonwood stand with an exotic-dominated understory along a free-flowing river (hydrology and geomorphology rank of A or B, vegetation and habitat rank of D) would warrant an overall condition rank of C.

A-rated condition

Hydrology, geomorphology, and biogeochemistry. Natural hydrologic processes are intact and the site has no geomorphic modifications. Indicators include:

- In all systems, subsurface flooding and saturation of low areas (swales, oxbows, old channels, depressions) occurs in most years as indicated by soils, vegetation, photographs.
- Overbank flooding occurs regularly (approximately every other year or more frequently) as indicated by soils, vegetation, photographs. This factor is important primarily for riverine systems with well developed floodplains.
- The floodplain is being actively developed, with multiple macrotopographic features present (e.g., oxbows, overflow/abandoned channels, floodplain, terraces, bars).
- Stream banks and channels have representative shape, are not riprapped, and are not unvegetated by excessive grazing or trampling.
- There is no evidence of geomorphic modification, excessive erosion, sediment deposition, or nutrient loading.

Vegetation and habitat

- Plant communities have representative structure and composition (e.g., cottonwood stands have a diverse and well developed shrub component).
- Regeneration is occurring and seedlings, saplings, or clonal shoots are present. In riverine floodplain systems, channel bar formation is creating substrate for woody vegetation colonization (this may be occurring in the system though not at the site).
- There is a high level of interspersion and connectivity among plant communities.
- Within native plant communities, no or very few exotic species are present, with no potential for expansion. Cultural or modified vegetation types are absent or are a very minor component of the site.

B-rated condition

Hydrology, geomorphology, and biogeochemistry. Hydrologic and geomorphic modifications are minimal and/or localized and are easily restorable. Indicators include:

- Overbank and subsurface flooding still occurs frequently, but flooding regimes may be slightly modified by irrigation withdrawal, small headwaters dams, or localized and minimal geomorphic alteration (roads, bridges, ditching, diking, bank revetment, soil compaction, clearing).
- Floodplain riverine systems have few macrotopographic features, but there is evidence of recent floodplain development.
- Stream banks may show some local adverse effects from excessive grazing or other activity.
- Any excessive erosion, deposition, or nutrient loading is restricted to localized pockets.

Vegetation and habitat

- Native plant community structure and composition has been somewhat altered by logging, grazing (including browse from native ungulates), fire suppression, etc. (e.g., the native shrub component is structurally and compositionally diverse, but browsing pressure has altered the structure and abundance, especially that of palatable species).
- Native species that increase with disturbance or changes in hydrology or nutrients are restricted to microsites.
- Limited regeneration and channel bar formation is occurring.
- There is a moderate level of interspersion and connectivity among plant communities.
- Exotic species and cultural vegetation are a minor component of the site and have little potential for expansion.

C-rated condition

Hydrology, geomorphology, and biogeochemistry. Hydrologic and geomorphic modifications are more systematic, and require either a long time (decades) or significant effort to restore. Indicators include:

- Subsurface flooding or saturation occurs relatively frequently, but overbank flooding occurs only during high floods. Hydrologic or geomorphic modifications have systematically altered the hydrologic regime. Modifications include regional hydropower or flood control dams, extensive irrigation withdrawals or return flows, widespread ditching, moderate bank revetment, etc.
- Floodplain riverine systems have few macrotopographic features and there is no evidence of recent floodplain development.
- Stream banks are significantly altered by excessive grazing, bank stabilization, channelization, road construction, etc.
- Excessive erosion, deposition, or nutrient loading is common.

Vegetation and habitat

- Native plant community structure and composition has been substantially altered by logging, grazing (including browse from native ungulates), fire suppression, etc.
- Native species that increase with disturbance or changes in hydrology or nutrients are widespread.

- Native species regeneration is not occurring or very restricted; no evidence of woody species colonization of channel bars.
- There is a low level of interspersion and connectivity among plant communities.
- Exotic species and cultural vegetation are widespread but potentially controllable.

D-rated condition

Hydrology, geomorphology, and biogeochemistry. Hydrology and geomorphology are significantly altered at both local and regional scales; restoration is unlikely.

- Surface/subsurface flooding occurs only during extreme flood events.
- Geomorphic modifications are extensive and a significant proportion of the channel is revetted.
- Stream banks are severely degraded.

Vegetation and habitat

- Community structure and composition is significantly affected by exotic species (e.g., understories of cottonwood stands have been converted from native shrubs or grasses to exotic graminoids).
- Native plant communities are fragmented by cultural vegetation.
- Exotic species, cultural vegetation, or native increasers are dominant and restoration is unlikely.

Landscape Context Specifications (weight factor = .25): This factor is a composite of context ranks for individual plant associations present at the site. The site context should be representative of the overall landscape context of these communities.

A-rated context

The site's hydrologic regime is not altered by flow regulation, augmentation, or reduction by upstream reservoirs, groundwater pumping, or irrigation withdrawal. Site is connected hydrologically and by suitable habitat (e.g., riparian vegetation along stream corridors) to other wetlands via unaltered surface or subsurface channels. Native vegetation in good condition occupies a 100-m buffer zone around the wetland. Adjacent uplands and the upstream watershed are unaltered (> 90% natural vegetation) by urban, agricultural, or other landuses (e.g., logging) that might affect hydrology or habitat connectivity. Habitat connectivity allows natural processes and species migration to occur.

B-rated context

Hydrologic regime is largely unaltered with few small reservoirs or irrigation withdrawals upstream. Hydrologic and habitat connectivity still largely intact, but a few barriers or gaps are present. Landuse in the wetland buffer is restricted to light grazing or selective logging. Adjacent uplands and the upstream watershed are moderately altered (60 to 90% natural vegetation) by urban, agricultural, or other uses.

C-rated context

Natural hydrological regimes are altered by upstream reservoirs or irrigation practices. Hydrologic connections are functional, but habitat connections are fragmented and multiple barriers are present. Landuse in the wetland buffer includes moderate grazing, logging, or haying. Adjacent uplands and upstream watershed are fragmented (20-60% natural vegetation) by urban, agricultural, or other uses.

D-rated context

Hydrology substantially altered by upstream reservoirs or irrigation practices (e.g., stream may go completely dry in most years, marsh may experience complete drawdown). Site may be hydrologically isolated due to hydrological or geomorphological modifications. Wetland buffer is heavily grazed, roaded, or tilled. Habitat is extremely fragmented and adjacent uplands and upstream watershed are largely converted to urban, agricultural, or other uses.

Diversity Specifications (weight factor = .20): This factor has three components: floristic diversity (measured by number of plant associations), plant physiognomic diversity (measured by number of Cowardin

classes/subclasses), and geomorphic diversity (measured by Cowardin water regimes). Cowardin classes are forest-evergreen, forest-deciduous, scrub-shrub, emergent, and aquatic bed. Cowardin water regimes include temporarily flooded, seasonally flooded, semipermanently flooded, and permanently flooded. Each component is considered separately, and the overall rank is the average score of the three components. Each component is weighted equally. To be counted, each component should occupy or occur over at least 10% of the site or 0.5 acres.

A-rated diversity

4 or more plant communities; 4 or more Cowardin classes; 4 or more Cowardin water regimes.

B-rated diversity

3 plant communities; 3 Cowardin classes; 3 Cowardin water regimes.

C-rated diversity

2 plant communities; 2 Cowardin classes; 2 Cowardin water regimes.

D-rated diversity

1 plant community; 1 Cowardin class; 1 Cowardin water regime.

Rarity Specifications (weight factor = .20): This factor is evaluated by the number and condition of rare or imperiled plants, animals, or communities present at the site. Sites with no rare elements as described below rank 0 for this factor. Peatlands are automatically ranked at A-level rarity.

A-rated rarity

One A-ranked G1 occurrence, four or more A or B-ranked G1 or G2 occurrences, four or more A-ranked G3 occurrences, or peatland associations form a significant component of the site.

B-rated rarity

One B through D-ranked G1 occurrence, one A or B-ranked G2 occurrence, one A-ranked G3 occurrence, or four or more B-ranked G3 or C-ranked G2 occurrences.

C-rated rarity

One C or D-ranked G2 occurrence, one B-ranked G3 occurrence, or four or more A or B-ranked S1 (G4 or G5) occurrences.

D-rated rarity

One C-ranked G3 occurrence, one A or B-ranked S1 (G4 or G5) occurrence, one A-ranked S2 (G4 or G5) occurrence, or four or more B-ranked S2 (G4 or G5) or A-ranked S3 (G4 or G5) occurrences.

Size Specifications (weight factor = .10): This factor will vary depending on the type of wetland being evaluated (e.g., slope, depressional, riverine, lacustrine fringe). If site boundaries are defined by land ownership or similar factors, evaluate this factor based on the size of the site's ecological boundaries.

A-rated size

> 100 acres for riverine; > 50 acres for slope, depressional, or lacustrine fringe; > 10 acres for peatland

B-rated size

50 to 100 acres for riverine; 25 to 50 acres for slope, depressional, or lacustrine fringe; 5 to 10 acres for peatland

C-rated size

10 to 50 acres for riverine; 5 to 25 acres for slope, depressional, or lacustrine fringe; 1 to 5 acres for peatland

D-rated size

< 10 acres for riverine; < 5 acres for slope, depressional, or lacustrine fringe; < 1 acre for peatland

Calculating Site Ranks: To calculate the overall site rank, the A – D ranks for each factor are given numeric equivalents, such that A = 4, B = 3, C = 2, and D = 1. These numeric equivalents are then multiplied by the weighting assigned to each factor and then added together, as illustrated by the following formula:

$$(R_{cond}*w_{cond}) + (R_{cont}*w_{cont}) + (R_{div}*w_{div}) + (R_{rare}*w_{rare}) + (R_{size}*w_{size}) = \text{overall site rank}$$

where R_{cond} = numeric equivalent for condition rank
R_{cont} = numeric equivalent for landscape context rank
R_{div} = numeric equivalent for diversity rank
R_{rare} = numeric equivalent for rarity rank
R_{size} = numeric equivalent for size rank

and w_{cond} = weight factor for condition
w_{cont} = weight factor for landscape context
w_{div} = weight factor for diversity
w_{rare} = weight factor for rarity
w_{size} = weight factor for size

The overall site rank is then determined given the following correspondence:

Site Rank	Numeric Range
A	>3.25 and ≤4.00
B	>2.50 and ≤3.25
C	>1.75 and ≤2.50
D	>0.80 and ≤1.75

For example, a site with B-ranked condition, A-ranked landscape context, C-ranked diversity, D-ranked rarity, and C-ranked size would have an overall site rank of B, as illustrated below:

(3*0.25) + (4*0.25) + (2*0.20) + (1*0.20) + (2*0.10) = 2.55

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Date: March 19, 2001

Appendix C

INTERNATIONAL CLASSIFICATION OF ECOLOGICAL COMMUNITIES:

TERRESTRIAL VEGETATION OF THE UNITED STATES

Common Wetland Communities Documented in the upper Yellowstone River Watershed

Report from
Biological Conservation Datasystem
March, 2001

by

Association for Biodiversity Information

1101 Wilson Blvd., 15th floor
Arlington, VA 22209

This subset of the International Classification of Ecological Communities (ICEC) covers vegetation alliances and associations attributed to the upper Yellowstone River, Montana**.** This community classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. A fully searchable and periodically updated on-line source for the ICEC is at www.natureserve.org. Comments and suggestions regarding the contents of this subset should be directed to Marc Jones (marcj@state.mt.us) and Marion Reid (mreid@abi.org).

The following citation should be used in any published materials, which reference these data:
The Association for Biodiversity Information. 2001. International Classification of Ecological Communities: Terrestrial Vegetation. Natural Heritage Central Databases. The Association for Biodiversity Information, Arlington, VA.

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Association For Biodiversity Information
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These data are extracted from:

The Association for Biodiversity Information. 2001. International Classification of Ecological Communities: Terrestrial Vegetation. Natural Heritage Central Databases. The Association for Biodiversity Information, Arlington, VA.

This document may be generally cited as follows:

Association for Biodiversity Information[1]. 2001. International classification of ecological communities: Terrestrial vegetation of the United States. Common wetland communities documented in the upper Yellowstone River watershed. Association for Biodiversity Information, Arlington, VA and Montana Natural Heritage Program, Helena, MT.

[1] The Association for Biodiversity Information (ABI) is an international organization including ABI regional offices, an ABI central office, US State Natural Heritage Programs, and Conservation Data Centres (CDC) in Canada and Latin America and the Caribbean. Ecologists from the following organizations have contributed the development of the ICEC:

United States
Central ABI Office, Arlington, VA; Eastern Regional Office, Boston, MA; Midwestern Regional Office, Minneapolis, MN; Southeastern Regional Office, Durham, NC; Western Regional Office, Boulder, CO; Alabama Natural Heritage Program, Montgomery AL; Alaska Natural Heritage Program, Anchorage, AK; Arizona Heritage Data Management Center, Phoenix AZ; Arkansas Natural Heritage Commission Little Rock, AR; Blue Ridge Parkway, Asheville, NC; California Natural Heritage Program, Sacramento, CA; Colorado Natural Heritage Program, Fort Collins, CO; Connecticut Natural Diversity Database, Hartford, CT; Delaware Natural Heritage Program, Smyrna, DE; District of Columbia Natural Heritage Program/National Capital Region Conservation Data Center, Washington DC; Florida Natural Areas Inventory, Tallahassee, FL; Georgia Natural Heritage Program, Social Circle, GA; Great Smoky Mountains National Park, Gatlinburg, TN; Gulf Islands National Seashore, Gulf Breeze, FL; Hawaii Natural Heritage Program, Honolulu, Hawaii; Idaho Conservation Data Center, Boise, ID; Illinois Natural Heritage Division/Illinois Natural Heritage Database Program, Springfield, IL; Indiana Natural Heritage Data Center, Indianapolis, IN; Iowa Natural Areas Inventory, Des Moines, IA; Kansas Natural Heritage Inventory, Lawrence, KS; Kentucky Natural Heritage Program, Frankfort, KY; Louisiana Natural Heritage Program, Baton Rouge, LA; Maine Natural Areas Program, Augusta, ME; Mammoth Cave National Park, Mammoth Cave, KY; Maryland Wildlife & Heritage Division, Annapolis, MD; Massachusetts Natural Heritage & Endangered Species Program, Westborough, MA; Michigan Natural Features Inventory, Lansing, MI; Minnesota Natural Heritage & Nongame Research and Minnesota County Biological Survey, St. Paul, MN; Mississippi Natural Heritage Program, Jackson, MI; Missouri Natural Heritage Database, Jefferson City, MO; Montana Natural Heritage Program, Helena, MT; National Forest in North Carolina, Asheville, NC; National Forests in Florida, Tallahassee, FL; National Park Service, Southeastern Regional Office, Atlanta, GA; Navajo Natural Heritage Program, Window Rock, AZ; Nebraska Natural Heritage Program, Lincoln, NE; Nevada Natural Heritage Program, Carson City, NV; New Hampshire Natural Heritage Inventory, Concord, NH; New Jersey Natural Heritage Program, Trenton, NJ; New Mexico Natural Heritage Program, Albuquerque , NM; New York Natural Heritage Program, Latham, NY; North Carolina Natural Heritage Program, Raleigh, NC; North Dakota Natural Heritage Inventory, Bismarck, ND; Ohio Natural Heritage Database, Columbus, OH; Oklahoma Natural Heritage Inventory, Norman, OK; Oregon Natural Heritage Program, Portland, OR; Pennsylvania Natural Diversity Inventory, PA; Rhode Island Natural Heritage Program, Providence, RI; South Carolina Heritage Trust, Columbia, SC; South Dakota Natural Heritage Data Base, Pierre, SD; Tennessee Division of Natural Heritage, Nashville, TN; Tennessee Valley Authority Heritage Program, Norris, TN; Texas Conservation Data Center, San Antonio, TX; Utah Natural Heritage Program, Salt Lake City, UT; Vermont Nongame & Natural Heritage Program, Waterbury, VT; Virginia Division of Natural Heritage, Richmond, VA; Washington Natural Heritage Program, Olympia, WA; West Virginia Natural Heritage Program, Elkins, WV; Wisconsin Natural Heritage Program, Madison, WI; Wyoming Natural Diversity Database, Laramie, WY

Canada
Alberta Natural Heritage Information Centre, Edmonton, AB, Canada; Atlantic Canada Conservation Data Centre, Sackville, New Brunswick, Canada; British Columbia Conservation Data Centre, Victoria, BC, Canada; Manitoba Conservation Data Centre. Winnipeg, MB, Canada; Ontario Natural Heritage Information Centre, Peterborough, ON, Canada; Quebec Conservation Data Centre, Quebec, QC, Canada; Saskatchewan Conservation Data Centre, Regina, SK, Canada; Yukon Conservation Data Centre, Yukon, Canada

Latin American and Caribbean
Centro de Datos para la Conservacion de Bolivia, La Paz , Bolivia; Centro de Datos para la Conservacion de Colombia, Cali,Valle, Columbia; Centro de Datos para la Conservacion de Ecuador, Quito, Ecuador; Centro de Datos para la Conservacion de Guatemala, Ciudad de Guatemala , Guatemala; Centro de Datos para la Conservacion de Panama, Querry Heights , Panama; Centro de Datos para la Conservacion de Paraguay, San Lorenzo , Paraguay; Centro de Datos para la Conservacion de Peru, Lima, Peru; Centro de Datos para la Conservacion de Sonora, Hermosillo, Sonora , Mexico; Netherlands Antilles Natural Heritage Program, Curacao , Netherlands Antilles; Puerto Rico-Departmento De Recursos Naturales Y Ambientales, Puerto Rico; Virgin Islands Conservation Data Center, St. Thomas, Virgin Islands.

ABI also has partnered with many International and United States Federal and State organizations, which have also contributed significantly to the development of the International Classification. Partners include the following The Nature Conservancy; Provincial Forest Ecosystem Classification Groups in Canada; Canadian Forest Service; Parks Canada; United States Forest Service; National GAP Analysis Program; United States National Park Service; United States Fish and Wildlife Service; United States Geological Survey; United States Department of Defense; Ecological Society of America; Environmental Protection Agency; Natural Resource Conservation Services; United States Department of Energy; and the Tennessee Valley Authority. Many individual state organizations and people from academic institutions have also contributed to the development of this classification.

TABLE OF CONTENTS

INTRODUCTION TO THE INTERNATIONAL CLASSIFICATION OF ECOLOGICAL COMMUNITIES (ICEC)

PREFACE

This is a subset of communities defined in the International Classification of Ecological Communities (ICEC), presented in a hierarchical arrangement consistent with that of the ICEC system. The ICEC was developed by ecologists at the Association for Biodiversity Information (ABI) and The Nature Conservancy (TNC)[1], in conjunction with the network of state Natural Heritage programs and International Conservation Data Centers (CDCs). What follows is a brief introduction to the classification. Considerably more information on the ICEC's development and its uses has been published by the ABI/TNC Ecology Working Group (Grossman et al. 1998, Maybury 1999) and is available at <http://www.abi.org> under the Information Resources, Heritage Library link.

The classification presented here is a snapshot of a work in progress. As the classification is applied in various places and for various purposes there will be additions, modifications, and revisions. For this reason, **printed reports have a suggested shelf life of one year from the "data current as of" date** that you should see in the footer of the document. Please request an updated version if the data in your document are more than one year old.

DEVELOPMENT OF THE CLASSIFICATION

The ICEC grew out of a longstanding recognition on the part of The Nature Conservancy and the Natural Heritage network that ecological communities were important elements of conservation. These organizations employ what is often referred to as a "coarse filter/fine filter" approach to preserving biological diversity (Jenkins 1976, Hunter 1991). This approach involves the identification and protection of the best examples of all ecological communities (coarse filter) as well as rare species (fine filter). Identifying and protecting representative examples of ecological communities assures the conservation and maintenance of biotic interactions and ecological processes, in addition to conservation of most species. Certain species, however, usually the rarest ones, may fall through the community filter. Very rare species often have specialized life histories, or are simply so rare and restricted that their conservation requires explicit planning based on species-specific information. Identification and protection of viable occurrences of rare species served as the fine filter for preserving biological diversity. Using both filters for identifying conservation targets ensures that the most complete spectrum of biological diversity is protected.

In the U.S., state community classifications were developed for many states by the Heritage ecologist(s), with each state using its own classification scheme. This approach works effectively at a state level to assure protection of ecological communities. However, a major obstacle to using communities as conservation units at the regional, national, and global levels was the lack of a consistent classification system developed through analysis of data from a range-wide perspective. To overcome this problem, TNC and the Natural Heritage/CDC network began working to develop a standardized, hierarchical system to classify vegetated terrestrial communities across the U.S.

The first steps taken by TNC regional ecologists were to begin compiling an enormous amount of fine-scale state and local information on vegetation pattern into four regional classifications spanning the U.S. and to decide upon a single, standardized framework for the classifications they were developing. The U.S. regional classifications were of necessity developed somewhat independently. In the western U.S., for example, most of the existing state classifications were based on vegetation and were strongly influenced by the habitat type approach, which allowed a relatively straightforward compilation into a regional classification for the west. In the Midwest, East, and Southeast, there was less of a tradition of floristically-based classifications, and as a result, there was more emphasis on a synthesis of descriptive information on vegetation, often done with close consultation and review by Heritage program ecologists, along with other partner in state and federal agencies, and university scientists.

Synthesis of the four regional classifications into a U.S. National Vegetation Classification was completed and the first iteration of that classification was published (Anderson et al. 1998).

While classification development has so far focused on the United States (and is ongoing there), classification of Canadian vegetation using the ICEC system is proceeding on a relatively fast track, as is classification of the

1 In 2000, TNC decided to form a new organization that could focus its energies more tightly on developing and providing Heritage network data to Natural Resources decision makers (including those in TNC). Many of the ecologists and other scientists and data managers formerly in TNC's Conservation Science Division are now part of this new organization, tentatively called the Association for Biodiversity Information (ABI). ABI and TNC ecologists continue to work together, and to work with Heritage, federal and state agencies, and academic partners, on ICEC development.

vegetation of portions of northern Mexico. Caribbean vegetation has also been an area of recent classification development.

THE ICEC: FOUNDATIONS AND SCOPE

The following basic tenets underlie the terrestrial portion of the ICEC:

1. The ICEC is based primarily on vegetation, rather than soils, landforms or other non-biologic features.

This was decided upon mainly because plants are easily measured biological expressions of environmental conditions and are directly relevant to biological diversity. Vegetation is complex and continuously variable, with species forming only loosely repeating assemblages in ecologically similar habitats. The ICEC does not solve the problems inherent in any effort to categorize the continuum of vegetation pattern, but it presents a practical set of methods to bring consistency to the description, modeling, and conservation of vegetation.

2. The ICEC system applies to all terrestrial vegetation. In addition to upland vegetation, "terrestrial vegetation" is defined to include all wetland vegetation with rooted vascular plants. It also includes communities characterized by sparse to nearly absent vegetation cover, such as those found on boulder fields or talus.

3. The ICEC focuses on existing vegetation rather than potential natural or climax vegetation.

The vegetation types described in the classification range from the ephemeral to the stable and persistent. Recognizing and accommodating this variation is fundamental to protecting biodiversity. The manner in which a community occurs is, in part, an intrinsic property of the vegetation itself. A classification that is not restricted to static vegetation types ensures that the units are useful both for inventory/site description, and as the basis for building dynamic ecological models.

The following tenets reflect the current scope of the ICEC:

1. While the ICEC framework can be used to classify all vegetation, emphasis has been given to vegetation types that are natural or near-natural, i.e., those that appear to be unmodified or only marginally impacted by human activities. Where anthropogenic impacts are apparent, the resulting physiognomic and floristic patterns have a clear, naturally-maintained analog.

2. Classification development at the finest levels of the system has so far focused on the contiguous United States and Hawaii. Some classification at finer levels has also been done for southeastern Alaska, parts of Canada, the Caribbean, and a few areas in northern Mexico.

THE ICEC: THE HIERARCHY

SYSTEM LEVEL

The top division of the classification hierarchy separates vegetated communities (Terrestrial System) from those of unvegetated deepwater habitats (Aquatic System) and unvegetated subterranean habitats (Subterranean System). The Terrestrial System is broadly defined to include areas with rooted submerged vegetation of lakes, ponds, rivers, and marine shorelines, as well as the vegetation of uplands.

The hierarchy for the Terrestrial System has seven levels: the five highest (coarsest) levels are physiognomic and the two lowest (finest) levels are floristic. The levels of the terrestrial classification system are listed and described below.

VEGETATION CLASSIFICATION SYSTEM

physiognomic levels	FORMATION CLASS FORMATION SUBCLASS FORMATION GROUP FORMATION SUBGROUP FORMATION
floristic levels	ALLIANCE ASSOCIATION

PHYSIOGNOMIC LEVELS

The physiognomic portion of the ICEC hierarchy is a modification of the UNESCO world physiognomic classification of vegetation (1973) and incorporates some of the revisions made by Driscoll et al. (1984) for the United States.

Formation class

The physiognomic class is based on the structure of the vegetation as defined by the type, height, and relative percentage of cover of the dominant, uppermost life-forms. There are seven mutually exclusive classes:

Forest:	Trees with their crowns overlapping (generally forming 60% - 100% cover).
Woodland:	Open stands of trees with crowns not usually touching (generally forming 25% - 60% cover).
Shrubland:	Shrubs generally greater than 0.5 meter tall with individuals or clumps overlapping to not touching (generally forming greater than 25% cover, with trees generally less than 25% cover). Vegetation dominated by woody vines is generally treated in this class.
Dwarf-shrubland:	Low-growing shrubs, usually less than 0.5 meter tall. Individuals or clumps overlapping to not touching (generally forming greater than 25% cover; with trees and tall shrubs generally less than 25% cover).
Herbaceous:	Herbaceous plants dominant (generally forming at least 25% cover, with trees, shrubs, and dwarf-shrubs generally with less than 25% cover).
Nonvascular:	Nonvascular cover (bryophytes, non-crustose lichens, and algae) dominant (generally forming at least 25% cover).
Sparse Vegetation:	Abiotic substrate features dominant. Vegetation is scattered to nearly absent and generally restricted to areas of concentrated resources (total vegetation cover is typically less than 25%).

Formation subclass
The physiognomic subclass is determined by the predominant leaf phenology of the forest, woodland, shrubland and dwarf-shrubland classes. Subclass is determined by the persistence (perennial or annual) and growth form (graminoid, forb, hydromorphic) of the vegetation for the herbaceous vegetation class. The relative dominance of lichens, mosses, or algae is the determining factor in the nonvascular class, and particle size of the substrate is the determining factor for the sparse vegetation class Examples include: Evergreen Forest, Deciduous Forest, Deciduous Shrubland, Perennial Graminoid Vegetation, Annual Graminoid or Forb Vegetation, Lichen Vegetation, and Consolidated Rock Sparse Vegetation.

Formation group
The group generally represents vegetation units defined based on leaf characters, such as broad-leaf, needle-leaf, microphyllous, and xeromorphic. These units are identified and named with broadly defined macroclimatic types to provide a structural-geographic orientation, but the ecological climate terms do not define the groups *per se*. Examples include: Temperate or subpolar needle-leaved evergreen forest, Cold-deciduous forest, Cold-deciduous shrubland, Temperate or subpolar grassland, Sparsely vegetated cliffs.

Formation subgroup
The subgroup (or formation subgroup) represents a distinction between planted/cultivated vegetation and natural/semi-natural vegetation. The latter is broadly defined to include all vegetation not actively planted or maintained through intensive management activities by humans. Examples of subgroups include: Natural temperate and subpolar needle-leaved evergreen forest; Cultural temperate and subpolar needle-leaved evergreen forest (e.g., pine and spruce plantations).

Formation
The formation represents a grouping of community types that share a definite physiognomy or structure and broadly defined environmental factors, such as elevation and hydrologic regime. Structural factors such as crown shape and lifeform of the dominant lower stratum are used in addition to the physiognomic characters already specified at the higher levels. The hydrologic regime modifiers were adapted from Cowardin et al. (1979). Examples include: Rounded-crowned temperate or subpolar needle-leaved evergreen forest, Seasonally flooded cold-deciduous forest, Semipermanently flooded cold-deciduous shrubland, Tall sod temperate grassland, Cliffs with sparse vascular vegetation.

FLORISTIC LEVELS
Alliance
The alliance is a physiognomically uniform group of plant associations (see association below) sharing one or more dominant or diagnostic species, which as a rule are found in the uppermost strata of the vegetation (see Mueller-Dombois and Ellenberg 1974). Dominant species are often emphasized in the absence of detailed floristic information (such as quantitative plot data), whereas diagnostic species (including characteristic species, dominant differential, and other species groupings based on constancy) are used where detailed floristic data are available (Moravec 1993).

For forested communities, the alliance is roughly equivalent to the "cover type" of the Society of American Foresters (Eyre 1980), developed for use primarily by foresters to describe the forest types of North America. The alliance may be finer in detail than a cover type when the dominant tree species extend over large geographic areas and varied environmental conditions (e.g. the *Pinus ponderosa* Forest Alliance, *Pinus ponderosa* Woodland Alliance, and *Pinus*

ponderosa Temporarily Flooded Woodland Alliance are all within the *Pinus ponderosa* Cover Type of the SAF). Alliances, of course, have also been developed for non-forested vegetation.

The alliance is similar in concept to the "*series*," as developed for the Habitat Type System to group habitat types that share the same dominant species under "climax" conditions (Daubenmire 1952, Pfister and Arno 1980). Alliances, however, are described by the dominant or diagnostic species for *all* existing vegetation types, whereas series are generally restricted to potential "climax" types and are described by the primary dominant species.

Association
The association is the lowest level, as well as the basic unit for vegetation classification, in the ICEC. The association is defined as "a plant community of definite floristic composition, uniform habitat conditions, and uniform physiognomy" (see Flahault and Schroter 1910 in Moravec 1993). This basic concept has been used by most of the schools of floristic classification (Whittaker 1962, Braun-Blanquet 1965, Westhoff and van der Maarel 1973, Moravec 1993).

The plant association is differentiated from the alliance level by additional plant species, found in any stratum, which indicate finer scale environmental patterns and disturbance regimes. This level is derived from analyzing complete floristic composition of the vegetation unit when plot data are available. In the absence of a complete data set, approximation of this level is reached by using available information on the dominant species or environmental modifiers, and their hypothesized indicator species.

Nomenclature for Alliances and Associations
Alliances are named for constant dominants, codominants, or diagnostic species identified from the dominant and/or top strata of the vegetation. Associations are named with one or more species from the alliance name, and have additional species that represent dominants or indicators from any layer of the vegetation. Species occurring in the same stratum are separated by a hyphen (-); those occurring in different strata are separated by a forward slash (/). Parentheses around one or more species in a name indicate that the species may or may not occur within all associations in the alliance, or an all occurrences (stands) of the association are placed within parentheses.

Vascular plant species nomenclature in the alliance names follows the nationally standardized list, Kartesz (1994), with very few exceptions. Nomenclature for nonvascular plants follows Anderson (1990), Anderson et al. (1990), Egan (1987, 1989, 1990), Esslinger and Egan (1995), and Stotler and Crandall-Stotler (1977).
Association and Alliance names include the formation class (Forest, Woodand, etc.) in which they are placed. Alliances also include the word “alliance” to distinguish them from associations (e.g., *Pinus ponderosa* Woodland **Alliance**. For wetland alliances, the hydrologic regime that the alliance is found in is always provided for clarity, e.g. *Populus fremontii* **Temporarily Flooded** Woodland Alliance. All alliances that have no hydrological modifier are upland alliances.

Environmental or geographic descriptors (e.g., serpentine, Interior Plateau) are used sparingly, when species composition for a type is not known well enough to distinguish it using only species in a name. When an environmental/geographic descriptor is used, it is inserted between the floristic nominals and the class descriptor (e.g., *Quercus palustris - Quercus bicolor - Quercus macrocarpa - Acer rubrum* **Sand Flatwoods** Forest).

THREE EXAMPLES OF THE CLASSIFICATION SYSTEM HIERARCHY

CLASS	FOREST	WOODLAND	SHRUBLAND
SUBCLASS	Deciduous Forest	Evergreen Woodland	Deciduous Shrubland
GROUP	Cold-deciduous Forest	Temperate or Subpolar Needle-leaved Evergreen Woodland	Temperate Broad-leaved Evergreen Shrubland
SUBGROUP	Natural/Semi-natural	Natural/Semi-natural	Natural/Semi-natural
FORMATION	Lowland or Submontane Cold-deciduous Forest	Saturated Temperate or Subpolar Needle-leaved Evergreen Woodland	Sclerophyllous Temperate Broad-leaved Evergreen Shrubland
ALLIANCE	*Quercus stellata - Quercus marilandica* Forest Alliance	*Pinus palustris* Saturated Woodland Alliance	*Quercus havardii* Shrubland Alliance
ASSOCIATION	*Quercus stellata - Quercus marilandica - Carya (glabra, texana) / Vaccinium arboreum* Forest	*Pinus palustris / Leiophyllum buxifolium / Aristida stricta* Woodland	*Quercus havardii - (Penstemon ambiguus, Croton dioicus) / Sporobolus giganteus* Shrubland

ECOLOGICAL GROUPS

Ecological groups are separate from the “standard” ICEC hierarchy. They are aggregations of associations that are being developed by ecologists in the different ABI regions. Also known as ecological systems, these aggregations are “mid-scale” units—there are about 225 in 25 southeastern and midwestern states as compared to about 800 alliances and 2000 associations in the same area. Each is unified by similar ecological conditions and processes

(e.g., fire, riverine flooding), underlying environmental features (e.g., shallow soils, serpentine geology), and/or environmental gradients (e.g., elevation). Their distributions are bounded by broad biogeographic provinces. For example, low elevation riparian forests of the desert Southwestern United States, the Great Plains, the Southeastern Coastal Plain, and the Chaco would each constitute a different ecological group.

The groups are intended as landscape-scale conservation planning tools and as categories that will be more intuitively understandable and will facilitate communication. They can also be used to develop viability and ranking criteria in a more efficient way. Separate groups have been developed for the midwestern, southeastern, and eastern ABI regions. However, eventually, the groups will be crosswalked among ABI regions to achieve a single, non-duplicative set.

KNOWN DATA GAPS - GEOGRAPHIC

The ICEC is primarily comprised of a classification of the vegetation of the contiguous U.S. and Hawaii. Most of the vegetation of Alaska has not yet been incorporated into the ICEC.

Even within the contiguous U.S. and Hawaii, regional differences endure in the U.S. National classification due to regional differences in inventory data and in classification history. Some states or regions have focused their efforts on those alliances and associations that are considered to be imperiled (conservation ranks G1 or G2), while others, like the western U.S. Forest Service Districts, focused on more common communities. Also, while the classification system is intended to develop units with consistent scale, associations are more narrowly defined in some areas, resulting in a greater number of associations per alliance than average. On the other hand, limited inventory and classification work in areas such as the Great Basin area of the southwestern United States might lead a casual observer of the classification to believe that it is an area with low ecological diversity. In fact, it is an area about which little is known.

In the near term, significant refinements to the classification are anticipated with further integration of local and state classification work from Alaska, California, and Canadian provinces. Future classification refinement will also focus on underclassified portions of the U.S. interior southwest and adjacent Mexico.

KNOWN DATA GAPS - TAXONOMIC

In general, more information is available for Forest, Woodland, Shrubland, and Herbaceous classes than for Dwarf-Shrubland, Nonvascular, and Sparse Vegetation classes. Shortgrass prairie vegetation and many riparian types have not been consistently classified. In addition, the degree of classification confidence for upland types is generally higher than for wetland types. The classification of communities that occur as vegetation complexes will also require additional research and analysis.

CAVEATS ABOUT DISTIBUTION DATA

In general: Absence of a state or ecoregion from any list of the distribution of a type cannot be interpreted to be a definitive statement that the type does not occur there.

Federal Lands: Some data may be available listing federal land units (such as National Park Service units, individual National Forests, etc.) within which an association occurs. However, this field is *extremely incompletely populated* and absence of a federal land management unit should not be considered to indicate that the type is absent on that unit.

CONSERVATION STATUS RANKING

Associations are given a conservation status rank based on factors such as present geographic extent, threats, number of distinct occurrences, degree of decline from historic extent, and degree of alteration of natural processes affecting the dynamics, composition, or function of the type. Ranks are customarily assigned by the various members of the Natural Heritage programs and the regional offices of ABI.

Associations are ranked on a global (G), national (N), and subnational (S) scale of 1 to 5, with 1 indicating critical imperilment and 5 indicating little or no risk of extirpation or elimination. For example, a rank of G1 indicates critical imperilment on a rangewide basis, i.e., a great risk of “extinction” of the type worldwide; S1 indicates critical imperilment in the specific state, province, or other subnational unit, i.e., a great risk of extirpation of the type from the subnation.

Special attention is generally given to taxa of high endangerment, as opportunities for their conservation may be limited in space and time. However, occurrences of relatively secure communities can also be of critical conservation importance. In eastern North America, for example, a large tract of a common forest type in pristine condition that occurs in an intact landscape and with relatively intact ecological processes would be of high priority for conservation. Though the type itself is common, the opportunity to conserve such a high quality example may be very limited.

Global conservation status ranks for natural/near-natural communities are defined as follows:

GX **ELIMINATED** throughout its range, with no restoration potential due to extinction of dominant or characteristic species.

GH **PRESUMED ELIMINATED (HISTORIC)** throughout its range, with no or virtually no likelihood that it will be rediscovered, but with the potential for restoration (e.g., *Castanea dentata* Forest).

G1 **CRITICALLY IMPERILED** Generally 5 or fewer occurrences and/or very few remaining acres or very vulnerable to elimination throughout its range due to other factor(s).

G2 **IMPERILED** Generally 6-20 occurrences and/or few remaining acres or very vulnerable to elimination throughout its range due to other factor(s).

G3 **VULNERABLE** Generally 21-100 occurrences. Either very rare and local throughout its range or found locally, even abundantly, within a restricted range or vulnerable to elimination throughout its range due to specific factors.

G4 **APPARENTLY SECURE** Uncommon, but not rare (although it may be quite rare in parts of its range, especially at the periphery). Apparently not vulnerable in most of its range.

G5 **SECURE** Common, widespread, and abundant (though it may be quite rare in parts of its range, especially at the periphery). Not vulnerable in most of its range.

GU **UNRANKABLE** Status cannot be determined at this time.

G? **UNRANKED** Status has not yet been assessed**.**

Modifiers and Rank Ranges

? A question mark added to a rank expresses an uncertainty about the rank in the range of 1 either way on the 1-5 scale. For example a G2? rank indicates that the rank is thought to be a G2, but could be a G1 or a G3.

G#G# Greater uncertainty about a rank is expressed by indicating the full range of ranks which may be appropriate. For example, a G1G3 rank indicates the rank could be a G1, G2, or a G3.

Q A"Q" added to a rank denotes questionable taxonomy. It modifies the degree of imperilment and is *only* used in cases where the type would have a *less imperiled* rank if it were not recognized as a valid type (i.e., if it were combined with a more common type). A GUQ rank often indicates that the type is unrankable *because of* daunting taxonomic/definitional questions.

ranks indicating semi-natural/altered communities:

GD **RUDERAL** Vegetation resulting from succession following anthropogenic disturbance of an area. Generally characterized by unnatural combinations of species (primarily native species, though often containing slight to substantial numbers and amounts of species alien to the region as well).

GM **MODIFIED/MANAGED** Vegetation resulting from the management or modification of natural/near natural vegetation, but producing a structural and floristic combination not clearly known to have a natural analogue.

GW **INVASIVE** Vegetation dominated by invasive alien species; the vegetation is spontaneous, self-perpetuating, and is not the (immediate) result of planting, cultivation, or human maintenance.

rank indicating planted/cultivated communities

GC **PLANTED/CULTIVATED** Areas dominated by vegetation that has been planted in its current location by humans and/or is treated with annual tillage, a modified conservation tillage, or other intensive management or manipulation.

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Saturated temperate or subpolar needle-leaved evergreen forest

PICEA ENGELMANNII SATURATED FOREST ALLIANCE

Engelmann Spruce Saturated Forest Alliance

ALLIANCE CONCEPT

Summary: The vegetation in this alliance occurs in riparian areas in northwestern Montana. The climate regime is maritime; moist air masses from the Pacific Ocean release large amounts of snow and rain. Summers are warm and dry as dry air masses move across western Montana. Afternoon thunderstorms are common. Stands are located in low-elevation (880-900 m) valleys adjacent to meandering streams and ponds. Stands are found on level sites that have a high water table; the water table is usually within 50 cm of the soil surface throughout the year. Standing water is present in depressions. Soils are poorly drained and have a high organic matter content in the upper horizon. *Picea engelmannii* and hybrid swarms of *Picea* (a result of its hybridization with *Picea glauca*, a common lower elevation condition) dominate a moderately open tree canopy. *Betula papyrifera* is occasionally present. A number of shrub species occur in the understory; the most common species are *Alnus incana, Betula occidentalis*, and *Cornus sericea*. The herbaceous layer is dominated by the forb *Lysichiton americanus*. *Cinna latifolia* and *Athyrium filix-femina* are common associates, but occur in low abundances. *Carex* spp., *Phalaris arundinacea, Typha latifolia*, and *Salix* spp. dominate adjacent riparian communities.

Environment: The vegetation in this alliance occurs in riparian areas in northwestern Montana. The following is based on Hansen et al. (1995). The climate regime is maritime during the winter and spring when moisture air masses from the Pacific Ocean release large amounts of snow and rain. Summers are warm and dry as dry air masses move across western Montana. Afternoon thunderstorms are common. Stands are located in low-elevation (880-900 m) valleys adjacent to meandering streams and ponds. Stands are found on level sites that have a high water table; the water table is usually within 50 cm of the soil surface throughout the year. Standing water is present in depressions. Soils are poorly drained and have a high organic matter content in the upper horizon. Adjacent riparian communities are dominated by *Carex* spp., *Phalaris arundinacea, Typha latifolia*, and *Salix* spp.

Vegetation: The vegetation in this alliance occurs in riparian areas in northwestern Montana. The association of *Picea engelmannii* and hybrid swarms of *Picea* (a result of its hybridization with *Picea glauca*, a common lower elevation condition) is found in wetland areas in Montana. A moderately open canopy of *Picea* spp. dominates the tree canopy. *Betula papyrifera* is occasionally present. A number of shrub species occur in the understory; the most common species are *Alnus incana, Betula occidentalis*, and *Cornus sericea*. The herbaceous layer is dominated by the forb *Lysichiton americanus*. *Cinna latifolia* and *Athyrium filix-femina* are common associates, but occur in low abundances.

Dynamics: The presence of the vegetation in this alliance corresponds roughly with the Inland Maritime climatic regime, but the driving variable of greatest importance is permanent soil saturation (spring flooding common).

Comments: The association of *Picea engelmannii* and hybrid swarms of *Picea* (a result of its hybridization with *Picea glauca*, a common lower elevation condition) with wetland conditions is well known in Montana.

PICEA ENGELMANNII / CALAMAGROSTIS CANADENSIS FOREST

Engelmann Spruce / Bluejoint Forest

ELEMENT CONCEPT

Summary: This forest plant association occurs on cool, moist sites at low to high elevations in the Rocky Mountains of Montana, Wyoming, and southeastern Idaho. It is generally restricted to flat to gently sloping sites with poor drainage, such as fen and lake margins, toeslopes, and low stream and river terraces. This community usually is saturated for a good portion of the year, and stands have a high water table year round. The ground surface in these stands is characterized by a large amount of microtopography stemming from windthrown trees. The overstory is dominated by *Picea engelmannii* or *Picea (engelmannii X glauca)* hybrids, and *Abies lasiocarpa* may also be present. Not infrequently *Pinus contorta* is a long-persisting seral component. Shrub canopy coverage is low, although the diversity of shrub species present is fairly high. *Calamagrostis canadensis* and *Calamagrostis stricta* are diagnostic species when well represented; usually under these shaded forest conditions *Calamagrostis canadensis* dominates the ground layer, often forming what appears to be a pure grass sward.

GRank & Reasons: G4 (00-01-18). This type is the result of merging two associations, with ranks of G3 and G4, resulting in a rank of G4 for this newly defined type. There are a moderate number of estimated occurrences of this community across its range, and apparently the specific hydrologic and geomorphic conditions required for this community are uncommon. Timber harvest has occurred in this community in the past, and this will likely continue;

opening the canopy can leave remaining trees (shallowly-rooted) susceptible to blowdown. However, other threats such as exotic species and development are relatively low.
Comments: Former *Picea (engelmannii X glauca, engelmannii) / Calamagrostis canadensis* Forest (CEGL000404) in Montana has been merged with *Picea engelmannii / Calamagrostis canadensis* Forest (CEGL000356) into a single entity which can include pure *Picea engelmannii* and *Picea engelmannii X glauca* hybrids, or both. This type was described in Montana as the *Picea* spp. / *Calamagrostis canadensis* community type by Hansen et al. (1995). The authors explain that the frequent absence of cones and similar morphology and ecological amplitudes caused them to lump stands dominated by *Picea engelmannii* and *Picea glauca* (hybrids) into a single type. Youngblood et al. (1985) also describe a *Picea / Calamagrostis canadensis* community type; these authors explain that the similar ecological amplitudes lead them to lump *Picea engelmannii* and *Picea pungens* into a single type. A few Utah stands (Padgett et al.1989), classified as Conifer / *Calamagrostis canadensis*, have a *Picea engelmannii*-dominated overstory.

ELEMENT DISTRIBUTION

States/Provinces: ID:S4, MT:S4, WY:S3

ELEMENT SOURCES

Authors: J. Greenlee, WCS
References: Boggs et al. 1990, Hansen et al. 1995, Jankovsky-Jones 1997, Padgett et al. 1989, Youngblood et al. 1985, Zuck 1974

Temporarily flooded cold-deciduous forest

POPULUS BALSAMIFERA SSP. TRICHOCARPA TEMPORARILY FLOODED FOREST ALLIANCE

Black Cottonwood Temporarily Flooded Forest Alliance

ALLIANCE CONCEPT

Summary: This riparian forest alliance occurs on alluvial terraces along major streams and rivers throughout the western United States, west of the Continental Divide. Elevations range from sea level in California to 1800 m. They can occur on alluvial terraces of major streams and rivers, margins of lakes, meadows, deltas, river mouths, and terraces. Stands can occupy broad floodplains or form narrow stringers adjacent to streams with a much steeper slope. Soils typically overlay river gravel and/or cobbles and are coarse-textured. Water tables usually drop below 1 m of the soil surface in summer, but can remain moist due to capillary action. Vegetation within this alliance is characterized by an open to moderately dense tree layer that is dominated by *Populus balsamifera ssp. trichocarpa*. Tree associates include *Populus deltoides, Populus angustifolia, Pinus ponderosa, Picea* spp., and *Alnus rhombifolia, Alnus rubra*, and *Fraxinus latifolia* in stands along the west coast. A shrub layer is usually present and may be dominated by *Alnus incana, Betula papyrifera, Cornus sericea, Crataegus douglasii, Prunus virginiana, Ribes americanum, Salix exigua*, and *Symphoricarpos albus*. The herbaceous layer is usually relatively sparse and is dominated by either forbs or graminoids. Common species include *Actaea rubra, Cicuta douglasii, Equisetum sylvaticum, Mentha arvensis*, and *Symphyotrichum spathulatum (= Aster occidentalis)*. The graminoid cover is usually less than 10%, but can be up to 80% consisting mainly of introduced hay grasses on disturbed sites. Species information on the graminoid and forb layers is lacking for much of the range of this alliance. Diagnostic of this alliance is the dominance of *Populus balsamifera ssp. trichocarpa* in the tree canopy in forests that are briefly flooded during the growing season.
Environment: Vegetation types in this alliance occur on alluvial terraces along major streams and rivers throughout the western United States, west of the Continental Divide. Elevations range from sea level in California to 1800 m. They can occur on alluvial terraces of major streams and rivers, margins of lakes, meadows, deltas, river mouths, and terraces. Stands can occupy broad floodplains (1-3% slopes) or form narrow stringers adjacent to streams with a much steeper slope (10-15%). Soils are typically Entisols, usually up to 1 m of mineral soil overlying river gravel and/or cobbles. Soil texture varies from loam to coarse sand. Water tables usually drop below 1 m of the soil surface in summer, but can remain moist due to capillary action. A fluctuating water table in these soils is evidenced by the common presence of mottles. ^Adjacent wetter communities may be dominated by a variety of types including *Salix exigua* and *Salix lucida ssp. lasiandra (= Salix lasiandra)* community types, or the *Typha latifolia*- and *Eleocharis* spp.-dominated habitat types. Adjacent drier communities may be dominated by coniferous or aspen forests.
Vegetation: Vegetation types within this alliance are classified as temporarily flooded forests, but many individual stands have cover less than 60% (see Classification comments). The tree layer is dominated by an open to moderately dense canopy (>50%) of *Populus balsamifera ssp. trichocarpa*. *Populus deltoides, Populus angustifolia, Pinus ponderosa*, and *Picea* spp. can occur in the canopy with *Populus balsamifera* in the Montana stands. The Oregon, Washington, and California data state that *Alnus rhombifolia, Alnus rubra*, and *Fraxinus latifolia* occur in the tree

canopy. The shrub layer in the Montana stands typically is dominated by *Cornus sericea, Alnus incana, Betula papyrifera, Prunus virginiana*, and *Ribes americanum*. The Pacific Northwest and California stands contain *Crataegus douglasii, Salix exigua*, and *Symphoricarpos albus* in the shrub layer, and the forb *Cicuta douglasii* is common. The forb layer from the Montana stands ranges from 1-20%, dominated by *Actaea rubra, Mentha arvensis*, and *Symphyotrichum spathulatum (= Aster occidentalis)*. The graminoid cover is usually less than 10%, but can be up to 80%, and mainly consists of introduced hay grasses. *Equisetum sylvaticum* can dominate the fern layer with up to 40% cover. There was no species information on the graminoid and forb layers for the Pacific Northwest and California types.
Dynamics: *Populus balsamifera ssp. trichocarpa* is susceptible to fire during the late summer and fall. This species is adapted to light and in some instances to moderate-intensity fires and may produce new sprouts following burns (Hansen et al. 1995). In Montana, many of these sites are seral to *Picea engelmannii* (including *Picea engelmannii X glauca*) and *Thuja plicata* forests.
Comments: This alliance needs review of the woodland versus forest status of the associations within it. Cover of the tree canopy can be highly variable within associations in this alliance, but many appear to be more characteristically woodlands. In addition, the alliance probably occurs in Alaska where a *Populus balsamifera ssp. trichocarpa* temporarily flooded woodland alliance has been identified, but is currently undescribed. The floristic relationships of these two alliances are unknown at present.

POPULUS BALSAMIFERA SSP. TRICHOCARPA / CORNUS SERICEA FOREST
Black Cottonwood / Red-osier Dogwood Forest

ELEMENT CONCEPT
Summary: This association has been documented from Washington south to northern California and eastward to Idaho and all of Montana west of the Continental Divide, as well as central Montana. In Montana alone it occurs over a broad elevation range of 610-2010 m (2000-6600 feet) where *Populus balsamifera ssp. trichocarpa* is the dominant cottonwood at elevations considered relatively low- to mid-gradient; in Idaho it ranges to 2135 m (7000 feet). This forest type occupies alluvial terraces of major rivers and streams, point bars, side bars, mid-channel bars, delta bars, an occasional lake or pond margin, and even creeps onto footslopes and lower subirrigated slopes of hilly or mountainous terrain. Many of these sites are flooded in the spring and dry deeply by summer's end; capillary action keeps upper portions of soil profile moist. Other sites are merely subirrigated. *Populus balsamifera ssp. trichocarpa* dominates the overstory with cover values ranging from approximately 12-90%, though the modal range, at least in Montana is 40-60%. *Populus angustifolia* is a subordinate canopy species in the eastern portion of the range, and *Populus tremuloides* and *Betula papyrifera* occur as subordinates in the western portion. The shrub layer comprises at least 25% cover with *Cornus sericea* diagnostic for the type and having anywhere from 1-90% cover; other shrub taxa with high constancy include *Symphoricarpos* spp., *Rosa* spp., *Salix* spp., *Crataegus* spp., *Amelanchier alnifolia*, and *Alnus incana*. There are no graminoids exhibiting high constancy, though any one of a number of disturbance-associated exotics can manifest high coverages. *Maianthemum stellatum, Galium triflorum, Solidago canadensis*, and *Equisetum* spp. are the only forbs that exhibit even relatively high constancy across the range of the type. This is a successional community that colonizes moist, newly deposited alluvium exposed to full sunlight; in the absence of fluvial disturbance it is capable of developing into conifer-dominated communities belonging to alliances as diverse as *Thuja plicata, Picea* spp. and *Juniperus scopulorum*. Adjacent wetter sites are dominated by a suite of wetland *Salix* spp., *Alnus incana*, wetland-associated *Carex* spp. often including *Carex utriculata, Carex aquatilis* and *Carex buxbaumii* or *Typha latifolia*-dominated communities. Adjacent drier sites are dominated by *Populus balsamifera ssp. trichocarpa* or *Populus tremuloides* types or any of a vast array of conifer-dominated types that are capable of growing within the elevational zone occupied by the *Populus balsamifera ssp. trichocarpa / Cornus sericea* Forest (CEGL000672).
GRank & Reasons: G3? (00-05-01). Association rank has been changed from G3? to G3G4 on the basis of this type's broad geographic distribution and the fact that within local landscapes, say western Montana, it is relatively common. In Montana alone, this type is represented by 26 plots, and this is for the case of the most restrictive or conservative interpretation of criteria for the association. A thorough crosswalk of this type across its range of distribution is needed; there may be local variations in composition and ecology that would bear recognition of separate associations. Threats to this type include floodplain harvesting of cottonwood and over-browsing from livestock and wildlife, both entities of which find *Cornus sericea* extremely palatable to the point of extirpating it from local floodplain landscapes. The more serious over-browsing consequence is reduced diversity, the introduction of weedy species and the increase in unpalatable native taxa such as *Symphoricarpos occidentalis, Ribes spp*. and *Urtica dioica*.
Comments: There is considerable variability in defining this community at both the alliance (based on tree species composition) and association levels (based on undergrowth species). Some authors taking a habitat type approach have considered any stands with conifers represented (even in the seedling/sapling size classes) to be members of the alliance (series in habitat type idiom) of the most shade-tolerant conifer represented on site and not the alliance of the *Populus balsamifera ssp. trichocarpa*, or other deciduous trees dominant on the site. It is also a highly debatable point as to

whether stands containing *Populus balsamifera ssp. trichocarpa* and *Populus tremuloides* should be allocated to the *Populus tremuloides* Forest Alliance (A.274) regardless of its cover value (as some authors have advocated) when in fact *Populus balsamifera ssp. trichocarpa* generally has a narrower ecological amplitude and better serves as a diagnostic species. Another troubling observation is that more than half of the identified stands have less than 60% tree canopy cover, which means that a significant portion of this association qualifies physiognomically as woodland, rather than as forest as currently classified. There are strongly discordant criteria as to how much *Cornus sericea* cover should be represented (ranging from 1-25%) for a stand to be considered a member of this association.

ELEMENT DISTRIBUTION

States/Provinces: CA:S1?, ID:S3, MT:S3?, OR:S2, WA:S2?

ELEMENT SOURCES

Authors: S.V. Cooper, WCS
References: Evans 1989a, Hall and Hansen 1997, Hansen et al. 1991, Hansen et al. 1995, Kovalchik 1987, Kovalchik 1993

POPULUS TREMULOIDES TEMPORARILY FLOODED FOREST ALLIANCE

Quaking Aspen Temporarily Flooded Forest Alliance

ALLIANCE CONCEPT

Summary: This alliance contains a number of communities found from the Great Lakes to the western and southwestern United States. Most stands of this alliance are found in riparian zones. Some may be near lakes where the ground is flooded or saturated for a short time in the spring. The moderate to closed tree canopy is dominated by *Populus tremuloides*, sometimes with *Populus balsamifera* codominant. More open stands have a prominent shrub layer containing species such as *Alnus incana, Cornus sericea*, and *Salix* spp. The sole reference cited for the *Populus tremuloides* Canyon Formation Forest (CEGL000576) does not mention *Populus tremuloides*.
Environment: Forests included in this alliance occur extensively in the western U.S., northern Great Plains and extend into the western Great Lakes area. Elevations range from 600 to 3230 m. Climate is temperate with a relatively long growing season, typically cold winters and often deep snow. Mean annual precipitation is greater than 38 cm and typically greater than 50 cm, except in semi-arid environments. Most of these temporarily flooded stands are found in riparian zones. Some may occur near lakes where the ground is flooded or saturated for a short time in the spring or on upland slopes below seepage areas. Distribution of these forests is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondarily, its range is limited by the length of the growing season or low temperatures (Mueggler 1988). Topography is variable. Sites are typically gently sloping but also include steep slopes near upland seeps. Aspect varies according to the limiting factors. Stands at high elevations or northern latitudes are restricted by cold temperatures and found on warmer southern aspects. At lower elevations and southern latitudes stands are restricted by lack of moisture and are found on cooler northern aspects and mesic microsites. The soils are typically deep and well-developed with rock often absent from the soil. Soils are typically mesic or hydric, poorly drained, and fine-textured, consisting of silts and clays, often with an organic surface layer. Many are gleyed and would be classified as wetland soils. However, some of the alluvial soils are coarser so soil texture ranges from clay to sandy loams. Parent materials are variable and may include sedimentary, metamorphic or igneous rocks, but these forests appear to grow best on limestone, basalt, and calcareous or neutral shales (Mueggler 1988).
Vegetation: Vegetation included in this widespread forest alliance occurs in temporarily flooded sites in the western U.S. to the western Great Lakes area. Stands a have a somewhat closed to closed canopy of trees to 5-20 m tall, that is dominated or codominated by the cold-deciduous broad-leaved tree *Populus tremuloides*. Other broad-leaved trees, such as *Populus balsamifera ssp. trichocarpa, Populus balsamifera ssp. balsamifera, Quercus macrocarpa*, and *Betula papyrifera* may be present to codominant depending on geography and topography. Several species of conifer trees may also be present in the tree canopy. Conifers include *Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus contorta, Pinus ponderosa*, and *Pseudotsuga menziesii*. Conifer species may contribute up to 25% of the tree canopy before the stand is reclassified as a mixed stand. ^Because of the open growth form of *Populus tremuloides* enough light can penetrate for lush understory development depending on available soil moisture and other factors. The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. ^In the western U.S. common tree associates include *Populus balsamifera ssp. trichocarpa* in the northern Rocky Mountains (Cooper and Heidel 1997). One or more of the conifer trees listed above are often scattered in the canopy or understory of stands occurring in the montane and subalpine zones. If present the tall-shrub layer may be dominated by *Quercus gambelii, Amelanchier alnifolia, Alnus incana, Betula occidentalis, Betula nana, Prunus virginiana* or *Salix* species such as *Salix bebbiana, Salix drummondiana, Salix monticola* or many others. Common short shrubs include *Cornus sericea, Ribes montigenum, Rosa woodsii, Symphoricarpos albus*, and *Symphoricarpos oreophilus*. The dwarf-shrubs *Mahonia repens* and *Vaccinium myrtillus* are common. The herbaceous layer may be lush and diverse, dominated

by graminoids or tall forbs. Other common graminoids may include *Bromus ciliatus, Bromus carinatus, Calamagrostis canadensis, Carex siccata (= Carex foenea), Carex hoodii, Elymus glaucus, Elymus trachycaulus*, and *Festuca thurberi*. Forbs may include *Achillea millefolium, Eucephalus engelmannii (= Aster engelmannii), Delphinium X occidentale, Equisetum arvense, Fragaria virginiana, Geranium richardsonii, Ligusticum porteri, Maianthemum stellatum, Mertensia arizonica, Osmorhiza occidentalis, Senecio bigelovii var. bigelovii, Thalictrum occidentale, Veratrum californicum* and many others. Exotic grasses such as the perennial *Poa pratensis* and the annual *Bromus tectorum* are often common in stands disturbed by grazing. ^In the northern Great Plains and western Great Lakes areas, these stands have a moderate to closed tree canopy that is dominated by *Populus tremuloides* with *Populus balsamifera* codominant. More open stands have a prominent shrub layer containing species such as *Alnus incana, Cornus sericea*, and *Salix* spp. Little information was available for stands in the northern Great Plains and midwestern U.S.
Dynamics: Stands in this alliance often originate and likely are maintained by stand-replacing disturbances such as crown fire, disease and windthrow, or clearcutting by man and beaver. The stems of these thin-barked, clonal trees are easily killed by ground fires. They can quickly and vigorously resprout in densities of up to 30,000 stems per hectare (Knight 1993). Stands are favored by fire in the conifer zone (Mueggler 1988). The stems are relatively short-lived (100-150 years) and individual stands will be succeed to longer-lived conifer forest if undisturbed. With adequate disturbance a clone may live many centuries. Although *Populus tremuloides* produces abundant seeds, seedling survival is rare because the long warm, moist conditions required to establish are rare in the habitats where it occurs.
Comments: Clarification is needed as to why some associations were included in this alliance instead of the seasonally flooded alliance. Stands in this alliance also had wetland soils (gleyed, hydric, organic muck) as well as better drained 'upland' soils. It is not clear if the *Populus tremuloides - Populus balsamifera* alliances also included *Populus balsamifera ssp. trichocarpa* or just *Populus balsamifera ssp. balsamifera*. Little information was available on stands occurring in the northern Great Plains and western Great Lakes areas. Also, the sole reference cited for *Populus tremuloides* Canyon Formation Forest (CEGL000576) does not mention *Populus tremuloides*. Stands in California need association-level description.

POPULUS TREMULOIDES / CORNUS SERICEA FOREST
Quaking Aspen / Red-osier Dogwood Forest

ELEMENT CONCEPT

Summary: In Colorado, this riparian forest is located in narrow ravines where upland *Populus tremuloides* forests intermix with the riparian shrub vegetation. Stands have a deciduous tree canopy that is dominated by *Populus tremuloides* with and a shrub layer dominated by *Cornus sericea*. The obligate riparian shrub species distinguish this association from upland *Populus tremuloides* communities. Information on stands that occur outside Colorado will be added later.
GRank & Reasons: G4 (96-02-01).

ELEMENT DISTRIBUTION

States/Provinces: CA?, CO:S2, ID:S3, MT:S3, OR:S2?, WA:S1S2

ELEMENT SOURCES

Authors: WCS
References: Crowe and Clausnitzer 1997, Evans 1989a, Hansen et al. 1990, Hansen et al. 1991, Hansen et al. 1995, Kittel et al. 1994, Kittel et al. 1999, Kovalchik 1993, Richard et al. 1996, Washington Natural Heritage Program (WANHP) n.d.

Seasonally flooded cold-deciduous forest

POPULUS TREMULOIDES SEASONALLY FLOODED FOREST ALLIANCE

Quaking Aspen Seasonally Flooded Forest Alliance

ALLIANCE CONCEPT

Summary: This alliance occurs locally in seasonally flooded areas in the Rocky Mountain region. Stands in this alliance are restricted to sites saturated by seepage from springs and streams from snowmelt. They occur below seeps on gentle slopes, wet draws and flats, and in depressions along streambank terraces. Aspects are variable. Soils are often fine-textured, poorly drained with high organic content, but in some stands the alluvial soils are coarse-textured and permit rapid groundwater movement. The water table is typically at or near the soil surface in the spring but may drop more than 1 m by midsummer. Vegetation included in this broad-leaved deciduous forest alliance is characterized by a

somewhat closed to closed canopy of trees that is dominated by *Populus tremuloides*. In northern stands *Populus balsamifera ssp. trichocarpa* may be present to codominant. Scattered conifer trees may occur throughout the range and contribute up to 25% of the tree canopy. The shrub layers in these communities are typically absent or sparse, commonly consisting of scattered *Alnus* spp., *Lonicera involucrata, Ribes montigenum, Rosa woodsii, Salix* spp., or *Symphoricarpos albus*. The highly diverse herbaceous layer is typically dense and dominated by mesic graminoids and forbs like *Calamagrostis canadensis, Equisetum arvense* or *Ranunculus alismifolius*. The exotic forage species may have significant cover in stands grazed by cattle or near hay meadows. Diagnostic of this alliance is the dominance of *Populus tremuloides* in a forest that is flooded for extended periods during the growing season and has a high water table.

Environment: Forests included in this alliance occur in locally in seasonally flooded areas in the Rocky Mountain region. Elevations range from 850-3170 m. Climate is temperate with a relatively long growing season, typically cold winters and often deep snow. Mean annual precipitation is greater than 38 cm and typically greater than 50 cm. The distribution of *Populus tremuloides* forests is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondarily, its range is limited by the length of the growing season or low temperatures (Mueggler 1988). Habitats vary in aspect according to elevation and latitude in respect to the most limiting factor. Stands in this alliance are restricted to sites saturated by seepage from springs and streams from snowmelt. They occur on below seeps on gentle slopes, wet draws and flats, and in depressions along streambank terraces. Aspects are variable. In Colorado they are typically on cool, moist north and northeast whereas in northwest Wyoming aspects often are on warmer eastern or western slopes. Soils are often fine-textured, poorly drained, consisting of silts and clays, often forming an organic muck (Youngblood and Mueggler 1981). However, some the alluvial soils are coarse-textured and permit rapid groundwater movement (Hansen et al. 1995). The water table is typically at or near the soil surface in the spring but may drop more than 1 m by midsummer (Hansen et al. 1995). Parent materials are variable and may include sedimentary, metamorphic or igneous rocks, but it appears to grow best on limestone, basalt, and calcareous or neutral shales (Mueggler 1988). ^Adjacent upland stands may include conifer forests dominated by *Abies lasiocarpa, Picea engelmannii* or *Pseudotsuga menziesii*, or non-flooded *Populus tremuloides*-dominated forests. Adjacent wetter stands may be dominated by *Alnus, Salix* or *Carex* communities and drier sites may include communities dominated by *Artemisia tridentata* or xeric grasses.

Vegetation: Vegetation included in this Rocky Mountain forest alliance occurs locally in seasonally saturated riparian and seepage areas. Stands a have a somewhat closed to closed canopy of trees to 5-20 m tall, that is dominated or codominated by the cold-deciduous broad-leaved tree *Populus tremuloides*. In northern stands, another broad-leaved tree, *Populus balsamifera ssp. trichocarpa*, may be present to codominant. Scattered conifer trees may occur throughout the range. Conifers such as *Pseudotsuga menziesii, Pinus contorta, Picea engelmannii, Abies concolor* or *Abies lasiocarpa* may be present and contribute up to 25% of the tree canopy before the stand is reclassified as a mixed stand. ^Because of the open growth form of *Populus tremuloides* enough light can penetrate for lush understory development, depending on available soil moisture and other factors. These shrub layer in these stands in typically absent or sparse commonly consisting of scattered *Alnus incana, Alnus incana ssp. tenuifolia (= Alnus tenuifolia), Lonicera involucrata, Ribes montigenum, Rosa woodsii, Salix bebbiana, Salix geyeriana, Salix monticola*, or *Symphoricarpos albus*. The highly diverse herbaceous layer is typically dense and often dominated *Calamagrostis canadensis, Equisetum arvense* or *Ranunculus alismifolius*. Other common herbs include graminoids such as *Alopecurus alpinus, Bromus ciliatus, Calamagrostis stricta, Carex aquatilis, Carex siccata (= Carex foenea), Carex hoodii, Carex microptera, Elymus glaucus, Festuca subulata, Glyceria striata*, and *Juncus balticus*. Common forbs may include *Achillea millefolium, Angelica arguta, Symphyotrichum laeve (= Aster laevis), Galium boreale, Geranium richardsonii, Heracleum* spp., *Ligusticum porteri, Mertensia ciliata, Nemophila breviflora, Osmorhiza* spp., *Rudbeckia occidentalis, Senecio triangularis, Viola canadensis, Wyethia amplexicaulis*, and many others. The exotic forage species *Poa pratensis, Poa palustris*, and *Phleum pratense* may have significant cover in stands grazed by cattle or near hay meadows.

Dynamics: Stands in this alliance often originate and are likely maintained by stand-replacing disturbances such as crown fire, disease and windthrow, or clearcutting by man or beaver. The stems of these thin-barked, clonal trees are easily killed by ground fires. They can quickly and vigorously resprout in densities of up to 30,000 stems per hectare (Knight 1993). Stands are favored by fire in the conifer zone (Mueggler 1988). The stems are relatively short-lived (100-150 years), and individual stands will succeed to longer-lived conifer forest if undisturbed. With adequate disturbance a clone may live many centuries. Although *Populus tremuloides* produces abundant seeds, seedling survival is rare because the long warm, moist conditions required to establish are rare in the habitats where it occurs. Youngblood and Mueggler (1981) noted that some stands appeared stable because of the multiple age classes of *Populus tremuloides* present. They suggested these stands may be too wet to readily succeed to conifers, although *Abies lasiocarpa* and *Picea engelmannii* were on higher ground in adjacent stands and on hummocks within the stand. They hypothesized that given enough time (several centuries), *Abies lasiocarpa* could colonize enough hummocks to lower the water table and dominate the site if there were no disturbances. ^Many of these stands have had a history of livestock grazing or are adjacent to hay meadows as evidenced by relative abundance of the exotic weeds and forage species *Phleum pratense, Taraxacum officinale, Poa pratensis, Poa palustris*, and other grazing-tolerant plants.

Comments: These stands are restricted to the Rocky Mountains region. More study is needed, especially into the flood regime differences between stands in this alliance and those in the widespread *Populus tremuloides* Temporarily Flooded Forest Alliance (A.300) that are found from the northwestern U.S. to the western Great Lakes, south to the Great Basin and southern Rocky Mountains. Stands in California need association-level description.

POPULUS TREMULOIDES / CALAMAGROSTIS CANADENSIS FOREST
Quaking Aspen / Bluejoint Forest

ELEMENT CONCEPT

Summary: These lush deciduous forests occur in the mountains of Montana, Idaho, Colorado, and possibly Wyoming. Elevations range from 850-970 m in Montana and 2770-3170 m in Colorado. Sites are riparian, occurring along stream terraces or floodplains, or upland on wet flats, benches, and gentle toeslopes where groundwater seeps. Substrates are often coarse-loamy soils over coarse alluvium. Stands have a moderately dense to dense tree canopy that is dominated by *Populus tremuloides*. The shrub layer is sparse to moderately dense, and composed of a variety of shrubs such as *Alnus incana, Rosa* spp, *Symphoricarpos* spp., and several *Salix* spp., including *Salix geyeriana, Salix bebbiana*, and *Salix monticola*. The herbaceous layer is moderately dense to dense depending on shrub cover. It is dominated by the wet-site perennial graminoid *Calamagrostis canadensis*. Other common species include *Bromus ciliatus, Carex siccata (= Carex foenea), Equisetum arvense, Geranium richardsonii, Heracleum* spp., *Ligusticum porteri, Maianthemum stellatum, Mertensia ciliata, Senecio triangularis*, and *Viola* spp. The introduced species *Poa pratensis, Poa palustris*, and *Taraxacum officinale* may be present. The predominance of the *Calamagrostis canadensis*-dominated herbaceous layer in the understory separates this type from other *Populus tremuloides* forests.
GRank & Reasons: G3 (99-12-29). This riparian association is known from the mountains in northern Utah, northern Nevada, southeastern Idaho and western Wyoming. Stands may also occur in Colorado. The association is rare (<100 occurrences) and is found only locally throughout much of its range. Sites are uncommon and small in size. The trend is stable, however, improper grazing by livestock can degrade the condition of these stands by reducing the abundance of palatable species. Additional threats may include introduce plants species and possibly logging. Additional survey is needed to determine if this type also occurs in Colorado.

ELEMENT DISTRIBUTION

Range: This association occurs in the mountains of Montana, Idaho, Colorado, and possibly Wyoming.
States/Provinces: CO:S3, ID:S2, MT:S2, OR:S1, WA:S1, WY?

ELEMENT SOURCES

Authors: K.A. Schulz, WCS
References: Boggs et al. 1990, Crowe and Clausnitzer 1997, Hansen et al. 1991, Hansen et al. 1995, Mutel 1973, Powell 1988a

Temporarily flooded temperate or subpolar needle-leaved evergreen woodland

PICEA ENGELMANNII TEMPORARILY FLOODED WOODLAND ALLIANCE
Engelmann Spruce Temporarily Flooded Woodland Alliance

ALLIANCE CONCEPT

Summary: These forests are characterized by *Picea engelmannii* as the dominant tree species in the upper forest canopy.
Environment:
Vegetation: These forests are characterized by *Picea engelmannii* as the dominant tree species in the upper forest canopy.
Dynamics:
Comments: The complex of riparian and wetland forests and woodlands dominated by *Picea engelmannii* needs extensive review to clarify floristic and ecological similarities and differences. This includes the *Picea engelmannii* Seasonally Flooded Forest Alliance (A.191), *Picea engelmannii* Seasonally Flooded Woodland Alliance (A.572), *Picea engelmannii* Temporarily Flooded Woodland Alliance (A.566), and *Picea engelmannii* Temporarily Flooded Forest Alliance (A.179). Only the *Picea engelmannii* Seasonally Flooded Woodland Alliance has been described; the other three will be completed following review of the classification of the individual associations.

PICEA ENGELMANNII / CORNUS SERICEA WOODLAND
Engelmann Spruce / Red-osier Dogwood Woodland

ELEMENT CONCEPT

Summary: This woodland is found on cool, moist sites in the mountains of the northern Rockies west into Oregon and Washington. This community occurs from 820-2300 m in elevation across its range. This community is restricted to flat or gently sloping alluvial terraces or benches and, less frequently, moist toeslopes or margins of fens or marshes. Stands may be temporarily flooded in the spring, and due to its location in riparian zones, the water table is usually within 1 m of the surface. Water flow and aeration in the rooting zone is usually good. The overstory canopy is dominated by *Picea engelmannii* or *Picea (engelmannii X glauca)* hybrids. Other conifers or *Populus* spp. are often present. Shrub cover is typically high, with *Cornus sericea* usually the dominant shrub, although other species like *Alnus incana* or *Ribes lacustre* are often present. Forb species richness is high but cover is low.
GRank & Reasons: G3 (00-01-18). This community has a broad range, and the environmental conditions capable of supporting the community (i.e. alluvial terraces) are not uncommon. Although it has been impacted by human activities like logging and stream channelization, it is nevertheless a relatively common riparian type in areas where lack of disturbance has allowed succession from cottonwood to spruce dominated communities. In addition, this type is the result of merging two G3 associations, and should be maintained until more range information is available.
Comments: *Picea engelmannii* and/or *Picea engelmannii X glauca* (hybrids) are the diagnostic overstory species in this woodland plant association. Former *Picea (engelmannii X glauca, engelmannii) / Cornus sericea* Forest (CEGL000407) in Montana has been merged with *Picea engelmannii / Cornus sericea* Woodland (CEGL000892) into a single entity which could include pure *Picea engelmannii* and the *Picea engelmannii X glauca* hybrid, or both. This type was described in Montana as *Picea* spp. / *Cornus stolonifera* habitat type by Hansen et al. (1995); and in eastern Idaho and western Wyoming as *Picea* spp. / *Cornus stolonifera* habitat type by Youngblood et al. (1985). Hansen et al. (1995) explained that the frequent absence of mature cones, similar morphology, and ecological amplitudes lead them to lump *Picea engelmannii* and *Picea glauca* (hybrids) into a single type. Youngblood et al. (1985) reported that the similar ecological amplitudes lead them to lump *Picea engelmannii* and *Picea pungens* into a single type. Therefore we have adopted *Picea* spp. as the diagnostic species regardless of overstory dominance.

ELEMENT DISTRIBUTION

States/Provinces: BC?, ID:S2, MT:S3, OR:S1, UT?, WA:S2?, WY:S3?

ELEMENT SOURCES

Authors: J. Greenlee, WCS
References: Crowe and Clausnitzer 1997, Hall and Hansen 1997, Hansen et al. 1995, Kovalchik 1993, Padgett et al. 1989, Youngblood et al. 1985, Youngblood et al. 1985b

Temporarily flooded cold-deciduous woodland

POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE

Eastern Cottonwood Temporarily Flooded Woodland Alliance

ALLIANCE CONCEPT

Summary: This alliance occurs throughout the Great Plains near rivers and large streams. It is dominated by *Populus deltoides* throughout its range. Secondary canopy species include *Acer negundo* throughout, *Salix nigra* (in the eastern part of its range), *Fraxinus pennsylvanica* and *Ulmus americana* (central and eastern), and *Salix amygdaloides* (central and western). *Fraxinus pennsylvanica* and *Ulmus americana* often increase in abundance and dominance as stands of this alliance age (Johnson et al. 1976). *Populus deltoides* does not reproduce well in established stands. The understory composition and structure are variable. A shrub layer may be present, with species such as *Salix* spp., *Symphoricarpos occidentalis*, and *Prunus virginiana* predominating. Sites experience seasonal floods, which, after receding, leave areas available for colonization. This process often favors the establishment of aggressive native and exotic plants. Among the species that are common in this alliance are *Carex* spp., *Juncus* spp., *Spartina pectinata* (in the east), *Pascopyrum smithii* (in the west), *Elymus* spp., *Cenchrus longispinus, Melilotus officinalis*, and *Equisetum* spp. Typical exotics found in this alliance are *Poa pratensis* and *Bromus* spp. ^Stands of this alliance are found on level to gently sloping topography near rivers, streams, lakes, and ponds. The areas may have been very recently deposited by water action, or they may have been deposited earlier and occupied by other communities (Wilson 1970). The water table fluctuates with the level of the adjacent water body. This can lead to periods of flooding and soil saturation in the spring and after heavy rains and also to periods of drought when the water level falls in the summer and fall. The soils are silts, loams, and sands, and are derived from alluvial material (Wilson 1970, Hansen et al. 1984, Thilenius et al. 1995).

Environment: Stands of this alliance are found on level to gently sloping topography near rivers, streams, lakes, and ponds. The areas may have been very recently deposited by water action or they may have been deposited earlier and occupied by other communities (Wilson 1970). The water table fluctuates with the level of the adjacent water body. This can lead to periods of flooding and soil saturation in the spring and after heavy rains and also to periods of drought when the water level falls in the summer and fall. The soils are silts, loams, and sands, and are derived from alluvial material (Wilson 1970, Hansen et al. 1984, Thilenius et al. 1995).
Vegetation: This alliance occurs throughout the Great Plains near rivers and large streams. It is dominated by *Populus deltoides* throughout its range. Secondary canopy species include *Acer negundo* throughout, *Salix nigra* (in the eastern part of its range), *Fraxinus pennsylvanica* and *Ulmus americana* (central and eastern), and *Salix amygdaloides* (central and western). *Fraxinus pennsylvanica* and *Ulmus americana* often increase in abundance and dominance as stands of this alliance age (Johnson et al. 1976). *Populus deltoides* does not reproduce well in established stands. The understory composition and structure are variable. A shrub layer may be present, with species such as *Salix* spp., *Symphoricarpos occidentalis*, and *Prunus virginiana* predominating. Sites experience seasonal floods which, after receding, leave areas available for colonization. This process often favors the establishment of aggressive native and exotic plants. Among the species that are common in this alliance are *Carex* spp., *Juncus* spp., *Spartina pectinata* (in the east), *Pascopyrum smithii* (in the west), *Elymus* spp., *Cenchrus longispinus, Melilotus officinalis*, and *Equisetum* spp. Typical exotics found in this alliance are *Poa pratensis* and *Bromus* spp.
Dynamics: Cottonwood forests grow within an alluvial environment that is continually changing due to the ebb and flow of the river. Riparian vegetation is constantly being 're-set' by flooding disturbance. Cottonwood communities are early, mid- or late-seral, depending on the age class of the trees and the associated species of the stand. Mature cottonwood stands do not regenerate in place, but regenerate by 'moving' up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities. The process of cottonwood regeneration is well documented. Periodic flooding events can leave sandbars of bare, mineral substrate. Cottonwood seedlings germinate and become established on newly-deposited, moist sandbars. In the absence of large floods in subsequent years, seedlings begin to trap sediment. In time, the sediment accumulates and the sandbar rises. The young forest community is then above the annual flood zone of the river channel. ^In this newly elevated position, with an absence of excessive browsing, fire, or agricultural conversion, this cottonwood community can grow into a mature riparian forest. At the same time, the river channel continually erodes streambanks and creates fresh, new surfaces for cottonwood establishment. This results in a dynamic patchwork of different age classes, plant associations and habitats (TNC 1996). ^As cottonwoods mature, other tree species may become established. If the land surface is subject to reworking by the river, the successional processes will start over with erosion and subsequent flooding deposition. If the land surface is not subject to alluvial processes, for example on a high terrace, the cottonwoods will be replaced by upland shrub or tree species from adjacent areas.
Comments: In many parts of the Great Plains, stands within this alliance border on and succeed to stands belonging to less flood-prone mesic alliances such as II.B.2.N.a *Fraxinus pennsylvanica - (Ulmus americana)* Woodland Alliance (A.629), I.B.2.N.a *Fraxinus pennsylvanica - (Ulmus americana)* Forest Alliance (A.259), and I.B.2.N.d *Fraxinus pennsylvanica - Ulmus americana - Celtis (occidentalis, laevigata)* Temporarily Flooded Forest Alliance (A.286). Flood control also appears to hasten this successional process (Johnston et al. 1976). Sites that are temporal or spatial transition zones can be difficult to classify. The former *Populus deltoides* Temporarily Flooded Wooded Herbaceous Alliance (A.1507) has been merged with this alliance.

POPULUS DELTOIDES / SYMPHORICARPOS OCCIDENTALIS WOODLAND
Eastern Cottonwood / Western Snowberry Woodland

ELEMENT CONCEPT

Summary: This riparian woodland community is found in the northwestern Great Plains of the United States on medium to coarse-textured alluvial soils on the floodplains of major rivers. The floodplains are both seasonally inundated and subirrigated. It is found more rarely at higher elevations in the mountains of eastern Wyoming and western South Dakota. This community is dominated by a single deciduous tree species, *Populus deltoides*. In some stands other species, such as *Acer negundo* and *Fraxinus pennsylvanica*, may contribute to the canopy. The tallest trees exceed 15 m. The shrub layer is typically 0.5-1 m tall. It is dominated by *Symphoricarpos occidentalis* and commonly includes *Juniperus scopulorum* and *Rosa* spp. In Wyoming, *Ericameria nauseosa (= Chrysothamnus nauseosus)* is present and increases with heavy grazing. The herbaceous layer usually includes *Pascopyrum smithii*. Weedy species such as *Melilotus officinalis, Taraxacum officinale*, and *Poa secunda* are very common, especially in the presence of grazing. *Maianthemum stellatum* is abundant only where grazing is absent.
Environment: This community is found on medium to coarse-textured alluvial soils on the floodplains of major rivers. The floodplains are both seasonally inundated and subirrigated (Thilenius et al. 1995). The meandering erosional and

depositional pattern of rivers maintains and influences this community along rivers (Hanson 1990). It is rarely found at higher elevations in the mountains of eastern Wyoming and western South Dakota (Johnston 1987).
Vegetation: This community is typically dominated by a single deciduous tree species, *Populus deltoides*. In some stands other species, such as *Acer negundo* and *Fraxinus pennsylvanica*, may contribute to the canopy. The tallest trees exceed 15 m. *Populus deltoides* is a pioneer species that requires moist, sparsely vegetated alluvium to become established from seed; therefore stands of this community may be considered seral, but the stage is long persistent (up to 100 years) (Girard et al. 1989). The shrub layer is typically 0.5-1 m tall. It is dominated by *Symphoricarpos occidentalis* and commonly includes *Juniperus scopulorum* and *Rosa* spp. In Wyoming, *Ericameria nauseosa (= Chrysothamnus nauseosus)* is present and increases with heavy grazing (Thilenius et al. 1995). The herbaceous layer usually includes *Pascopyrum smithii* and *Elymus trachycaulus*. Weedy species such as *Cirsium arvense, Melilotus officinalis, Taraxacum officinale*, and *Poa secunda* are very common, especially in the presence of grazing (Jones and Walford 1995, Thilenius et al. 1995). *Maianthemum stellatum* is abundant only where grazing is absent.
Dynamics: This type is found closest to the river on young, unstabilized floodplains, where it colonizes the freshly deposited alluvial substrates on the meanders of the streams and rivers. Proceeding away from the river, other later successional stages may include *Populus deltoides / Fraxinus pennsylvanica* Forest (CEGL000658) and *Fraxinus pennsylvanica - (Ulmus americana) / Symphoricarpos occidentalis* Forest (CEGL002088). As the stream continues to move away from the more recent deposits, the stand may eventually succeed to the *Fraxinus pennsylvanica* type, a process that could take 100 years (Girard et al. 1989).
GRank & Reasons: G2G3 (98-06-22). The total number of occurrences is unknown. Thirteen have been documented in North Dakota, where the community is ranked S1S2?. Although no other occurrences have been documented, the community is also reported from Wyoming (S2), Colorado (S2) and may occur in South Dakota (SP). It is found in three northern Great Plains ecoregional sections. The community occurs on medium- to coarse-textured soils on the floodplains of major rivers.
Comments: Concept of the type may have come from Thilenius and Smith (1990). In eastern Montana, Hanson et al. (1990) describe a *Populus deltoides / Symphoricarpos occidentalis* type as a grazing-induced stage of the *Populus deltoides / Cornus sericea* type. This contrasts with information from Wyoming, where Thilenius et al. (1995) found that *Symphoricarpos occidentalis* decreases with grazing and *Ericameria nauseosa (= Chrysothamnus nauseosus)* increases.

ELEMENT DISTRIBUTION

Range: This riparian woodland community is found in floodplains of the northwestern Great Plains of the United States, ranging from North Dakota to Colorado.
States/Provinces: CO:S2, ND:S1S2?, SD?, WY:S2

ELEMENT SOURCES

Authors: J. Drake, MCS
References: Girard et al. 1989, Hansen et al. 1990, Johnson et al. 1990a, Johnston 1987, Jones and Walford 1995, Kittel et al. 1999, Thilenius and Smith 1985, Thilenius et al. 1995

Temporarily flooded cold-deciduous shrubland

ALNUS INCANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE

Speckled Alder Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Summary: Vegetation types within this temporarily flooded, cold-deciduous shrubland alliance typically occur adjacent to streams and in mountain meadows. Landforms associated with this alliance are streambanks, alluvial bars, and floodplains. Sites are young, active channel shelves that lie between active and flood-stage streambanks along second-order and larger streams in moderately graded (3-5%) valleys. Elevations range from near sea level in Alaska to 3000 m in Colorado. Soils are shallow, skeletal alluvium over water-worked cobbles and gravels. Active channel shelves have surface soil textures that are loamy sands, while older sites are silts and loam. Available water-holding capacity is low; surface water is present briefly during the growing season. The water table usually lies well below the ground surface. *Alnus incana* forms a dense canopy with at least 90% cover. The diverse understory shrub layer may include *Cornus sericea, Betula occidentalis, Ribes hudsonianum, Symphoricarpos albus, Salix drummondiana*, and *Oplopanax horridus*. The forb layer is sparse and may include *Canadanthus modestus (= Aster modestus), Symphyotrichum spathulatum (= Aster occidentalis), Galium triflorum, Senecio triangularis*, and *Thalictrum occidentale*. The graminoid layer is usually dominated by 1 or 2 species that include *Agrostis stolonifera* and *Calamagrostis canadensis*. The fern and fern allies layer is generally dense with at least 40% cover. The dominant species typically are *Gymnocarpium dryopteris* and *Athyrium filix-femina*. Coniferous and cottonwood forests typically grow on adjacent upslopes.

Environment: Vegetation types within this alliance typically occur adjacent to streams and in mountain meadows. Landforms associated with this alliance are streambanks, alluvial bars, and floodplains. Sites are young, active channel shelves that lie between active and flood-stage streambanks along second-order and larger streams in moderately graded (3-5 percent) valleys. Elevations range from near sea level in Alaska to 3000 m in Colorado. ^Soils are shallow, skeletal alluvium over water-worked cobbles and gravels. Active channel shelves have surface soil textures that are loamy sands while older sites are silts and loam. Available water-holding capacity is low, surface water is present briefly during the growing season. The water table usually lies well below the ground surface. ^Coniferous and cottonwood forests typically grow on adjacent upslopes.
Vegetation: Vegetation types within this alliance are classified as temporarily flooded, cold-deciduous shrublands. *Alnus incana* forms a dense canopy with at least 90% cover. The diverse understory shrub layer may include *Cornus sericea, Betula occidentalis, Ribes hudsonianum, Symphoricarpos albus, Salix drummondiana*, and *Oplopanax horridus*. The forb layer is sparse and may include *Canadanthus modestus (= Aster modestus), Symphyotrichum spathulatum (= Aster occidentalis), Galium triflorum, Senecio triangularis*, and *Thalictrum occidentale*. The graminoid layer is usually dominated by 1 or 2 species that include *Agrostis stolonifera* and *Calamagrostis canadensis*. The fern and fern allies layer is generally dense with at least 40% cover. The dominant species typically are *Gymnocarpium dryopteris* and *Athyrium filix-femina*.
Dynamics: *Alnus incana* is a long-lived, early-seral species. It is one of the first species to establish on fluvial or glacial deposits as well as the spoils of placer mining (Hansen et al. 1989). After establishment, young stands of *Alnus incana* are continually flooded. As stands mature, the stems can slow flood waters and trap sediment. Fine-textured sediments accumulate on top of the coarser alluvial material, and the land surface eventually rises above annual flood levels. Flooding is then less frequent and soils begin to develop (Padgett et al. 1989). ^*Alnus incana* is shade-intolerant (Viereck 1970, Chapin et al. 1994 as cited in Kittel et al. 1999), and many mature stands are restricted to streambank edges, possibly because these are the only sites where light can penetrate the neighboring overstory canopy. *Alnus incana* has been observed on high-gradient streams and is thought to require well-aerated water (Hansen et al. 1988, Padgett et al. 1989). ^Undisturbed *Alnus incana* stands may become dominated by *Salix* species or conifer stands (Hansen et al. 1989). In Alaska, thick stands of alders inhibit succession by competing with spruce for nutrients and light (Chapin et al. 1994 as cited in Kittel et al. 1999). In Utah, *Acer negundo* often becomes the dominant canopy species on more xeric sites (Padgett et al. 1989). ^*Alnus incana* fixes atmospheric nitrogen through a symbiotic relationship with the bacteria *Frankia* and increases the ecosystem nitrogen supply with the deposition of nitrogen-rich leaf litter (Binkley 1986 as cited in Kittel et al. 1999). The annual input of nitrogen to soils from alder species ranges from 16 to 150 kg/ha annually compared to 1 to 10 kg/ha/yr deposited by atmospheric precipitation alone (Binkley 1986 as cited in Kittel et al. 1999). Nitrogen-rich detritus is an important source of nutrients for the aquatic ecosystem as well.
Comments:

ALNUS INCANA / CALAMAGROSTIS CANADENSIS SHRUBLAND
Speckled Alder / Bluejoint Shrubland

ELEMENT CONCEPT

GRank & Reasons: G3Q (94-02-23).

ELEMENT DISTRIBUTION

States/Provinces: MT:S3Q, OR:S1, WA:S2, WY:S?

ELEMENT SOURCES

Authors: WCS
References: Crowe and Clausnitzer 1997, Kovalchik 1993

SALIX BEBBIANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Bebb's Willow Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Summary: This alliance occurs along rivers and streams in the western Great Plains and Rocky Mountains. This alliance is a briefly flooded, scrub-shrub wetland on slightly to moderately alkaline soils, usually near low-gradient streams. The water table is well below the soil surface for over half the growing season. However, there are periods of several days to a few weeks when water is at the surface. It is typically dominated by a dense growth of shrubs 0.5-3 m tall. Multiple-stemmed trees and/or shrubs 0.5-5 m tall have 30-100% cover; single-stemmed trees have less than 30% cover. The most abundant species in the shrub layer are *Salix bebbiana, Salix scouleriana*, and *Salix lucida ssp. caudata (= Salix fendleriana)*. Other species found in this strata include *Betula occidentalis, Cornus sericea, Salix exigua, Salix*

fluviatilis, and *Prunus virginiana*. The herbaceous layer often contains *Scirpus* spp., *Carex* spp., *Triglochin palustris, Calamagrostis canadensis*, and *Equisetum* spp. along the wetter margins of the alliance. In the drier areas *Gentianella amarella ssp. acuta (= Gentiana strictiflora), Prunella vulgaris, Pyrola asarifolia, Ranunculus macounii, Sanicula marilandica, Viola canadensis, Vicia americana*, and *Zizia aptera (= Zizia cordata)* are frequently present.

Environment: Communities within this *Salix bebbiana* alliance occur on temporarily flooded, low-gradient streams or along narrow alluvial terraces of canyons. Communities can also occur on broad, seep-fed meadows. Stream channels range from steep and narrow to wider, less steep, and moderately sinuous. Elevations range from 985 m in Montana to 3290 m in Colorado. The soils are highly stratified layers of sandy loams, clay loams, and silty clay typically with mottling near the surface. The soils can be deep, dark-colored silty clay loams with high organic content and mottling or shallow, becoming skeletal at about 25 cm depth. In the spring and early summer, soils are saturated for several days to weeks and then slowly dry out over the rest of the growing season. *Pinus ponderosa - Quercus gambelii* forests and *Populus tremuloides* woodlands occur on adjacent hillsides.

Vegetation: Vegetation in this alliance occurs in the western Great Plains and Rocky Mountains along rivers and streams. The vegetation is typically dominated by dense shrubs up to 6 m tall. *Salix bebbiana* forms a dense overstory with a tree-like growth form. *Salix boothii, Salix scouleriana, Alnus incana*, or *Salix lutea* are occasionally present in minor to moderate amounts. The most abundant species in the shrub layer in the Great Plains stands are *Betula occidentalis, Cornus sericea, Salix exigua, Salix fluviatilis*, and *Prunus virginiana*. The low-shrub layer in stands in the western United States include *Ribes inerme, Cornus sericea, Rosa woodsii*, and *Symphoricarpos oreophilus*. For the most part the herbaceous layer is dominated by hay grasses, graminoids and low-growing forbs (Padgett et al. 1989, Hansen 1995). The herbaceous layer in stands from the midwestern United States often contains *Scirpus* spp., *Carex* spp., *Triglochin palustris, Calamagrostis canadensis*, and *Equisetum* spp. along the wetter margins of the stand. In the drier areas *Gentianella amarella ssp. acuta (= Gentiana strictiflora), Prunella vulgaris, Pyrola asarifolia, Ranunculus macounii, Sanicula marilandica, Viola canadensis, Vicia americana*, and *Zizia aptera (= Zizia cordata)* are frequently present.

Dynamics: The Montana stands within this *Salix bebbiana* alliance represent a browsing/grazing disclimax of the *Salix geyeriana*-, *Salix lutea*-, or *Salix drummondiana*-dominated habitat types (Hansen et al. 1995). *Salix bebbiana* seems to be a highly palatable willow. However, this high level of palatability does not tend to negatively affect the status of *Salix bebbiana* on a site. In fact, *Salix bebbiana* seems to have evolved a physiological tolerance to browsing and remains on a site under all but the most severe conditions, such as sustained long-term browsing. This tolerance to repeated browsing allows *Salix bebbiana* to increase. Willows less tolerant of browsing include *Salix geyeriana, Salix boothii, Salix lutea*, and *Salix drummondiana* (Hansen et al. 1995). *Salix bebbiana* sprouts rapidly following fire. Prescribed burning is a commonly used wildlife management tool to rejuvenate decadent communities dominated by *Salix bebbiana* (Hansen et al. 1995). The New Mexico stands (Dick-Peddie 1993) have been invaded by non-native species, e.g., *Tamarix* spp. and *Elaeagnus angustifolia*. Hay grasses were reported in the majority of plots from several studies.

Comments: This alliance has not been extensively described. Distinguishing characteristics beyond the dominance by *Salix bebbiana* and its relationship to other wetland shrub alliances are not well known.

SALIX BEBBIANA SHRUBLAND
Bebb's Willow Shrubland

ELEMENT CONCEPT

Summary: This willow shrubland is found in the montane regions and western plains of the United States. This community is a briefly flooded scrub-shrub wetland on slightly to moderately alkaline soils, usually near low-gradient streams. This shrubland is typically dominated by a dense growth of shrubs 0.5-3 m tall. The most abundant species in the shrub layer are *Salix bebbiana, Salix scouleriana*, and *Salix lucida ssp. caudata (= Salix fendleriana)*. Other species found in this strata include *Betula occidentalis, Cornus sericea ssp. sericea, Salix exigua, Salix melanopsis (= Salix fluviatilis)*, and *Prunus virginiana*. Multiple-stemmed trees and/or shrubs 1.5-5 m tall have 30-100% cover; single-stemmed trees have less than 30% cover. The herbaceous layer often contains *Schoenoplectus* spp. (= *Scirpus* spp.), *Carex* spp., *Triglochin palustris, Calamagrostis canadensis*, and *Equisetum* spp. along the wetter margins of the community. In the drier areas *Gentianella amarella ssp. acuta (= Gentiana strictiflora), Prunella vulgaris, Pyrola asarifolia, Zizia aptera (= Zizia cordata), Sanicula marilandica, Viola canadensis, Vicia americana*, and *Ranunculus macounii* are frequently present.

Environment: Stands occur on slightly to moderately alkaline soils, usually near low-gradient streams. The water table is well below the soil surface for over half the growing season. However, there are brief periods of several days to a few weeks when water is at the surface.

Vegetation: This shrubland is typically dominated by a dense growth of shrubs 0.5-3 m tall. The most abundant species in the shrub layer are *Salix bebbiana, Salix scouleriana*, and *Salix lucida ssp. caudata (= Salix fendleriana)*. Other species found in this strata include *Betula occidentalis, Cornus sericea ssp. sericea, Salix exigua, Salix fluviatilis*, and

Prunus virginiana. Multiple-stemmed trees and/or shrubs 1.5-5 m tall have 30-100% cover; single-stemmed trees have less than 30% cover. The herbaceous layer often contains *Schoenoplectus* spp. (= *Scirpus* spp.), *Carex* spp., *Triglochin palustris, Calamagrostis canadensis*, and *Equisetum* spp. along the wetter margins of the community. In the drier areas *Gentianella amarella ssp. acuta (= Gentiana strictiflora), Prunella vulgaris, Pyrola asarifolia, Zizia aptera (= Zizia cordata), Sanicula marilandica, Viola canadensis, Vicia americana*, and *Ranunculus macounii* are frequently present.
Dynamics: Brief floods can occur in spring or after heavy rains.
GRank & Reasons: G3? (96-02-01). Most sites have been impacted by grazing.
Comments: The distribution and classification of this community need further investigation. Changes in historic natural processes, including flooding, and more recent human impacts, such as grazing, have altered this community.

ELEMENT DISTRIBUTION

Range: This beaked willow shrubland is found in the montane regions and western plains of the United States, ranging from South Dakota and Montana south to New Mexico.
States/Provinces: CO:S2, MT:S3?, NM:S?, SD:S2, WY:S2S3

ELEMENT SOURCES

Authors: J. Drake, WCS
References: Baker 1982, Dick-Peddie 1993, Hansen et al. 1991, Hayward 1928, Kittel et al. 1999, Szaro 1989, The Nature Conservancy 1991, Thilenius 1971

SALIX BOOTHII TEMPORARILY FLOODED SHRUBLAND ALLIANCE

Booth's Willow Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Summary: This widespread riparian shrubland alliance is found throughout the interior western U.S. between 1320-2800 m in elevation. Stands occur in valley bottoms, swales, streambanks, and occasionally terraces of stream channels in areas that have surface water present for only brief periods of time during the growing season, and are usually found within 1 m of the water table. Stands are also located adjacent to seeps on gently sloping toeslopes. The ground surface is often uneven and hummocky due to past flooding and beaver activity. The soils are variable and include highly stratified alluvium or fine-textured, highly organic soils. Shrublands within this alliance are dominated by *Salix boothii* with a canopy ranging from 20-80% cover. *Salix geyeriana, Salix lemmonii*, or *Salix drummondiana* may codominate. Other shrubs present include *Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda)* and *Betula nana (= Betula glandulosa)*. A mixture of forbs and graminoids growing on raised hummocks characterizes the moderately dense herbaceous layer. Common forb and graminoid species include *Swertia perennis, Pedicularis groenlandica, Polygonum bistortoides, Heracleum maximum (= Heracleum lanatum), Achillea millefolium, Carex aquatilis, Carex utriculata*, and *Calamagrostis canadensis*. Diagnostic of this riparian alliance is a *Salix boothii*-dominated or -codominated tall shrubland that is flooded for brief periods during the growing season and has a shallow water table.
Environment: Vegetation types in the *Salix boothii* Temporarily Flooded Shrubland Alliance (A.972) occur in valley bottoms on swales, banks, and occasionally terraces of stream channels, areas which have surface water present for only brief periods of time during the growing season. Stands are usually found within 1.0 m of the water table, but are occasionally located above the channel on low terraces of straight sections of rivers. Vegetation in the alliance is also located adjacent to seeps on gently sloping toeslopes. Elevation ranges from 1320-2800 m. The ground surface is often uneven and hummocky due to past flooding and beaver activity. ^Soils are typically highly stratified with alternating layers of sandy loam and clay loam and are mottled within the top 10 cm. Other soils are finely textured, dark-colored, highly organic soils with silty clay loam. Lower profiles typically contain a gravel or cobble layer which may indicate that the soil section is a silted-in beaver pond (Kittel et al. 1999). ^Mixed conifer-*Populus tremuloides* and *Populus tremuloides* forests often occur on adjacent hillslopes at higher elevations, and *Artemisia tridentata* scrub occurs on adjacent hillsides at lower elevations.
Vegetation: Communities within this alliance are characterized as seasonally flooded, cold-deciduous shrubland. The tall-shrub layer is dominated by large stands of *Salix boothii* with a canopy ranging from 20-80% cover. Several stands are codominated (35-50% cover) by *Salix geyeriana, Salix lemmonii*, or *Salix drummondiana*. Other shrubs present include *Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda)* and *Betula nana (= Betula glandulosa)*. The herbaceous layer is characterized by a moderate forb layer growing on raised hummocks. No one forb species is dominant, but rather several species have a combined cover of 40-60%. Forb species include *Swertia perennis, Pedicularis groenlandica, Polygonum bistortoides, Heracleum maximum (= Heracleum lanatum)*, and *Achillea millefolium*. Graminoid cover is moderate (<40%) and commonly includes *Carex aquatilis, Carex utriculata*, and *Calamagrostis canadensis*.

Dynamics: Stands within this alliance are dominated by *Salix boothii* which is often highly productive. Understory production varies, depending on the density of overstory shrubs. Thick shrub stands make access by livestock difficult, therefore stands within this alliance are somewhat resistant to grazing effects (Youngblood et al. 1985).
Comments:

SALIX BOOTHII / CAREX UTRICULATA SHRUBLAND
Booth's Willow / Beaked Sedge Shrubland

ELEMENT CONCEPT

Summary: In Colorado, this riparian shrubland occurs in the wettest micro-habitats of the floodplain, including low floodplains adjacent to beaver ponds and low areas between beaver dams. The ground is very wet, and the water table is at or near the soil surface all season long. Stands have a short to tall (1-4 m), closed, broad-leaved, deciduous shrub canopy that is dominated by *Salix boothii* with an herbaceous layer of *Carex utriculata*. Information on stands that occur outside Colorado will be added later.
GRank & Reasons: G4 (96-02-01).

ELEMENT DISTRIBUTION

States/Provinces: CA?, CO:S3, ID:S4, OR:S3, UT:S3?, WY:S2S3

ELEMENT SOURCES

Authors: WCS
References: Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999, Kovalchik 1987, Mutz and Graham 1982, Mutz and Queiroz 1983, Norton et al. 1981, Padgett et al. 1988, Padgett et al. 1989, Tuhy and Jensen 1982, Youngblood et al. 1985, Youngblood et al. 1985b

SALIX EXIGUA TEMPORARILY FLOODED SHRUBLAND ALLIANCE

Coyote Willow Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Summary: Plant associations within this temporarily flooded shrub alliance are located on floodplains and gravel bars at an elevational range between 780-1760 m. These shrublands are found on open sandbars without canopy shading on larger, well-developed drainages and along larger sandy rivers. They are associated with annual flooding and inundation and will grow well into the channel, where it is flooded, even in drier years. Even though the flooding is frequent, surface water is not present for much of the growing season, and the water table is well below the surface. Some stands form large, wide stands on mid-channel islands on larger rivers, or narrow stringer bands on small, rocky tributaries. Stream reaches range widely from moderately sinuous and moderate-gradient reaches to broad, meandering rivers with wide floodplains or broad, braided channels. Many stands also occur within highly entrenched or eroding gullies. Soils of this alliance are typically coarse alluvial deposits of sand, silt and cobbles that are highly stratified with depth from flooding scour and deposition. The stratified profiles consist of alternating layers of clay loam and organic material with coarser sand or thin layers of sandy loam over very coarse alluvium. Occasionally, stands may occur on deep pockets of sand. pH ranges from 6.0-6.8. The canopy is dominated by a tall, 2- to 5-m, broad-leaved deciduous shrub that is typically many-branched with continuous cover of 60-100%. The herbaceous stratum has sparse to moderate cover including a variety of pioneering species. Plant associations within this alliance are characterized as temporarily flooded, cold-deciduous shrubland dominated by *Salix exigua*. The tall-shrub layer is dominated by *Salix exigua* with 15-90% cover, ranging in height between 2-5 m. Other willows can occur in the canopy including *Salix ligulifolia* and *Salix monticola*. Occasionally the taller *Salix amygdaloides* or *Populus deltoides* occur within the tree subcanopy. The herbaceous layer has at least 20-35% cover of various graminoid species including *Carex nebrascensis, Carex pellita (= Carex lanuginosa), Spartina pectinata, Phalaris arundinacea, Equisetum arvense, Panicum bulbosum*, and *Muhlenbergia rigens*. The forb cover is usually sparse. The understory can be dominated by barren ground or gravel bar. This alliance represents an early seral, primary successional stage on newly deposited sediments that may persist under a regime of repeated fluvial disturbance. *Salix exigua* is highly adapted to most forms of disturbance. It is a prolific sprouter and will reestablish itself on sites dominated by other disturbance-associated species, e.g., *Glycyrrhiza lepidota* and *Pascopyrum smithii (= Agropyron smithii)*. *Salix exigua* alliances differ due to the structure of the vegetation and hydrologic regimes. The forest alliances are characterized by trees with overlapping crowns (generally forming 60-100% cover). The woodland alliances contain open stands of trees with crowns not touching, generally forming 25-60% cover. The hydrologic regimes differ due to the length of time that the surface water is present and depth to the water table. The surface water in the seasonally flooded alliances is present for extended periods during the growing season, and the water table is typically near the surface. Whereas, the surface water in the temporarily flooded alliances is only present for

brief periods during the growing season, and the water table is well below the surface. Associations in this alliance are common and widespread. Their range extends from the Pacific Northwest and California, east to the Rocky Mountains and the northern Great Plains, south to the Colorado Plateau and New Mexico. They occur in the Midwest in Iowa, Illinois, Indiana, Kansas, North Dakota, Nebraska, South Dakota, and Ohio. They also extend into Arkansas and Oklahoma, and possibly in Pennsylvania, as well as in Manitoba, Canada. In western Oklahoma and throughout the Ozarks the associations are local along major streams. Adjacent upland plains communities include agricultural fields and rolling hills of *Artemisia filifolia*, xeric tallgrass prairies, and *Bouteloua gracilis* shortgrass prairies. In the steep canyons of the foothills, upslope vegetation includes *Pseudotsuga menziesii* and *Pinus ponderosa* forests, *Pinus edulis* and *Juniperus* spp. woodlands, oak, sagebrush, and greasewood scrub. In the lower montane, upslope vegetation includes *Pinus contorta* and *Populus tremuloides* forests.

Environment: Plant associations within the *Salix exigua* Temporarily Flooded Shrubland Alliance (A.947) are located on floodplains and gravel bars at an elevational range between 780 and 1760 m. These shrublands are found on open sandbars without canopy shading on larger, well-developed drainages and along larger sandy rivers. They are associated with annual flooding and inundation and will grow well into the channel, where it is flooded, even in drier years. Even though flooding is frequent, surface water is not present for much of the growing season and the water table is well below the surface. Some stands form large, wide stands on mid-channel islands on larger rivers, or narrow stringer bands on small, rocky tributaries. Stream reaches range widely from moderately sinuous and moderate-gradient reaches to broad, meandering rivers with wide floodplains or broad, braided channels. Many stands also occur within highly entrenched or eroding gullies. ^Soils of this alliance are typically coarse alluvial deposits of sand, silt and cobbles that are highly stratified with depth from flooding scour and deposition. The stratified profiles consist of alternating layers of clay loam and organic material with coarser sand or thin layers of sandy loam over very coarse alluvium. Occasionally, stands may occur on deep pockets of sand. pH ranges from 6.0-6.8 (Johnson 1987). ^Adjacent upland plains communities include agricultural fields and rolling hills of *Artemisia filifolia*, xeric tall-grass prairies and *Bouteloua gracilis* shortgrass prairies. In the steep canyons of the foothills, upslope vegetation includes *Pseudotsuga menziesii* and *Pinus ponderosa* forests, *Pinus edulis* and *Juniperus* spp. woodlands, oak, sagebrush, and greasewood scrub. In the lower montane, upslope vegetation includes *Pinus contorta* and *Populus tremuloides* forests.

Vegetation: Plant associations within this alliance are characterized as temporarily flooded cold-deciduous shrubland dominated by *Salix exigua*. The tall-shrub layer is dominated by *Salix exigua* with 15-90% cover, ranging in height between 2-5 m. Other willows can occur in the canopy including *Salix ligulifolia* and *Salix monticola*. Occasionally the taller *Salix amygdaloides* or *Populus deltoides* occur within the tree subcanopy. The herbaceous layer has at least 20-35% cover of various graminoid species including *Carex nebrascensis, Carex pellita (= Carex lanuginosa), Spartina pectinata, Phalaris arundinacea, Equisetum arvense, Panicum bulbosum*, and *Muhlenbergia rigens*. The forb cover is usually sparse. The understory can be dominated by barren ground or gravel bar.

Dynamics: This alliance represents an early seral primary successional stage on newly deposited sediments that may persist under a regime of repeated fluvial disturbance. *Salix exigua* is highly adapted to most forms of disturbance. It is a prolific sprouter and will reestablish itself on sites dominated by other disturbance associated species, e.g., *Glycyrrhiza lepidota* and *Pascopyrum smithii (= Agropyron smithii)*.

Comments: *Salix exigua* alliances differ due to the structure of the vegetation and hydrologic regimes. The forest alliances are characterized by trees with overlapping crowns (generally forming 60-100% cover). The woodland alliances contain open stands of trees with crowns not touching (generally forming 25-60% cover). The hydrologic regimes differ due to the length of time that the surface water is present and depth to the water table. The surface water in the seasonally flooded alliances is present for extended periods during the growing season, and the water table is typically near the surface. Whereas, the surface water in the temporarily flooded alliances is only present for brief periods during the growing season, and the water table is well below the surface.

SALIX EXIGUA TEMPORARILY FLOODED SHRUBLAND

Coyote Willow Temporarily Flooded Shrubland

ELEMENT CONCEPT

Summary: This willow shrubland community is found along rivers and streams at lower elevations throughout the northwestern United States and Great Plains. This type is an early successional stage that occurs on recently flooded riparian areas. Stands occur most commonly on alluvial sand, but silt, clay, or gravel may also be present. *Salix exigua* is the dominant canopy species. It can form dense stands up to 4 m tall, but there are often patches where the shrub layer is absent. Seedlings and small saplings of *Populus deltoides* and *Salix amygdaloides* may be present. The herbaceous cover is sparse to moderate, but rarely exceeds 30%. Species present include *Cenchrus longispinus, Polygonum lapathifolium, Schoenoplectus americanus (= Scirpus americanus), Triglochin maritima*, and *Xanthium strumarium*. The composition of this community, especially the herbaceous layer, varies from year to year with succession or renewed disturbance.

Environment: This community is found on recently deposited or disturbed alluvial material. The parent material is alluvial sand, although silt, clay, or gravel may be present. Soil development is poor to absent.
Vegetation: This community is dominated by shrubs, generally between 2 and 4 m tall. The most common of these is *Salix exigua*. *Salix irrorata* and saplings of *Populus deltoides* or *Salix amygdaloides* are also frequently found in the shrub layer. This stratum can have moderate to high stem density in the community as a whole. The species in the shrub layer do not form a closed canopy, allowing significant light to reach the ground layer. There are often patches where the shrub layer is absent. The herbaceous cover is sparse to moderate, but rarely exceeds 30%. Older stands and places with less competition from the shrubs have greater herbaceous cover. The composition of the herbaceous layer can vary greatly. Species that are often found in this community are *Cenchrus longispinus, Polygonum lapathifolium, Schoenoplectus americanus (= Scirpus americanus), Triglochin maritima*, and *Xanthium strumarium*.
Dynamics: This type originates after flash floods that create new deposits or scour existing alluvial material. This community is a primary or early secondary community and requires floods to create new areas on which it can develop. Once established, this community may not exist for more than 10-20 years before it is replaced by a later seral stage.
GRank & Reasons: G5 (99-05-06). This type is widespread and common throughout its range.
Comments: This type may be an early successional shrubland that matures into *Salix exigua* / Mesic Graminoids Shrubland (CEGL001203), or the two types may be essentially synonymous. This plant association occupies a wide range. Review of the western part of its range is needed to see if the type should be split.

ELEMENT DISTRIBUTION

Range: This sandbar willow shrubland community is found along rivers and streams at lower elevations throughout the northwestern United States and Great Plains, ranging sporadically from Illinois northwest to the Dakotas and Manitoba, west to Washington, and south to Oklahoma.
States/Provinces: AR:S?, IA:S5, ID:S3?, IL?, MB:S?, MT:S5, ND:S?, NE:S4S5, OK:S?, OR:S1, SD:S2, WA:S?, WY:S3Q

ELEMENT SOURCES

Authors: Drake, J. F., WCS
References: Bellah and Hulbert 1974, Evenden 1990, Foti et al. 1994, Hansen et al. 1989, Hansen et al. 1991, Hansen et al. 1995, Hoagland 1997, Kittel and Lederer 1993, Kovalchik 1987, Phillips 1977, Steinauer 1989, Steinauer and Rolfsmeier 1997, The Nature Conservancy 1991, Wilson 1970

SYMPHORICARPOS OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE

Western Snowberry Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Summary: This alliance is found in the northern Great Plains in mesic swales, depressions, ravines and floodplains. Some sites experience intermittent and brief flooding. The soils are fertile and well-drained to imperfectly drained silts and loams (Johnston 1987, Jones 1995). The upper soil horizon is usually deep, although a thin layer of sand may be present if the site has been recently flooded (Jones 1995).^The sites that are in this alliance are dominated by shrubs approximately 1 m tall. Shrub cover is typically greater than 50%, and in places it can approach 100% (Hansen et al. 1984, Hansen and Hoffman 1987, Meyer 1985). These shrubs form dense clumps that exclude most other species. *Symphoricarpos occidentalis* is the most common shrub. *Rhus aromatica* and *Prunus virginiana* can be locally abundant, and both can grow to 2-3 m in places (Hansen et al. 1984). Rarely, scattered small trees are present. These are most often *Fraxinus americana* or *Populus deltoides*. Herbaceous species and smaller shrubs are most abundant at the edge of stands of this alliance and in gaps between the taller shrubs where the shading is less complete. *Rosa woodsii* is a typical smaller shrub. *Achillea millefolium, Artemisia ludoviciana, Galium boreale*, and *Pascopyrum smithii* are common herbaceous species. Woody vines sometimes occur, most commonly *Parthenocissus vitacea*. *Symphoricarpos occidentalis* shrublands often have a significant component of exotic species, especially where grazing has been intense (Hansen and Hoffman 1987, Jones 1995). *Bromus inermis, Cirsium arvense*, and *Poa pratensis* are the most abundant of these exotics. Overgrazing of prairies can lead to the expansion of degraded forms of this alliance.
Environment: The vegetation in this alliance occurs in riparian habitats in the northern Great Plains and in foothill canyons of the Rocky Mountains. Stands are located on terraces above the floodplain of large rivers, on small and intermittent creeks, and on hillsides below springs or seeps. Stands are found between 600-2000 m elevation. Soils are classified as Entisols (Fluvents) or Mollisols (Borolls). Soil textures range from well-drained loamy sands to poorly drained silty clays. The upper soil horizon is relatively thick. The vegetation is tolerant of brief flooding. Adjacent riparian vegetation includes *Acer negundo, Fraxinus pennsylvanica, Populus deltoides*, or *Populus angustifolia* woodlands and *Alnus incana, Salix exigua*, and *Shepherdia argentea* shrublands.

Vegetation: The vegetation in this alliance occurs in riparian habitats in the northern Great Plains and in foothill canyons of the Rocky Mountains. Stands are located along large rivers and small and intermittent creeks, and on hillsides below springs or seeps. *Symphoricarpos occidentalis* dominates the shrub canopy and occurs in large, thick patches or in narrow bands parallel to the stream channel. Dense thickets exclude other shrub species, but more open stands have *Prunus virginiana, Rhus aromatica*, and *Rosa* spp. Occasionally small trees are present, such as *Acer negundo, Fraxinus americana, Fraxinus pennsylvanica* or *Populus deltoides*. Native and exotic herbaceous species are present in the understory with sparse to moderate cover. Herbaceous species include *Achillea millefolium, Artemisia ludoviciana, Bromus inermis, Bromus tectorum, Cirsium arvense, Galium boreale, Glycyrrhiza lepidota, Pascopyrum smithii*, and *Poa pratensis*. Woody vines sometimes occur, most commonly *Parthenocissus vitacea*.
Dynamics:
Comments: This alliance may grade into *Fraxinus pennsylvanica - (Ulmus americana)* Woodland Alliance (A.629) or *Populus deltoides* Temporarily Flooded Woodland Alliance (A.636). Some communities within the latter woodland alliances contain significant amounts of *Symphoricarpos occidentalis* and may be difficult to distinguish from the shrubland where the two meet. This alliance includes grassland areas that are near or between shrub-covered areas. Establishing the boundaries between this alliance and surrounding grasslands is problematic and may be somewhat arbitrary.

SYMPHORICARPOS OCCIDENTALIS SHRUBLAND
Western Snowberry Shrubland

ELEMENT CONCEPT
Summary: This western snowberry shrubland is found in the western tallgrass and northern Great Plains of the United States and Canada. Stands occur in mesic depressions and swales, typically surrounded by upland grassland communities. The soils are silts and loams. This type has three distinct vegetation layers, a shrub layer (approximately 80 cm tall), a graminoid-dominated layer (approximately 30 cm tall), and a forb-dominated layer (<20 cm tall). *Symphoricarpos occidentalis* is the predominant species in the shrub layer and at times forms almost monospecific stands. *Rosa woodsii* commonly occurs interspersed with the *Symphoricarpos occidentalis*. Other shrubs, such as *Rhus aromatica* and *Prunus virginiana*, often occur as thickets on the fringe of this community. *Rhus aromatica* and *Prunus virginiana* can reach 2 m or more. The herbaceous layer is poorly represented where the shrubs are dense, although *Poa pratensis* occurs in many stands. Common forbs include *Artemisia ludoviciana, Solidago* spp., and *Achillea millefolium*. Vines, such as *Parthenocissus vitacea*, are often found climbing through the shrubs. This type is frequently observed in heavily grazed meadows and prairies.
Environment: This community is found in mesic swales, depressions, ravines and floodplains. Some examples of this community experience intermittent and brief flooding. The soils are fertile and well-drained to imperfectly drained silts and loams. The upper soil horizon is usually deep, although a thin layer of sand may be present if the site has been recently flooded (Jones 1995).
Vegetation: Throughout its range this community is dominated by shrubs approximately 1 m tall. Shrub cover is typically greater than 50%, and in places it can approach 100%. These shrubs form dense clumps that exclude most other species. *Symphoricarpos occidentalis* is the most common shrub, but *Rhus aromatica* (or *Rhus trilobata*) and *Prunus virginiana* can be locally abundant and can grow to 2-3 m in places. *Toxicodendron rydbergii* may also be present. Herbaceous species and smaller shrubs are most abundant at the edges of this community and in gaps between the clumps of taller shrubs where the shading is less complete. *Rosa woodsii* is a typical smaller shrub. Common graminoids include *Pascopyrum smithii* and *Poa pratensis*. *Achillea millefolium, Artemisia ludoviciana, Galium boreale*, and *Solidago* spp. are common forbs of this community. Woody vines sometimes occur, including *Parthenocissus vitacea*.
Dynamics: Stands may occasionally be flooded (Jones 1995). *Symphoricarpos occidentalis* seems to thrive in disturbed areas (Hansen and Hoffman 1988), especially those subject to disturbance by fire and cattle grazing.
GRank & Reasons: G4G5 (96-02-01). This type is common throughout the northern Great Plains. Historically, it may never have been very extensive. It has been observed to grow out from forest or woodland edges and shade out the grasses. It is tolerant of both grazing and fire (Hansen and Hoffman 1988), and is under no threat from human activities. In some cases, heavily grazed pastures may favor this types. Many examples are somewhat weedy; thus the type is not demonstrably secure.
Comments: This type often occurs in heavily disturbed areas in conjunction with exotic species such as *Poa pratensis* and *Cirsium arvense*. Because it occurs in mesic swales, depressions, ravine bottoms and floodplains, some stands are occasionally flooded whereas others are just very moist. Thus it tends to fall on both sides of the upland/wetland division.

ELEMENT DISTRIBUTION
Range: This western snowberry shrubland is found in the western tallgrass and northern Great Plains of the United States and Canada.

States/Provinces: CO:S3, IA?, MB?, MT:S4S5, ND:S4?, NE:S4, SD:SU, SK:S?, WY:SR

ELEMENT SOURCES

Authors: Drake, J. F., WCS
References: Christy 1973, Clark 1977b, Clark et al. 1980, Hansen et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Johnston 1987, Jones 1992, Jones and Walford 1995, Kittel et al. 1994, Kittel et al. 1999, McAdams et al. 1998, Meyer 1985, Steinauer and Rolfsmeier 1997

Seasonally flooded cold-deciduous shrubland

SALIX BOOTHII SEASONALLY FLOODED SHRUBLAND ALLIANCE

Booth's Willow Seasonally Flooded Shrubland Alliance

ALLIANCE CONCEPT

Summary: This widespread alliance occurs throughout much of the western U.S. at elevations from 1320-2800 m. Sites include valley bottoms on swales, banks, and occasionally terraces of stream channels which receive surface water for extended periods of time, especially during the early part of the growing season. Stands adjacent to the stream channel receive moisture from overland and lateral stream flows, and are often associated with beaver ponds. Stands occur on terraces that have a continually high water table. Vegetation in the alliance is also located adjacent to seeps on gently sloping toeslopes, and occasionally in bogs or fens. Soils generally have a deep organic layer with some minerals, fine sands, loams, and clays and gravel or cobbles below. Communities within this shrubland alliance are characterized by a moderately dense to dense *Salix boothii*-dominated tall-shrub layer. Other shrubs may codominate, including *Salix geyeriana, Salix planifolia* or *Salix drummondiana*. *Salix wolfii* may occasionally form a relatively sparse, low-shrub layer. Other shrubs may include *Lonicera involucrata, Betula nana (= Betula glandulosa)*, and*Ribes* spp. The moderately dense to dense herbaceous layer is dominated by graminoids and includes *Carex aquatilis, Carex utriculata, Carex nebrascensis, Deschampsia caespitosa, Juncus balticus*, and *Trisetum wolfii*. Forb cover is sparse to moderately dense. Common forbs are *Symphyotrichum foliaceum (= Aster foliaceus), Hedysarum sulphurescens, Geum macrophyllum, Mertensia ciliata, Trollius laxus*, and *Urtica dioica*. Diagnostic of this wetland alliance is a *Salix boothii*-dominated or -codominated tall shrubland that is flooded for extended periods during the growing season.
Environment: Vegetation types in the *Salix boothii* Seasonally Flooded Shrubland Alliance (A.1001) occur in valley bottoms on swales, banks, and occasionally terraces of stream channels which receive surface water for extended periods of time, especially during the early part of the growing season. Stands adjacent to the stream channel receive moisture from overland and lateral stream flows, and are often associated with beaver ponds. Stands occur on terraces which have a continually high water table. Vegetation in the alliance is also located adjacent to seeps on gently sloping toeslopes, and occasionally in bogs or fens. Elevation ranges from 1320-2800 m. ^Organic soils develop from the accumulation of fine materials on ponded or previously ponded sites. The upper soil layers generally contain a deep organic layer with some minerals, fine sands, loams, and clays. Some mottling is evident. The lower layers are gravel or cobble. Soils are typically saturated at or near the surface. ^Mixed conifer-*Populus tremuloides* and *Populus tremuloides* forests occur on adjacent hillslopes at higher elevations, and *Artemisia tridentata* scrub occurs on adjacent hillsides at lower elevations.
Vegetation: Communities within this alliance are characterized as seasonally flooded cold-deciduous shrublands. The tall-shrub layer is dominated by *Salix boothii*. Several stands are codominated (35-50% cover) by *Salix geyeriana, Salix planifolia* or *Salix drummondiana*. *Salix wolfii* may occasionally form a sparse (20-30% cover), low-shrub layer. Other shrubs, *Lonicera involucrata, Betula nana (= Betula glandulosa), Ribes oxyacanthoides ssp. setosum (= Ribes setosum)*, or *Ribes inerme*, may also be present with 10-25% cover. The undergrowth is characterized by a graminoid layer of 40-60% cover and includes *Carex aquatilis, Carex utriculata, Carex nebrascensis, Deschampsia caespitosa, Juncus balticus*, and *Trisetum wolfii*. Forb cover is typically 10-25% cover. Forbs include *Symphyotrichum foliaceum (= Aster foliaceus), Hedysarum sulphurescens, Geum macrophyllum, Mertensia ciliata, Trollius laxus*, and *Urtica dioica*.
Dynamics: Stands within this alliance are dominated by *Salix boothii*, which is often highly productive. Understory production varies, depending on the density of overstory shrubs. Thick shrub stands make access by livestock difficult, therefore this alliance is resistant to grazing effects.
Comments:

SALIX BOOTHII / CALAMAGROSTIS CANADENSIS SHRUBLAND
Booth's Willow / Bluejoint Shrubland

ELEMENT CONCEPT

GRank & Reasons: G3G4Q (96-02-01).

ELEMENT DISTRIBUTION

States/Provinces: CO:S2S3, ID:S3, MT:SR, NV:S?, UT:S2?, WY:S2?

ELEMENT SOURCES

Authors: WCS
References: Mutz and Graham 1982, Mutz and Queiroz 1983, Norton et al. 1981, Padgett et al. 1988, Tuhy and Jensen 1982, Youngblood et al. 1985

SALIX GEYERIANA SEASONALLY FLOODED SHRUBLAND ALLIANCE

Geyer's Willow Seasonally Flooded Shrubland Alliance

ALLIANCE CONCEPT

Summary: Communities within this temporarily flooded, cold-deciduous shrubland alliance occur from the foothills to high elevations in the mountains of the western United States. Elevation ranges from 1320-2900 m. Landforms include broad benches and alluvial terraces of streams, springs, and seeps. Stands often develop on abandoned and sediment-filled beaver ponds. Soils are composed of deep, fine-textured alluvium over subsurface soils of various textures and origin. Surface textures are silt to silty clay loam with mottling near the surface. Soils have a high water-holding capacity. Organic matter may accumulate on the surface. The communities are characterized by a tall-shrub layer dominated by *Salix geyeriana*. Occasional codominants include *Salix monticola, Salix boothii, Salix lemmonii*, or *Salix eriocephala*. Some stands have shorter willows in the understory, including *Salix wolfii* and *Salix planifolia*. Other shrub species include *Lonicera utahensis, Dasiphora fruticosa ssp. floribunda (= Pentaphylloides fruticosa)*, and *Ribes* spp. *Calamagrostis canadensis, Calamagrostis stricta, Poa palustris, Deschampsia caespitosa, Carex aquatilis*, and *Carex utriculata* are the dominant graminoid species with 10-60% cover. The forb layer is minor with 10-20% cover and includes *Geum macrophyllum, Pyrola asarifolia, Galium trifidum*, and *Epilobium ciliatum*. *Populus tremuloides, Pinus contorta*, and *Pinus ponderosa* forests occur on surrounding hillslopes.
Environment: Communities within this alliance occur from the foothills to high elevations in the mountains of the western United States. Elevation ranges from 1320-2900 m. Landforms include broad benches and alluvial terraces of streams, springs, and seeps. Stands often develop on abandoned and sediment-filled beaver ponds. Soils are composed of deep, fine-textured alluvium over subsurface soils of various textures and origin. Surface textures are silt to silty clay loam with mottling near the surface. Soils have a high water-holding capacity. Organic matter may accumulate on the surface. ^*Populus tremuloides, Pinus contorta*, and *Pinus ponderosa* forests occur on surrounding hillslopes.
Vegetation: Communities within this alliance are classified as temporarily flooded cold-deciduous shrublands. The communities are characterized by a tall-shrub layer dominated by *Salix geyeriana*. Occasional codominants include *Salix monticola, Salix boothii, Salix lemmonii* or *Salix eriocephala*. Some stands have shorter willows in the understory, including *Salix wolfii* and *Salix planifolia*. Other shrub species include *Lonicera utahensis, Dasiphora fruticosa ssp. floribunda (= Pentaphylloides fruticosa)*, and *Ribes* spp. *Calamagrostis canadensis, Calamagrostis stricta, Poa palustris, Deschampsia caespitosa, Carex aquatilis*, and *Carex utriculata* are the dominant graminoid species with 10-60% cover. The forb layer is minor with 10-20% cover and includes *Geum macrophyllum, Pyrola asarifolia, Galium trifidum*, and *Epilobium ciliatum*.
Dynamics: Characteristics of the herbaceous layer and soils suggest that many of the vegetation types within this alliance are stable (Youngblood et al. 1985). However, livestock grazing pressure will cause a decrease in the native graminoids (Hansen et al. 1995).
Comments:

SALIX GEYERIANA / CAREX UTRICULATA SHRUBLAND

Geyer's Willow / Beaked Sedge Shrubland

ELEMENT CONCEPT

Summary: In Colorado, this riparian shrubland occurs often on wet soils, that are saturated throughout much of the growing season. Stands have a 1.5- to 2.5-m tall, nearly closed canopy that is dominated by the deciduous shrub *Salix geyeriana* with a thick carpet of graminoids in the undergrowth that is dominated by *Carex utriculata*. Information on stands that occur outside Colorado will be added later.
GRank & Reasons: G5 (96-02-01).

ELEMENT DISTRIBUTION

States/Provinces: CO:S3, ID:S4, MT:S5, NV:SR, OR:S2, UT:S2S3, WY:SR

ELEMENT SOURCES

Authors: WCS
References: Hansen et al. 1991, Hansen et al. 1995, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1999, Mutz and Queiroz 1983, Padgett et al. 1989, Tuhy and Jensen 1982, Youngblood et al. 1985

SALIX PLANIFOLIA SEASONALLY FLOODED SHRUBLAND ALLIANCE

Planeleaf Willow Seasonally Flooded Shrubland Alliance

ALLIANCE CONCEPT

Summary: Communities within the *Salix planifolia* Seasonally Flooded Shrubland Alliance (A.1008) are common and abundant in the upper montane and subalpine zones (above 1525 m) throughout the western United States. They occur in wide, wet valleys on snowmelt-fed swales. They also occur in narrow valleys with sinuous streams and wet floodplains associated with beaver ponds. Snowmelt is the primary source of moisture during the growing season. Soils have an organic peat top layer over mineral silty clays, heavy silty clay loams, silty loams, sandy loams, or loamy sands. Mottling is often evident. The water table at several stands is usually near the surface throughout the growing season and may be perched by a clay horizon. Still other stands occur on deep, dark clay loams with high organic content or a fibric or hemic layer on top. Soil pH levels are acidic, ranging from 4.8-7.8. *Salix planifolia* dominates the shrub layer with at least 70% cover. Other willows can include *Salix monticola, Salix wolfii, Salix boothii, Salix geyeriana*, and *Salix drummondiana*. The undergrowth is dominated by graminoids and can include *Carex aquatilis, Carex utriculata, Calamagrostis canadensis*, and *Deschampsia caespitosa*. Forb cover is typically less than 20% of the total undergrowth cover and may include *Caltha leptosepala, Cardamine cordifolia*, and *Pedicularis groenlandica*. Adjacent riparian and wetland vegetation includes *Carex aquatilis, Carex utriculata*, or *Calamagrostis canadensis* wet meadows. *Salix brachycarpa* shrublands occur on higher ground. At higher elevations, *Abies lasiocarpa - Picea engelmannii* or *Pinus contorta* forests occur on adjacent hillsides.
Environment: Communities within the *Salix planifolia* Seasonally Flooded Shrubland Alliance (A.1008) are common and abundant in the upper montane and subalpine zones (above 1525 m) throughout the western United States. They occur in wide, wet valleys on snowmelt-fed swales. They also occur in narrow valleys with sinuous streams and wet floodplains associated with beaver ponds. Snowmelt is the primary source of moisture during the growing season. Soils have an organic peat top layer over mineral silty clays, heavy silty clay loams, silty loams, sandy loams, or loamy sands. Mottling is often evident. The water table at several stands is usually near the surface throughout the growing season and may be perched by a clay horizon. Still other stands occur on deep, dark clay loams with high organic content or a fibric or hemic layer on top (Kittel et al. 1999). Soil pH levels are acidic, ranging from 4.8-7.8 (Komarkova 1986). ^Adjacent riparian and wetland vegetation includes *Carex aquatilis, Carex utriculata*, or *Calamagrostis canadensis* wet meadows. *Salix brachycarpa* shrublands occur on higher ground. At higher elevations, *Abies lasiocarpa - Picea engelmannii* or *Pinus contorta* forests occur on adjacent hillsides.
Vegetation: Communities within this alliance are characterized as seasonally flooded, cold-deciduous shrublands. *Salix planifolia* dominates the shrub layer with at least 70% cover. Other willows can include *Salix monticola, Salix wolfii, Salix boothii, Salix geyeriana*, and *Salix drummondiana*. The undergrowth is dominated by graminoids and can include *Carex aquatilis, Carex utriculata, Calamagrostis canadensis*, and *Deschampsia caespitosa*. Forb cover is typically less than 20% of the total undergrowth cover and may include *Caltha leptosepala, Cardamine cordifolia*, and *Pedicularis groenlandica*.
Dynamics: *Carex utriculata, Carex aquatilis*, and *Calamagrostis canadensis* are dominant understory species of several *Salix* alliances. These graminoids indicate different microenvironments within the *Salix* communities (Padgett et al. 1989) and may represent different stages of succession of the floodplain (Cooper 1986a). *Carex utriculata, Carex aquatilis*, and *Calamagrostis canadensis* separate out along a moisture gradient related to the depth of the water table at a particular site. *Carex utriculata* occurs on the wettest sites, such as low-lying swales, with the highest water tables. *Carex aquatilis* occurs on intermediate sites. *Calamagrostis canadensis* dominates the driest sites with the lowest water tables and often colonizes clumps of *Carex utriculata* and *Carex aquatilis* (Cooper 1986a). ^Floodplain aggradation, or build up, can result in a change in species composition over time. Late spring snowmelt and long periods of summer rain cause upper elevation streams to overflow their banks. Sediments are deposited on the floodplain, raising the surface higher above the water table (Cooper 1986a). As aggradation of the floodplain proceeds and the site becomes less saturated, the dominant graminoid understory can change from *Carex utriculata* to *Carex aquatilis* to *Calamagrostis canadensis*.
Comments:

SALIX (FARRIAE, PLANIFOLIA) / CAREX UTRICULATA SHRUBLAND
(Farr's Willow, Planeleaf Willow) / Beaked Sedge Shrubland

ELEMENT CONCEPT

GRank & Reasons: G3 (00-05-03).

ELEMENT DISTRIBUTION

States/Provinces: BC?, ID:S3, WA:S2?

ELEMENT SOURCES

Authors: WCS
References: Kovalchik 1993, Mutz and Queiroz 1983

SALIX PLANIFOLIA / CAREX AQUATILIS SHRUBLAND
Planeleaf Willow / Aquatic Sedge Shrubland

ELEMENT CONCEPT

Summary: In Colorado, this low-statured willow shrubland occurs in wet to saturated soils above 2800 m. It is a common plant association of subalpine glacial valleys. Stands have a deciduous shrub canopy is dominated by *Salix planifolia* with and herbaceous layer dominated by *Carex aquatilis*. *Salix planifolia* occasionally mixes with *Salix brachycarpa* or *Salix wolfii* at higher elevations and grades into taller willow carrs with *Salix monticola* at lower elevations. ^Information on stands that occur outside Colorado will be added later.
GRank & Reasons: G5 (96-02-01).

ELEMENT DISTRIBUTION

States/Provinces: CO:S4, ID:S4, MT:S3, UT:S2S3, WY?

ELEMENT SOURCES

Authors: WCS
References: Baker 1989a, Cooper and Cottrell 1990, Hansen et al. 1988, Hansen et al. 1991, Hansen et al. 1995, Hess 1981, Hess and Wasser 1982, Jensen and Tuhy 1981, Johnston 1987, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kittel et al. 1999, Komarkova 1986, Lewis 1970, Mattson 1984, Mutz and Queiroz 1983, Padgett et al. 1988, Padgett et al. 1989, Terwilliger et al. 1979

Medium-tall sod temperate or subpolar grassland

PASCOPYRUM SMITHII HERBACEOUS ALLIANCE
Western Wheatgrass Herbaceous Alliance

ALLIANCE CONCEPT

Summary: This alliance is common and widespread in the Great Plains, especially the northern portions, and parts of the Great Basin. The communities in it range from dry or dry-mesic to wet-mesic. Mid grasses are the dominant vegetation in most communities, although short grasses and sedges can be codominant. The vegetation tends to be denser where the mid grasses are predominant and more open where shorter graminoids are abundant (e.g., Hansen and Hoffman 1988, USFS 1992). The mid grasses grow to 0.5-1.0 m on favorable sites, while the short grasses and sedges are less than 0.5 m tall (Weaver and Albertson 1956). The most abundant midgrass is *Pascopyrum smithii*. Common associates include *Hesperostipa comata (= Stipa comata), Nassella viridula, Koeleria macrantha, Schizachyrium scoparium, Hesperostipa spartea (= Stipa spartea)*, and *Poa* spp. In the drier communities of this alliance *Bouteloua gracilis* is the most common shortgrass. Other short graminoids typically found in the drier communities include *Carex inops ssp. heliophila, Carex duriuscula (= Carex eleocharis), Carex filifolia*, and *Bouteloua curtipendula* (in the northern portion of this alliance's range), *Aristida purpurea*, and *Buchloe dactyloides* (in the southern half of this alliance's range). In the wetter communities within this alliance, *Distichlis spicata, Hordeum jubatum, Elymus trachycaulus*, and *Iva annua* are common. Forbs and shrubs are generally minor components of communities within this alliance. If shrubs are present they are rarely taller than 1 m. Some forbs that are usually scattered about are *Gaura coccinea, Sphaeralcea coccinea, Amorpha canescens, Astragalus* spp., and *Tragopogon dubius*. Shrubs include *Symphoricarpos occidentalis, Artemisia cana, Artemisia frigida*, and *Opuntia* spp. ^Communities within this alliance occur on several different soil types (Hanson and Whitman 1938, Johnston 1987, USFS 1992). The soil is most often

clay or clay loam, however. it can be loam or sandy loam. In the east and central part of this alliance's range, these communities can be found on flat or rolling uplands, hillslopes, or along streams or depressions. In the western part of this alliance's range, its communities are found where local conditions are wetter than the average. This includes such areas as the base of slopes or along rivers or streams (Weaver and Albertson 1956, Jones 1992).

Environment: Grasslands included in this alliance occur across the Great Plains, on several different soil types (Hanson and Whitman 1938, Johnston 1987, USFS 1992). The soil is most often clay or clay loam, however it can be loam or sandy loam. In the eastern and central part of this alliance's range, these communities can be found on flat or rolling uplands, hillslopes, or along streams or depressions. In the western part of this alliance's range, communities are found where local conditions are wetter than the average. This includes such areas as the base of slopes or along rivers or streams (Weaver and Albertson 1956, Jones 1992).

Vegetation: This alliance is common and widespread in the Great Plains, especially the northern portions, and parts of the Great Basin. These communities range from dry or dry-mesic to wet-mesic. Mid grasses are the dominant vegetation in most communities, although short grasses and sedges can be codominant. The vegetation tends to be denser where the mid grasses are predominant and more open where shorter graminoids are abundant (e.g., Hansen and Hoffman 1988, USFS 1992). The mid grasses grow to 0.5-1.0 m on favorable sites, while the short grasses and sedges are less than 0.5 m tall (Weaver and Albertson 1956). The most abundant midgrass is *Pascopyrum smithii*. Common associates include *Hesperostipa comata (= Stipa comata), Elymus trachycaulus, Nassella viridula, Koeleria macrantha, Schizachyrium scoparium, Hesperostipa spartea (= Stipa spartea)*, and *Poa* spp. In the drier communities of this alliance *Bouteloua gracilis* is the most common shortgrass. Other short graminoids typically found in the drier communities include *Carex inops ssp. heliophila, Carex duriuscula (= Carex eleocharis), Carex filifolia*, and *Bouteloua curtipendula* (in the northern portion of this alliance's range), *Aristida purpurea* and *Buchloe dactyloides* (in the southern half of this alliance's range). In the wetter communities within this alliance *Distichlis spicata, Hordeum jubatum, Elymus trachycaulus*, and *Iva annua* are common. Forbs and shrubs are generally minor components of communities within this alliance. If shrubs are present they are rarely taller than 1 m. Some forbs that are usually scattered about are *Gaura coccinea, Sphaeralcea coccinea, Amorpha canescens, Astragalus* spp., and *Tragopogon dubius*. Shrubs include *Symphoricarpos occidentalis, Artemisia cana, Artemisia frigida*, and *Opuntia* spp.

Dynamics: *Pascopyrum smithii* is rhizomatous and is tolerant of moderate grazing. If severely over-grazed, *Pascopyrum smithii* will decline and may be replaced by less desirable warm season grasses and exotic species such as *Poa pratensis*.

Comments: *Pascopyrum smithii* is a common constituent in many communities in the Great Plains. Its presence in so many communities can make it difficult to distinguish communities within this alliance from other dry-mesic midgrass communities in other alliances. The dominance of *Pascopyrum smithii* is typically a good diagnostic feature. Stands that have other species as codominants or even dominants may be difficult to classify. These stands will most likely be similar to stands within the *Bouteloua gracilis* Herbaceous Alliance (A.1282), *Hesperostipa comata* Bunch Herbaceous Alliance (A.1270), *Distichlis spicata - (Hordeum jubatum)* Temporarily Flooded Herbaceous Alliance (A.1341), or *Distichlis spicata* Intermittently Flooded Herbaceous Alliance (A.1332). Associations in this alliance differ from those in the *Hesperostipa comata - Bouteloua gracilis* Herbaceous Alliance (A.1234) in having cover of *Pascopyrum smithii* exceeding that of *Hesperostipa comata*. In some stands of this association, *Distichlis spicata* may dominate, but contribution of at least 25% of the canopy cover by *Pascopyrum smithii* is diagnostic; stands with <25% of the cover contributed by *Pascopyrum smithii* belong to the *Distichlis spicata* alliance. In general a stand must have at least 25% cover of *Pascopyrum smithii* to be included in this alliance.

PASCOPYRUM SMITHII HERBACEOUS VEGETATION

Western Wheatgrass Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This midgrass prairie type is found in the northern and western Great Plains, Rocky Mountains, and western basins of the United States and possibly Canada. Stands occur on level to gently sloping terrain. They are sometimes found on alluvial fans. The soils are clay, clay loam, and silt loam. The dominant mixedgrass species grow to approximately 1 m. *Pascopyrum smithii* may have as much as 50% coverage. Other grasses that co-occur and may achieve local dominance are *Koeleria macrantha* and *Poa* spp. Many other species common in midgrass prairies are also found in this community. These include *Artemisia ludoviciana, Bouteloua gracilis, Nassella viridula*, and *Hesperostipa comata (= Stipa comata)*. This community is similar to several others that have significant amounts of *Pascopyrum smithii*. Further work needs to be done to better define the diagnostic characteristics of this community.

Environment: This community occurs on flat to gently sloping topography. Soils are clay, clay loam, and silt loam. It is sometimes found on alluvial fans of small streams. The soils are deep (40-100 cm) and well-developed.

Vegetation: This is a midgrass community. Shrubs are rare. The dominant species grow to approximately 1 m. *Pascopyrum smithii* is the only constant dominant species and may have 50% cover. Other species such as *Koeleria*

macrantha and *Poa* spp. may be locally abundant. Many other species common in midgrass prairies are also found in this community. These include *Artemisia ludoviciana, Bouteloua gracilis, Nassella viridula*, and *Hesperostipa comata (= Stipa comata)*.
GRank & Reasons: G3G5Q (96-02-01).
Comments: This community is similar to several others that are dominated or codominated by *Pascopyrum smithii*. As currently defined, it represents a western Great Plains and foothills version of the western wheatgrass types in the central Great Plains. Further work needs to be done to refine the differences in composition and environmental characteristics. See recent descriptions by Thilenius et al. (1995, *Pascopyrum smithii* sodgrass steppe, a more playa-like wheatgrass type) and by Steinauer and Rolfsmeier (1997). In Nebraska, Steinauer and Rolfsmeier (1997) suggest that their stands may resemble *Pascopyrum smithii - Nassella viridula* Herbaceous Vegetation (CEGL001583).

ELEMENT DISTRIBUTION

Range: This midgrass prairie type is found in the northern and western Great Plains, Rocky Mountains and western basins of the United States and possibly Canada, ranging from North Dakota and possibly Saskatchewan, south to Nebraska and Colorado, west to Utah, and north to Idaho.
States/Provinces: CO:S1?, ID:S1Q, MT:S4, NE:S?, SD:S?, SK:S?, UT:S3S5, WY:S4Q

ELEMENT SOURCES

Authors: Drake, J. F., WCS
References: Aldous and Shantz 1924, Baker 1983c, Baker and Kennedy 1985, Bunin 1985, Christensen and Welsh 1963, Godfread 1994, Hansen et al. 1991, Marr and Buckner 1974, Ramaley 1916, Ramaley 1919, Ramaley 1942, Shanks 1977, Soil Conservation Service 1978, Thilenius et al. 1995

Intermittently flooded temperate or subpolar grassland

DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE

Saltgrass Intermittently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Summary: This alliance occurs throughout much of the semi-arid and arid western U.S. in lowland sites such as playas, swales and terraces along washes that are intermittently flooded. The flooding is usually the result of highly localized thunderstorms. The unpredictable nature of the flooding is the key environmental factor separating this alliance from similar alliances with more predictable flooding regimes. Soils are deep, saline, alkaline and fine-textured. They generally have an impermeable layer and therefore are poorly drained. When the soil is dry, the surface usually has salt accumulations. This intermittently flooded grassland of playas and ephemeral streams has a sparse to dense herbaceous layer that is dominated by *Distichlis spicata*, sometimes occurring in nearly pure stands. The level of salinity in the soil may restrict associated species. Associated graminoids may include *Puccinellia nuttalliana, Hordeum jubatum, Pascopyrum smithii, Sporobolus airoides, Carex filifolia*, and *Juncus balticus*. Forb cover is generally low and may include *Salicornia rubra, Triglochin maritima, Suaeda calceoliformis (= Suaeda depressa), Helianthus* spp., and *Aster* spp. Diagnostic of this alliance is the *Distichlis spicata*-dominated herbaceous layer and the presence of surface water for brief periods at unpredictable times during the growing season.
Environment: Grasslands in this western alliance occur in lowland habitats such as playas, swales and terraces along washes that are intermittently flooded. The flooding is usually the result of highly localized thunderstorms which can flood one basin and leave the next dry. The unpredictable nature of the flooding is the key environmental factor separating this alliance from similar alliances with more predictable flooding regimes. Climate is semi-arid to arid. Soil texture ranges from clay loam to sandy clay (Johnston 1987, Redmann 1972). These soils are deep, saline and alkaline. They generally have an impermeable layer and therefore are poorly drained. When the soil is dry, the surface usually has salt accumulations.
Vegetation: Vegetation included in this alliance occurs in lowland sites throughout much of the semi-arid and arid western U.S. This is an intermittently flooded grassland of playas and intermittent and ephemeral streams. Cover is sparse to dense and is dominated by *Distichlis spicata*, occurring in nearly pure stands. Stands have higher diversity and cover during wet years and near boundaries with other vegetation types. Higher soil salinity favors *Distichlis spicata* over less salt-tolerant species. However, very high salinity will dwarf the *Distichlis spicata* and reduce cover. Generally, vegetation height and cover, and species diversity tend to vary inversely with salinity (Ungar 1967, Steinauer 1989). Associated species may be restricted by the level of salinity in the soil. Those from higher soil salinity sites may include the graminoid *Puccinellia nuttalliana* and the forbs *Salicornia rubra, Triglochin maritima*, and *Suaeda calceoliformis (= Suaeda depressa)*. Species from lower salinity sites include the graminoids *Hordeum jubatum, Pascopyrum smithii, Sporobolus airoides, Carex filifolia*, and *Juncus balticus*, and the forbs *Helianthus* spp. and *Aster* spp. (Ungar 1974). Forb cover is generally low. Shrubs are rare, but may include scattered *Atriplex canescens* and *Sarcobatus vermiculatus*.

Dynamics: The intermittent flooding regime combined with high evaporation rate in these dry climates causes accumulations of soluble salts in the soil. Total vegetation cover (density and height), species composition, and soil salinity depend on the amount and timing of precipitation and flooding. Growth-inhibiting salt concentrations are diluted when the soil is saturated allowing the growth of less salt-tolerant species and more robust growth of *Distichlis spicata*. As the saturated soils dry, the salt concentrates until it precipitates on the soil surface (Dodd and Coupland 1966, Ungar 1968). This osmotic stress of growing in alkaline and saline soils is compensated by the accumulation of proline by some halophytic species including *Distichlis spicata*. This aids the plants' water uptake by increasing the osmotic potential of the plant (Shupe et al. 1986). Vegetation forms zones at some saline sites, where species abundance is stratified by salt tolerance (Shupe et al. 1986, Ungar 1969). In playas, the soil salinity at field capacity generally increases from the edge to the center allowing for several different vegetation stands to co-occur (Ungar 1967, 1969, 1970). Microtopography can also affect vegetation structure. Where soil accumulates to form hummocks, less salt- and alkali-tolerant plants can occur (Ungar 1972, Johnson 1987). ^*Distichlis spicata* is rhizomatous and is tolerant of moderate grazing and its roots resist trampling. Although relatively unpalatable, it can provide valuable winter forage for livestock if needed. If grazed heavily, *Distichlis spicata* will decline and may be replaced by less desirable warm-season grasses such as tumblegrass, *Schedonnardus paniculatus* (Costello 1944). Weeds are generally not a problem because few grow well in saline soils.
Comments: The classification of vegetation in this alliance is difficult for two reasons. First, *Distichlis spicata* is a widespread halophytic grass species that dominates or codominates the herbaceous layer of stands classified into many different associations in several different alliances. This results in many closely related associations in other alliances where this grass is a diagnostic species. Secondly, most of these related alliances have an intermittent, temporary, seasonal or tidal flood regime. These flood regimes sometimes separate vegetation that otherwise is very similar. For example, the flood regime that separates this alliance from the *Distichlis spicata - (Hordeum jubatum)* Temporarily Flooded Herbaceous Alliance (A.1341) can be somewhat arbitrary in regions that have large year-to-year variation in precipitation.

DISTICHLIS SPICATA HERBACEOUS VEGETATION
Saltgrass Herbaceous Vegetation

ELEMENT CONCEPT

Summary: These are seasonally and non-seasonally flooded inland saltgrass communities; forb diversity is low. Salinity is likely more important than flooding. Includes all flooded conditions, (temporarily, seasonally, and semipermanently) (in arid western United States where precipitation is seasonally unpredictable and does not produce annual flooding, that is, intermittently flooded AND intermittently exposed, are temporarily(?) included in this alliance). Groundwater wicking to surface and tends to be saturated for long periods, lakeshores. Monotypic dominance is typical with minor species such as *Juncus balticus, Eleocharis palustris, Hordeum jubatum*.
GRank & Reasons: G5 (96-02-01).

ELEMENT DISTRIBUTION

States/Provinces: AZ:S3, CA:S3, CO:S3, ID:S4, MT:S4, NM:S4, NV:S?, OR:S4, SK:S?, UT:S3S5, WA:S1?, WY:S3

ELEMENT SOURCES

Authors: WCS
References: Baker 1984a, Beatley 1976, Brotherson 1987, Bunin 1985, Costello and Turner 1944, Crouch 1961a, Daniels 1911, Daubenmire 1970, Franklin and Dyrness 1973, Graham 1937, Hansen et al. 1991, Hansen et al. 1995, Hyder et al. 1966, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Klipple and Costello 1960, Osborn 1974, Ralston 1969, Ramaley 1942, Rogers 1950a, Rogers 1953, Shanks 1977, Soil Conservation Service 1978, Stearns-Roger Inc. 1978, Tuhy and Jensen 1982, Vestal 1914, Weaver and Albertson 1956

Seasonally flooded temperate or subpolar grassland

CALAMAGROSTIS CANADENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE

Bluejoint Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Summary: This alliance is found throughout the northern states of the United States, excluding the Great Plains states. It is a wide-ranging alliance with much variability in species composition and habitat. Stands of this alliance have a dense graminoid cover, generally over 1 m tall, with either a flat or tussocky microtopography. Tall shrubs may occupy

as much as 25% cover. *Calamagrostis canadensis* is the characteristic dominant but can be associated with *Phalaris arundinacea* or a variety of Carices. Other associates include, in the Northeast, shrubs such as *Viburnum nudum, Alnus incana*, or *Alnus serrulata, Viburnum dentatum, Spiraea alba*, and graminoids such as *Agrostis gigantea (= Agrostis alba)*. In the Midwest, typical associates include several Carices, such as *Carex stricta, Carex rostrata*, or *Carex lacustris*, and occasionally *Poa palustris* or *Glyceria grandis* (Harris et al. 1996). The ground layer can be a heavy mat of grass stems and leaves, with patches of bare soil present in wetter locations. ^The habitat of this alliance is typically mineral soil or well-decomposed peat, usually held together by a dense root mat. Stands are found in floodplains of small streams, beaver meadows, and lakeshores. The hydrology is typically seasonally flooded (Harris et al. 1996). In the southern Appalachians of Tennessee and Virginia, this vegetation occurs in depression meadows and occasionally in beaver ponds.

Environment: This is a very wide-ranging alliance, found from coast-to-coast of the conterminous United States. Stands are found in wet meadows, basins, moist forest openings, broad glaciated valleys, floodplains of small streams, silted-in beaver ponds, on alluvial benches, terraces, or point bars, and on lake- or pond-shores. If along streams, they are typically small and low-gradient, and if found in depressions or meadows, slopes are flat to gentle. The elevation range is large, from near sea level in the eastern part of its range to well over 3500 meters in the Rocky Mountains, where it occurs from mid-montane into lower alpine zones. ^The hydrology is typically seasonally flooded (Harris et al. 1996), with spring flooding common. Soils commonly remain moist throughout the growing season. Parent materials include coarse-textured alluvium or sediments, or well-decomposed peat, usually held together by a dense root mat. Soil textures range from clay loam to sands, and sometimes are over subhorizons of coarse fragment-rich buried streambeds (Crowe and Clausnitzer 1997, Hansen et al. 1995). There is usually an organic surface horizon.

Vegetation: This alliance is found throughout the northern states of the United States, excluding the Great Plains states. Stands of this alliance have a dense graminoid cover, generally over 1 m tall, with either a flat or tussocky microtopography. Tall shrubs may occupy as much as 25% cover. *Calamagrostis canadensis* is the characteristic dominant, in some stands forming a near monoculture. It can also be associated with *Phalaris arundinacea* or a variety of *Carex* species. In the northeast of its range, other associates include shrubs such as *Viburnum nudum, Alnus incana*, or *Alnus serrulata, Viburnum dentatum, Spiraea alba* and graminoids such as *Agrostis gigantea (= Agrostis alba)*. In the Midwest, typical associates include several Carices, such as *Carex stricta, Carex rostrata*, or *Carex lacustris*, and occasionally *Poa palustris* or *Glyceria grandis* (Harris et al. 1996). The ground layer can be a heavy mat of grass stems and leaves, with patches of bare soil present in wetter locations. ^In the Rocky Mountains, this alliance is characterized by a dense cover of *Calamagrostis canadensis*. One or more of several *Carex* species can be present, including *Carex aquatilis, Carex scopulorum*, or *Carex utriculata*. Other graminoids that may be abundant in some stands include *Deschampsia caespitosa, Scirpus microcarpus, Glyceria* spp., *Elymus glaucus*, and *Poa* spp. Forb cover is typically minor, but may include *Cardamine cordifolia, Senecio triangularis, Epilobium* spp., *Achillea millefolium, Heracleum maximum (= Heracleum lanatum), Ligusticum* spp., *Aster* spp., *Mertensia ciliata*, or *Veronica* spp. Woody species are uncommon, although species of *Salix, Lonicera involucrata, Rubus idaeus*, or *Cornus sericea* may be present.

Dynamics: *Calamagrostis canadensis* is an aggressive invader of recently burned sites. In the Rocky Mountains, *Calamagrostis canadensis* meadows appear to be long-lived, mid-seral vegetation types. In Utah and Colorado, stands of this alliance often occur adjacent to *Pinus contorta*-dominated communities. When there is tree mortality due to bark beetle infestations, the water table rises as a result of less evapotranspiration. Increased available soil moisture allows for the expansion of *Calamagrostis canadensis*-dominated communities at the meadow/forest ecotone (Padgett et al. 1989).

Comments: Where *Calamagrostis* occurs in relatively pure stands or with a variety of forbs as codominants, stands can be assigned relatively confidently to this alliance. However, stands that are codominated by *Carex* species may overlap in composition with alliances such as V.A.5.N.k *Carex stricta* Seasonally Flooded Herbaceous Alliance (A.1397) or V.A.5.N.k *Carex lacustris* Seasonally Flooded Herbaceous Alliance (A.1367). These relationships require further study, as does the very broad range of the alliance, which currently stretches from California to Maine.

CALAMAGROSTIS CANADENSIS WESTERN HERBACEOUS VEGETATION
Bluejoint Western Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This type occurs widely throughout mountainous areas of the western United States and probably into Canada. In Colorado, these grasslands are a relatively small, meadow association that occurs in broad glaciated valleys, openings in moist forests, silted-in beaver ponds, and narrow floodplains of lower montane canyons. It generally has few shrubs and fairly dense cover of grasses dominated by *Calamagrostis canadensis*. ^Information on stands outside of Colorado will be added later.

Environment: These grasslands are a relatively small, meadow association that occurs in broad glaciated valleys, openings in moist forests, silted-in beaver ponds, and narrow floodplains of lower montane canyons.

Vegetation: The vegetation has few shrubs and contains a fairly dense cover of grasses dominated by *Calamagrostis canadensis*.
GRank & Reasons: G4 (00-04-26).

ELEMENT DISTRIBUTION

Range: This type occurs widely throughout mountainous areas of the western United States and probably into Canada.
States/Provinces: BC?, CA:S?, CO:S4, ID:S4, MT:S4, ND:S?, OR:S3S4, SD:S?, UT:S2S3, WA:S3S4, WY:S2

ELEMENT SOURCES

Authors: D. Faber-Langendoen, WCS
References: Cooper 1986a, Cooper and Cottrell 1990, Crowe and Clausnitzer 1997, Gysel 1960, Hansen et al. 1988, Hansen et al. 1991, Komarkova 1976, Kovalchik 1993, Mattson 1984, Mattson n.d., Mutel 1976, Mutel and Marr 1973, Mutz and Queiroz 1983, Padgett et al. 1989, Wilson 1969

CAREX (ROSTRATA, UTRICULATA) SEASONALLY FLOODED HERBACEOUS ALLIANCE

(Swollen-beak Sedge, Beaked Sedge) Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Summary: This alliance is found in the upper midwestern United States and most western states as well as several Canadian provinces. Stands usually occur on wet mineral soil, muck, or shallow peat (<0.5 m). Standing water (generally stagnant) is present in the spring and after heavy rains, but the water table is generally below the surface for most of the growing season. This permits the breakdown of dead organic matter and the release of nutrients. Where stands are found along stream courses or lake margins, water levels may be more constant relative to stands in depressions or basins. This vegetation is dominated by tall wider-leaved sedges, with a mixture of forbs. Typical dominants include *Carex rostrata* or *Carex utriculata (= Carex rostrata var. utriculata)*, as well as *Carex vesicaria*. Further study is needed to clarify the floristic characteristics of this alliance.
Environment: Vegetation types within this alliance are commonly wet meadow communities that occur around the edges of montane lakes and beaver ponds, along the margins of slow-moving reaches of streams and rivers, and in marshy swales and overflow channels on broad floodplains throughout the western United States. Elevations range from near sea level in California to 2900 m in Colorado. Occurrences are either adjacent to low-gradient streams in wide valley bottoms or associated with perennial seeps. The vegetation occurs in standing water or on sites that become relatively dry during the latter part of the growing season. Many sites are located in old beaver ponds that have filled with sediment. The surface may occasionally be mounded. Mounds result from a build-up of *Carex* spp. sod and downcutting of small channels by overland flow during spring runoff (Hansen et al. 1995). ^A wide range of soils are associated with this alliance. Histosols are most common and often have organic accumulations greater than 1 m thick. Mollisols and Entisols are also associated with this type. Soil texture varies widely from loamy clay to sandy loam. Mottling often occurs within a few centimeters of the surface. Water tables are typically at or above the soil surface throughout the growing season. Soil reaction is slightly acid to neutral (pH 6.5-7.0). ^Communities are often part of a wetland mosaic, with *Salix monticola, Salix drummondiana*, and *Salix geyeriana* shrublands. Communities also occur adjacent to and intergrade with *Carex aquatilis* or *Eleocharis palustris* meadows. *Populus angustifolia* and *Picea pungens* riparian forests occur on adjacent stream terraces in narrower valleys. *Abies lasiocarpa - Picea engelmannii* forests and *Populus tremuloides* woodlands occur on adjacent hillslopes at higher elevations; *Pinus ponderosa* and *Populus tremuloides* forests and *Quercus gambelii* shrublands occur at lower elevations (Kittel et al. 1999).
Vegetation: Vegetation types within this alliance are classified as seasonally flooded temperate grasslands. The vegetation is often characterized by nearly pure stands of *Carex utriculata* (20-98%). Other *Carex* species present include *Carex aquatilis, Carex vesicaria, Carex lenticularis, Carex atherodes*, and *Carex microptera*. Other graminoid species present are *Juncus balticus, Deschampsia caespitosa, Glyceria striata*, and *Calamagrostis canadensis*. Forb cover ranges from 0-40%. Species include *Epilobium ciliatum, Polygonum amphibium, Comarum palustre (= Potentilla palustris)*, and *Ranunculus gmelinii*. The layer of fern allies is typically dominated by either *Equisetum fluviatile* or *Equisetum arvense* with percent cover up to 80%. Willow carrs are often adjacent, and a few scattered willows can occur within a *Carex utriculata* stand, such as *Salix monticola, Salix drummondiana, Salix geyeriana*, or *Salix planifolia*.
Dynamics: *Carex utriculata* vegetation types occur on the wettest sites of the riparian or wetland area, such as low-lying swales, and shallow margins of lakes and ponds, often in standing water. The community is early seral and is known to invade margins of newly formed beaver ponds, as well as the freshly exposed silt beds of drained beaver ponds (Padgett et al. 1989). With time, these types will grade into *Carex aquatilis* and *Calamagrostis canadensis* types. *Calamagrostis canadensis* dominates the driest sites with the lowest water tables and colonizes drying stands of *Carex utriculata* and *Carex aquatilis* (Cooper 1986a). ^Successional shifts in species composition is often initiated by a change

in the physical environment of the riparian area. Flooding events result in sediments deposited on the floodplain, raising the surface higher above the water table (Cooper 1986a). As aggradation, or build up, of the floodplain proceeds, the site becomes drier and the dominant graminoid cover changes. ^Abandoned beaver ponds also go through a similar succession. With time, ponds fill in with silt, and *Carex utriculata* establishes on the new, saturated substrate. As the site becomes firm and raised above the old pond level, *Carex aquatilis* and *Calamagrostis canadensis* become established in the undergrowth. Depending on site characteristics, various willow species may become established in the overstory as well, creating the *Salix monticola / Carex utriculata* Shrubland (CEGL002657) and the *Salix geyeriana / Calamagrostis canadensis* Shrubland (CEGL001205), for example. ^Distance from the stream channel can also differentiate the graminoid spatially within the riparian mosaic. *Carex utriculata* commonly occurs at the stream channel edge where the water table is close to or at the surface. As the floodplain surface becomes higher with increased distance from the channel edge, the ground becomes slightly less saturated and shifts to mesic meadows of *Carex aquatilis*, or on higher surfaces, to slightly drier meadows of *Calamagrostis canadensis* (Kittel et al. 1999).
Comments: This alliance is currently found in two disjunct regions, the upper Midwest and the northwestern United States. Species nomenclature is a problem in this alliance. In Gleason and Cronquist (1991), *Carex rostrata* is circumboreal and only occurs in the U.S. in northern Michigan and northern Minnesota, whereas *Carex utriculata*, also circumboreal, extends southward to Delaware, Indiana, Nebraska, New Mexico, and California. As such, *Carex utriculata* may be the only typical component of this alliance in Midwest sedge meadows. However, Ownbey and Morley (1991) referred all material in Minnesota to *Carex rostrata var. utriculata*, and Voss (1972) only recognized *Carex rostrata* in Michigan. Kartesz (1999) recognizes both *Carex rostrata* and *Carex utriculata* as distinct species. Until the distinction between these two species is more clearly resolved they are kept together in the same alliance.

CAREX UTRICULATA HERBACEOUS VEGETATION
Beaked Sedge Herbaceous Vegetation

ELEMENT CONCEPT
Summary: In Colorado, these common wet meadows occur in montane and subalpine areas around the edges of lakes and beaver ponds, along the margins of slow-moving reaches of streams and rivers, and in marshy swales and overflow channels on broad floodplains. The water table is usually near the surface for most of the growing season. Stands have a medium-tall herbaceous layer that is dominated by *Carex utriculata*. ^Information on stands occurring outside Colorado will be added later.
GRank & Reasons: G5 (96-02-01).

ELEMENT DISTRIBUTION
States/Provinces: AZ?, CA:S4, CO:S4, ID:S4, MT:S5, NM:S3, NV:S?, OR:S4, UT:S3S4, WA:S3S4, WY:S3

ELEMENT SOURCES
Authors: WCS
References: Andrews 1983, Baker 1983a, Benedict 1983, Franklin and Dyrness 1973, Hansen et al. 1987a, Hansen et al. 1991, Hansen et al. 1995, Hess and Wasser 1982, Kerr and Henderson 1979, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kovalchik 1987, Kovalchik 1993, Looman 1982, Mattson 1984, Mutel 1973, Mutel 1976, Mutel and Marr 1973, Mutz and Graham 1982, Mutz and Queiroz 1983, Nachlinger 1985, Norton et al. 1981, Padgett 1982, Padgett et al. 1988, Padgett et al. 1989, Ramaley 1919a, Ramaley and Robbins 1909, Schlatterer 1972, Seyer 1979, Tuhy 1981, Tuhy and Jensen 1982, Youngblood et al. 1985, Youngblood et al. 1985b

CAREX BUXBAUMII SEASONALLY FLOODED HERBACEOUS ALLIANCE
Brown Bog Sedge Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT
Summary: Vegetation types within these seasonally flooded, temperate or subpolar grasslands are found in peat bogs, marshes, and wet meadows from near sea level in the Pacific Northwest to moderately high (3200 m) elevations in the Rocky Mountains. Types occur in moderately broad valley bottoms in wet meadows or fens. Soils are mineral with accumulations of well-decomposed organic matter throughout the upper soil horizon. Wet stands may have accumulations of organic matter 20-35 cm thick overlying clayey mineral soils, resulting in a perched water table. Occurrences are widespread but uncommon. Vegetation types within this alliance are dominated by *Carex buxbaumii* with greater than 25% cover in the graminoid stratum. *Carex aquatilis, Carex saxatilis*, and *Carex utriculata* are present and occasionally codominant. *Deschampsia caespitosa, Caltha leptosepala, Pedicularis groenlandica*, and *Ligusticum tenuifolium* are among the common associates typically present in minor cover. Adjacent wetlands are often dominated

by sedges such as *Carex utriculata* and *Carex aquatilis*. Adjacent upland communities are *Pinus contorta* or *Picea engelmannii* forests.
Environment: Vegetation types within this alliance are found in peat bogs, marshes, and wet meadows from near sea level in the Pacific Northwest to moderately high (3200 m) elevations in the Rocky Mountains. Occurrences are widespread but uncommon. Types occur in moderately broad valley bottoms in wet meadows or fens. Soils are mineral with accumulations of well-decomposed organic matter throughout the upper soil horizon. Wet stands may have accumulations of organic matter 20-35 cm thick overlying clayey mineral soils, resulting in a perched water table (Mattson 1984). Adjacent wetlands are often dominated by sedges such as *Carex utriculata* and *Carex aquatilis*. Adjacent upland communities are *Pinus contorta* or *Picea engelmannii* forests.
Vegetation: Vegetation types within this alliance are classified as seasonally flooded, temperate or subpolar grasslands. Vegetation types are dominated by *Carex buxbaumii* with greater than 25% cover in the graminoid stratum. *Carex aquatilis, Carex saxatilis*, and *Carex utriculata* are present and occasionally codominant. *Deschampsia caespitosa, Caltha leptosepala, Pedicularis groenlandica*, and *Ligusticum tenuifolium* are among the common associates typically present in minor cover (Padgett et al. 1989).
Dynamics:
Comments:

CAREX BUXBAUMII HERBACEOUS VEGETATION
Brown Bog Sedge Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This vegetation has been found in fens and wet meadows in the mountains of Utah, Idaho, Montana, and western Wyoming at elevations 1700-3200 m. Sites are flat and range from moderately broad valley bottoms to forest openings. Size of wetland is dependent on the presence of permanently saturated soils and it often occurs along streams and in the wettest portion of the wetland complex. Soils are mineral from alluvium with accumulations of well-decomposed organic matter throughout the upper soil horizon (20-50 cm deep). ^Stands have a dense perennial graminoid layer characterized by 25% or more cover of *Carex buxbaumii*. *Carex aquatilis, Carex saxatilis* and *Carex utriculata* are usually present and occasionally codominant. Other common species include *Deschampsia caespitosa, Caltha leptosepala, Pedicularis groenlandica*, and *Ligusticum tenuifolium*. Occasional shrubs such as *Salix planifolia (= Salix phylicifolia), Vaccinium uliginosum (= Vaccinium occidentale)*, and *Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda)* may be scattered in the stand. Adjacent are often dominated by sedges such as *Carex utriculata* and *Carex aquatilis*. This vegetation is separated from adjacent wetlands by the dominance or codominance of *Carex buxbaumii*.
GRank & Reasons: G3 (00-01-03). This naturally rare wetland vegetation is found in mountains of Utah, Idaho, Montana, and western Wyoming. Although it occurs over relatively wide range, stands are uncommon. Stands typically occur on valley bottoms were the water table is at or near the surface. Soil have a surface organic layer and are saturated seasonally. Habitats are similar to those of the more common *Carex aquatilis* wetland. These wetlands are threatened by presence of invasive non-native plants, and human activity which results in alterations of natural wetland processes, such as diversions, pumping ground water, roads, and clear cutting. Soils are usually too wet for livestock, but alteration of hydrology causing dewatering may result in increased cattle use and invasion of introduces forage species from pastures.

ELEMENT DISTRIBUTION

Range: This wetland is found in mountains of Utah, Idaho, Montana, and western Wyoming. Occurrences have a relatively broad range, but are uncommon. *Carex buxbaumii* is a circumboreal species and this association possibly occurs in other western states and Canada.
States/Provinces: ID:S1, MT:S3, UT:S2?, WY:S2?

ELEMENT SOURCES

Authors: K.A. Schulz, WCS
References: Hansen et al. 1988, Mattson 1984, Moseley et al. 1991, Moseley et al. 1994, Padgett et al. 1989, Pierce 1986, Pierce and Johnson 1986, Tuhy 1981

CAREX PELLITA SEASONALLY FLOODED HERBACEOUS ALLIANCE

Woolly Sedge Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Summary: Vegetation types within this seasonally flooded grassland alliance occur in wet meadows, basins, and sometimes shallow standing water. They are found from the plains (<300 m) and lowlands (1050 m) to moderate (2700

m) elevations in the mountains in low-gradient, trough-shaped, moderately wide valleys with gentle to moderately steep sideslopes. Stands occur in depressions and swales at the saturated edge of stream channels or in standing water. Sites are poorly drained, often flooded during spring runoff, and water levels normally remain in the rooting zone throughout the growing season. Soils are variable, but most commonly mineral with large amounts of organic matter or, more rarely, with thick accumulations of partially decomposed sedges. Streambanks have alluvial soils composed of sand, silt, and clay deposits. This alliance is often characterized by a nearly monotypic cover of 40-90% *Carex pellita (= Carex lanuginosa)*. Other graminoid cover is minor, but includes *Carex microptera, Phalaris arundinacea, Calamagrostis stricta, Carex nebrascensis, Juncus balticus, Scirpus microcarpus, Schoenoplectus acutus (= Scirpus acutus)*, and *Schoenoplectus pungens (= Scirpus pungens)*. Scattered forbs include *Geum macrophyllum, Mentha arvensis, Prunella vulgaris*, and *Potentilla gracilis*.

Environment: Vegetation types within this alliance occur in wet meadows, basins, and sometimes shallow water. They are found from the plains (<300 m) and lowlands (1050 m) to moderate (2700 m) elevations in the mountains in low-gradient (1-2% slope), trough-shaped, moderately wide valleys with gentle to moderately steep sideslopes. Stands occur in depressions and swales at the saturated edge of stream channels or in standing water. Soils are variable, but most commonly mineral with large amounts of organic matter or more rarely, with thick accumulations of partially decomposed sedges. Stands are poorly drained, and water may persist on the soil surface through the summer. Streambanks have alluvial soils composed of sand, silt, and clay deposits. These stands are often flooded during spring runoff, and water levels normally remain in the rooting zone throughout the growing season (Hansen et al. 1988a). Mottling often occurs throughout the profile. ^Adjacent vegetation along foothill streams includes *Salix amygdaloides, Populus balsamifera ssp. trichocarpa (= Populus trichocarpa)*, and *Populus angustifolia* woodlands. *Populus deltoides* woodlands occur along streams on the eastern Great Plains. Adjacent communities at higher elevations are typically *Artemisia* spp. shrublands or *Pinus contorta* forests.

Vegetation: This grassland alliance is characterized by a nearly monotypic stand of 40-90% cover of *Carex pellita (= Carex lanuginosa)*. Other graminoid cover is minor (0-20%), but includes *Carex microptera, Phalaris arundinacea, Calamagrostis stricta, Carex nebrascensis, Juncus balticus, Scirpus microcarpus, Schoenoplectus acutus (= Scirpus acutus)*, and *Schoenoplectus pungens (= Scirpus pungens)*. Scattered forbs include 0-40% cover of *Geum macrophyllum, Mentha arvensis, Prunella vulgaris*, and *Potentilla gracilis*. In the plains, the most abundant species are *Calamagrostis stricta, Carex pellita, Carex sartwellii, Anemone canadensis, Apocynum cannabinum, Symphyotrichum lanceolatum (= Aster lanceolatus), Eleocharis compressa, Juncus balticus, Phalaris arundinacea, Polygonum amphibium*, and *Schoenoplectus americanus (= Scirpus americanus)*. *Carex buxbaumii* can be common (Nelson et al. 1981, Dix and Smeins 1967).

Dynamics: The *Carex pellita* plant association appears to be a fairly stable community due to the dominant species' rhizomatous roots (Padgett et al. 1989). In Montana, the *Carex pellita* plant association can include communities dominated by *Carex lasiocarpa*. With season-long grazing, *Carex pellita* decreases in abundance, shifting dominance towards *Poa pratensis*. In Colorado, stands of *Carex pellita* that occur on streambanks with a consistent water table depth and heavy, cohesive clay soils, appear stable as long as the water table remains constant.

Comments:

CAREX PELLITA HERBACEOUS VEGETATION
Woolly Sedge Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This plant association occurs along stream channels, and in depressions and swales along floodplains at low to moderate elevations in the western U.S. from Washington to Montana south to Oregon, Utah, and Colorado. It also has been reported from British Columbia, Canada. These wetlands form small to medium-sized meadows. *Carex pellita (= Carex lanuginosa)*, a distinctive wetland-indicator species, clearly dominates stands with 30-80% cover. Low species diversity, with few associates having high constancy, is characteristic. *Deschampsia caespitosa, Carex microptera, Carex nebrascensis, Carex simulata, Carex praegracilis, Elymus glaucus, Juncus balticus, Schoenoplectus pungens (= Scirpus pungens), Equisetum arvense*, and *Equisetum hyemale* are sometimes present with low cover. On the eastern plains of Colorado, it can occur under a canopy of cottonwood trees, forming *Populus deltoides / Carex pellita* Woodland (CEGL002649).

GRank & Reasons: G3 (00-10-17). This association has been documented in small stands throughout much of the western United States and Canada. High-quality stands are uncommon due to improper grazing by livestock, hydrologic alterations, and ground-disturbing activities. The diagnostic species in this association is very palatable to livestock when young. Stands may be dry at the surface as early as July allowing season-long livestock utilization. Overuse by livestock can result in introduction of non-native species such as *Poa pratensis* and *Taraxacum officinale* or an increase in less palatable species such as *Carex nebrascensis* and *Juncus balticus*. Overuse by livestock can also result in stream downcutting that may permanently change the site potential from a wet to a dry meadow. *Phalaris arundinacea*, an

additional non-native species, may become established due to alteration of hydrology or sediment inputs. Meadows that support stands of *Carex pellita* are often used for hay pasture and may be drained, ditched and flood irrigated, or seeded with pasture grasses to increase hay production.
Comments: This plant association has been described in recent classifications throughout its range (Kovalchik 1987, Padgett et al. 1989, Evenden 1990, Crowe and Clausnitzer 1997, Manning and Padgett 1995, Kittel et al. 1999). Hansen et al. (1995) included all combinations of *Carex pellita (= Carex lanuginosa), Carex lasiocarpa*, and *Carex buxbaumii* in the *Carex lasiocarpa* habitat type. There may be some similarities between sites supporting *Carex pellita, Carex lasiocarpa*, and *Carex buxbaumii* plant associations. However, *Carex pellita* stands typically occur on mineral soils in seasonally saturated floodplains along runoff-dominated stream channels or headwater basins, while *Carex lasiocarpa* and *Carex buxbaumii* occur on organic soils in association with semipermanently saturated spring-fed or groundwater-driven wetlands. From a biodiversity conservation standpoint, the three associations should be recognized as distinct types. Identification of this association is complicated when shrubs are present and when *Carex pellita* is not clearly dominant.

ELEMENT DISTRIBUTION

Range: This plant association is a minor type in Colorado, Utah, Idaho, Montana, Washington, Oregon, and British Columbia, Canada. *Carex pellita* is a common sedge that occurs throughout the northern and western United States. It is likely that this or a closely related association occurs in Wyoming, California, and New Mexico.
States/Provinces: BC:S2Q, CO:S3, ID:S2, MT?, OR:S5Q, UT:S2S3, WA:S1Q

ELEMENT SOURCES

Authors: WCS
References: Crowe and Clausnitzer 1997, Evenden 1990, Hansen et al. 1987a, Hansen et al. 1995, Kittel et al. 1995, Kittel et al. 1999, Kovalchik 1987, Manning and Padgett 1995, Padgett et al. 1988, Padgett et al. 1989

ELEOCHARIS PALUSTRIS SEASONALLY FLOODED HERBACEOUS ALLIANCE

Common Spikesedge Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Summary: This herbaceous wetland alliance occurs in shallow, mostly still water throughout the much of the western United States and central Great Plains, from sea level to alpine. Stands occur on a variety of landforms including lake margins, stream terraces, floodplains, gravel bars, and wet basins (cienegas). Sites are flat to gently sloping on any aspect. Soils and parent materials are variable, but often highly organic and derived from alluvium. Surface water is typically present for an extended period during the growing season, and the high water table remains high most of the year. The vegetation is characterized by a sparse to dense herbaceous layer that is dominated or codominated by *Eleocharis palustris*, a facultative wetland species. Because of the variety of habitats where this alliance occurs, associated species are diverse. Characteristic associates include several species of *Carex, Juncus*, and *Scirpus*, most notably *Carex praegracilis* and *Juncus balticus*. Other important graminoids are *Phalaris arundinacea (= Phalaroides arundinacea), Spartina pectinata, Panicum virgatum, Deschampsia caespitosa, Distichlis spicata*, and *Muhlenbergia asperifolia*. Forb cover is also variable, and may include *Sparganium angustifolium, Lemna* spp., *Potamogeton* spp., *Berula erecta, Rorippa nasturtium-aquaticum, Pedicularis groenlandica, Rhodiola integrifolia, Caltha leptosepala, Mentha arvensis, Rumex crispus, Iris missouriensis*, and *Ranunculus cymbalaria*. Diagnostic of this herbaceous wetland alliance is the dominance or codominance of *Eleocharis palustris* and the presence of surface water for extended periods during the growing season.
Environment: Plant associations included in this alliance are conspicuous, common emergent associations that occur in shallow, mostly still water throughout the western United States. Elevation ranges from sea level in California to 3050 m in Colorado. Stands occur on a variety of landforms including lake margins, stream terraces, floodplains, gravel bars, and wet basins (cienegas). Stands occur on sites that are flat, 1% slope with all aspects (Crowe and Clausnitzer 1997). Soils vary from Histosols to Entisols. High-elevation stands consistently occur on organic (highly sapric) soils, or on a thick organic horizon that overlays fine to coarse alluvial material. Lower elevation stands occur on fresh alluvial deposits of fine-textured loamy sands, clays, and sandy clays (Kittel et al. 1999). Soil reaction is often alkaline (Hansen et al. 1988). All sites are saturated throughout much of the growing season. Oregon stands are located on soils derived from volcanic (andesite, basalt) or sedimentary parent materials (Crowe and Clausnitzer 1997). ^At higher elevation, *Carex aquatilis* or *Carex utriculata* meadows and *Salix wolfii* or *Salix planifolia* shrublands occur within the riparian mosaic. At lower elevation, *Schoenoplectus pungens (= Scirpus pungens)* often occurs within the stream channel while wet meadow prairies of *Panicum virgatum* and *Sorghastrum nutans* occupy the immediate streambanks and low floodplains.
Vegetation: Plant associations within this alliance are classified as seasonally flooded, temperate or subpolar grasslands. *Eleocharis palustris*, a facultative wetland species, dominates the graminoid stratum. Cover ranges from sparse to quite dense (10-80%). *Eleocharis palustris* plant associations occur within a wide elevational range, and the

species composition can be quite variable. In the Great Plains stands, co-occurring species often include *Phalaris arundinacea (= Phalaroides arundinacea), Juncus balticus, Carex praegracilis, Schoenoplectus pungens (= Scirpus pungens), Panicum virgatum, Carex pellita (= Carex lanuginosa), Spartina pectinata*, and *Schoenoplectus americanus (= Scirpus americanus)*. Forb cover can also include *Sparganium angustifolium, Lemna* spp., and *Potamogeton* spp. (Kittel et al. 1999). *Distichlis spicata* and *Muhlenbergia asperifolia* codominate the graminoid layer in the cienegas (Arizona and New Mexico). Forb cover is composed of *Berula erecta* and *Rorippa nasturtium-aquaticum*, especially in stands with deep water (Cross 1991). ^At higher, montane elevations other graminoids present include *Carex aquatilis, Carex utriculata, Carex buxbaumii, Eleocharis rostellata*, and *Deschampsia caespitosa*. Forb cover is typically low, but can be up to 25% in some stands. Common forb species include *Pedicularis groenlandica, Rhodiola integrifolia*, and *Caltha leptosepala* (Hansen et al. 1995, Kittel et al. 1999). ^Crowe and Clausnitzer (1997) state that *Eleocharis palustris* is an aggressive species, typically excluding other species from establishing. In the Oregon stands, associated forbs include *Mentha arvensis, Rumex crispus, Iris missouriensis*, and *Ranunculus cymbalaria*.

Dynamics: At lower elevations *Eleocharis palustris* plant associations occur well within the active channel and are inundated annually. These early seral communities colonize backwater eddies and shallow edges of slow moving reaches of small and larger rivers. The stands are probably ephemeral, as the eddies and river edges are scoured out each year during high spring flows (Kittel et al. 1999). These communities have also been described as early seral stages by Padgett et al. (1989). Padgett et al. (1989) describe light colored soils for the sites, indicating an early phase of soil development. Kovalchik (1987) reports that the lower elevation plant associations within this alliance frequently form seral communities in ponded sites between stream rehabilitation structures such as loose rock check dams. ^In the montane zone, associations within this alliance occur in ponded sites on faster moving streams. If siltation occurs, sites may become dominated by *Carex utriculata*. At higher elevations, the associations appear to be stable. Stands occur near seeps on soils with deep organic layers, often sapric, and are saturated throughout the growing season. ^Crowe and Clausnitzer (1997) state that *Eleocharis palustris* is of little to no forage value to livestock and wild ungulates. On seasonally drier sites, ungulate trampling may cause this species to increase (Snyder 1992 as cited in Crowe and Clausnitzer 1997). However, this species does provide seed forage and cover to ducks and geese (Kovalchik 1987).

Comments:

ELEOCHARIS PALUSTRIS HERBACEOUS VEGETATION
Common Spikerush Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This spikerush wet meadow community is found in the central Great Plains of the United States and Canada and in the western United States. Stands occur in small depressions in intermittent stream beds or depression pond that flood early in the season and dry out by summer. Stands are dominated by submersed and emergent rooted vegetation under 1 m tall. In northwestern Nebraska, *Eleocharis acicularis* and *Eleocharis palustris* commonly cover the bottoms of the pools and emerge above the water as the pools dry out. Ephemeral submersed aquatics, such as *Callitriche palustris (= Callitriche verna), Potamogeton diversifolius* and *Marsilea vestita*, may be present. As the pools dry out in mid summer, ephemeral annual forbs, such as *Limosella aquatica* and *Plagiobothrys scouleri*, may appear. By late summer *Amaranthus californicus* and *Gnaphalium palustre* may dominate in the lowest parts of the depression. In southwestern South Dakota, vegetation is composed of nearly homogeneous stands of *Eleocharis palustris*. Other emergents, such as *Polygonum amphibium, Marsilea vestita*, and *Eleocharis ovata* are occasionally found. Herbaceous cover is greater than 75%, except in areas of deeper open water where floating and submerged aquatic plants occur, including *Bacopa rotundifolia* and *Heteranthera limosa*.

Environment: In northwest Nebraska and southwest South Dakota, this community occurs in small depressions in intermittent stream beds and depression ponds that flood early in the season and dry out by summer. Soils are silty clay formed from weathered siltstone and shale (Steinauer and Rolfsmeier 1997). In southwestern South Dakota, the type occupies depression ponds in prairies (H. Marriott pers. comm. 1999).

Vegetation: In northwestern Nebraska, stands are dominated by submersed and emergent rooted vegetation under 1 m tall. *Eleocharis acicularis* and *Eleocharis palustris* commonly cover the bottoms of the pools and emerge above the water as the pools dry out. Ephemeral submersed aquatics, such as *Callitriche palustris (= Callitriche verna), Potamogeton diversifolius* and *Marsilea vestita*, may be present. As the pools dry out in mid-summer, ephemeral annual forbs, such as *Limosella aquatica* and *Plagiobothrys scouleri*, may appear. By late summer *Amaranthus californicus* and *Gnaphalium palustre* may dominate in the lowest parts of the depression (Steinauer and Rolfsmeier 1997). In southwestern South Dakota, vegetation is composed of nearly homogeneous stands of *Eleocharis palustris*. Other emergents, such as *Polygonum amphibium, Marsilea vestita*, and *Eleocharis ovata* are occasionally found. Herbaceous cover is greater than 75% except in areas of deeper open water where floating and submerged aquatic plants occur, including *Bacopa rotundifolia* and *Heteranthera limosa* (H. Marriott pers. comm. 1999).

GRank & Reasons: G5 (96-02-01).

ELEMENT DISTRIBUTION

Range: This spikerush wet meadow community is found in the central Great Plains of the United States and Canada, and in the western United States, ranging from South Dakota northwestward to Montana and Saskatchewan, west to Washington, south to possibly California and east to Nevada.
States/Provinces: CA?, CO:S4, ID:S3, MT:S5, NE:S?, NV:SR, OR:S5, SD:S?, SK:S?, UT:S3?, WA:S?, WY:S3

ELEMENT SOURCES

Authors: D. Faber-Langendoen, WCS
References: Baker 1983c, Baker and Kennedy 1985, Brotherson and Barnes 1984, Bunin 1985, Ellis et al. 1979, Flowers 1962, Hansen et al. 1987a, Hansen et al. 1991, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1994, Kovalchik 1987, Kovalchik 1993, Mutel 1973, Mutel and Marr 1973, Padgett et al. 1988, Padgett et al. 1989, Ramaley 1919a, Ramaley 1942, Stearns-Roger Inc. 1978, Steinauer and Rolfsmeier 1997, Stewart 1940, Youngblood et al. 1985

Semipermanently flooded temperate or subpolar grassland

SCHOENOPLECTUS ACUTUS - (SCHOENOPLECTUS TABERNAEMONTANI) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

Hardstem Bulrush - (Softstem Bulrush) Semipermanently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Summary: This alliance is found in the midwestern and western United States and central Canada. Vegetation is characterized by medium to tall graminoids which typically range from 1 to over 2 m (Weaver 1960). The vegetation is moderately dense to dense. Some stands are heavily dominated by one or two *Scirpus* species while others have several graminoids common throughout the stand. The most abundant species are typically *Schoenoplectus acutus (= Scirpus acutus), Schoenoplectus fluviatilis (= Scirpus fluviatilis)*, and *Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)*. Species composition and abundance can vary from year to year depending mostly on water level fluctuations. In most years, typical species include *Lemna* spp., *Phragmites australis, Schoenoplectus americanus (= Scirpus americanus)* (in alkaline stands), *Triglochin maritima* (in alkaline stands), *Typha latifolia*, and *Utricularia macrorhiza*. *Potamogeton* spp. often occur in the deeper parts of stands of this alliance and where emergent species are not densely packed. Shrubs, such as *Salix* spp., are not common but may become established in shallow water areas. During droughts, species more tolerant of low water, such as *Polygonum amphibium*, may invade and alter the species composition of stands of this alliance. ^Stands of this alliance are flooded for most or all of the growing season. Stands can have water from 0 (exposed soil) to approximately 1.5 m deep, but usually are less than 1 m (Tolstead 1942, Steinauer 1989). Within a stand, water levels can vary by up to 1 m during the year (Tolstead 1942). The water can be fresh to mildly saline throughout most of this alliance's range (Stewart and Kantrud 1971), however, in the Nebraska Sandhills some stands occur in moderately alkaline water (Steinauer 1989). Across the range of this alliance, soils are deep, poorly drained, muck, peat, or mineral.
Environment: This relatively widespread alliance occurs on pond and lake margins, and in backwater areas. It also occupies basins where the water table may remain relatively high, but can drop below the soil surface late in the growing season. Elevations range from sea level in coastal areas to 2025 m in Montana. Stands of this alliance are flooded for most or all of the growing season. Stands can have water from 0 (exposed soil) to approximately 1.5 m deep, but usually are less than 1 m (Tolstead 1942, Steinauer 1989). Within a stand, water levels can vary by up to 1 m during the year (Tolstead 1942). The water can be fresh to mildly saline throughout most of this alliance's range (Stewart and Kantrud 1971), however, in the Nebraska Sandhills some stands occur in moderately alkaline water (Steinauer 1989). Across the range of this alliance, soils are deep, poorly drained muck, peat, or mineral. Adjacent wetter sites are typically dominated by *Typha latifolia*, while drier sites support herbaceous communities dominated by *Carex* spp., *Poa pratensis* or other grasses.
Vegetation: This alliance is found in the midwestern and western United States and central Canada. Vegetation is characterized by medium to tall graminoids which typically range from 1 to over 2 m (Weaver 1960). The vegetation is moderately dense to dense. Some stands are heavily dominated by one or two *Scirpus* species while others have several graminoids common throughout the stand. The most abundant species are typically *Schoenoplectus acutus (= Scirpus acutus), Schoenoplectus fluviatilis (= Scirpus fluviatilis)*, and *Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)*. Species composition and abundance can vary from year-to-year depending mostly on water level fluctuations. In most years, typical species include *Lemna* spp., *Phragmites australis, Schoenoplectus americanus (= Scirpus americanus)* (in alkaline stands), *Triglochin maritima* (in alkaline stands), *Typha latifolia*, and *Utricularia*

macrorhiza. *Potamogeton* spp. often occur in the deeper parts of stands of this alliance and where emergent species are not densely packed. Shrubs, such as *Salix* spp., are not common, but may become established in shallow water areas. During droughts, species more tolerant of low water, such as *Polygonum amphibium*, may invade and alter the species composition of stands of this alliance.
Dynamics: *Schoenoplectus acutus* and *Schoenoplectus tabernaemontani* are early colonizers of suitable habitats (Hansen et al. 1995), and are able to persist under wet conditions. *Schoenoplectus* spp. stands are generally considered permanent wetland communities. They will remain in place unless the hydrologic regime is severely altered. If water levels have fallen, stands of this alliance can burn in either late fall or early spring. Stands of *Schoenoplectus* are important to wildlife species, especially birds, by providing cover and nesting habitat.
Comments:

SCHOENOPLECTUS ACUTUS HERBACEOUS VEGETATION
Hardstem Bulrush Herbaceous Vegetation

ELEMENT CONCEPT

GRank & Reasons: G5 (96-02-01).

ELEMENT DISTRIBUTION

States/Provinces: CA:S3?, ID:S4, MT:S5, NV?, OR:S4, WA:S4

ELEMENT SOURCES

Authors: WCS
References: Dethier 1990, Evans 1989a, Hansen et al. 1991, Hansen et al. 1995, Kunze 1994

SCHOENOPLECTUS PUNGENS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

Threesquare Semipermanently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Summary: This alliance, found in the northern Great Plains, Utah, and Nevada, is made up of graminoid-dominated communities found in saline wetlands. Medium-tall and short graminoids predominate. Woody species are very uncommon. *Schoenoplectus pungens (= Scirpus pungens), Suaeda calceoliformis, Distichlis spicata* (on drier margins), and *Ruppia maritima* are all common species. *Chenopodium incanum, Monolepis nuttalliana*, and *Picradeniopsis oppositifolia* are sometimes abundant on less saline portions of the alliance. ^This alliance occurs in depressions and river valleys. The loam to sandy loam soils are deep, poorly drained and formed in alluvium (Steinauer 1989). These soils are slightly to strongly affected by soluble salt. Standing water is at or near the surface for most of the year.
Environment: Plant associations within this alliance occur in saline meadows, depressions, playas, and river valleys in the western United States. Elevations range from 750-1380 m. Sites are located in wet areas such as along smaller streams and the edges of marshes, ponds, and playas (Hansen et al. 1995, Bundy et al. 1996, Jones and Walford 1995, Walford 1996). Although these sites are often subjected to inundation (up to 1.5 m) in the early season, they are generally free of standing water by midsummer. Groundwater levels are often at or near ground surface (Brotherson and Barnes 1984). Soils are typically Entisols or Mollisols. Soil texture ranges from clay loam to sandy loam, and the soils are commonly poorly drained. Soil reaction is typically alkaline (pH 8.5) (Steinauer 1989, Hansen et al. 1995). ^Adjacent wetter communities are usually dominated by *Eleocharis palustris*. *Typha latifolia* or *Schoenoplectus acutus (= Scirpus acutus)* can dominate the open water. In Nevada, adjacent communities are dominated by *Sarcobatus vermiculatus*.
Vegetation: Plant associations within this alliance are classified as semipermanently flooded temperate or subpolar grasslands. *Schoenoplectus pungens (= Scirpus pungens)* dominates the graminoid layer, forming dense stands. Other common herbaceous associates include *Suaeda calceoliformis, Spartina pectinata, Muhlenbergia asperifolia, Distichlis spicata*, and *Ruppia maritima*. *Chenopodium incanum*, *Monolepis nuttalliana*, and *Picradeniopsis oppositifolia* are sometimes abundant on less saline portions of the alliance. In eastern Wyoming, *Hordeum jubatum* and *Hordeum jubatum ssp. intermedium (= Hordeum caespitosum)* are present in most stands in small amounts (Jones and Walford 1995).
Dynamics: Hansen et al. (1995) state that *Schoenoplectus pungens* is an early colonizer of suitable habitats and able to persist under wet conditions. It is tolerant of alkaline conditions, but does not require it (Cronquist et al. 1977). Because of the wet soil conditions and aggressive growth of *Schoenoplectus pungens*, other species can be precluded from the sites. Disturbance can cause the establishment of increaser species such as *Juncus balticus* and *Hordeum jubatum*.

Lowering the water table may dry the site and result in a decrease of *Schoenoplectus pungens*. An increase in salinity may increase alkaline-tolerant species.
Comments: This alliance is found mostly in the western United States and needs rangewide review. There are taxonomic issues between *Schoenoplectus americanus* and *Schoenoplectus pungens* that need to be understood before the concept of this alliance is clear.

SCHOENOPLECTUS PUNGENS HERBACEOUS VEGETATION
Threesquare Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This bulrush wet meadow community is found in the western United States in the intermountain basins, as well as in western parts of the Great Plains. *Schoenoplectus pungens (= Scirpus pungens)* dominates the herbaceous vegetation layer, which is 0.3-0.6 m tall. Other species that often are present include *Schoenoplectus pungens, Spartina gracilis, Hordeum jubatum, Pascopyrum smithii*, and *Eleocharis palustris*. In Kansas, species present include *Schoenoplectus maritimus (= Scirpus maritimus), Lemna minor, Sagittaria latifolia*, and *Typha* spp. Stands of this association contain no tree or shrub layer, but a few scattered trees and shrubs may be present, most commonly of *Populus deltoides, Salix amygdaloides, Salix exigua*, or *Symphoricarpos occidentalis*. Stands of this association are found along low-gradient, meandering, usually perennial streams and around the margins of ponds and marshes.
Environment: Stands of this association are found along low-gradient, meandering, usually perennial streams and around the margins of ponds and marshes (Hansen et al. 1995, Jones and Walford 1995, Walford 1996).
Vegetation: *Schoenoplectus pungens (= Scirpus pungens)* dominates the herbaceous vegetation layer, which is 0.3-0.6 m tall. Other species that often are present include *Schoenoplectus pungens, Spartina gracilis, Hordeum jubatum, Pascopyrum smithii*, and *Eleocharis palustris*. Stands of this association contain no tree or shrub layer, but a few scattered trees and shrubs may be present, most commonly of *Populus deltoides, Salix amygdaloides, Salix exigua*, or *Symphoricarpos occidentalis*. In Kansas, species present include *Schoenoplectus maritimus (= Scirpus maritimus), Lemna minor, Sagittaria latifolia*, and *Typha* spp. (Lauver et al. 1999).
GRank & Reasons: G3G4 (98-04-09).

ELEMENT DISTRIBUTION

Range: This community is found in the western United States in the inter-mountain basins, as well as in western parts of the Great Plains, from Montana south to Colorado, and west into Nevada, Utah, and Wyoming.
States/Provinces: CO:S3, KS:S?, MT:S3, ND:S?, NV:S?, SD:S?, UT:S2S4, WY:S?

ELEMENT SOURCES

Authors: G.P. Jones, WCS
References: Brotherson and Barnes 1984, Gleason and Cronquist 1991, Great Plains Flora Association 1986, Hansen et al. 1991, Hansen et al. 1995, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999, Larson 1993, Montana Natural Heritage Program 1998, Walford 1996

TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCHOENOPLECTUS SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

(Narrowleaf Cattail, Broadleaf Cattail) - (Bulrush species) Semipermanently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Summary: This alliance, found in virtually every state in the United States and probably most Canadian provinces, contains stands dominated by *Typha angustifolia* and/or *Typha latifolia*, either alone or in combination with other tall emergent marsh species. Associated species vary widely; in the Midwest they include many sedges such as *Carex aquatilis, Carex rostrata, Carex pellita (= Carex lanuginosa)*, bulrushes such as *Schoenoplectus americanus (= Scirpus americanus), Schoenoplectus acutus (= Scirpus acutus)*, and *Schoenoplectus heterochaetus (= Scirpus heterochaetus)*, and broad-leaved herbs such as *Thelypteris palustris, Asclepias incarnata, Impatiens capensis, Sagittaria latifolia, Scutellaria lateriflora, Sparganium eurycarpum, Hibiscus moscheutos*, and *Verbena hastata*. Floating aquatics such as *Lemna minor* may predominate in deeper zones (Anderson 1982, MNNHP 1993). ^This alliance is found most commonly along lake margins and in shallow basins, and occasionally in river backwaters. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. *Typha angustifolia* can grow in deeper water compared to *Typha latifolia*, although both species reach maximum growth at a water depth of 50 cm (Grace and Wetzel 1981). *Typha* often occurs in pure stands, and can colonize areas recently exposed by either natural or human causes.

Lythrum salicaria, an exotic species from Europe, has become a common associate of many eastern *Typha* marshes. In the Southeast, this alliance is widespread and currently representative of a wide variety of mixed marshes with no clear dominants. Vegetation in this alliance may be natural or semi-natural and includes mixed stands of the nominal species, as well as essentially monospecific stands of *Typha latifolia*. These monospecific stands occur especially in artificial wetlands, such as borrow pits or ponds. This alliance occurs on hydric soils in wetlands, ditches, ponds, lakes, and rivers, as well as on shorelines and streambanks. Inundation is commonly 3-6 dm (1-2 feet) in depth. These marshes have hydric soils and are flooded with water levels ranging from several centimeters to more than 1 m for a significant part of the growing season. Occurrences may display areas of open water, but emergent vegetation dominates (80% cover). Seasonal flooding during winter and spring or flooding during heavy rains help maintain these marshes by causing water exchange which replenishes freshwater and circulates nutrients and organic debris. Soils which support this community can be mineral or organic but are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. Vegetative diversity and density is highly variable in response to water depth, water chemistry, and natural forces.

Environment: This alliance is found most commonly along lake or pond margins, slow-moving ditches, in shallow basins, adjacent to stream or river channels in wet mud, oxbows, and occasionally in river backwaters. Elevations range from near sea level to around 2000 m in Colorado. Sites where this alliance occurs are typically semipermanently flooded, inundated with 30-100 cm of water throughout the year. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. *Typha angustifolia* can grow in deeper water compared to *Typha latifolia*, although both species reach maximum growth at a water depth of 50 cm (Grace and Wetzel 1981). Soils are characterized by accumulations of organic matter over deposits of fine silt and clay (Hansen et al. 1995), or loams, sandy loams, or coarse sand (Jones and Walford 1995, Bundy et al. 1996). *Typha* often occurs in pure stands, and can colonize areas recently exposed by either natural or human causes. ^Adjacent herbaceous wetland vegetation types can be dominated by species of *Scirpus, Carex*, or *Eleocharis*. Riparian shrublands or forests include those dominated by species of *Salix, Fraxinus*, or *Populus*.

Vegetation: This alliance, is found at low to moderate elevations in virtually every state in the United States and probably most Canadian provinces. It contains stands dominated by *Typha angustifolia* and/or *Typha latifolia*, either alone or in combination with other tall emergent marsh species. Associated species vary widely; in the central and western United States, they include many sedges such as *Carex aquatilis, Carex rostrata, Carex pellita (= Carex lanuginosa)*, and bulrushes such as *Schoenoplectus americanus (= Scirpus americanus), Schoenoplectus acutus (= Scirpus acutus), Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)*, and *Schoenoplectus heterochaetus (= Scirpus heterochaetus)*. Other graminoids can include *Juncus* spp., *Eleocharis* spp., or *Glyceria* spp. In the central and eastern parts of its range, broad-leaved herbs such as *Thelypteris palustris, Asclepias incarnata, Impatiens capensis, Sagittaria latifolia, Scutellaria lateriflora, Sparganium eurycarpum, Hibiscus moscheutos*, and *Verbena hastata*, may be present. In the west, forbs may include *Mentha arvensis, Polygonum amphibium, Epilobium ciliatum* and many others. Floating aquatics such as *Lemna minor* may predominate in deeper zones (Anderson 1982, MNNHP 1993, Hansen et al. 1995).

Dynamics: *Typha angustifolia* occupies inundated and disturbed grounds and can tolerate deeper water and higher alkalinity levels than *Typha latifolia* (Great Plains Flora Association 1986). *Typha* species are prolific seed producers, spreading rapidly to become the early colonizers of wet mineral soil and will persist under wet conditions (Hansen et al. 1995). Roots and lower stems are well-adapted to prolonged submergence, but periods of draw-down are required for seed germination to occur (Hansen et al. 1995). These are important wetland communities for many species of birds and waterfowl. Hansen et al. (1995) report that in Montana heavy livestock use may convert stands to *Carex nebrascensis*-dominated communities.

Comments: It has been suggested that mixed emergent marshes tend to occur on harder pond, lake, or river bottoms and are less likely to contain a peaty mat with its diverse mixture of forbs (MNNHP 1993). Alliances that describe marshes dominated by mixed emergents other than cattails and the associates listed above include the V.A.5.N.l *Phragmites australis* Semipermanently Flooded Herbaceous Alliance (A.1431), the V.A.5.N.l *Schoenoplectus acutus - (Schoenoplectus tabernaemontani)* Semipermanently Flooded Herbaceous Alliance (A.1443), the V.A.5.N.l *Schoenoplectus americanus* Semipermanently Flooded Herbaceous Alliance (A.1432), and the V.A.5.N.l *Zizania (aquatica, palustris)* Semipermanently Flooded Herbaceous Alliance (A.1441). In shallow flooded conditions this alliance grades into the V.A.5.N.k *Typha spp. - (Schoenoplectus spp., Juncus spp.)* Seasonally Flooded Herbaceous Alliance (A.1394), as well as V.A.5.N.k *Schoenoplectus fluviatilis* Seasonally Flooded Herbaceous Alliance (A.1387). *Typha latifolia* can hybridize with *Typha angustifolia*, and the hybrid, *Typha X glauca*, may be more invasive of disturbed areas than the parent species. In the West, some studies have classified marshes dominated by *Typha domingensis* as phases of *Typha latifolia* marshes. This alliance now includes wetland communities dominated by *Typha latifolia*, often in disturbed or sedimented situations. The concept and distribution of this alliance in the Southeast needs reassessment. Many of the presettlement occurrences of this alliance have been drained and converted to cropland or

destroyed by siltation, which greatly accelerates the natural successional process from shallow inundation to moist soil. *Lythrum salicaria* is an aggressive exotic species that threatens this vegetation type in Canada, the Northeast, and more recently in the Midwest.

TYPHA LATIFOLIA WESTERN HERBACEOUS VEGETATION
Broadleaf Cattail Western Herbaceous Vegetation

ELEMENT CONCEPT

Summary: *Typha latifolia* Herbaceous Vegetation ranges across the western United States and western Great Plains near streams, rivers, and ponds. The soil is flooded or saturated for at least part of the growing season. The dominant species, *Typha latifolia*, often forms dense, almost monotypic stands. *Carex* spp. and *Schoenoplectus* spp. (= *Scirpus* spp.) are often found in this community, especially on the margins. Other species that occur regularly in this community are not well known. This community is common in its range, but little work has been done to characterize it.
Environment: This community is found along streams, rivers, and the banks of ponds. The soil is saturated or flooded for much of the year. It usually has a high organic content.
Vegetation: This community is dominated by hydrophytic macrophytes, especially *Typha latifolia*, which grow to approximately 2 m. *Typha latifolia* can form dense stands in places, almost to the exclusion of other species. Other species typical of wetlands are found in lesser amounts in this community; among these are *Carex* spp.
GRank & Reasons: G5 (94-02-23).
Comments: This community is a common element found in many wetland systems, but has received little attention. Consequently, the diagnostic features and species of this community are not well known.

ELEMENT DISTRIBUTION

Range: *Typha latifolia* Herbaceous Vegetation is widely distributed, occurring across the western United States and western Great Plains.
States/Provinces: AZ:S3, BC?, CA:S3, CO:S3, ID:S4, MT:S5, NM:S5, NV:S?, OR:S5, UT:S2S4, WA:S5, WY:S?

ELEMENT SOURCES

Authors: J. Drake, WCS
References: Bunin 1985, Christy 1973, Crowe and Clausnitzer 1997, Dethier 1990, Hansen et al. 1991, Hansen et al. 1995, Kittel et al. 1996, Kovalchik 1993, Kunze 1994, Lindauer 1978, Lindauer and Christy 1972, Masek 1979, McEachern 1979, Muldavin et al. 1993, Padgett et al. 1989, Ramaley 1939, Titus et al. 1996, Tolstead 1942, Youngblood et al. 1985

Intermittently flooded temperate or subpolar grassland with a sparse xeromorphic (evergreen and/or deciduous) shrub layer

SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SHRUB HERBACEOUS ALLIANCE
Black Greasewood Intermittently Flooded Shrub Herbaceous Alliance

ALLIANCE CONCEPT

Summary: This alliance is found in the northern Great Plains and Rocky Mountain foothills. The vegetation typically has moderate to dense cover (Jones and Walford 1995, Walford 1996, Thilenius et al. 1995). Medium-tall (0.5-1.5 m) shrubs are scattered throughout; their total canopy cover is 10-25%. The shrub layer is dominated by *Sarcobatus vermiculatus*, with *Atriplex confertifolia, Artemisia tridentata*, and *Chrysothamnus viscidiflorus* in smaller amounts. *Symphoricarpos occidentalis* and *Rhus aromatica* are sometimes found in more mesic microhabitats within this community (Hirsch 1985). Herbaceous cover is sparse beneath the shrubs and moderate to dense in between. The dominant species are typically 0.5-1 m tall. The most abundant species is *Pascopyrum smithii*, usually accompanied by *Bouteloua gracilis, Bromus japonicus, Bromus tectorum*, and *Hesperostipa comata (= Stipa comata)*. Few forbs are found in this community. *Achillea millefolium* and *Opuntia polyacantha* are the only species with high constancy. Overall species diversity in this community is low (Hansen and Hoffman 1988). ^Stands in this alliance are found on flat to gently sloping alluvial fans, terraces, lakebeds, and floodplains (Mueggler and Stewart 1978, Hansen and Hoffman 1988). Dodd and Coupland (1966) found *Sarcobatus vermiculatus* in association with *Pascopyrum smithii* only on the most arid parts of southwestern Saskatchewan. The soil is usually deep clay, silty clay, sandy clay, or loam (Hirsch 1985, Jones and Walford 1995), although coarse soils are possible (USFS 1992, Thilenius et al. 1995). They are saline or alkaline, but salt crusts on the surface are absent (Thilenius et al. 1995). Parent material is usually alluvium. Flooding during the spring is possible.

Environment: Shrublands included in this alliance occur on lowland sites in the northwestern Great Plains and central Wyoming. Precipitation varies with geography but ranges from 25-35 cm. Elevations range from 655-2400 m. Stands occur on flat to gently sloping alluvial fans, terraces, lakebeds, and floodplains (Mueggler and Stewart 1978, Hansen and Hoffman 1988). Dodd and Coupland (1966) found *Sarcobatus vermiculatus* in association with *Pascopyrum smithii* only on the most arid parts of southwest Saskatchewan. Sites are poorly drained and intermittently flooded with a shallow or perched water table often within 1 m depth (Hansen et al. 1995). Substrates are generally shallow, fine-textured soils (clays to silt-loams), derived from alluvium, although coarse soils are possible (USFS 1992, Thilenius et al. 1995) Soils are alkaline or saline, although not strongly saline because salt crusts do not generally form (Thilenius et al. 1995) ^Adjacent upland vegetation varies with geography. In the Great Plains, it is likely short- or midgrass prairie and in central Wyoming it is typically shrublands dominated by *Artemisia tridentata*.
Vegetation: Vegetation included in this alliance is found on intermittently flooded lowland sites such as stream terraces, swales, playas and gently sloping alluvial fans in the northern Great Plains and Rocky Mountain foothills. The vegetation typically has moderate to dense cover (Jones and Walford 1995, Thilenius et al. 1995, Walford 1996) dominated by the cool-season mid grasses. The herbaceous cover is sparse beneath the shrubs and moderate to dense between them. The dominant species are typically 0.5-1 m tall. The most abundant species is *Pascopyrum smithii*, usually accompanied by *Bouteloua gracilis, Hesperostipa comata (= Stipa comata)* and the exotics *Bromus japonicus* and *Bromus tectorum*. Medium-tall (0.5-1.5 m) shrubs are scattered throughout; their total canopy is 10-25%. The shrub layer is dominated by *Sarcobatus vermiculatus*, with *Atriplex confertifolia*, *Artemisia tridentata*, and *Chrysothamnus viscidiflorus* in smaller amounts. *Symphoricarpos occidentalis* and *Rhus aromatica* are sometimes found in more mesic microhabitats within this community (Hirsch 1985). Few forbs are found in this community. *Achillea millefolium* and *Opuntia polyacantha* are the only species with high constancy. Overall species diversity in this community is low (Hansen and Hoffman 1988).
Dynamics: *Sarcobatus vermiculatus*, like many facultative halophytes, is tolerant of alkaline and saline soil conditions that allow it to occur in sites with less interspecific competition (Ungar et al. 1969, Bransen et al. 1976). *Sarcobatus vermiculatus* is often found on sites with high water tables that are intermittently flooded. Hansen et al. (1995) reported that it can tolerate saturated soil conditions for up to 40 days. *Sarcobatus vermiculatus* is not ordinarily browsed, but Daubenmire (1970) found that under heavy stocking rates the shrubs will develop a compact canopy. Hansen et al. (1995) also reported browsing damage with heavy spring and summer grazing, but noted that *Sarcobatus vermiculatus* is moderately poisonous to livestock especially in the fall, and supplemental feed is recommended to avoid livestock loss. Hanson (1929) states that *Sarcobatus vermiculatus* can form an important part of winter forage for sheep. Fire will topkill *Sarcobatus vermiculatus*, but the shrub will promptly resprout from the root crown (Daubenmire 1970).
Comments: Some authors recognize a *Sarcobatus vermiculatus / Pseudoroegneria spicata* Shrub Herbaceous Vegetation (Hansen and Hoffman 1988, MTNHP 1988, USFS 1992) in addition to or combined with *Sarcobatus vermiculatus / Pascopyrum smithii* Shrub Herbaceous Vegetation (Brown 1971). There is no *Sarcobatus vermiculatus / Pseudoroegneria spicata* Shrub Herbaceous Vegetation in the USNVC. For this description these two communities were not merged. *Sarcobatus vermiculatus / Pseudoroegneria spicata* Shrubland (CEGL001367) is found on moderate to steep slopes and appears to be slightly drier. Further review needs to be completed to determine if the *Sarcobatus vermiculatus / Pseudoroegneria spicata* community described by others is actually different. If it is a separate community, its place in the classification needs to be established (Drake 1996).

SARCOBATUS VERMICULATUS / PASCOPYRUM SMITHII - (ELYMUS LANCEOLATUS) SHRUB HERBACEOUS VEGETATION

Black Greasewood / Western Wheatgrass - (Streamside Wild Rye) Shrub Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This greasewood shrub prairie is found in saline habitats in the northwestern Great Plains of the United States and Canada. Stands occur on flat to gently sloping alluvial fans, terraces, lakebeds, and floodplains. The soil is usually deep clay, silty clay, sandy clay, or loam, although coarse soils are possible. They are saline or alkaline, but salt crusts on the surface are typically absent. Parent material is usually alluvium. This community has moderate to dense vegetation cover. Medium-tall (0.5-1.5 m) shrubs are scattered throughout with a total shrub canopy of 10-25%. The shrub layer is dominated by *Sarcobatus vermiculatus*, with *Artemisia tridentata, Atriplex confertifolia*, and *Chrysothamnus viscidiflorus* in smaller amounts. *Symphoricarpos occidentalis* and *Rhus aromatica* are sometimes found in more mesic microhabitats within this community. Herbaceous cover is sparse beneath the shrubs and otherwise moderate to dense. The dominant species are typically 0.5-1 m tall. The most abundant species is *Pascopyrum smithii*, usually accompanied by *Bouteloua gracilis, Bromus japonicus, Bromus tectorum*, and *Hesperostipa comata (= Stipa comata)*. Few forbs are found in this community. *Achillea millefolium* and *Opuntia polyacantha* are the only species with high constancy. Overall species diversity in this community is low.
Environment: This community is found on flat to gently sloping alluvial fans, terraces, lakebeds, and floodplains (Mueggler and Stewart 1978, Hansen and Hoffman 1988). Dodd and Coupland (1966) found *Sarcobatus vermiculatus* in association with *Pascopyrum smithii* only on the most arid parts of southwestern Saskatchewan. The soil is usually deep

clay, silty clay, sandy clay, or loam (Hirsch 1985, Jones and Walford 1995), although coarse soils are possible (USFS 1992, Thilenius et al. 1995). They are saline or alkaline, but salt crusts on the surface are absent (Thilenius et al. 1995, but see Steinauer and Rolfsmeier 1997). Parent material is usually alluvium. Flooding during the spring is possible.
Vegetation: This community has moderate to dense vegetation cover (Jones and Walford 1995, Thilenius et al. 1995). Medium-tall (0.5-1.5 m) shrubs are scattered throughout, with a total shrub canopy of 10-25% (Hansen and Hoffman 1988, USFS 1992). The shrub layer is dominated by *Sarcobatus vermiculatus*, with *Atriplex confertifolia, Atriplex canescens, Atriplex argentea, Artemisia tridentata*, and *Chrysothamnus viscidiflorus* in smaller amounts. *Symphoricarpos occidentalis* and *Rhus aromatica* are sometimes found in more mesic microhabitats within this community (Hirsch 1985). Herbaceous cover is sparse beneath the shrubs and moderate to dense in between. The dominant species are typically 0.5-1 m tall. The most abundant species is *Pascopyrum smithii*, usually accompanied by *Bouteloua gracilis, Bromus japonicus, Bromus tectorum*, and *Hesperostipa comata (= Stipa comata)*. Few forbs are found in this community. *Achillea millefolium* and *Opuntia polyacantha* are the only species with high constancy. Other species present may include *Grindelia squarrosa*. Overall species diversity in this community is low (Hansen and Hoffman 1988, Von Loh et al. 1999). In Nebraska, shrub species cover may be very low, and saline pockets may contain *Distichlis spicata* and *Sporobolus airoides*. *Astragalus bisulcatus* may be prominent (Steinauer and Rolfsmeier 1999).
GRank & Reasons: G4 (96-02-01).
Comments: Compare this association with *Sarcobatus vermiculatus / Elymus elymoides - Pascopyrum smithii* Shrubland (CEGL001365) from New Mexico. ^See Steinauer and Rolfsmeier (1997) for a description of the stands in Nebraska. *Sarcobatus vermiculatus / Distichlis spicata - (Puccinellia nuttalliana)* Shrub Herbaceous Vegetation (CEGL002146) may be a more saline version of this type.

ELEMENT DISTRIBUTION

Range: This greasewood shrub prairie is found in saline habitats in the northwestern Great Plains of the United States and Canada, ranging from northwestern Nebraska north to the Dakotas and Saskatchewan.
States/Provinces: MT:S4, ND:S4?, NE:S2, SD:SU, SK?, WY:S4

ELEMENT SOURCES

Authors: J. Drake, WCS
References: Brown 1971, Dodd and Coupland 1966, Earth Resource Technology n.d., Fisser et al. 1965, Hamner 1964, Hansen and Hoffman 1988, Hansen et al. 1984, Hirsch 1985, Johnston 1987, Jones and Walford 1995, Montana Natural Heritage Program 1988, Mueggler and Stewart 1978, Mueggler and Stewart 1980, Olson and Gerhart 1982, Steinauer and Rolfsmeier 1997, Thilenius et al. 1995, U.S. Forest Service (USFS) 1992, Von Loh et al. 1999

Permanently flooded temperate or subpolar hydromorphic rooted vegetation

NYMPHAEA ODORATA - NUPHAR SPP. PERMANENTLY FLOODED TEMPERATE HERBACEOUS ALLIANCE

White Waterlily - Yellow Pondlily species Permanently Flooded Temperate Herbaceous Alliance

ALLIANCE CONCEPT

Summary: This alliance, common throughout most of the eastern and central United States and adjacent Canadian provinces, contains vegetation which may occur in a variety of slow-moving water bodies, including rivers, millponds, blackwater rivers, streams, shallow ponds or lakes, or on shores of deeper water bodies including freshwater tidal areas. The water depth is generally greater than 0.5 m and up to 2 m. Stands are dominated by hydromorphic rooted aquatic plants, typically *Nuphar lutea* (any of its various subspecies), with or without *Nymphaea odorata*. Emergent vegetation is less than 25%, and typically plant species diversity is low. Other species present may include *Utricularia* spp., *Potamogeton* spp., and others. In the north, *Brasenia schreberi* may be locally dominant. Other characteristic northern species include *Nymphaea tetragona* and *Potamogeton amplifolius*. Associates found in the Midwest include *Polygonum amphibium*. In the Southeast, examples may include the floating or emergent 'pad-leaved' species *Nelumbo lutea* or *Nymphoides aquatica*. Submerged aquatic species which may be present include *Cabomba caroliniana, Ceratophyllum demersum*, and *Heteranthera dubia*. Stands of this alliance are permanently to semipermanently flooded.
Environment: This alliance contains vegetation which may occur in a variety of slow-moving water bodies, including rivers, millponds, blackwater rivers, streams, shallow ponds or lakes, or on shores of deeper water bodies including freshwater tidal areas. The water depth is generally greater than 0.5 m and up to 2 m. Stands of this alliance are permanently to semipermanently flooded. These communities have been found at elevations as high as 2800 m in the southern Rocky Mountains.
Vegetation: Stands are dominated by hydromorphic rooted aquatic plants, typically *Nuphar lutea* (any of its various subspecies), with or without *Nymphaea odorata*. Emergent vegetation is less than 25%, and typically plant species

diversity is low. Other species present may include *Utricularia* spp., *Potamogeton* spp., and others. In the north, *Brasenia schreberi* may be locally dominant. Other characteristic northern species include *Nymphaea tetragona* and *Potamogeton amplifolius* (Harris et al. 1996). Associates found in the Midwest include *Polygonum amphibium*. In the Southeast, examples may include the floating or emergent 'pad-leaved' species *Nelumbo lutea* or *Nymphoides aquatica*. Submerged aquatic species which may be present include *Cabomba caroliniana, Ceratophyllum demersum*, and *Heteranthera dubia*.

Dynamics:

Comments: Field guidelines for separating floating-leaved aquatic alliances from submerged aquatic alliances are also needed.

NUPHAR LUTEA SSP. POLYSEPALA HERBACEOUS VEGETATION

Yellow Pond-lily Herbaceous Vegetation

ELEMENT CONCEPT

GRank & Reasons: G5 (96-02-01).

ELEMENT DISTRIBUTION

States/Provinces: CA:S?, CO:S1, ID:S4, OR:S5, WA:S4S5, WY?

ELEMENT SOURCES

Authors: WCS

References: Kovalchik 1993, Kunze 1994, Marr et al. 1980, Ramaley and Robbins 1909, Sawyer and Keeler-Wolf 1995

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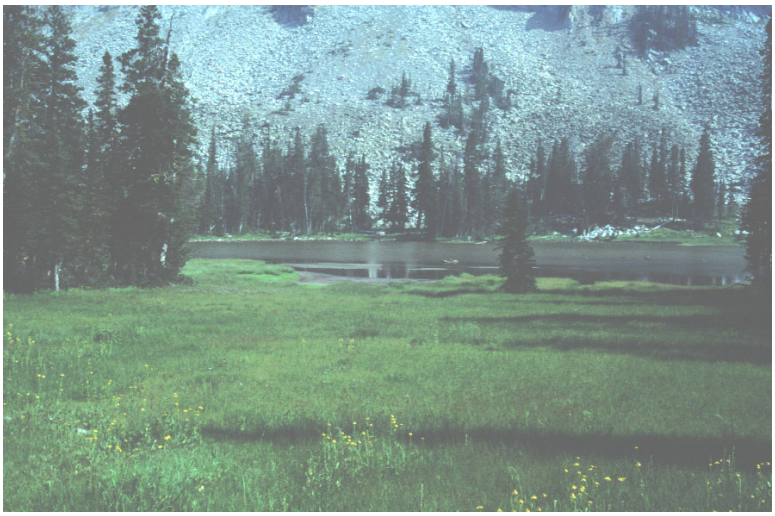
Appendix D – Site Descriptions



Subalpine lake with wetland fringe (Twin Lakes)

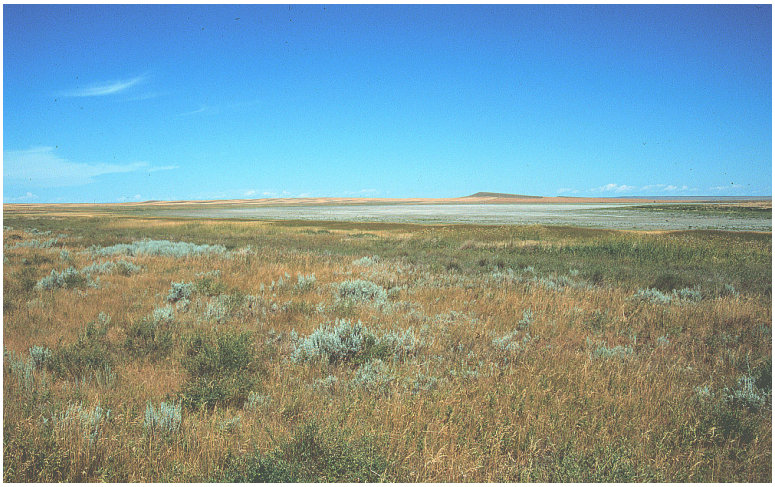
Poor fen with *Sphagnum* hummocks (Crater Fen)

Spruce, willow, and sedge-dominated lacustrine fringe communities (East Rosebud Lake)

Figure 1. Site Photographs

Sedge, aquatic, and wet spruce communities (East Rosebud Complex)

Morainal depressional wetland (West Rosebud Moraine)



Low-elevation alkaline lacustrine fringe communities (Big Lake)

Figure 1. Site Photographs (cont.)

Beaver-influenced wetlands (West Rosebud Trailhead)

Beaver pond with lodge (West Rosebud Complex)

Wet aspen draws and potholes in morainal topography (East Fork Fiddler Creek Complex)

Figure 1. Site Photographs (cont.)

Cottonwood communities along the Yellowstone River (Riverfront Park)

Plains cottonwood stand with diverse shrub layer including red-osier dogwood (Buffalo Mirage)

Degraded cottonwood stand: the native shrub component is absent and the herbaceous layer is dominated by smooth brome (Riverfront Park)

Figure 1. Site Photographs (cont.)

Wet aspen community in the arid Bighorn Basin (Grove Creek Aspens)

Spruce sapling colonizing a floodplain cottonwood community (Horsethief Station)

Prairie dog town on a terrace along the Yellowstone River (Young's Point)

Figure 1. Site Photographs (cont.)

BASIN LAKES

Directions

Basin Lakes is located in the Beartooth Mountains of south central Montana. From Red Lodge, travel 7.5 miles on Forest Service Route 71 to Forest Service Trail 35. Follow Forest Service Trail 35 southerly for about 2 miles to Basin Lakes.

Description

This collection of wetlands occurs in a lower subalpine basin in the Beartooth Mountains. These wetlands consist of small glacial depressions on and adjacent to several small creeks. Some of these depressions are supplied primarily with surface water from the creeks, while groundwater is the primary water source for the others. These depressions are small, ranging in size from 2 to 11 acres. The uplands are forests dominated by *Pinus contorta* (lodgepole pine) and *Pinus albicaulis* (whitebark pine) in the upper canopy and *Vaccinium scoparium* (grouse whortleberry) in the undergrowth. The wetter portions of the depressions in this complex are generally dominated by *Carex aquatilis* (water sedge), although in one instance *Nuphar lutea* (yellow pond-lily) dominates open water in the center of the wetland. Fens have developed in some of the small, shallow depressions. They are dominated by a *Salix planifolia* / *Carex aquatilis* (planeleaf willow / water sedge) community. Most of the examples of this community have dense *Sphagnum* (mosses characteristic of poor fens and bogs) cover as well. In one instance, *Sphagnum* appears to be invading small *Pinus contorta*-dominated islands within the fen. One depression is dominated by a *Carex limosa* (mud sedge) floating mat surrounded by a fringe of *Carex utriculata* (beaked sedge). A small stand of *Salix geyeriana* / *Carex utriculata* (Geyer's willow / beaked sedge) occurs along one of the streams.

Key Environmental Factors

Groundwater generated by meltwater from surrounding basin slopes is responsible for maintaining these wetlands.

Rarity

No rare plants or animals were observed. This site supports many high quality occurrences of common plant communities and one G3 plant association, *Carex limosa* (mud sedge) herbaceous vegetation. Some of the wetlands are fens, which are a rare wetland type in Montana and have a high conservation value.

Land Use

No human impacts were discovered within the wetlands in the course of inventory.

Exotics

No exotic species were found.

Uplands

This basin has experienced past mining activity; associated structures (cabins) and evidence of activities (timbering) remain.

Information Needs

None have been noted.

Management Needs

The uplands should be managed to maintain the site's hydrology.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Calamagrostis canadensis Western Herbaceous Vegetation	S4	G4	A
Carex aquatilis Herbaceous Vegetation	S4	G5	A
Carex limosa Herbaceous Vegetation	S3	G3	A
Carex utriculata Herbaceous Vegetation	S5	G5	B
Nuphar lutea Dominance Type	*	*	*
Salix geyeriana / *Carex utriculata* Shrubland	S5	G5	A
Salix planifolia / *Carex aquatilis* Shrubland	S3	G5	A, B
Salix planifolia / *Carex scopulorum* Shrubland	S?	G4	A

* Rank not assigned

BEAVER LODGE

Directions

Beaver Lodge is located in the foothills and high plains of south central Montana. From Red Lodge, travel north on U.S. Highway 212 for approximately 5.5 miles. Turn east on a dirt road that is signed for Rock Creek fishing access. Follow this road for approximately 0.5 mile. After crossing Rock Creek, turn right at a T-intersection and travel south for approximately 1 mile. The access to Beaver Lodge Fishing Access is signed.

Description

Beaver Lodge is located in the floodplain of Rock Creek. In this reach, Rock Creek is braided with two or three primary channels. The site is composed primarily of mature cottonwood forest, with *Populus balsamifera* ssp. *trichocarpa* / *Symphoricarpos occidentalis* (black cottonwood / western snowberry) occupying most of the floodplain at this site. This community has an open canopy of *Populus balsamifera* ssp. *trichocarpa* with scattered *Picea engelmannii* (Engelmann spruce) saplings and an herbaceous layer dominated by the exotics *Poa pratensis* (Kentucky bluegrass) and *Bromus inermis* (smooth brome). *Symphoricarpos occidentalis* is widespread, but other shrubs, such as *Prunus virginiana* (chokecherry), *Betula occidentalis* (water birch), and *Rosa acicularis* (prickly rose), are poorly represented and confined to mesic swales. A *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) community occurs on a large island between channel braids. Although heavily browsed, the shrub layer is well developed and dominated by tall *Prunus virginiana*. *Poa pratensis* dominates the herbaceous layer.

This site also has mesic seeps and swales that intercept groundwater and support an *Alnus incana* / *Equisetum arvense* (mountain alder / field horsetail) community. Very small backwater sloughs along the active channels collect fine sediments and support small stands of *Typha latifolia* (broadleaf cattail), *Calamagrostis canadensis* (bluejoint reedgrass), and the exotic *Phalaris arundinacea* (reed canarygrass). Point and side gravel-cobble bars are common and are being colonized by herbaceous species, including many exotics.

Key Environmental Factors

Fluvial processes, such as seasonal flooding and high groundwater, and the associated channel migration and microtopography are the primary influences on vegetation structure and composition at this site. Browsing by wild ungulates (perhaps elk and moose) has altered the structure of the shrub layer in some cottonwood stands by suppressing and reducing the cover of palatable species, such as *Cornus sericea* (red-osier dogwood).

Rarity

No special status plant or animal species were observed. Two G3 communities in fair condition were documented: *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) and *Alnus incana* / *Equisetum arvense* (mountain alder / field horsetail).

Other Values

Although there are several diversion ditches upstream of and within this reach, this section of Rock Creek appears to support important hydrologic functions, such as dynamic water storage and surface water - groundwater interactions. The floodplain is still accessed by surface and subsurface flooding regimes, and native vegetation appears to be highly connected and to occupy much of the floodplain.

Land Use

Beaver Lodge is a state fishing access site, and informal recreational trails occur throughout the site. There is also a small camping area.

Exotics

Weeds are abundant around the camping area and along trails. These include *Centaurea maculosa* (spotted knapweed), *Euphorbia esula* (leafy spurge), *Cynoglossum officinale* (hound's tongue), *Taraxacum officinale* (common dandelion), *Poa pratensis* (Kentucky bluegrass), *Leucanthemum vulgare* (ox-eye daisy), *Dactylis glomerata* (orchard grass), and *Phleum pratense* (common timothy).

Uplands

Native vegetation occupies the floodplain of Rock Creek along the active channels immediately up and downstream of the site. Land use adjacent to this riparian corridor is predominately pasture and housing development.

Information Needs

What was the land use at this site before its acquisition by the Department of Fish, Wildlife & Parks?

Management Needs

Although this site would benefit from noxious weed management, the influx of river-borne weed propagules from the upstream watershed will make weed control efforts even more challenging.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Alnus incana / *Equisetum arvense* Shrubland	S?	G3	C
Populus balsamifera ssp. *trichocarpa* / *Cornus sericea* Forest	S3?	G3?	C
Populus balsamifera ssp. *trichocarpa* / *Symphoricarpos occidentalis* Forest	S3?	*	B

* Rank not assigned

BIG BEAVER

Directions

Big Beaver is located in the Beartooth Mountains of south central Montana. From McLeod proceed 16 miles south on State Route 298 to Forest Service Trail 117. Big Beaver is located 0.5 miles south on State Route 298.

Description

This wetland/riparian area, located in the active floodplain of the Boulder River, is a complex array of aquatic, emergent, shrub, and riparian communities. Some of the shrub and emergent communities lack well-defined boundaries and appear to intergrade depending mainly on the depth to the water table. The water source is primarily surface and groundwater from the Boulder River. *Castor canadensis* (beaver) activity has resulted in a series of dams that have ponded water in an old river slough adjacent to the main channel. The

flooded beaver ponds have aquatic communities that support a variety of species such as *Potamogeton foliosus* (close-leaved pondweed), *Callitriche heterophylla* (different-leaved water starwort), *Ranunculus aquatilis* (water buttercup), *Hippuris vulgaris* (common mare's tail), *Sparganium* sp. (bur-reed), and *Nitella* sp. (an algal species). A small *Typha latifolia* (broadleaf cattail) community occurs at one end of the beaver pond, and *Carex utriculata* (beaked sedge) occurs along some of the slough margins. An exotic community of *Poa palustris* (fowl bluegrass) occurs on some sparsely vegetated silt deposits next to the beaver ponds.

The remaining portion of the site occurs on drier terrace deposits. A *Salix exigua* (sandbar willow) community occurs on a low terrace next to the river. This community has a diverse understory of forbs and graminoids, and later-successional willow species are beginning to dominate the overstory. An *Alnus incana* (mountain alder) community occurs at other low spots on the interior part of this terrace. Dominance in this community shifts at times from *Alnus incana* to *Salix exigua* or *Salix boothii* (Booth's willow). There is a small patch of *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red osier dogwood) on the terrace as well. Most of this stand is fairly young and poorly developed. The dominant forested community, however, is a climax riparian community, *Picea engelmannii* / *Cornus sericea* (Engelmann spruce / red osier dogwood). There is some spruce blowdown in this community and the red-osier dogwood undergrowth is heavily browsed by ungulates (wild and/or domesticated).

Key Environmental Factors

The primary factors structuring this site's plant communities are beaver activity (primarily harvesting), high water tables, and seasonal flooding.

Rarity

No rare plants or animals were observed. Two high quality G3 plant associations were documented: *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) and *Picea engelmannii* / *Cornus sericea* (Engelmann spruce / red-osier dogwood).

Land Use

The presence of pasture grasses, weedy species, and severe browsing of *Cornus sericea* (red-osier dogwood) all point to past and perhaps ongoing grazing disturbance.

Exotics

Pasture grasses, such as *Phleum pratense* (common timothy), *Poa palustris* (fowl bluegrass), and *Poa pratensis* (Kentucky bluegrass), and other exotic increaser species, including *Trifolium pratense* (red clover), *Medicago lupulina* (black medic), and *Taraxacum officinale* (common dandelion), occur on dry to mesic terraces. More mesic to hydric conditions favor *Phalaris arundinacea* (reed canarygrass), *Leucanthemum vulgare* (oxeye-daisy), *Tanacetum vulgare* (common tansy), and *Cirsium vulgare* (bull thistle).

Uplands

A road exists along the eastern edge of the wetland, but it probably is no more confining of the channel than the talus slope that also borders this section of the wetland. Upstream, grazing and construction of homesites is occurring within the riparian corridor.

Information Needs

Is this a management allotment or is the heavy browsing on *Cornus sericea* (red-osier dogwood) all attributable to wild ungulates?

Management Needs

A weed management plan is needed to keep out *Euphorbia esula* (leafy spurge). This is a very aggressive noxious weed and was noted along the trail to Green Mountain in the vicinity of Natural Bridge. *Phalaris arundinacea* (reed canarygrass) is also very aggressive and should be controlled.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Aquatic	*	*	*
Carex utriculata Herbaceous Vegetation	S5	G5	B
Picea engelmannii / *Cornus sericea* Woodland	S3	G3	A
Poa palustris Herbaceous Vegetation	S4	GW	*
Populus balsamifera ssp. *trichocarpa* / *Cornus sericea* Forest	S3?	G3?	C
Salix boothii / Mesic graminoids Shrubland	S?	G3?	B
Salix exigua Temporarily Flooded Shrubland	S5	G5	A
Typha latifolia Herbaceous Vegetation	S5	G5	B

* Rank not assigned

BIG LAKE

Directions

Big Lake is north of the Yellowstone River in south central Montana. From Molt, 22 miles west of Billings on State Route 302, travel 10 miles northwesterly to Wheat Basin Road. Proceed approximately 1 mile southeasterly on Wheat Basin Road to Big Lake.

Description

This site is composed of a large, shallow lake basin. Big Lake has no outlet, and is the recipient of water from several intermittent creeks. During wet climatic periods (e.g., several years with above average precipitation), it fills with water. However, during drier periods, it dries up and leaves expansive, unvegetated, alkaline mud flats. Crested wheatgrass (*Agropyron cristatum*) is common in the adjacent uplands. Big Lake, like the nearby Hailstone and Halfbreed Wildlife Refuges, has little in the way of emergent vegetation. Parts of the large saline mud flats are covered with a *Salicornia rubra* (red glasswort) community, but in general these flats are unvegetated. The next higher community along a topographic and moisture gradient is *Distichlis spicata* (saltgrass), which occurs on flat areas slightly above the mud flats on the edges of Big Lake. Slightly above the *Distichlis spicata* community is a *Schoenoplectus pungens* (threesquare) community. This community also occurs as a narrow band around some parts of the edge of Big Lake. A *Hordeum jubatum* (foxtail barley) community occurs in the driest position on the site, above the two previous communities. One of the inlet creeks has been impounded to form a small wetland that commonly has standing water for part of the year. The neighboring borrow pit (where fill material for the impoundment was taken from) also had standing water at the time of the site visit and contained populations of *Stuckenia pectinata* (sago pondweed) and the green alga *Chara*.

Key Environmental Factors

Variation in landform, heavy-textured soils (and associated slow-drainage), and seasonal flooding of the basin setting structure this site's wetlands.

Rarity

No rare plants or animals were observed. A sizeable occurrence of *Salicornia rubra* (red glasswort), G2G3, was documented.

Other Values

Big Lake is an important migratory bird stopover and a breeding production site when it has water; it supports abundant *Stuckenia pectinata* (sago pondweed) in the aquatic portions and *Schoenoplectus acutus* (hardstem bulrush) and *Schoenoplectus pungens* (threesquare) as emergent vegetation, all of which constitute important waterfowl food sources.

Land Use

At Big Lake and Pond 1f, hunting is the only allowed activity; at Pond 2 hunting and grazing is permitted. Grazing has caused conspicuous hummocking in this area.

Exotics

There are numerous exotics in the wet meadow vegetation, including *Melilotus officinalis* (yellow sweet clover), *Thinopyrum intermedium* (intermediate wheatgrass), *Kochia scoparia* (summer cypress), *Sonchus* spp. (sow-thistle), *Cirsium vulgare* (bull thistle), and *Cirsium arvense* (Canada thistle). Several exotic species also occur in the surrounding uplands, including *Agropyron cristatum* (crested wheatgrass), *Salsola kali* (Russian thistle) and *Chenopodium album* (lambsquater). The only exception to this pattern of disturbance-vegetation is the south side of Big Lake, where *Artemisia cana* is dominant with *Stipa* spp. (needlegrass) and native forbs comprising the undergrowth.

Uplands

There is a buffer where no farming or grazing occurs in the uplands immediately adjacent to the wetland. Adjacent to this buffer, the uplands are managed for dryland wheat farming.

Information Needs

The water source for the ponds is unknown but assumed to be groundwater. Big Lake and ponds in the immediate vicinity have emergent vegetation, whereas those ponds further removed apparently do not. Is excessive alkalinity a factor?

Management Needs

A management plan for exotics should be developed, although the exotics do not significantly negatively impact the value of the wetlands to waterfowl.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Distichlis spicata Herbaceous Vegetation	S4	G5	B
Eleocharis palustris Herbaceous Vegetation	S5	G5	*
Hordeum jubatum Herbaceous Vegetation	S4	G4	B
Salicornia rubra Herbaceous Vegetation	S2?	G2G3	B
Schoenoplectus acutus Herbaceous Vegetation	S5	G5	*
Schoenoplectus pungens Herbaceous Vegetation	S3	G3G4	B

* Rank not assigned

BLUEWATER SPRINGS

Directions

The Bluewater Springs site is located along Bluewater Creek, approximately 5 miles southeast of Fromberg and 5 miles northeast of Bridger, MT. From Bridger, take the county road east to East Bridger, then south and east towards Bluewater Fish Hatchery, about 5.5 miles from East Bridger.

Description

This site consists of a series of springs along Bluewater Creek and several of its tributaries. Soils are fairly sandy and calcareous and are derived from Chugwater sandstone interbedded with thin lenses of limestone. The springs support species-rich wet or saturated meadows, many of which have extensive marl deposits. Wet areas adjacent to springs support populations of *Eleocharis rostellata* (beaked spikerush), *Carex aquatilis* (water sedge), *Carex aurea* (gold sedge), *Carex pellita* (woolly sedge), and *Juncus tracyi* (Tracy's rush). A healthy population of *Epipactis gigantea* (giant helleborine) with *Rorippa nasturtium-aquaticum* (watercress), *Platanthera hyperborea* (northern green orchid), and *Mimulus guttatus* (seep monkeyflower) occurs around

one of the upper springs. This site also includes an undeveloped thermal spring, Bluewater warm spring, which flows into Bluewater Creek. Bluewater Creek supports riparian areas that vary in condition depending on grazing intensity.

Key Environmental Factors

Surface and subsurface seeps and springs are critical in maintaining this site. Geothermal activity and calcareous substrate are also important factors.

Rarity

The wet meadows support several rare plant species, including *Asclepias incarnata* (swamp milkweed), S1 G5, *Epipactis gigantea* (giant helleborine), S2 G5, *Eupatorium maculatum* var. *bruneri* (Joe-pye weed), S2 G5, and *Eleocharis rostellata* (beaked spikerush), S2 G5. *Lampropeltis triangulum* (milk snake) is recorded from this site. Springs and seeps as well as thermal springs are rare features, especially in this arid region of the state.

Land Use

The springs are largely undeveloped, except for one spring along the North Fork of Bluewater Creek that has some development for domestic use. Portions of the riparian areas and adjacent grasslands have been disturbed and degraded by overgrazing.

Exotics

Euphorbia esula (leafy spurge) is abundant and increasing at this site. *Phalaris arundinacea* (reed canarygrass) has invaded some of the wet meadows. Pasture grasses, such as *Poa pratensis* (Kentucky bluegrass) and *Bromus inermis* (smooth brome), occur in grasslands adjacent to the springs and some of the drier meadows.

Uplands

Bottomland adjacent to seeps/springs and riparian areas has been converted into hay pastures in places. Vegetation on the canyon walls and rims is in good condition.

Information Needs

Plant community surveys are needed, as are additional surveys for plants and animals. The warm springs could potentially harbor rare or endemic aquatic insects, and specific surveys for these aquatic insects should be undertaken.

BOULDER FORKS

Directions

Note: A portion of this site is located on private land, and landowner permission is needed to access that area. The Boulder Forks site is located in the foothills of the Beartooth Mountains in south central Montana. From McLeod, travel south on State Route 298 for approximately 0.5 mile. After crossing the West Boulder, turn west (left) at the Boulder Forks Fishing Access.

Description

This site is located at the confluence of the West and Main Boulder Rivers. Much of the site occupies a narrow floodplain and low terrace between the active channel and a high terrace dominated by the exotic grass *Bromus inermis* (smooth brome). *Populus balsamifera* ssp. *trichocarpa* (black cottonwood) communities occupy most of this floodplain/terrace. Most cottonwood stands are a *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) community. The shrub component of this community varies from diverse and well developed to sparse, and exotic grasses dominate the herbaceous layer. The most degraded stands are classified as a *Populus balsamifera* ssp. *trichocarpa* / mesic graminoids

community: they have almost no shrub component and a dense cover of *Bromus inermis* dominates the herbaceous layer. A senescent stand of cottonwood on a low terrace, with large gaps created by tree mortality, has succeeded to a *Symphoricarpos occidentalis* (western snowberry) community. Old channels and swales support small *Salix lutea* / *Calamagrostis canadensis* (yellow willow / bluejoint reedgrass) and *Carex utriculata* (beaked sedge) communities, which form mesic inclusions within the cottonwood stands. At the southern end of the site on the Main Boulder River, an overflow channel has created a ponded area that supports *Carex utriculata*, aquatic, and *Salix lutea* / *Carex utriculata* communities. Scattered mature *Pseudotsuga menziesii* (Douglas-fir) occupy portions of the slope between the floodplain and high terrace.

This site also contains two seep areas. One has been modified by an old beaver dam that is silting in. *Typha latifolia* (broadleaf cattail) occupies areas of greater sediment deposition. Deeper portions of the pond support an aquatic community made up of *Sparganium angustifolium* (narrowleaf bur-reed), *Hippuris vulgaris* (common mare's-tail), *Ranunculus gmelinii* (Gmelin's buttercup), and *Potamogeton* sp. (pondweed). The other seep area is fed by outflow from an irrigation ditch. It may also receive groundwater from the uplands. The seep edges are dominated by *Juncus balticus* (Baltic rush) and have a high cover of *Cirsium arvense* (Canada thistle). Wetter areas support a *Carex utriculata* community co-dominated by *Carex aquatilis* (water sedge) and *Glyceria striata* (fowl mannagrass), and the wettest areas are dominated by *Carex utriculata* with *Typha latifolia*. *Salix exigua* (sandbar willow) and *Salix lutea* / *Carex utriculata* communities occur along the outflow swale of this seep area.

Key Environmental Factors

Seasonal flooding and groundwater seepage are the primary factors influencing vegetation at this site. *Castor canadensis* (beaver) modification, hydrologic augmentation from an irrigation ditch, and past grazing practices are also important influences.

Rarity

No special status plant or animal species were observed. Two G3 communities, *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) and *Salix lutea* / *Calamagrostis canadensis* (yellow willow / bluejoint reedgrass), were documented in fair condition.

Land Use

A portion of this site is Montana Department of Fish, Wildlife & Parks fishing access site, and it receives high levels of recreational use. However, road and campground development are restricted to the high terrace, and the site appears to be little affected by this use. The private portion of the site is not currently grazed and appears to receive little use.

Exotics

Herbaceous exotic species are abundant in drier portions of this site, such as cottonwood stands and the margins of seeps, and often dominate the ground layer in cottonwood communities. Abundant species include *Bromus inermis* (smooth brome), *Poa pratensis* (Kentucky bluegrass), and *Dactylis glomerata* (orchard grass). Other common weeds are *Cynoglossum officinale* (hound's tongue), *Cirsium arvense* (Canada thistle), *Phalaris arundinacea* (reed canarygrass), *Arctium* sp. (burdock), and *Thlaspi arvense* (pennycress). There are small patches of *Euphorbia esula* (leafy spurge) along the Main Boulder.

Uplands

The riparian zone is very linear and has been greatly influenced by grazing. In some areas it has been reduced to a *Poa pratensis* (Kentucky bluegrass) disclimax. The site is adjacent to the town of McLeod.

Information Needs

What is the grazing history? Is the dominance of exotic grasses, especially on the high terrace, a grazing disclimax? Was *Bromus inermis* (smooth brome) seeded? Is the grazing history of the *Populus balsamifera*

ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) community different from the *Populus balsamifera* ssp. *trichocarpa* / mesic graminoids community?

Management Needs

Some of the noxious weeds, such as *Euphorbia esula* (leafy spurge) and *Cynoglossum officinale* (hound's tongue), are still localized and could be eradicated or contained.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Aquatic	*	*	*
Carex utriculata Herbaceous Vegetation	S5	G5	B
Populus balsamifera ssp. *trichocarpa* / *Cornus sericea* Forest	S3?	G3?	C
Populus balsamifera ssp. *trichocarpa* / Mesic graminoids Forest	SW	*	*
Salix boothii Dominance Type	*	*	*
Salix exigua Temporarily Flooded Shrubland	S5	G5	B
Salix lutea / *Calamagrostis canadensis* Shrubland	S3?	G3?	C
Salix lutea / *Carex utriculata* Shrubland	S4	G4	B/C
Symphoricarpos occidentalis Shrubland	S4S5	G4G5	C
Typha latifolia Western Herbaceous Vegetation	S5	G5	B

* Rank not assigned

BUFFALO MIRAGE

Directions

Note: a portion of this site is located on private land, and landowner permission is required to access that area. Buffalo Mirage is located along the Yellowstone River near its confluence with the Clark's Fork Yellowstone River in south central Montana. The site can be accessed from a frontage road south of Park City.

Description

This site occurs in the bottomland of the Yellowstone River. It occupies both high terraces and the river's active floodplain, including recent depositional bars. Except for high terraces, this site appears to have been inundated by the 100-year floods of 1996 and 1997. High terraces are a mix of cottonwood stands and areas converted to agricultural uses. The condition of the cottonwood communities varies, with stands on private land in the best condition. Terrace cottonwood communities on private land include *Populus angustifolia* / *Rhus trilobata* (narrowleaf cottonwood / skunkbush sumac) and *Populus angustifolia* / *Symphoricarpos occidentalis* (narrowleaf cottonwood / western snowberry). Both these communities have open canopies with well-developed shrub layers of *Rhus trilobata* and *Shepherdia argentea* (silver buffaloberry) or *Symphoricarpos occidentalis*. *Poa pratensis* (Kentucky bluegrass) dominates the herbaceous layer, although droughtier patches without woody cover retain low cover of *Pascopyrum smithii* (western wheatgrass). Both these communities have large, open, shrub-dominated patches. Terraces on state land have patches of *Populus deltoides* (plains cottonwood) with well-developed *Rhus trilobata* and *Shepherdia argentea* understories, but for the most part they are dominated by a *Populus deltoides* / mesic graminoids grazing disclimax. Heavy grazing in this latter community has greatly reduced shrub diversity and cover and has facilitated the dominance of exotic pasture grasses. *Elaeagnus angustifolia* (Russian olive) forms a well developed mid-canopy through much of this community.

More mesic areas in abandoned and overflow channels support *Populus deltoides* / *Symphoricarpos occidentalis*, *Populus deltoides* / *Cornus sericea* (plains cottonwood / red-osier dogwood), and *Carex praegracilis* (clustered field sedge) communities. The cottonwood communities support a diverse and well-developed shrub layer of *Symphoricarpos occidentalis*, *Rhus trilobata*, *Shepherdia argentea*, *Ribes aureum*

(golden currant), *Prunus virginiana* (chokecherry), *Salix lutea* (yellow willow), *Rosa acicularis* (prickly rose), *Clematis ligusticifolia* (western clematis), *Vitis riparia* (riverbank grape), and, in places, *Cornus sericea*. As in the aforementioned terrace communities, exotics grasses, especially *Poa pratensis*, dominate the herbaceous layer. There are limited patches of cottonwood regeneration (sapling-sized *Populus angustifolia*) along an overflow channel.

Key Environmental Factors

Seasonal flooding and channel migration support these riparian communities and are necessary for their continued vigor and regeneration. The high flood events of 1996/1997 caused a realignment of the channel. *Castor canadensis* (beaver) are causing localized but heavy cottonwood mortality in places. Grazing intensity is variable; however, past grazing may explain the absence of *Cornus sericea* (red-osier dogwood) from much of the site.

Rarity

No special status plants or animals were observed. Two rare plant communities, *Populus deltoides* / *Symphoricarpos occidentalis* (plains cottonwood / western snowberry) and *Populus deltoides* / *Cornus sericea* (plains cottonwood / red-osier dogwood), were documented in fair condition. Although these stands have high cover of exotic grasses, especially *Poa pratensis* (Kentucky bluegrass), the shrub layers are robust and diverse, making them high quality stands from a regional perspective.

Other Values

Cottonwood stands have significant wildlife values. High quality stands with an intact native shrub understory are very rare along the Yellowstone River in the study area, and those that remain have a high conservation value.

Land Use

Portions of the high terraces in this site have been converted to pasture and other agricultural uses. The site is currently grazed by livestock (mostly cattle with limited horse use), and has probably received long-term heavy grazing pressure in the past. Current livestock use varies, with the greatest utilization on the state land section. In contrast, livestock use on the private land portion of the site does not appear to be adversely altering the structure of the native vegetation.

Exotics

Pasture grasses, especially *Poa pratensis* (Kentucky bluegrass), dominate the ground layer. *Bromus tectorum* (cheatgrass) and *Alopecurus pratensis* (meadow foxtail) are locally abundant. *Arctium* sp. (burdock), *Cirsium arvense* (Canada thistle), *Cynoglossum officinale* (hound's tongue), *Taraxacum officinale* (common dandelion), and *Tanacetum vulgare* (common tansy) are present at low cover. Small populations of *Euphorbia esula* (leafy spurge) and *Tamarix chinensis* (tamarisk) are present in areas with fresh deposition from the 1996/1997 flood events. *Elaeagnus angustifolia* (Russian olive) is well established on the state land section, and saplings are encroaching on the private land portion of the site.

Uplands

The bottomlands along the Yellowstone River in this reach still retain patches (some large) of cottonwood stands. However, much of the high terrace has been converted to pasture and other agricultural uses. There is limited placement of revetment along portions of the channel. Except for this localized geomorphic modification, fluvial processes are intact.

Information Needs

None were noted.

Management Needs

Some of the most troublesome weeds, *Euphorbia esula* (leafy spurge), *Tamarix chinensis* (tamarisk), and *Elaeagnus angustifolia* (Russian olive) (in places), are present at low cover and should be eradicated before they spread and become an intractable problem. The good grazing practices on the private land portion of the site should be encouraged to continue.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Carex praegracilis Herbaceous Vegetation	S?	G3	C
Populus angustifolia / *Rhus trilobata* Woodland	S?	G3	C
Populus angustifolia / *Symphoricarpos occidentalis* Woodland	S?	*	C
Populus deltoides / *Cornus sericea* Forest	S2S3	G2G3	C
Populus deltoides / Mesic graminoids Forest	SW	*	*
Populus deltoides / *Symphoricarpos occidentalis* Woodland	S2S3	G2G3	C

* Rank not assigned

BULL SPRINGS

Directions

Bull Springs is located in the foothills and high plains of south central Montana. From Red Lodge, travel north on U.S. Highway 212 for approximately 5.5 miles. Turn east on a dirt road that is signed for Rock Creek fishing access. Follow this road for approximately 0.5 mile. After crossing Rock Creek, turn left at a T-intersection. The Bull Springs Fishing Access is just past the intersection on the left.

Description

Bull Springs occurs in the floodplain of Rock Creek and is characterized by cottonwood gallery forests and willow communities along wet swales. Rock Creek is braided with two or three primary channels and many swales, some of which intersect riverine groundwater and have standing or flowing water. These wet microsites occur as narrow stringers within cottonwood communities and support a *Salix boothii* / *Calamagrostis canadensis* (Booth's willow / bluejoint reedgrass) association. Dominant shrubs are *Salix boothii*, *Alnus incana* (mountain alder), and *Betula occidentalis* (water birch). *Calamagrostis canadensis* dominates the herbaceous layer, except for the wettest locations in and immediately adjacent to swales, which have high cover of *Carex utriculata*.

The remainder of the site occurs on higher floodplain deposits that predominately support *Populus balsamifera* ssp. *trichocarpa* (black cottonwood) communities. The largest community is *Populus balsamifera* ssp. *trichocarpa* / mesic graminoids. An open canopy of mature *Populus balsamifera* ssp. *trichocarpa* characterizes this community. Saplings (probably from suckering) form a scattered midstory, and clumps of *Juniperus communis* (common juniper) form a minor shrub component. *Poa pratensis* dominates the herbaceous layer with *Centaurea maculosa* (spotted knapweed) present at low cover. Microtopographic relief provides small mesic swales where native herbaceous species are abundant. These include *Calamagrostis canadensis*, *Poa glaucifolia* (pale-leaf bluegrass), *Carex aenea* (bronze sedge), and *Equisetum arvense* (field horsetail). A smaller *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) association also occurs at the site. Similar to the previous community, this community also has an open overstory of mature *Populus balsamifera* ssp. *trichocarpa*, but the shrub component is much better developed. The diagnostic shrub *Cornus sericea* is very restricted and present at very low cover. *Prunus virginiana* (chokecherry) is abundant and is the dominant shrub; *Alnus incana* and *Symphoricarpos occidentalis* (western snowberry) are present at low cover. The herbaceous layer is dominated by *Elymus glaucus* (blue wildrye) and *Poa pratensis*, both of which are abundant. *Calamagrostis canadensis* is locally abundant in numerous shallow swales. The exotics *Cynoglossum officinale* (hound's tongue) and *Dactylis glomerata* (orchard grass) are present at low cover and *Bromus inermis* is well represented. Finally, the site

also supports a small undescribed *Populus tremuloides* / *Symphoricarpos occidentalis* community. *Populus tremuloides* forms a closed canopy, and *Prunus virginiana* forms a scattered midstory. *Symphoricarpos occidentalis* is very abundant throughout. *Poa pratensis* is abundant and is the dominant herbaceous species, except in swales where *Calamagrostis canadensis* is locally dominant. Herbaceous openings have a high cover of exotic species, such as *Cynoglossum officinale*, *Cirsium* spp. (thistle), *Centaurea maculosa*, and *Euphorbia esula* (leafy spurge). Beaver-caused mortality may be limiting *Populus tremuloides* regeneration in places.

Key Environmental Factors

Seasonal flooding and high groundwater tables are responsible for creating and maintaining the structure and composition of the plant associations at this site. Browsing by native ungulates and beaver and possible past browsing by livestock may be responsible for the sparse shrub layer in the majority of the site. This could also be explained by differences in soil or geomorphic characteristics.

Rarity

No special status plants or animals were observed. One G3? community, *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood), and one undescribed community, *Populus tremuloides* / *Symphoricarpos occidentalis* (quaking aspen / western snowberry), were documented. (The *Populus tremuloides* / *Symphoricarpos occidentalis* community appears to be similar to the G3?-ranked *Populus tremuloides* / *Symphoricarpos albus* [quaking aspen / common snowberry] community.) Both were only in fair condition, primarily due to the presence of exotics.

Other Values

Although there are several diversion ditches upstream of and within this reach, this section of Rock Creek appears to support important hydrologic functions, such as dynamic water storage and surface water - groundwater interactions. The floodplain is still accessed by surface and subsurface flooding regimes, and native vegetation appears to be highly connected and to occupy much of the floodplain.

Land Use

Despite being a dedicated recreation site, there is little evidence of use, except for a few trails and some garbage near the parking area.

Exotics

Pasture grasses, especially *Poa pratensis* (Kentucky bluegrass), dominate the ground layer. *Centaurea maculosa* (spotted knapweed) and *Cynoglossum officinale* (hound's tongue) occur at low cover over much of the site. *Euphorbia esula* (leafy spurge) is present (for now) as one patch.

Uplands

Native vegetation occupies the floodplain of Rock Creek along the active channels immediately up and downstream of the site. Adjacent to this corridor, human uses (pasture, houses) dominate, and portions of the floodplain further away from the active channel are grazed.

Information Needs

How do irrigation diversions affect the functionality of the site? What was the grazing history of this site before the Department of Fish, Wildlife & Parks acquired it? Is the paucity of shrubs in cottonwood stands throughout much of the site a product of past livestock grazing, or is it a result of differences in soil texture or geomorphic characteristics?

Management Needs

Although pasture grasses are very well established at the site, noxious weeds, such as *Centaurea maculosa* (spotted knapweed), *Cynoglossum officinale* (hound's tongue), and *Euphorbia esula* (leafy spurge), are currently present at low cover and should be eradicated or controlled with a weed management plan.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Populus balsamifera ssp. *trichocarpa* / *Cornus sericea* Forest	S3?	G3?	C
Populus balsamifera ssp. *trichocarpa* / Mesic graminoids Forest	SW	*	*
Populus tremuloides / *Prunus virginiana* Forest	S?Q	G3?Q	C
Salix boothii / *Calamagrostis canadensis* Shrubland	S3	G3G4Q	B

* Rank not assigned

CHROME LAKE

Directions

Note: a portion of this site is located on private land, and landowner permission is needed to access this area. Chrome Lake is located in the Beartooth Mountains of south central Montana. From Dean, travel southwesterly on Benbow Road for 11.5 miles to an intersection with an un-named 4-wheel drive road to the south. Proceed southerly on the un-named road for 0.6 mile to the first of three Chrome Lake wetlands.

Description

This wetland is a fen that occurs in a relatively narrow drainage divide in the subalpine zone in the Beartooth Mountains. The fen is fed by groundwater seeps from the two adjoining toeslopes, and it drains in two opposite directions via surface water: to the southeast into Chrome Lake, and to the northwest into a small creek. Smaller fens also occur along the outflow streams. *Pinus contorta* (lodgepole pine), *Pinus albicaulis* (whitebark pine), and *Vaccinium scoparium* (grouse whortleberry) dominate the upland. The wetland is dominated by what appears to be a raised and patterned fen: small ridges or "strings" parallel each other and are separated from one another by small troughs or "flarks." The flarks are wetter and dominated by a *Carex utriculata* (beaked sedge) community, which is a fairly species rich example of this type of community. Associated species include *Carex aquatilis* (water sedge), *Carex aurea* (golden sedge), *Eriophorum polystachion* (many-spiked cottongrass), *Caltha leptosepala* (white marsh-marigold), *Utricularia minor* (lesser bladderwort), and brown mosses. The strings or ridges are drier and dominated by a *Salix planifolia* / *Carex aquatilis* (planeleaf willow / water sedge) community, which has the following associated species: *Dasiphora fruticosa* ssp. *floribunda* (shrubby cinquefoil), *Carex utriculata*, *Caltha leptosepala*, *Symphyotrichum foliaceum* (leafy aster), *Antennaria corymbosa* (flat-topped pussytoes), and *Sphagnum* (a group of mosses associated with poor fens and bogs). This community also occurs along the outflow streams. Wet areas away from these streams are dominated by *Carex utriculata*. Chrome Lake has an aquatic community of *Potamogeton gramineus* (grassy pondweed), *Potamogeton amplifolius* (large-leaved pondweed), and *Sparganium* sp. (bur-reed). A small, undescribed community, dominated by *Salix glauca* (gray-leaf willow) and *Carex aquatilis*, occurs between one of the fens and the upland forest.

Key Environmental Factors

Springs and seeps produce the waters necessary to maintain this raised fen and the associated vegetation patterns.

Rarity

No special status plants, animals, or communities were observed. However, this site is a high quality example of a patterned fen, which is a regionally rare wetland type with only a few other such fens known from the state.

Other Values

Rana pretiosa (spotted frog) and *Pseudacris triseriata* (western chorus frog) were noted in a number of the fen communities.

Land Use
The main fen has ATV tracks.

Exotics
No exotics were documented.

Uplands
Mining and associated roads and woodcutting has occurred in the past. Currently there is no active mining, but hunting, ATV use, and hiking does occur.

Information Needs
Has the hydrology of the site been affected by mining?

Management Needs
ATV use of the site should be halted.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Aquatic	*	*	*
Carex utriculata Herbaceous Vegetation	S5	G5	A
Salix glauca / *Carex aquatilis* Dominance Type	*	*	*
Salix planifolia / *Carex aquatilis* Shrubland	S3	G5	A

* Rank not assigned

CLARK'S FORK WATERFOWL PRODUCTION AREA

Directions
Clark's Fork Waterfowl Production Area is adjacent to the Clark's Fork Yellowstone River in south central Montana. From Bridger, travel 0.75 mile north on State Route 310. Proceed east for 0.5 mile on an un-named road and then travel north for 0.25 miles to Clark's Fork Waterfowl Production Area.

Description
This site is a human-created marsh located in the historic floodplain of the Clark's Fork of the Yellowstone River. Although a high-magnitude flood event could inundate this wetland, the chief water source is groundwater that is perched on a relatively impermeable clay layer. The marsh is created by a small impoundment that blocks water flow. The water drains back to the river through a saturated meadow. The marsh is dominated by a *Typha latifolia* (broadleaf cattail) community, which occurs in one to several feet of standing water. A diverse aquatic plant community occurs in the open water of the marsh. The following species were observed in this community: *Potamogeton richardsonii* (red-head pondweed), *Polygonum amphibium* (water smartweed), *Ranunculus aquatilis* (water crowfoot), *Myriophyllum sibiricum* (Siberian water milfoil), *Sagittaria cuneata* (arumleaf arrowhead), *Lemna minor* (common duckweed), *Alisma gramineum* (narrowleaf waterplantain), and the green alga *Chara*. A large wet meadow planted with *Thinopyrum intermedium* (intermediate wheatgrass) occurs next to the marsh and is dominated by a dense stand of this exotic grass. Below the marsh in the drainage pathway are stands of *Schoenoplectus acutus* (hardstem bulrush) and *Juncus balticus* (Baltic rush). A *Populus angustifolia / Symphoricarpos occidentalis* (narrowleaf cottonwood / western snowberry) riparian community occurs along the river. Although the community keys to narrowleaf cottonwood / western snowberry, the shrub understory is dominated by *Elaeagnus angustifolia* (Russian olive) and *Rhus trilobata* (smooth sumac). On the same terrace, adjacent to the cottonwood stand, is a community of the exotic grass *Bromus inermis* (smooth brome).

Key Environmental Factors

Groundwater draining from uplands, intercepted and perched by a relatively impermeable clay layer and impounded by a manmade structure, is the reason this wetland site exits.

Rarity

This is a created wetland and no rare plants, animals, or communities were observed.

Other Values

This wetland site was created to stimulate waterfowl production (and breeding populations of *Anas platyrhynchos* [mallards] and *Anas arcuta* [pintails] were observed). The marsh appears to have an abundance of aquatic foods for waterfowl, in addition to hiding and breeding cover. Other wildlife noted during the site visit included *Ardea herodias* (great blue heron), *Podilymbus podiceps* (pie-billed grebe), *Bufo woodhousii* (Woodhouse's toad), and *Odocoileus virginianus* (whitetail deer).

Land Use

The composition of much of the wetland site is planted pasture grasses, including *Bromus inermis* (smooth brome), *Thinopyrum intermedium* (intermediate wheatgrass), and *Dactylis glomerata* (orchard grass).

Exotics

A number of noxious weeds/increasers are present, although they are not yet abundant. These species include *Centaurea maculosa* (spotted knapweed), *Kochia scoparia* (summer cypress), *Euphorbia esula* (leafy spurge), *Chenopodium album* (lambsquater), *Melilotus officinalis* (yellow sweet-clover), *Taraxacum officinalis* (common dandelion), *Elymus repens* (quackgrass), *Tamarix chinensis* (salt cedar), and *Convolvulus arvensis* (field morning-glory).

Uplands

The adjacent uplands are farmed for corn and wheat and grazed by livestock, and these uplands probably serve as the source for most of the weed and increaser species.

Information Needs

The source of water for this site has not been pinpointed; is it the ditch or the river? The history of the site has not been documented: was it farmed or did it merely serve as unimproved rangeland?

Management Needs

The marsh portion appears to be functioning well, producing abundant aquatic vegetation and, as a consequence, waterfowl. However, the uplands and wet meadow portion of the WPA are dominated by exotics, and a plan to reduce their coverage and concomitantly increase that of native species needs to be explored.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Aquatic	*	*	*
Bromus inermis Dominance Type	*	*	*
Juncus balticus Herbaceous Vegetation	S5	G5	B
Populus angustifolia / *Symphoricarpos occidentalis* Forest	S?	*	B
Salix exigua Temporarily Flooded Shrubland	S5	G5	B
Schoenoplectus acutus Herbaceous Vegetation	S5	G5	B
Thinopyrum intermedium Dominance Type	*	*	*
Typha latifolia Herbaceous Vegetation	S5	G5	A

* Rank not assigned

CRATER FEN

Directions

The Crater Fen site is located in the foothills of the Beartooth Mountains in south central Montana. From Fishtail, travel west and south on State Highway 419 for approximately 1 mile to the intersection with State Highway 425. Turn onto State Highway 425 and travel south for approximately 6 miles to the intersection with Forest Route 2072. Travel south on this road for approximately 5 miles. Park just before the cattle guard where the road crosses onto the Lazy E-L Ranch. Travel west across the ridge that separates the West Rosebud from East Fork Fiddler Creek. The East Fork of Fiddler Creek lies on the other side of the ridge approximately 1 mile from the road.

Description

This site occurs above Crater Lake in a cold air ponding glacial kettle. The site is a poor fen that receives groundwater from the adjacent toeslopes. The southern half of the fen is a mixed mire with boglike *Sphagnum* hummocks interspersed with poorly vegetated flats. Common *Sphagna* include *Sphagnum warnstorfii*, *Sphagnum fuscum*, and *Sphagnum teres*. *Sphagnum* hummocks are relatively diverse and support a stunted *Betula glandulosa* / *Carex utriculata* (bog birch / beaked sedge) community co-dominated by *Dasiphora fruticosa* ssp. *floribunda* (shrubby cinquefoil). Other common vascular species include *Salix planifolia* (planeleaf willow), *Carex buxbaumii* (Buxbaum's sedge), *Calamagrostis canadensis* (bluejoint reedgrass), *Menyanthes trifoliata* (bog buckbean), and *Lilium philadelphicum* (red lily). Interspersed among these hummocks is a depauperate *Carex buxbaumii* community that occurs on bare peat flats. This community becomes dominant in the northern portion of the basin, where it forms a flat/mound complex. Somewhat higher microsites have small inclusions of *Alnus incana* / *Calamagrostis canadensis* (mountain alder / bluejoint reedgrass) shrubland. *Nuphar lutea* ssp. *polysepala* (yellow pond-lily) occupies a narrow open water band in the center of the basin.

Key Environmental Factors

Saturation from groundwater and the stability of the hydrologic regime are key factors that influence the site's vegetation. The *Carex buxbaumii* community is seasonally inundated. The surrounding uplands are underlain by glacial till derived from granitic gneiss; correspondingly, the groundwater draining into the site is nutrient poor. This greatly influences the site's floristic composition and explains the abundance of *Sphagnum*. There is a small eastern outlet that flows seasonally and the intactness of the eastern rim is critical to the hydrological stability of the basin. This wetland is an autotrophic system with peat (derived from *Sphagnum* and sedge species) accumulation.

Rarity

No special status plants or animals were observed. One G3 community, *Carex buxbaumii* (Buxbaum's sedge), was observed.

Other Values

This site is an excellent example of a poor fen, which is a regionally rare wetland type. The site has relatively high species and microhabitat diversity for a poor fen.

Land Use

No evident human uses.

Exotics

No exotic species were observed.

Uplands

The uplands are dominated by *Pinus contorta* (lodgepole pine) on morainal substrate derived from granitic gneissic parent material.

Information Needs

Crater Fen is the highest in a cluster of three wetlands. The other two wetlands are open water bodies that may warrant further consideration: deep-water Crater Lake and Lily Pad Lake, which is a shallow-water open lake to the south with a shoreline border that has some of the same peat-forming sedges as found in Crater Fen.

Management Needs

The uplands surrounding the fen should be managed such that the hydrology and water chemistry of the site remain undisturbed.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Alnus incana / *Calamagrostis canadensis* Shrubland	S3Q	G3Q	A
Betula glandulosa / *Carex utriculata* Shrubland	S4	G4?	A
Carex buxbaumii Herbaceous Vegetation	S3	G3	A

DRY FORK CREEK MARSHES

Directions

This site is located in the foothills of the Beartooth Mountains in south central Montana. From McLeod, travel south on State Route 298 for approximately 2.5 miles. Take the East Boulder Road for approximately 10 miles. The site is located about a mile past the locked gate.

Description

This group of depressional wetlands is probably glacial in origin. They are dominated by either aquatic or marsh vegetation. The water source for each of the wetlands is an intermittent creek, and either groundwater or an intermittent creek drains each wetland. The uplands are dominated by *Pinus contorta* (lodgepole pine) forest.

A *Carex utriculata* (beaked sedge) community dominates substantial portions of each wetland in areas that are seasonally flooded. One wetland has a diverse aquatic community, which includes *Hippuris vulgaris* (common mare's-tail), *Stuckenia pectinata* (sago pondweed), *Ranunculus aquatilis* (water crowfoot), and the green alga *Chara*. The other has extensive seeps along one margin that support an undescribed spruce community that has an Engelmann spruce (*Picea engelmannii*) overstory and a diverse understory dominated by *Ledum glandulosum* (Labrador tea). This second wetland has a *Carex buxbaumii* (Buxbaum's sedge) community that occurs on the margins of the depression, and a small patch of an undescribed sedge type, dominated by *Carex flava* (yellow sedge), which occurs in a seepy area. The bottom of the open water portion of this wetland is marl covered, and springs bubble up from the bottom of the open water portion in a few areas.

Key Environmental Factors

The hydrologic regime (seasonal flooding) and calcareous parent material appear to be the primary influence on plant community structure and composition.

Rarity

A population of *Eleocharis rostellata* (beaked spikerush), S2G5, occurs in the marsh. A high quality occurrence of a rare community, *Carex buxbaumii* (Buxbaum's sedge), G3, was documented.

Land Use

Current land use appears restricted to occasional use by hunters. This site may have been grazed in the past, as evidenced by the presence of *Phleum pratense* (common timothy) and the native increaser *Prunella vulgaris* (selfheal) in drier portions of the site.

Exotics

Pasture grasses (*Poa palustris* [fowl bluegrass], *Phleum pratense* [common timothy], *Poa pratensis* [Kentucky bluegrass]), *Trifolium pratense* (red clover), and *Phalaris arundinacea* (reed canarygrass) are present at low cover. This may be indicative of past grazing at the site.

Uplands

The surrounding upland forest is intact. There are nearby mining claims, and one claim is adjacent to one of the marshes.

Information Needs

What is the status and scope of the adjacent mining claims? A series of groundwater monitoring wells are adjacent to one of the marshes - what is their purpose?

Management Needs

The intact character of the uplands and the corresponding hydrologic regime are essential to the integrity and functioning of these wetlands.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Aquatic	*	*	*
Carex buxbaumii Herbaceous Vegetation	S3	G3	A
Carex flava Dominance Type	*	*	*
Carex utriculata Herbaceous Vegetation	S5	G5	B
Picea engelmannii / *Ledum glandulosum* Dominance Type	*	*	*
Plant Elements			
Eleocharis rostellata	S2	G5	*

* Rank not assigned

EAST FORK FIDDLER CREEK COMPLEX

Directions

The East Fork Fiddler Creek site is located in the foothills of the Beartooth Mountains in south central Montana. From Fishtail, travel west and south on State Highway 419 for approximately 1 mile to the intersection with State Highway 425. Turn onto State Highway 425 and travel south for approximately 6 miles to the intersection with Forest Route 2072. Travel south on this road for approximately 5 miles. Park just before the cattle guard where the road crosses onto the Lazy E-L Ranch. Travel west across the ridge that separates the West Rosebud from East Fork Fiddler Creek. The East Fork of Fiddler Creek lies on the other side of the ridge approximately 1 mile from the road.

Description

The East Fork Fiddler Creek site is a complex of willow bottomlands and *Castor canadensis* (beaver)-influenced wetlands associated with East Fork Fiddler Creek, narrow draws, and lakes and kettles formed by past glaciation. A *Salix boothii* / *Carex utriculata* (Booth's willow / beaked sedge) community occupies much of the bottomland along East Fork Fiddler Creek. *Carex utriculata* dominates in wet swales; *Calamagrostis canadensis* (bluejoint reedgrass) and *Phleum pratense* (common timothy) are dominant on

higher microsites. On higher sites, this community grades into a *Populus tremuloides* / *Calamagrostis canadensis* (quaking aspen / bluejoint reedgrass) community. *Phleum pratense* completely replaces *Calamagrostis canadensis* on drier portions of the toe and lower slope. The uplands are *Pinus contorta* (lodgepole pine) forest.

On higher sections of Fiddler Creek, the riparian zone is very narrow and has been influenced in places by past beaver activity. Drained and silted in beaver dams have created substrate for marsh communities. Wetter sites support an undescribed community with high cover of *Glyceria grandis* (northern mannagrass), *Carex canescens* (gray sedge), *Agrostis scabra* (ticklegrass), and *Sparganium angustifolium* (narrowleaf bur-reed). A *Carex utriculata* community dominates slightly drier sites. Interspersed with and fringing these beaver ponds are *Salix geyeriana* / *Calamagrostis canadensis* (Geyer's willow / bluejoint reedgrass) and *Alnus incana* (mountain alder) communities.

This site also has narrow seepy draws. These support a *Populus tremuloides* / *Calamagrostis canadensis* community interspersed with *Salix boothii* / *Carex utriculata* and *Alnus incana* communities. These draws feed into a series of small glacially-formed kettle potholes that support a *Carex utriculata* community fringed by *Salix geyeriana* / *Calamagrostis canadensis*. A larger glacial depression, Lily Pad Lake, also occurs on the site. A *Nuphar lutea* ssp. *polysepala* (yellow pond-lily) community covers much of the lake surface, and the lake is fringed by a narrow band of *Carex buxbaumii* (Buxbaum's sedge) and a small patch of *Alnus incana* / *Calamagrostis canadensis*.

Key Environmental Factors

Seasonal flooding and high groundwater tables are the primary factors influencing vegetation. Past beaver activity is also important in creating more mesic substrate.

Rarity

No special status plants or animals were observed. One G3 plant community, *Populus tremuloides* / *Calamagrostis canadensis* (quaking aspen / bluejoint reedgrass), was documented.

Other Values

A breeding pair of *Grus canadensis* (sandhill cranes) with a fledgling was observed.

Land Use

Mesic sites along the East Fork Fiddler Creek bottomlands are dominated by *Phleum pratense* (common timothy), so the site was probably grazed in the past. The section contains several old roads. Otherwise land use seems minimal.

Exotics

Phleum pratense (common timothy) and *Cirsium arvense* (Canada thistle) are well established in some communities. Drier *Populus tremuloides* (quaking aspen) communities upslope of the riparian areas are dominated by *Phleum pratense*.

Uplands

The uplands are largely intact.

Information Needs

What is the grazing history of the site?

Management Needs

The site should be managed to maintain the hydrology of the wetland features, especially Lily Pad Lake and the wet aspen draws.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Alnus incana Shrubland	S3	G?Q	A
Carex utriculata Herbaceous Vegetation	S5	G5	A
Glyceria grandis Dominance Type	*	*	A
Populus tremuloides / *Calamagrostis canadensis* Forest	S2	G3	A, B/C
Salix boothii / *Calamagrostis canadensis* Shrubland	S3	G3G4Q	B
Salix boothii / *Carex utriculata* Shrubland	S4	G4	A, B
Salix geyeriana / *Calamagrostis canadensis* Shrubland	S4	G5	A

* Rank not assigned

EAST ROSEBUD COMPLEX

Directions

East Rosebud Complex is located in the Beartooth Mountains of south central Montana. From Roscoe, travel 8 miles southwesterly on Forest Route 117 to East Rosebud Complex.

Description

The East Rosebud complex of wetlands occurs in a stream valley along low river terraces in which there are numerous old river meanders. These wetlands are primarily fed by groundwater and many have developed peat, so it is reasonable to assume that they have a fairly stable hydrologic regime. *Castor canadensis* (beaver) have dammed some of the shallow streams that drain into this complex, thus helping to maintain a high water table at the site. The uplands are characterized by *Pinus contorta* (lodgepole pine) and *Populus tremuloides* / *Symphoricarpos occidentalis* (quaking aspen / western snowberry) forest and *Festuca idahoensis – Pseudoroegneria spicata* (Idaho fescue – bluebunch wheatgrass) grassland. Open waters of the meanders and small beaver ponds support aquatic vegetation such as *Nuphar lutea* (yellow pond-lily), *Potamogeton pusillus* (small pondweed), *Potamogeton gramineus* (grassy pondweed), *Ranunculus aquatilis* (water crowfoot), and *Utricularia vulgaris* (common bladderwort). Some of the old meanders have silted in and have developed *Equisetum fluviatile* (water horsetail) communities, which are usually permanently flooded. On the margins of the open water there are *Carex utriculata* (beaked sedge) communities. A *Salix planifolia* / *Carex utriculata* (planeleaf willow / beaked sedge) community occupies slightly drier positions. This community has standing water and in some spots high cover of *Sphagnum* (moss species characteristic of poor fens and bogs). An *Alnus incana* (mountain alder) community also occurs around some of the ponds in areas with seasonally standing water. *Typha latifolia* (broadleaf cattail) stands occur around pond outlets where standing water is nearly continuously present. A complex of wet *Picea engelmannii* (Engelmann spruce)-dominated communities compose a large portion of the site. Numerous open water channels run through these communities, and *Alnus incana* (mountain alder) and *Carex utriculata* (beaked sedge) are common. On slightly higher ground between sloughs is a *Populus tremuloides* / *Calamagrostis canadensis* (quaking aspen / bluejoint reedgrass) community that is ecotonal between wetland and upland. This forested community has relatively high cover of exotic pasture grasses, suggesting that it may have been grazed at some time in the past.

Key Environmental Factors

Much of the surrounding watershed was burned recently which should at least temporarily influence the inflow of groundwater. *Castor canadensis* (beaver) have dammed shallow streams that flow through the old meanders; they continue to inhabit the wetland and feed on shrubby vegetation.

Rarity

Gentianopsis simplex (hiker's gentian, S1 G4) was found in this wetland in 1989. However, attempts to relocate this population in 1999 were unsuccessful, possibly due to the very narrow phenological window available to identify this species. Three relatively high quality occurrences of G3 plant communities, *Populus*

tremuloides / *Calamagrostis canadensis* (quaking aspen / bluejoint reedgrass), *Salix planifolia* / *Carex utriculata* (planeleaf willow / beaked sedge), and *Carex buxbaumii* (Buxbaum's sedge) were documented at this site.

Other Values

At the time of visitation several *Alces alces* (moose) were spotted feeding within the fen. *Rana pretiosa* (spotted frogs) were also noted in the *Carex utriculata* (beaked sedge) and *Carex buxbaumii* (Buxbaum's sedge)-dominated portions of the wetland complex. *Accipiter cooperi* (Cooper's hawk) was noted nesting in the near vicinity of, and making hunting forays over, the wetland.

Land Use

Recreation is the only known human use of the wetland.

Exotics

Exotics, including *Cirsium arvense* (Canada thistle), *Poa pratensis* (Kentucky bluegrass), *Agrostis stolonifera* (redtop), and *Phleum pratense* (timothy), constitute a very minor problem at this site. For the most part, they are presently confined to the driest portion of the site (the *Populus tremuloides* / *Calamagrostis canadensis* community), with a minor presence in the *Salix planifolia* / *Carex utriculata* community

Uplands

Significant residential development is occurring downstream from the wetland complex. The uplands have been logged and lightly grazed in the past.

Information Needs

How did the extensive burn within the watershed affect the hydrology and in turn the vegetation?

Management Needs

The exotic species are confined at this time to a given community type or perhaps a couple of types. A management plan should address the issue, and at the very least *Cirsium arvense* (Canada thistle) should be eradicated.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Carex buxbaumii Herbaceous Vegetation	S3	G3	B
Carex utriculata Herbaceous Vegetation	S5	G5	A
Equisetum fluviatile Herbaceous Vegetation	S4	G4	A
Nuphar lutea Dominance Type	*	*	*
Picea engelmannii / *Calamagrostis canadensis* Forest	S4	G4	A
Populus tremuloides / *Calamagrostis canadensis* Forest	S2	G3	B
Potamogeton pusillus Dominance Type	*	*	*
Salix planifolia / *Carex utriculata* Shrubland	S?	G3	A
Typha latifolia Herbaceous Vegetation	S5	G5	A
Plant Elements			
Gentianopsis simplex	S1	G4	*

* Rank not assigned

EAST ROSEBUD FLOODPLAIN SUBDIVISION

Directions

Note: This site is located on private land, and landowner permission is needed to access this site. East Rosebud Floodplain Subdivision is located at the base of the Beartooth Mountains in south central Montana. From Roscoe, travel approximately 4.5 miles southwest on FS RD 117. The midpoint of the site is located where power lines cross the road.

Description

This site is located in a glaciated valley along an unconfined reach of East Rosebud Creek. The site is comprised of floodplain deposits interspersed with oxbows and sloughs associated with old stream meanders. The oxbows and sloughs are mostly silted in and support a *Carex utriculata* (beaked sedge) community. This community is variable across the site and includes small inclusions of *Typha latifolia* (broadleaf cattail) and *Carex aquatilis* (water sedge). Active beaver (*Castor canadensis*) dams have maintained a significant open water component in some oxbows. These open water habitats support an aquatic community dominated by *Hippuris vulgaris* (common mare's tail). Gravel/cobble substrate side bars are being colonized in places by a *Populus balsamifera* ssp. *trichocarpa* / recent alluvial bar (black cottonwood / recent alluvial bar) community. Higher floodplain deposits are dominated by *Salix boothii* / *Calamagrostis canadensis* (Booth's willow / bluejoint reedgrass) with scattered mature *Populus balsamifera* ssp. *trichocarpa*. Although *Salix boothii* is abundant throughout, there are patches where *Salix bebbiana* (Bebb willow) or *Salix lucida* ssp. *caudata* (shining willow) are locally dominant. This community is characterized by dense willow cover interspersed with many small herbaceous openings dominated by exotic grasses, primarily *Phleum pratense* (common timothy), *Poa pratensis* (Kentucky bluegrass), and *Agrostis stolonifera* (redtop). Floodplain deposits also support a *Populus tremuloides* / *Calamagrostis canadensis* (quaking aspen / bluejoint reedgrass) community. Although this community consists of mature stands of *Populus tremuloides*, it also includes early-seral stands of small trees (4-5 feet high) that are suppressed by heavy browsing. These early-seral stands are adjacent to active beaver dams and show high beaver use (trails, tree mortality). Pasture grasses (*Poa pratensis, Phleum pratense*) dominate higher floodplain and terrace deposits.

Only a representative portion of the site was surveyed. The larger site also contains *Populus balsamifera* ssp. *trichocarpa* / mesic graminoids and *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) communities, but these stands were not inventoried.

Key Environmental Factors

Past and ongoing fluvial dynamics (flooding, erosion, deposition) are the primary factors influencing vegetation communities. *Castor canadensis* (beaver) have also influenced vegetation patterns by damming oxbows and causing tree mortality.

Rarity

No species of special concern were observed. However, two G3 plant communities in good to excellent condition were documented: *Salix boothii* / *Calamagrostis canadensis* (Booth's willow / bluejoint reedgrass) and *Populus tremuloides* / *Calamagrostis canadensis* (quaking aspen / bluejoint reedgrass).

Other Values

Alces alces (moose) sign was observed at the site.

Land Use

This site has been subdivided into approximately 15 20- to 40-acre parcels. Two 40-acre parcels, which appeared to be representative of the site, were inventoried. Despite the fragmented ownership, the site does not appear to have been developed beyond a few roads. Current land use appears to be mostly light horse grazing and recreational use. The presence of pasture grasses and the absence of willow communities from portions of the floodplain imply that the site has been grazed and/or hayed in the past.

Exotics

Higher portions of the floodplain are dominated by the pasture grasses *Phleum pratense* (common timothy) and *Poa pratensis* (Kentucky bluegrass). These species, in addition to *Agrostis stolonifera* (redtop), also dominate herbaceous openings scattered throughout the *Salix boothii* (Booth's willow) community. Other exotic species present in low abundance are *Phalaris arundinacea* (reed canarygrass) and *Cirsium arvense* (Canada thistle), both of which occur in the *Salix boothii* / *Calamagrostis canadensis* (Booth's willow / bluejoint reedgrass) community.

Uplands

The stream corridor, though subdivided, is still relatively intact. Higher, drier portions have been grazed. The site lies approximately 1 mile downstream of the Custer National Forest boundary. Home development has occurred downstream of the site as well as upstream near the Forest Service boundary. Home development has also occurred on the slopes to the west of the site.

Information Needs

Inventory of the parcels not surveyed might reveal greater community diversity at the site than currently known. For example, *Populus balsamifera* ssp. *trichocarpa* stands occur on the site upstream of the parcels surveyed. Only a relatively small portion of the site was inventoried in 2000.

Management Needs

If possible, the current intact nature of this site should be maintained. Though the dispersed ownership is problematic, conservation easements or other agreements might be used to conserve some or all of this site.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Carex utriculata Herbaceous Vegetation	S5	G5	A
Populus balsamifera ssp. *trichocarpa* / Recent Alluvial Bar Forest	S3	*	B
Populus tremuloides / *Calamagrostis canadensis* Forest	S2	G3	B
Salix boothii / *Calamagrostis canadensis* Shrubland	S3	G3G4Q	B

* Rank not assigned

EAST ROSEBUD LAKE

Directions

Note: A portion of this site is located on private land, and landowner permission is needed to access this area. East Rosebud Lake is located in the Beartooth Mountains in south central Montana. From Roscoe, travel south-southwest on Forest Route 117 for approximately 13 miles to the East Rosebud trailhead and campground. The site lies at the head of East Rosebud Lake, approximately 0.5 mile up Forest Trail 15.

Description

This site occurs on alluvial deposits along and around the inflow of East Rosebud Creek into East Rosebud Lake. Plant communities present include lacustrine fringe herbaceous and willow communities and wet *Picea engelmannii* (Engelmann spruce) forests associated with the East Rosebud Creek floodplain. The lowest and wettest lacustrine fringe community is dominated by *Carex utriculata* (beaked sedge). This community encompasses a topographic and soil moisture gradient. Dominance shifts from *Carex utriculata* in the lowest and wettest portions of the community to co-dominance of *Carex utriculata* and *Calamagrostis canadensis* (bluejoint reedgrass) on slightly higher deposits. Somewhat higher deposits are ecotonal between herbaceous and willow-dominated communities, with *Salix planifolia* (planeleaf willow) occurring as small to medium sized clumps. These grade into a *Salix planifolia* / *Calamagrostis canadensis* community characterized by large clumps of willows dominated by *Salix planifolia* and some cover of *Salix lucida* ssp. *caudata* (shining

willow), *Salix boothii* (Booth's willow), and *Salix bebbiana* (Bebb willow). The ground layer is dominated by *Calamagrostis canadensis* with a substantial *Phleum pratense* (common timothy) component. Moss also forms an important component of this community. Willows at this site have been heavily browsed, probably by *Alces alces* (moose). On slightly higher deposits along the floodplain of East Rosebud Creek, stands of *Picea engelmannii* / *Calamagrostis canadensis* occur. A closed canopy of mature *Picea engelmannii* with a relatively depauperate herbaceous layer dominated by *Calamagrostis canadensis* characterizes this community. Portions of this community have burned, and are now characterized by *Picea engelmannii* snags with a lush ground layer of *Calamagrostis canadensis*. *Picea engelmannii* is also colonizing the *Salix planifolia* / *Calamagrostis canadensis* community in places, forming small clumps of two to three sapling-sized trees.

Key Environmental Factors

Seasonal flooding and elevated groundwater tables are important in maintaining these communities. Herbivory is also important in structuring the *Salix planifolia* / *Calamagrostis canadensis* (planeleaf willow / bluejoint reedgrass) community. Fire has recently burned most of the upland *Pinus contorta* (lodgepole pine) forest and portions of the *Picea engelmannii* (Engelmann spruce)-dominated bottoms.

Rarity

No species of special concern or state or globally rare communities were observed.

Land Use

The site receives recreational, especially fishing, use and there are informal trails along East Rosebud Creek.

Exotics

Pasture grasses, especially *Phleum pratense* (common timothy), are abundant in mesic sites along the wetland/upland border.

Uplands

The entire shoreline of East Rosebud Lake is in private ownership and extensive small lot development has occurred along the north and east shores. The uplands are composed of seral stands of *Pinus contorta* (lodgepole pine), many of which recently burned. The site sits at the edge of the Absaroka-Beartooth Wilderness Area and is relatively undisturbed.

Information Needs

Is the presence of pasture grasses due to previous livestock grazing or stock use?

Management Needs

No noxious weeds were observed.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Carex utriculata Herbaceous Vegetation	S5	G5	A
Picea engelmannii / *Calamagrostis canadensis* Forest	S4	G4	A
Salix planifolia / *Calamagrostis canadensis* Shrubland	S?	G3	A

EAST ROSEBUD OXBOW

Directions

Note: A portion of this site is located on private land, and landowner permission is needed to access that area. The East Rosebud Oxbow site is located in the foothills of the Beartooth Mountains in south central Montana.

From Roscoe, travel south-southwest on Forest Route 117 for approximately 3.5 miles. After crossing East Rosebud Creek, turn right (south) at a T-intersection. The site can be accessed immediately after this intersection.

Description

This site is a partially silted in oxbow in the floodplain of East Rosebud Creek. An *Equisetum fluviatile* (water horsetail) community with patches of *Schoenoplectus tabernaemontani* (softstem bulrush) occupies the deepest portion of the oxbow, which had two feet of standing water at the time of the field inventory. This community grades into a *Carex utriculata* (beaked sedge) community along the oxbow margins. A *Salix bebbiana* (Bebb willow) community occurs on a terrace between the arms of the oxbow and as a narrow and discontinuous band along the oxbow edge. The portion of this community that occurs on the terrace has a dense understory of *Calamagrostis canadensis* (bluejoint reedgrass) and has an insignificant presence of exotic species. In contrast, a *Populus tremuloides* / *Poa pratensis* (quaking aspen / Kentucky bluegrass) community that occupies the rest of the terrace has a high cover of the exotic pasture grasses *Phleum pratense* (common timothy) and *Poa pratensis* (Kentucky bluegrass).

Key Environmental Factors

Seasonal groundwater fluctuations from the East Rosebud Creek are the primary influence on oxbow vegetation. Past grazing is probably a contributing factor for the abundance of exotic grasses and the paucity of *Calamagrostis canadensis* (bluejoint reedgrass) in the *Populus tremuloides* / *Poa pratensis* (quaking aspen / Kentucky bluegrass) community.

Rarity

No special status or tracked plant or animal species were observed. One G3 community, *Salix bebbiana* (Bebb willow), was documented in excellent condition.

Other Values

An adult *Sphyrapicus nuchalis* (red-naped sapsucker) was observed feeding chicks in the *Populus tremuloides* / *Poa pratensis* (quaking aspen / Kentucky bluegrass) community.

Land Use

The state land section is grazed, but the oxbow area is fenced off and is not currently grazed. It is possible that trespass cattle could access the site from the private land to the west.

Exotics

Exotic species are mostly restricted to the *Populus tremuloides* / *Poa pratensis* (quaking aspen / Kentucky bluegrass) community and to the portion of the *Salix bebbiana* (Bebb willow) community that occurs on the margin of the oxbow. These communities have high cover of *Phleum pratense* (common timothy) and *Poa pratensis* (Kentucky bluegrass). *Cynoglossum officinale* (hound's tongue), *Cirsium arvense* (Canada thistle), and *Arctium* sp. (burdock) are present at low cover. *Poa palustris* (fowl bluegrass) is present at low cover in the *Carex utriculata* (beaked sedge) community.

Uplands

The uplands appear to be used primarily for livestock grazing. Subdivision is occurring throughout the bottomland along East Rosebud Creek, and there are residences immediately adjacent to the site.

Information Needs

When was the fence around the oxbow installed? What was the grazing history? Why is the *Salix bebbiana* (Bebb willow) community so free of exotic pasture grasses?

Management Needs

The noxious weeds are present at low cover and should be eradicated. The western boundary of the State Land section should be fenced.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Carex utriculata Herbaceous Vegetation	S5	G5	A
Equisetum fluviatile Herbaceous Vegetation	S4	G4	B
Populus tremuloides / *Poa pratensis* Forest	SW	*	C
Salix bebbiana Shrubland	S3?	G3?	B

* Rank not assigned

EDGAR OXBOW

Directions

Note: this site is located on private land, and landowner permission is required to access this site. The Edgar Oxbow is located along the Clark's Fork Yellowstone River immediately south of the town of Edgar in south central Montana.

Description

Edgar Oxbow lies along the Clarks Fork River near Edgar and encompasses tamegrass meadows, three main stands of *Populus deltoides* (plains cottonwood), two oxbow wetlands, and approximately 2.5 miles of river shoreline. The cottonwood stands are mostly pole-sized trees with small clusters of large cottonwoods over 36-inches diameter at breast height. Shrub cover in these stands is widely scattered and includes *Clematis ligusticifolia* (western clematis), *Toxicodendron rydbergii* (poison ivy), *Ribes aurea* (golden currant), *Rosa acicularis* (prickly rose), *Prunus virginiana* (chokecherry), and *Shepherdia argentea* (silver buffaloberry). The small trees *Acer negundo* (box-elder) and *Salix amygdaloides* (peachleaf willow) are also present. The exotic *Elaeagnus angustifolia* (Russian olive) is common along the river. Although some native species are present, such as *Pascopyrum smithii* (western wheatgrass) and *Elymus trachycaulus* (slender wheatgrass), the herbaceous layer is dominated by exotic species, including *Elymus repens* (quackgrass), *Bromus inermis* (smooth brome), and *Poa pratensis* (Kentucky bluegrass).

The oxbow wetlands are dominated by *Schoenoplectus tabernaemontani* (softstem bulrush) with intermixed stands of *Typha latifolia* (broadleaf cattail). The open water component of the larger oxbow has been enhanced by a dike as well as recent beaver activity. The edges of these oxbows support stands of *Salix exigua* (sandbar willow), and there is a shallow marsh at one end with *Carex praegracilis* (clustered field sedge), *Eleocharis palustris* (common spikesedge), and *Schoenoplectus pungens* (threesquare). *Distichlis spicata* (saltgrass), *Hordeum jubatum* (foxtail barley), *Puccinellia nuttalliana* (Nuttall's alkaligrass), and *Suaeda calceoliformis* (seablite) occur in alkaline areas.

Key Environmental Factors

Seasonal flooding and past channel migration have created and maintain these wetlands.

Rarity

No rare plants or animals were documented.

Other Values

The oxbow wetlands are intact, and the cottonwood stands retain many compositional and structural characteristics that are natural. While they are not strictly natural vegetation benchmarks, and no rare species were documented, they are important to the conservation of the river corridor, its wildlife, and its processes. They also represent excellent stewardship and considerable work on the part of the landowners.

Land Use

Portions of the floodplain are hayed. The large oxbow is diked to provide open water habitat for waterfowl and the landowner has constructed islands to improve breeding success.

Exotics

Herbaceous exotics, including *Elymus repens* (quackgrass), *Bromus inermis* (smooth brome), *Cirsium arvense* (Canada thistle), *Cirsium vulgare* (bull thistle), *Cynoglossum officinale* (hound's tongue), *Euphorbia esula* (leafy spurge), *Phalaris arundinacea* (reed canarygrass), *Poa palustris* (fowl bluegrass), and *Poa pratensis* (Kentucky bluegrass). *Elaeagnus angustifolia* (Russian olive) is also present.

GROVE CREEK ASPENS

Directions

Note: this site is on private land, and landowner permission is needed to access this site. Grove Creek Aspens is located west of the Clark's Fork Yellowstone River in south central Montana. From Belfry, travel south 4.5 miles on State Route 72 to an intersection with an un-named road headed west. Travel west on the un-named road for 6 miles to Grove Creek Aspens.

Description

This mosaic of aspen and alkaline meadow lies on a gently sloping plain at the eastern base of the Beartooth Mountains. Several creeks drain through the aspen groves and some spring/seeps that arise in the aspen stands are the primary water source for the site. Because this site occurs in the rain shadow of the Beartooth Range, the climate is very arid. This fact makes the aspen stands even more significant, as they are surrounded by *Artemisia nova* (black sagebrush)-dominated shrub herbaceous vegetation. The most striking community at this site is the aspen forest, which is composed of both *Populus tremuloides* / *Cornus sericea* (quaking aspen / red osier dogwood) and *Populus tremuloides* / *Prunus virginiana* (quaking aspen / common chokecherry) stands. Both these communities are characterized by an aspen-dominated overstory and a very dense shrub layer, except for some spots on the margins of the stands that have been impacted by cattle grazing. In one wetter area within the *Populus tremuloides* / *Prunus virginiana* stand there is a *Prunus virginiana* community that lacks an aspen overstory. Surrounding the aspen stands are alkaline wet meadows composed of a variety of communities. The most common plant association is *Pascopyrum smithii* (western wheatgrass), which generally occurs on the east side of the aspens. Although this community is dominated by *Pascopyrum smithii*, the canopy is not very dense and much open ground is apparent. Other associated species are *Spartina gracilis* (alkali cordgrass), *Muhlenbergia richardsonis* (mat muhly), *Iris missouriensis* (western blue flag), and *Antennaria* sp. (pussytoes). Dominance shifts to a *Spartina gracilis* community in a few areas, which are otherwise similar in composition to the former community. Salt efflorescence is evident on the soil surface. Two exotic-dominated communities, *Agrostis stolonifera* (redtop) and *Elymus repens* (quackgrass), also occur in the wet meadow. On the west or uphill side of the aspen groves, *Spartina pectinata* (prairie cordgrass) and *Glycyrrhiza lepidota* (American licorice) communities dominate the alkaline meadow community. Canopy coverage in these communities is higher and less open ground is visible. Along some of the creek corridors there are narrow riparian communities dominated by *Betula occidentalis* (water birch). A *Carex utriculata* (beaked sedge) community occupies some of the lower gradient areas. In the ecotone between the alkaline wet meadow and the upland there is an *Artemisia cana* / *Pascopyrum smithii* (silver sage / western wheatgrass) community, which has an overstory dominated by *Artemisia cana* with some *Chrysothamnus viscidiflorus* (green rabbit brush) cover, and an undergrowth dominated by *Pascopyrum smithii*.

Key Environmental Factors

In this very arid valley in the rainshadow of the Beartooth Range, the presence of perennial seepage and springs is the prime driver of plant community development.

Rarity

No rare plants or animals were observed. Four G3 or rarer plant associations in good to excellent condition were surveyed. These are *Populus tremuloides* / *Prunus virginiana* (quaking aspen / chokecherry), *Betula occidentalis* (river birch), *Spartina pectinata* (prairie cordgrass), and *Spartina gracilis* (alkali cordgrass).

Other Values

The following animal species were observed in the course of inventory: *Centrocercus urophasianus* (sage grouse), *Circus cyaneus* (northern harrier), *Crotalus viridis* (western rattlesnake), and *Odocoileus hemionus* (whitetail deer).

Land Use

Cattle grazing is occurring with the accompanying trails and minor introduction of exotics. At the time of the site visit, utilization of graminoids was quite low. A reservoir just east of the wetlands could concentrate cattle in the vicinity.

Exotics

Exotic pasture grasses, such as *Bromus inermis* (smooth brome), *Poa pratensis* (Kentucky bluegrass), and *Phleum pratense* (common timothy), and noxious weeds, including *Cirsium arvense* (Canada thistle), *Cirsium vulgare* (bull thistle), and *Cynoglossum officinale* (hound's tongue) have increased as result of grazing.

Uplands

On the surrounding private and public lands, intensive grazing is the primary use.

Information Needs

This site should be visited in spring/early summer for a complete description of community composition and a thorough rare plant survey should also be conducted.

Management Needs

The aspen component should be examined to see whether the age/size class structure and disease conditions could be improved by conducting a prescribed burn. Livestock numbers on the wet meadow portion should be carefully monitored and livestock should be kept off for a longer period in the spring to avoid hummocking. A noxious weed management plan is needed to prevent new introductions and pursue eradication/reduction of the existing populations.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Agrostis stolonifera Herbaceous Vegetation	SM	GM	*
Artemisia cana / *Pascopyrum smithii* Shrubland	S4	G4	B
Betula occidentalis Shrubland	S3	G3Q	B
Carex utriculata Herbaceous Vegetation	S5	G5	B
Elymus repens Dominance Type	*	*	*
Glycyrrhiza lepidota Herbaceous Vegetation	S?	*	B
Pascopyrum smithii Herbaceous Vegetation	S4	G3G5Q	B
Populus tremuloides / *Cornus sericea* Forest	S3	G4	B
Populus tremuloides / *Prunus virginiana* Forest	S?Q	G3?Q	B
Prunus virginiana Shrubland	S4	G4Q	A
Spartina pectinata Western Herbaceous Vegetation	S3?	G3?	B
Symphoricarpos occidentalis Shrubland	S4S5	G4G5	*

* Rank not assigned

HAILSTONE NATIONAL WILDLIFE REFUGE

Directions

Hailstone National Wildlife Refuge is located in the Lake Basin in south central Montana. From Rapelje, 24 miles north of Columbus on State Route 306, proceed easterly on the Rapelje-Molt Road for 4 miles to the Hailstone road. Travel 1 mile north on the Hailstone road to the entrance to Hailstone National Wildlife Refuge.

Description

This is a large, shallow brackish lake in the Lake Basin area of central Montana. Several intermittently flowing creeks drain into the lake, and one intermittent creek drains out of the lake. The north shore of Hailstone Lake has a very low gradient. During wet climatic periods (e.g., several years with ample precipitation), Hailstone Lake fills with water and expands to the north. During drier periods, the lake shrinks and leaves expansive unvegetated alkaline mud flats around a small body of water. The upland is a combination of native and disturbed grassland, and the exotic grass *Poa pratensis* (Kentucky bluegrass) is a common species. Wetland communities tolerant of moderately to highly saline conditions occur as a narrow fringe around the edge of Hailstone Lake and along the outlet creek. Immediately adjacent to the mud flats are narrow patches of *Puccinellia nuttalliana* (Nuttall's alkaligrass) and *Distichlis spicata* (saltgrass) communities. Slightly higher on the topographic gradient and somewhat drier is an exotic-dominated disturbance community. A variety of mustard and *Chenopodium* spp. (goosefoot) species dominate this community. Along the outlet creek there are *Schoenoplectus maritimus* (saltmarsh clubrush) and *Schoenoplectus pungens* (threesquare) communities in the wetter areas. *Distichlis spicata* and *Triglochin concinnum* (graceful arrowgrass) form small patches and narrow fringe communities at just a slightly higher point on the moisture gradient. Aquatic vegetation grows in the standing water, but the mud was too deep for this community to be sampled.

Key Environmental Factors

This site is a closed basin with no surface outlet, and the soils in this vicinity are derived from clay substrates, which means they swell on wetting and are consequently poorly drained. The restricted drainage results in the basin accumulating water in pluvial times and the formation of wetland communities.

Rarity

Two species of special concern were observed: *Himantopus mexicanus* (black-necked stilt) and *Cyonomys ludovicianus* (black-tailed prairie dog). No information was collected on the extent of the prairie dog colony.

Other Values

Recurvirostra americana (American avocet), *Limosa fedoa* (marbled godwit), *Numenius americanus* (long-billed curlew), *Dolichonyx oryzivorus* (boblink), and a species of dung beetle were all observed within the wetland site.

Land Use

An impoundment at the outflow on Hailstone Lake raises the lake level several feet. In the past, most of the uplands were farmed down to and through the low prairie zone. This has resulted in the development of the disturbance communities that now dominate most of the wetland edge.

Exotics

An extensive disturbance community, dominated by *Poa pratensis* (Kentucky bluegrass) and *Sonchus* spp. (mostly *Sonchus uliginosus* [marsh sow-thistle]), now dominates the low prairie and wet meadow zone.

Uplands

The uplands within the National Wildlife Refuge are not grazed or farmed. A road traverses the eastern edge of the lake about 50 feet from the edge of the current mudflat. Outside the Refuge, strip-cropped wheat is grown and these lands drain into the Refuge and lake.

Information Needs

What effects might the farmland drainage water have on the composition of the wetlands, particularly the microfauna and foodchain in general?

Management Needs

A management plan for the exotic species in "low prairie" needs to be developed. Strip-cropped wheat farms have led to a hypersalinity problem in Hailstone Lake, which will be placed on 303(d) list in the year 2000 as a water-quality limited water body (R. Apfelbeck, pers. comm..).

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Distichlis spicata Herbaceous Vegetation	S4	G5	C
Poa pratensis Semi-natural Seasonally Flooded Herbaceous Alliance	SW	GW	*
Puccinellia nuttalliana Herbaceous Vegetation	S?	G3?	C
Schoenoplectus maritimus Herbaceous Vegetation	S4	G4	C
Schoenoplectus pungens Herbaceous Vegetation	S3	G3G4	C
Triglochin concinnum Dominance Type	*	*	*
Animal Elements			
Cyonomys ludovicianus	S3S4	G4	*
Himantopus mexicanus	S2B,SZN	G5	*

* Rank not assigned

HALFBREED NATIONAL WILDLIFE REFUGE

Directions

Note: a portion of this site is located on private land, and landowner permission is required to access this area. Halfbreed National Wildlife Refuge is north of the Yellowstone River in south central Montana. From Rapelje, 24 miles north of Columbus on State Route 306, travel about 7.25 miles east of Rapelje on the Rapelje-Molt Road to an un-named road to the south. Proceed approximately 0.5 mile due south to Halfbreed National Wildlife Refuge.

Description

This site is located in the Lake Basin area of central Montana. It is a closed basin comprising four large, interconnected, shallow brackish lakes as well as numerous small alkaline potholes. During wet climatic periods (e.g., several years with above average precipitation), the lakes fill with water. However, in dry years and over the course of most growing seasons, the lakes decline and leave expansive unvegetated alkaline mud flats around a shrunken body of water. Several intermittently flowing creeks drain into Halfbreed Lake (one of which is from Hailstone Lake). When Halfbreed Lake is full, it drains into Goose Lake, which is also fed by the intermittent Cedar Creek. When full, Goose Lake drains into Grass Lake, which in turn drains into Big Lake.

Stuckenia pectinata (sago pondweed) is the dominant species at Halfbreed and Grass Lakes across the dried-out lakebeds, and appears to be a major component of submergent vegetation throughout the series of lakes. *Typha latifolia* (broadleaf cattail) and *Eleocharis* sp. (spikerush) occupy drier habitats. The *Typha latifolia* community occurs along the channel of the outflow creek from Halfbreed Lake (which was dry during the site

visit), and the spikerush community occurs in a dry pothole. There are also some patches of apparently dead *Schoenoplectus acutus* (hardstem bulrush) and *Schoenoplectus pungens* (threesquare) in Halfbreed Lake. The low-lying flats surrounding these lakes support patches of *Hordeum jubatum* (foxtail barley) and *Pascopyrum smithii* (western wheatgrass) but are mostly dominated by a *Sarcobatus vermiculatus* / *Pascopyrum smithii* (black greasewood / western wheatgrass) community. It is expansive, and there are small inclusions with very high coverage of exotic species, such as *Agropyron cristatum* (crested wheatgrass), *Lepidium perfoliatum* (clasping pepperweed), and *Bromus commutatus* (meadow brome). However, coverage of exotics is generally low, and the community is in good condition, especially in relation to other examples of this community in the basin. Only one aquatic community was sampled during this site visit. The water at this site is quite saline (conductivity = 17,500 µS/cm).

One-time visits have limited use for evaluating succession, but it appeared that permanent emergent vegetation at the shoreline, including *Hordeum jubatum* (foxtail barley) and *Puccinellia nuttalliana* (Nuttall's alkaligrass), was being replaced by annual species of alkali flats, such as *Chenopodium rubrum* (red goosefoot), *Chenopodium glaucum* (oakleaf goosefoot), and *Kochia scoparia* (summer cypress). These changes are consistent with a natural drawdown trend in a drought cycle.

Key Environmental Factors

The closed basin (a relatively uncommon geomorphological feature), coupled with soils weathered from a substrate high in clays and of low permeability, has created a condition promoting intermittent flooding, salt accumulation, and ponding of water. This flooded condition in turn structures the plant communities. The erosion and vegetation at the perimeter of Halfbreed Lake indicates that the lake levels are or were artificially elevated.

Rarity

Three species of special concern were observed: *Athene cunicularia* (burrowing owl), *Himantopus mexicanus* (black-necked stilt), and *Cynomys ludoviscianus* (black-tailed prairie dog).

Other Values

A one-time observation showed the following to be present (in addition to the species of concern): *Recurvirostra americana* (American avocet), *Limosa fedoa* (marbled godwit), *Ardea herodias* (great blue heron, 20+ observed), *Olor columbianus* (tundra swan), numerous duck species, *Thamnophis sirtalis* (common garter snake), and *Antilocapra americana* (pronghorn antelope).

The large complex of wetlands and their abundance of sago pondweed are significant for spring waterfowl migration. The decline of emergent cover in the current drought cycle temporarily reduces waterfowl breeding habitat value.

Land Use

Neither grazing nor hunting is currently permitted. Banding of waterfowl takes place on an annual basis.

Exotics

Numerous exotics/increaser species occur in a 20-30 foot band on the lake margin mud flat. These include *Lepidium perfoliatum* (clasping pepperweed), *Chenopodium album* (lambsquarters), *Chenopodium rubrum* (red goosefoot), *Tragopogon dubius* (goat's beard), *Iva axillaris* (poverty-weed), *Rumex* spp. (dock or sorrel), and *Kochia scoparia* (summer cypress). These species are typically found on alkali flats and appear to be replacing patches of dead emergent vegetation including *Schoenoplectus americanus* (American bulrush) and *Schoenoplectus acutus* (hardstem bulrush) along parts of the lakeshore. Patches of *Bromus commutatus* (meadow brome), *Lepidium perfoliatum*, and *Agropyron cristatum* (crested wheatgrass) are found within the *Sarcobatus vermiculatus* / *Pascopyrum smithii* (black greasewood / western wheatgrass) plant association.

Uplands

Most of the surrounding uplands are either strip-cropped wheatlands or heavily grazed rangelands. Greasewood flats extend onto private property in areas. A prairie dog town occurs on both sides of the northern refuge border and extends into the *Sarcobatus vermiculatus* (black greasewood) habitat.

Information Needs

None were noted.

Management Needs

The *Sarcobatus vermiculatus / Pascopyrum smithii* (black greasewood / western wheatgrass) habitat that prevails around the lakes is in good to excellent condition, but it has unusual levels of vegetation litter accumulation. This situation warrants further management consideration. Ironically, it is possible that in the absence of occasional grazing, the idle condition may shift the composition in favor of ruderal species.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Eleocharis sp. Dominance Type	*	*	B
Hordeum jubatum Herbaceous Vegetation	S4	G4	C
Pascopyrum smithii Herbaceous Vegetation	S4	G3G5Q	B
Sarcobatus vermiculatus / *Pascopyrum smithii* Shrub Herbaceous Vegetation	S4	G4	B
Stuckenia pectinata Dominance Type	*	*	*
Typha latifolia Herbaceous Vegetation	S5	G5	B
Animal Elements			
Athene cunicularia	S3B,SZN	G4	*
Cyonomys ludovicianus	S3S4	G4	*
Himantopus mexicanus	S2B,SZN	G5	*

* Rank not assigned

HELL'S CANYON

Directions

Hell's Canyon is in the Absaroka Range in south central Montana. Hell's Canyon is adjacent to Hells Canyon Campground 24 miles south of McLeod on State Route 298.

Description

This wetland is a series of marshes and wet meadows formed by beaver dams and connected by a small creek. This drainageway, alluvial in origin, flows into the Boulder River. Old beaver dams helped form this wetland, and the uppermost marsh still ponds water year-round. *Carex utriculata* (beaked sedge) and *Calamagrostis inexpansa* (narrow-spiked reedgrass) fringe the pond and an *Alnus incana* (mountain alder) community dominates the creek bottom down to the next marsh. A *Carex utriculata* community that is being invaded by *Calamagrostis inexpansa* and the exotic *Poa palustris* (fowl bluegrass) dominates this next marsh, which appears to be drying out. The part of this marsh just above the beaver dam is very wet and still dominated by *Carex utriculata*. The lowest marsh has another *Carex utriculata* community that also appears to be drying out; *Poa palustris* and *Calamagrostis inexpansa* are also increasing in cover in this marsh. *Pinus contorta* (lodgepole pine) and *Pseudotsuga menziesii* (Douglas-fir) forest dominate the uplands.

Key Environmental Factors

Castor canadensis (beaver) activity and seasonal high water cause flooding that in turn structures the communities present.

Rarity

An uncommon G3 community, *Alnus incana* / *Calamagrostis canadensis* (mountain alder / bluejoint reedgrass), occupies a minor portion of the wetland.

Other Values

Alces alces (moose) have heavily browsed the willow component. *Ondatra zibethica* (muskrats) were noted in the open water. *Rana pretiosa* (spotted frogs) were flushed in a number of plant communities.

Land Use

The only impacts to the site, and these are hypothesized, are trampling from fishermen and past grazing, which would account for the populations of exotic species.

Exotics

Within the *Alnus incana* (mountain alder)-dominated community are inexplicably dense patches of *Cirsium arvense* (Canada thistle). In the wet meadow portion of the site are numerous pasture grasses, including *Poa palustris* (fowl bluegrass), *Poa pratensis* (Kentucky bluegrass), *Phleum pratense* (common timothy), and *Agrostis stolonifera* (redtop), any of which can compete for dominance with the native dominants, primarily *Calamagrostis stricta* (narrow-spike reedgrass). *Phalaris arundinacea* (reed canarygrass) constitutes a threat in the meadow below the pond.

Uplands

A road runs parallel to the west edge of the site at the toe of the slope and crosses the inlet creek as well. Several dispersed campsites were found next to the pond.

Information Needs

What factors account for the high cover of *Cirsium arvense* (Canada thistle) in parts of the site? Could it be that the site is alluvial in nature and the seeds of weedy species are simply washed-in?

Management Needs

Make certain that beaver have access to the area so they in turn can maintain natural processes that result in the wetland's health and extent.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Alnus incana / *Calamagrostis canadensis* Shrubland	S3Q	G3Q	B
Aquatic	*	*	*
Calamagrostis canadensis Western Herbaceous Vegetation	S4	G4Q	C
Carex utriculata Herbaceous Vegetation	S5	G5	B
Eleocharis palustris Herbaceous Vegetation	S5	G5	B

* Rank not assigned

HORSETHIEF STATION

Directions

Horsethief Station is located in the foothills and high plains of south central Montana. From Red Lodge, travel north on U.S. Highway 212 for a little over 1 mile. Turn east on a dirt road signed for Rock Creek fishing access. Follow this road for a little less than 2 miles. The access is signed.

Description

Horsethief Station is located in the floodplain of Rock Creek. In this reach, Rock Creek is braided with two or three primary channels and many dry (at time of survey) gravel-cobble bed overflow channels. Channel banks are eroded and the system appears to be downcutting. The microtopography of the floodplain is complex with many swales and old channels. Much of the floodplain appears to be above the flood prone zone (twice the stage height at bankfull).

Most of the site is occupied by mature cottonwood gallery forest. Two communities comprise these forests: *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) and *Populus balsamifera* ssp. *trichocarpa* / *Symphoricarpos occidentalis* (black cottonwood / western snowberry). The *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* association occurs on mid-channel bars and more mesic portions of the floodplain, while the *Populus balsamifera* ssp. *trichocarpa* / *Symphoricarpos occidentalis* community occurs on higher floodplain deposits above the flood prone zone. Mesic swales that intercept groundwater are interspersed throughout these communities and support an *Alnus incana* / *Calamagrostis canadensis* (mountain alder / bluejoint reedgrass) community.

Old beaver activity has created ponded areas that have silted up and now support small *Carex utriculata* (beaked sedge) and *Carex pellita* (woolly sedge) communities and larger *Salix boothii* / *Carex utriculata* (Booth's willow / beaked sedge) and *Salix boothii* / *Calamagrostis canadensis* communities. There is also a small patch of *Populus tremuloides* / *Prunus virginiana* (quaking aspen / chokecherry).

Key Environmental Factors

Fluvial processes, such as seasonal flooding and high groundwater, and the associated channel migration and microtopography are the primary influences on vegetation structure and composition at this site. Past beaver activity is also very important and has created ponded areas that support mesic sedge and willow communities. Finally browsing by wild ungulates (perhaps elk and moose) has altered the structure of the shrub layer in some cottonwood stands by suppressing and reducing the cover of palatable species, such as *Cornus sericea* (red-osier dogwood).

Rarity

No special status species were observed. Four G3Q or G3? communities were documented: *Populus tremuloides* / *Prunus virginiana* (quaking aspen / chokecherry), *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood), *Alnus incana* / *Calamagrostis canadensis* (mountain alder, bluejoint reedgrass), and *Carex pellita* (woolly sedge). These occurrences range from small (*Carex pellita*) to moderately sized (*Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea*) and are in fair to good condition. Generally, more mesic sites are in better condition and less affected by exotic species.

Other Values

Although there are several diversion ditches upstream of and within this reach, this section of Rock Creek appears to support important hydrologic functions, such as dynamic water storage and surface water - groundwater interactions. The floodplain is still accessed by surface and subsurface flooding regimes, and native vegetation appears to be highly connected and to occupy much of the floodplain.

Land Use

This site is a dedicated recreation site, and there are many informal trail throughout. The site is well browsed, but not apparently by livestock. One low-flow side channel is blocked by a cobble and plastic-lined dam and is diverted into a small ditch, probably for irrigation use.

Exotics

Exotic species are well established in portions of this site. Pasture grasses, such as *Poa pratensis* (Kentucky bluegrass), *Phleum pratense* (common timothy), and *Dactylis glomerata* (orchard grass), are abundant in drier portions of the site. Some cottonwood stands have herbaceous openings with well-established patches of

noxious weeds, including *Centaurea maculosa* (spotted knapweed), *Leucanthemum vulgare* (ox-eye daisy), *Cynoglossum officinale* (hound's tongue), and *Cirsium arvense* (Canada thistle).

Uplands

Native vegetation occupies the floodplain of Rock Creek along the active channels immediately up and downstream of the site. Adjacent land uses are pasture and housing/ranchettes.

Information Needs

How do irrigation diversions affect the functionality of the site?

Management Needs

Although pasture grasses are very well established at the site, noxious weeds, such as *Centaurea maculosa* (spotted knapweed), *Cynoglossum officinale* (hound's tongue), and *Euphorbia esula* (leafy spurge), are currently present at low cover and could be eradicated or controlled with a weed management plan.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Alnus incana / *Calamagrostis canadensis* Shrubland	S3Q	G3Q	B
Carex pellita Herbaceous Vegetation	S2S3	G3?	*
Carex utriculata Herbaceous Vegetation	S5	G5	*
Populus balsamifera ssp. *trichocarpa* / *Cornus sericea* Forest	S3?	G3?	B
Populus balsamifera ssp. *trichocarpa* / *Symphoricarpos occidentalis* Forest	S3?	*	B
Populus tremuloides / *Prunus virginiana* Forest	SQ	G3?Q	C
Salix boothii / *Calamagrostis canadensis* Shrubland	S3	G3G4Q	B
Salix boothii / *Carex utriculata* Shrubland	S4	G4	B

* Rank not assigned

LOST LAKES

Directions

Lost Lakes are located in the Absaroka Range in south central Montana. From McLeod, travel south on State Route 298 for 0.5 mile. Turn onto the West Boulder Road and travel west-southwest for approximately 12 miles to the West Boulder trailhead. Travel south on Forest Trail 41 for approximately 1 mile. Follow an informal trail up the eastern slope of the valley for a little over 1 mile to Lost Lakes.

Description

This site consists of two lakes located on a small bench on the lower slope above the West Boulder River. The lakes have formed in shallow, glacial depressions, and receive both surface and groundwater inflows. A small creek drains the lower lake. Wetland communities fringe both lakes. The wettest communities are dominated by *Schoenoplectus acutus* (hardstem bulrush) and *Typha latifolia* (broadleaf cattail). These communities are semipermanently flooded, and while *Schoenoplectus acutus* fringes both lakes, *Typha latifolia* is confined to small patches. A *Carex utriculata* (beaked sedge) community dominates drier, seasonally flooded sites. The upper edge of this community has a few individual *Alnus incana* (mountain alder) shrubs and sapling-sized *Picea engelmannii* (Engelmann spruce). Pasture grasses, mostly *Poa pratensis* (Kentucky bluegrass) and *Phleum pratense* (common timothy), dominate the immediate uplands, and *Poa pratensis* is well established in the *Carex utriculata* community. There is also a very small *Carex nebrascensis* (Nebraska sedge) community along the lower lake.

Key Environmental Factors

Ground and surface water inflows and water level fluctuations are important influences on plant community structure.

Rarity

No rare plants, animals, or communities were observed at this site.

Other Values

Rana pretiosa (spotted frogs) were observed in the lake.

Land Use

This site receives some recreational use, and there is some pugging in the *Carex utriculata* (beaked sedge) community, possibly from horse use. The presence of pasture grasses implies that the site may have been grazed in the past.

Exotics

Poa pratensis (Kentucky bluegrass) and *Phleum pratense* (common timothy) are present in the uplands. *Poa pratensis* is well established in the drier margins of the wetland.

Uplands

The site is located in the Absaroka-Beartooth Wilderness Area. The lake basin does not appear to receive heavy recreational use.

Information Needs

What is the grazing history of the site? Is presence of pasture grasses a product of recreational stock use?

Management Needs

None were noted.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Carex nebrascensis Herbaceous Vegetation	S4	G4	A
Carex utriculata Herbaceous Vegetation	S5	G5	B
Schoenoplectus acutus Herbaceous Vegetation	S5	G5	A
Typha latifolia Western Herbaceous Vegetation	S5	G5	A

MAIN BOULDER

Directions

Note: This site is located on private land, and landowner permission is needed to access this site. The Main Boulder site is located in the foothills of the Beartooth Mountains in south central Montana. From McLeod, travel south on State Route 298 for approximately 10 miles. The site is located approximately 0.5 mile past the Natural Bridge trailhead.

Description

This site occurs on the floodplain of the Main Boulder River along the active channel and associated oxbows. *Populus balsamifera* ssp. *trichocarpa* (black cottonwood) and *Populus tremuloides* (quaking aspen) forest occupies the majority of the floodplain. Most of these stands are affected by historic grazing. They have a minimal shrub component and an herbaceous layer dominated by exotic grasses such as *Agrostis stolonifera*

(redtop), *Bromus inermis* (smooth brome), and *Phleum pratense* (common timothy). Cottonwood and aspen cover is primarily from mature trees. In contrast to the above described stands, this site also supports an outstanding example of a *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) community. Occurring on the inside of a meander bend, this community has an overstory dominated by mature (24-inches diameter at breast height and larger) *Populus balsamifera* ssp. *trichocarpa* and a well established mid-canopy of *Populus tremuloides*. The shrub layer is diverse with good *Cornus sericea*, *Symphoricarpos occidentalis* (western snowberry), and *Prunus virginiana* (chokecherry) cover, and the presence of exotic species is minimal.

Wetter areas on the site, such as floodplain swales and old oxbows, support well-developed sedge and aquatic communities. A *Carex utriculata* (beaked sedge) community with abundant *Carex vesicaria* (inflated sedge) cover occupies the silted in portions of old oxbows. A small depressional wetland has an open water component that supports a *Potamogeton richardsonii - Myriophyllum spicatum* (red-head pondweed - water milfoil) aquatic community. A *Salix exigua* (sandbar willow) community fringes many of these low areas. Willow communities also occur on lower portions of the floodplain such as aggrading point bars. These communities, including *Salix exigua* and small stands of *Salix lucida* ssp. *caudata* (shining willow) and *Salix lutea* / *Calamagrostis canadensis* (yellow willow / bluejoint reedgrass), have high cover of exotic herbaceous species.

Key Environmental Factors

The primary factors influencing vegetation at this site are fluvial dynamics, including flooding, erosion and deposition, and channel migration. Historic grazing is probably an important influence in reducing or eliminating the floodplain forest's shrub component and increasing the abundance of exotic species.

Rarity

No special status plant or animal species were observed. One G2 community, *Potamogeton richardsonii - Myriophyllum spicatum* (red-head pondweed - water milfoil), was documented in very good condition. Three G3 communities were documented: *Salix lucida* ssp. *caudata* (shining willow) and *Salix lutea* / *Calamagrostis canadensis* (yellow willow / bluejoint reedgrass) in fair to poor condition and *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) in excellent condition.

Other Values

Fluvial processes, such as flooding and associated sediment erosion and deposition, are still largely intact. This provides opportunity for cottonwood regeneration at the site.

Land Use

The effects of historic grazing have altered the structure and composition of cottonwood and aspen stands. Current browsing by wild ungulates, such as *Alces alces* (moose), may be contributing to the suppression of palatable native shrubs like *Cornus sericea* (red-osier dogwood). Horses lightly browse portions of the site. This has created some pugging in oxbow wet sedge communities. Signs of trespass cattle were observed in the riparian area east of the active channel. The site also receives angling use from the adjacent property.

Exotics

Herbaceous exotic species are well established at the site. The exotic grasses *Bromus inermis* (smooth brome) and *Agrostis stolonifera* (redtop) dominate the understory of many of the cottonwood and aspen stands. The noxious weeds *Cirsium arvense* (Canada thistle) and *Tanacetum vulgare* (common tansy) and the highly invasive *Phalaris arundinacea* (reed canarygrass) are locally abundant.

Uplands

The surrounding uplands are largely intact. Livestock grazing is widespread in the bottomland along the river corridor, and some riparian forest has been converted to hay pasture.

Information Needs

What is the site's grazing history? Is the abundance of *Bromus inermis* (smooth brome) and *Agrostis stolonifera* (redtop) affecting the recovery of native shrub species? What is the stability of the active channel?

Management Needs

Controlling exotic pasture grasses is probably not feasible; however, the smaller populations of *Cirsium arvense* (Canada thistle) and *Tanacetum vulgare* (common tansy) might be manageable.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Carex utriculata Herbaceous Vegetation	S5	G5	A
Populus balsamifera ssp. *trichocarpa* / *Cornus sericea* Forest	S3?	G3?	A
Populus balsamifera ssp. *trichocarpa* / Mesic graminoids Forest	SW	*	*
Populus tremuloides / *Cornus sericea* Forest	S3	G4	C
Potamogeton richardsonii – Myriophyllum spicatum Herbaceous Vegetation	S2Q	G2Q	A
Salix exigua Temporarily Flooded Shrubland	S5	G5	B, D
Salix lucida ssp. *caudata* Shrubland	S3	G3Q	D
Salix lutea / *Calamagrostis canadensis* Shrubland	S3?	G3?	C

* Rank not assigned

MCDONALD BASIN

Directions

McDonald Basin is located in the Beartooth Mountains of south central Montana. From Dean, travel southwesterly on Benbow Road for approximately 1.5 miles to a junction with an un-named road to the south. Follow this road for 0.1 mile to a 4-wheel drive trail continuing to the south. Continue on the 4-wheel drive trail for 2 miles to the site.

Description

This complex of wetlands occurs in the montane zone on the flanks of the Beartooth Mountains. The site is characterized by glacially-formed depressions dissected by small streams. These depressions, as well as *Castor canadensis* (beaver) activity along the stream courses, have created the current wetland complex. In addition, a few fens have formed on gently sloping ground around seeps. Both the glacial potholes and the beaver-dammed wetlands are dominated by marsh vegetation, primarily *Carex utriculata* (beaked sedge). Some wetter zones are dominated by *Glyceria borealis* (northern mannagrass), and *Nuphar lutea* (yellow pond-lily) dominates permanently flooded areas in the center of ponds. *Alnus incana* (mountain alder) stands have formed in the seeps and springs that permeate this area. Small inclusions of wetter areas within the alder stands are dominated by graminoids like *Carex utriculata* and *Calamagrostis canadensis* (bluejoint reedgrass). *Alnus incana* stands also occur along streams, as do stands of *Salix geyeriana* / *Carex utriculata* (Geyer's willow / beaked sedge). A couple of small fens have formed either in basins fed by groundwater or around seeps on gentle slopes. A poorly described community type, which has a low coverage of *Dasiphora fruticosa* ssp. *floribunda* (shrubby cinquefoil) and undergrowth dominated by *Carex buxbaumii* (Buxbaum's sedge), dominates the fen vegetation. Other associated species are *Carex interior* (inland sedge), *Carex lasiocarpa* (slender sedge), *Juncus alpinus* (northern rush), *Agrostis scabra* (tickle grass), *Menyanthes trifoliata* (bog buckbean), *Aster junciformis* (rush aster), and a nearly continuous blanket of moss cover. Forests of *Pinus contorta* (lodgepole pine) and *Abies lasiocarpa* (subalpine fir) with an undergrowth of *Spiraea betulifolia* (birchleaf spiraea) and *Vaccinium globulare* (globe huckleberry) dominate the surrounding uplands.

Key Environmental Factors

Seeps, streamflow, and beaver activity all contribute to structuring these wetlands.

Rarity

Three G3 communities in good condition were documented: *Alnus incana* / *Carex* spp. (mountain alder / sedge), *Carex buxbaumii* (Buxbaum's sedge), and *Dasiphora fruticosa* ssp. *floribunda* / *Carex* spp. (shrubby cinquefoil / sedge). Community diversity at this site is very high.

Land Use

Hiking and hunting can be expected as a trail (old jeep road) does traverse a portion of this wetland. Livestock grazing occurs within the site as well, though only the *Alnus incana* / *Carex* spp. community has received such use as to produce hummocking.

Exotics

The following exotic species generally comprised at most 1% cover in drier portions of the site: *Cirsium arvense* (Canada thistle), *Cirsium vulgare* (bull thistle), *Phleum pratense* (common timothy), *Poa pratensis* (Kentucky bluegrass), and *Poa palustris* (fowl bluegrass).

Uplands

Forests in the immediate upland are second growth. There are a couple of diversion ditches that formerly were used to augment the water levels in the lakes below the McDonald Wetlands.

Information Needs

None were noted.

Management Needs

A weed management plant is particularly needed for the noxious weeds, such as *Cirsium arvense* (Canada thistle), but grazing management should be part of the plan to control the other weeds/increaser species, such as *Poa pratensis* (Kentucky bluegrass).

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Alnus incana / *Carex* spp. Shrubland	S?	G3	B
Calamagrostis canadensis Western Herbaceous Vegetation	S4	G4Q	B
Carex buxbaumii Herbaceous Vegetation	S3	G3	A
Carex utriculata Herbaceous Vegetation	S5	G5	B
Eleocharis palustris Herbaceous Vegetation	S5	G5	C
Glyceria borealis Herbaceous Vegetation	S3	G4	C
Nuphar lutea Dominance Type	*	*	*
Dasiphora fruticosa ssp. *floribunda* / *Carex* spp. Shrubland	S3	G3?	B
Salix boothii / *Carex utriculata* Shrubland	S4	G4	B
Salix geyeriana / *Carex utriculata* Shrubland	S5	G5	C

* Rank not assigned

MEYERS CREEK

Directions

The Meyers Creek site is located at the base of the Beartooth Mountains is south central Montana. From Nye, travel north on State Highway 420 for about 1 mile. Turn west on Forest Route 2142, following Limestone Creek. Travel for 8.5 miles (turning north at Limestone) to the Meyers Creek Work Center. The site occurs

as a series of discontinuous aspen and willow-dominated stands along Meyers Creek from the Work Center to approximately 1 mile upstream.

Description

This site is located along Meyers Creek. Stands of mesic aspen and willow, which occur as discontinuous patches along the creek and adjacent slopes, are the dominant communities. Throughout the site, riparian communities occur primarily as narrow stringers along the active channel of Meyers Creek. These communities are characterized by very small and discontinuous patches of *Picea engelmannii* / *Cornus sericea* (Engelmann spruce / red-osier dogwood) and small patches of *Salix boothii* (Booth's willow). These communities are very heavily grazed and have high cover of exotic grasses, such as *Bromus inermis* (smooth brome) and *Phleum pratense* (common timothy).

In a few locations, the riparian zone supports larger stands of mesic aspen communities. These stands also occur on adjacent toeslopes subirrigated by groundwater. The stands furthest upstream are *Populus tremuloides* / *Symphoricarpos albus* (quaking aspen / common snowberry) and *Populus tremuloides* / *Osmorhiza occidentalis* (quaking aspen / western sweet-cicely) (the diagnostic *Osmorhiza* species present is actually *Osmorhiza depauperata* [blunt fruit sweet-cicely]). These stands are small and impacted from grazing. A *Populus tremuloides* / *Cornus sericea* community occurs closer to the Work Center along the creek and on an adjacent toeslope. The portion of this community along Meyers Creek is heavily grazed and has abundant *Phleum pratense* and *Bromus inermis* cover. In contrast, the portion of this community on the toeslope appears to be lightly browsed. It has an open canopy of *Populus tremuloides* with minor colonization of *Picea engelmannii*. The shrub component is diverse with *Amelanchier alnifolia* (serviceberry) and *Symphoricarpos albus* abundant and *Cornus sericea* well represented. The herbaceous layer is diverse: *Elymus glaucus* (blue wildrye) is abundant and numerous mesic forbs, including *Solidago canadensis* (Canada goldenrod), *Viola canadensis* (Canadian violet), *Osmorhiza depauperata*, *Heracleum maximum* (cow-parsnip), *Glycyrrhiza lepidota* (American licorice), and *Galium triflorum* (sweet-scented bedstraw) are common. This community also occurs in the Meyers Creek floodplain close to the Work Center, but this stand is characterized by an open overstory of mature and senescent *Populus balsamifera* ssp. *trichocarpa* (black cottonwood) with an open mid-canopy of *Populus tremuloides*. Saplings and small poles of *Picea engelmannii* are well established. The shrub layer is dominated by *Cornus sericea*, *Salix boothii*, and *Symphoricarpos occidentalis* (western snowberry), while mesic forbs and grasses similar to the previous stand represent the herbaceous layer. These stands have low cover of several exotic species, including *Phleum pratense*, *Cynoglossum officinale* (hound's tongue), *Cirsium vulgare* (bull thistle), and *Bromus inermis*.

Uplands at the site are characterized by grasslands on south-facing slopes and *Picea engelmannii* / *Physocarpus malvaceus* (Engelmann spruce / ninebark) and *Pseudotsuga menziesii* / *Physocarpus malvaceus* (Douglas-fir / ninebark) stands on north-facing slopes.

Key Environmental Factors

Groundwater flows both along Meyers Creek and from adjacent slopes provide the site moisture that supports the mesic and riparian communities. Meyers Creek is an intermittent stream (dry during the site visit) with very little floodplain development. Portions of the site are heavily browsed, which has altered the structure and composition of vegetation at the site.

Rarity

No plant or animal species of special concern were observed. Very small examples of two G3? communities were documented in fair to good condition. These were *Populus tremuloides* / *Osmorhiza occidentalis* (quaking aspen / western sweet-cicely) and *Populus tremuloides* / *Symphoricarpos albus* (quaking aspen / common snowberry).

Land Use

Livestock actively grazes this site. A fence separates the upper and lower portions of the site. The upper portion is heavily grazed, while the lower portion receives some grazing pressure from horse and cow.

Exotics

Phleum pratense (common timothy) and *Bromus inermis* (smooth brome) are well established at the site. Other exotic species are currently present at low cover but are likely to expand in the future. These include *Cynoglossum officinale* (hound's tongue), *Cirsium vulgare* (bull thistle), and *Cirsium arvense* (Canada thistle). On south-facing slopes, the adjacent upland communities have abundant *Phleum pratense* and *Bromus inermis* cover. This provides a large seed source for these species to colonize more mesic riparian sites.

Uplands

Livestock grazes the bottomland along Meyers Creek. The surrounding uplands are National Forest lands. These may also be grazed but have no other apparent management activities. Lands below the mouth of Meyers Creek in the Limestone drainage are in private ownership and ranching and agricultural land uses predominate.

Information Needs

What is the grazing history of the site?

Management Needs

Control of noxious weeds, especially *Cynoglossum officinale* (hound's tongue), *Cirsium vulgare* (bull thistle), and *Cirsium arvense* (Canada thistle), is needed. Also, the grazing intensity on the upper portions of the site should be reduced.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Populus tremuloides / *Cornus sericea* Forest	S3	G4	B
Populus tremuloides / *Osmorhiza occidentalis* Forest	S3?	G3?	C
Populus tremuloides / *Symphoricarpos albus* Forest	S3?	G3?	B
Salix boothii / *Carex utriculata* Shrubland	S4	G4	*
Salix boothii Dominance Type	*	*	*

* Rank not assigned

MUD LAKE-BOULDER RIVER

Directions

Mud Lake-Boulder River is in the Absaroka Range in south central Montana. From McLeod travel 12 miles south on State Route 298 to Contact Creek. Mud Lake-Boulder River is located 1.5 miles westerly upstream on Contact Creek.

Description

Mud Lake is a shallow, seasonally flooded lake that occurs in a glacially-formed depression along an intermittent creek. The creek, which is the primary water source, also drains the lake. The lake apparently dries down to a mud flat by the end of some growing seasons. At the time of the site visit, the lake was a mud flat dominated by equal portions of unvegetated mud and an *Eleocharis palustris* (common spikerush) community. The margins of the lake had a patchy drawdown zone where *Polygonum amphibium* (water smartweed) and *Mentha arvensis* (field mint) were common. At the upstream end of the lake, the *Eleocharis palustris* community grades into a *Carex utriculata* (beaked sedge) community on sites with a shorter period of standing water. Adjacent to the *Carex utriculata* community, and at a slightly drier position, is a *Salix drummondiana* / *Calamagrostis canadensis* (Drummond's willow / bluejoint reedgrass) community. The actual undergrowth dominant was *Calamagrostis inexpansa* (narrow-spiked reedgrass), which is considered by Hansen et al. (1995) to be an ecological equivalent of *Calamagrostis canadensis* for management

purposes. Forest of *Pseudotsuga menziesii* (Douglas-fir) and *Pinus contorta* (lodgepole pine) dominate the uplands.

Key Environmental Factors

This wetland is the product of favorable geomorphology (a glacial depression) and proximity to an intermittent creek that seasonally floods. The flooding and drying-down processes structure the resulting plant communities.

Rarity

No rare plants or animals were observed. One G3 plant association, *Salix drummondiana* / *Calamagrostis canadensis* (Drummond's willow / bluejoint reedgrass), was documented in fair condition.

Other Values

Heavy use by ungulates was noted along with *Ursus americanus* (black bear) scat and tracks. *Rana pretiosa* (spotted frog) and *Thamnophis sirtalis* (common garter snake) were also present.

Land Use

No land use was apparent, though the area has high potential for hunting, outfitter, and wildlife watching use. An unconfirmed report indicates that a lodge on the Boulder River stages outfitted trips from this point. The ubiquity and abundance of pasture grasses and increaser forbs implies a past grazing use.

Exotics

Phleum pratense (common timothy) and *Poa palustris* (fowl bluegrass) are prevalent at the lake inlet. *Poa pratensis* is an important component in the upland meadow at the south end of the lake. Scattered populations of *Cirsium arvense* (Canada thistle) and *Trifolium pratense* (red clover) are present throughout the site.

Uplands

The meadow communities immediately adjacent to the wetlands have abundant cover of pasture grasses and increaser forbs, which indicates that the area was grazed in the past. Other uses or disturbances were not documented.

Information Needs

What is the reason for the high populations of pasture grasses?

Management Needs

None were identified.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Aquatic	*	*	*
Carex utriculata Herbaceous Vegetation	S5	G5	A
Eleocharis palustris Herbaceous Vegetation	S5	G5	A
Phleum pratense Dominance Type	*	*	*
Salix drummondiana / *Calamagrostis canadensis* Shrubland	S2S3	G3	C

* Rank not assigned

NURSES LAKE

Directions

Note: a portion of this site is located on private land, and landowner permission is needed to access that area. Nurses Lake is east of the West Boulder River in south central Montana. From McLeod, travel south on West Boulder Road for approximately 11 miles to un-named road bearing east. Proceed on the un-named road for 2 miles in a generally southeasterly direction to Nurses Lake wetland.

Description

This site is a complex of small, steep-sided, muck-bottomed glacial potholes located in a morainal landform surrounded by aspen-conifer forest. Based on the convex shape of the moraine and the low conductivity (160 µS/cm) of water in the potholes, the water source for this site is primarily precipitation and subsequent drainage into the potholes. Smaller potholes (0.5-1 ac) generally have a fringe of *Carex utriculata* (beaked sedge) on the margin and a *Sparganium angustifolium* (narrowleaf bur-reed) community growing in the mucky-bottomed central portion of the pothole. *Sparganium angustifolium* grows as an emergent community in this setting; associated species include *Sagittaria cuneata* (arumleaf arrowhead), *Potamogeton gramineus* (grassy pondweed), *Ranunculus gmelinii* (Gmelin's buttercup), *Lemna minor* (common duckweed), and *Lemna trisulca* (star duckweed). Larger potholes (2-4 ac) have an aquatic community in the middle with *Carex utriculata* growing on the margins. Nearly all the potholes have scattered shrubs growing on the margins, including *Salix boothii* (Booth's willow), *Salix geyeriana* (Geyer's willow), and *Salix bebbiana* (Bebb willow). The surrounding uplands are mostly dominated by a *Populus tremuloides* / *Symphoricarpos* (trembling aspen / snowberry) cover type, which also has a high cover of *Calamagrostis rubescens* (pinegrass).

Key Environmental Factors

These glacial depressions are seasonally flooded by (mostly) overland flow. This dynamic is the primary factor for maintenance of these communities.

Rarity

No rare plants, animals, or communities were observed.

Other Values

Abundant *Rana pretiosa* (spotted frog) were found in the *Sparganium angustifolium* (narrowleaf bur-reed) community, and *Alces alces* (moose) were feeding in the various aquatic communities. Several specimens of a given type of snail were collected for identification.

Land Use

The *Carex utriculata* (beaked sedge) community is lightly grazed, whether from moose (*Alces alces*) or cattle is unknown. Past grazing may have been intense, judging from the extent of exotic species and hummocking.

Exotics

The only exotics are in the bankfull area of drawdown zone and the immediate upland. These include *Cirsium vulgare* (bull thistle), *Cirsium arvense* (Canada thistle), *Cynoglossum officinalis* (hound's tongue), *Trifolium pratense* (red clover), and pasture grasses such as *Agrostis stolonifera* (redtop) and *Phleum pratense* (common timothy).

Uplands

Adjacent public lands are lightly grazed while those in private ownership are heavily impacted. Cattle use ponds in the near vicinity.

Information Needs

Some of the potholes had unusual algal blooms. Is this the result of excessive fertilization from cattle use in the basin?

Management Needs

The site could benefit from a weed management plan, while the population levels are still controllable.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Aquatic	*	*	*
Carex utriculata Herbaceous Vegetation	S5	G5	B
Populus tremuloides / *Symphoricarpos occidentalis* Dominance Type	*	*	*
Sparganium angustifolium Herbaceous Vegetation	S?	G4	*

* Rank not assigned

PRUIT PARK

Directions

Note: Pruit Park is located on private land, and landowner permission is required to access this site. Pruit Park is located in the foothills of the Absaroka Range in south central Montana. From McLeod, travel south on State Route 298 for 0.5 mile. Turn onto the Wet Boulder Road and travel west-southwest for approximately 12 miles to the West Boulder trailhead. Hike east on Forest Trail 14. After reaching the top of the hill slope (approximately 1 mile), head cross-country bearing south-southeast for approximately 0.8 mile. The site is located on the northern edge of Pruit Park.

Description

Pruit Park occurs on an elevated bench of glacial origin, and the site receives groundwater from the adjacent slope. The site is dominated by a *Salix wolfii* / *Deschampsia caespitosa* (Wolf willow / tufted hairgrass) community. Shallow swales are more mesic and support *Carex aquatilis* (water sedge). Pole and sapling-sized clumps of *Picea engelmannii* (Engelmann spruce) are scattered throughout this community.

Key Environmental Factors

Subirrigation from the adjacent slope is the primary environmental influence on the vegetation at this site.

Rarity

No special status plant or animal species were observed. One G3 plant community, *Salix wolfii* / *Deschampsia caespitosa* (Wolf willow / tufted hairgrass), was documented in fair to good condition.

Land Use

Use of the site appears to be minimal. Cattle sign was observed, and willows are heavily browsed, although probably more by *Alces alces* (moose) than by cattle.

Exotics

Poa pratensis (Kentucky bluegrass) is well established in drier portions of the site.

Uplands

A cabin is located in Pruit Park near the site. The site borders the Absaroka-Beartooth Wilderness Area and the landscape context is largely pristine.

Information Needs
What is the grazing history of the site? How heavy is wild ungulate browsing pressure?

Management Needs
None were noted.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Salix wolfii / *Deschampsia caespitosa* Shrubland	S3	G3	B

RIVERFRONT PARK

Directions
Riverfront Park is located in the sedimentary unglaciated Great Plains of south central Montana. In Billings, travel south on South Billings Boulevard from Interstate 90. Riverfront Park is located just before the road crosses the Yellowstone River.

Description
Riverfront Park occurs on the floodplain of the Yellowstone River. The site is a mosaic of cottonwood forest interspersed with shrub openings, ponds, sloughs, and developed recreation and parking areas. Most cottonwood stands at this site are open gallery forests of mature *Populus deltoides* (plains cottonwood) with a mid-story of the exotic *Elaeagnus angustifolia* (Russian olive) and an understory dominated by exotic pasture grasses, predominately *Bromus inermis* (smooth brome) and *Poa pratensis* (Kentucky bluegrass). Within this community there are small inclusions where native shrubs are present. These patches have low to moderate cover of *Cornus sericea* (red-osier dogwood), *Acer negundo* (box-elder), *Salix lutea* (yellow willow), and *Toxicodendron rydbergii* (poison ivy). The eastern portion of the site contains *Populus deltoides* stands with a dense cover of the exotic shrub *Rhamnus cathartica* (common buckthorn).

Fluvial processes, including erosion, deposition, and associated channel migration, are active at the site, and this has created suitable habitat for cottonwood regeneration. Young stands of *Populus deltoides* and *Salix exigua* (sandbar willow) are colonizing recent bars, with small *Populus deltoides* saplings primarily colonizing raised deposits of silt. In many areas, especially along side channels not having received recent deposition, there are stands of *Salix exigua* with a dense ground layer dominated by the aggressive exotic *Phalaris arundinacea* (reed canarygrass). Higher deposits have an older cohort of pole-sized *Populus angustifolia* (narrowleaf cottonwood) with an understory dominated by *Bromus inermis* and the noxious weed *Euphorbia esula* (leafy spurge).

This site also contains a small *Symphoricarpos occidentalis* (western snowberry) community with high cover of *Pascopyrum smithii* (western wheatgrass), small stands of *Typha latifolia* (broadleaf cattail) around ponds, and a very small stand of *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood).

Key Environmental Factors
Seasonal flooding and the resulting floodplain development is the primary abiotic influence at the site. *Castor canadensis* (beaver) are also important and are causing cottonwood and willow mortality in places.

Rarity
No rare plants or animals were observed. A very small example of a G3 community, *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) was documented in fair condition.

Other Values

While most of the cottonwood forests at this site are degraded, they still provide important habitat for wildlife, including nesting habitat for many species of Neotropical migrant birds. Also, active cottonwood regeneration is occurring at this site.

Land Use

This site is a county park, and it receives heavy recreational use, especially fishing use around the lakes. There are many paved roads and trails throughout the site, and vehicle tracks were observed on recent floodplain deposits.

Exotics

Exotic pasture grasses, primarily *Bromus inermis* (smooth brome) and *Poa pratensis* (Kentucky bluegrass), dominate the ground layer at this site. In addition, several species of noxious weed are established, including *Euphorbia esula* (leafy spurge), *Centaurea maculosa* (spotted knapweed), and *Cynoglossum officinale* (hound's tongue). Wetter sites have heavy cover of *Phalaris arundinacea* (reed canarygrass). Perhaps most troubling, most of the cottonwood stands have a midstory dominated by *Elaeagnus angustifolia* (Russian olive). It is likely that as the cottonwoods die (and many of the cottonwoods are mature or senescent), these stands will convert to an *Elaeagnus angustifolia*-dominated community. This conversion will have unknown habitat and biodiversity implications.

Uplands

The surrounding area is dominated by urban and agricultural land uses.

Information Needs

What is the history of gravel extraction at the site?

Management Needs

The park needs a noxious weed management plan.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Phalaris arundinacea Western Herbaceous Vegetation	S4	G5	*
Populus angustifolia / Mesic graminoids Forest	SW	*	*
Populus balsamifera ssp. *trichocarpa* / *Cornus sericea* Forest	S3?	G3?	C
Populus deltoides / Mesic graminoids Forest	SW	*	*
Populus deltoides / Recent Alluvial Bar Forest	S3	*	B/C
Populus deltoides / *Rhamnus cathartica* Dominance Type	*	*	*
Salix exigua Temporarily Flooded Shrubland	S5	G5	C
Symphoricarpos occidentalis Shrubland	S4S5	G4G5	C
Typha latifolia Western Herbaceous Vegetation	S5	G5	C

* Rank not assigned

SAGE CREEK

Directions

Sage Creek is located west of the Pryor Mountains in south central Montana. From Warren, travel 1.25 miles south on State Highway 310 to Sage Creek wetland.

Description

This site is composed of marsh and willow bottom vegetation associated with the floodplain of Sage Creek, a meandering, low gradient stream in the northern end of the Bighorn Basin between the Beartooth Plateau and the Pryor Mountains. Surface and groundwater from Sage Creek are the water sources for this wetland. Some very old beaver dams suggest that beaver played a historic role in shaping these wetlands. There was no water flowing in Sage Creek at the time of the site visit. The adjacent upland is dominated by *Artemisia tridentata* (big sagebrush), *Sarcobatus vermiculatus* (black greasewood), and *Leymus cinereus* (basin wildrye). The wettest and largest community at the site is *Typha latifolia* (broadleaf cattail). Two minor communities, *Schoenoplectus maritimus* (alkali bulrush) and *Eleocharis palustris* (common spikerush), occupy slightly drier positions. *Carex pellita* (woolly sedge) is also a dominant community at the site and it occurs on positions somewhat drier than the previously listed communities. All these emergent communities occur in what are perhaps old oxbows or old beaver ponds associated with Sage Creek. Willow communities also form a significant portion of the site. *Salix exigua* (sandbar willow) is a minor community that occurs on both low and high terraces. *Salix lutea* (yellow willow) forms the largest willow community. It occurs on a higher terrace, and it lacks any significant graminoid or forb coverage within the ground layer, possibly because of past grazing. Small patches of *Distichlis spicata* (saltgrass) can be found in the driest areas at the margins of the wetland.

Key Environmental Factors

This site receives annual floods and may be somewhat expanded in size due to past beaver activity.

Rarity

No rare plants, animals, or communities were observed.

Land Use

Though there has been grazing in the past current evidence points to low levels or grazing.

Exotics

Various combinations of *Sonchus uliginosus* (marsh cow-thistle), *Chenopodium album* (lambsquarters), *Alopecurus arundinaceus* (creeping foxtail), *Arctium minus* (common burdock), *Cardaria* sp. (hoarycress), and *Cirsium arvense* (Canada thistle) were found in all communities except for *Schoenoplectus maritimus* (saltmarsh clubrush).

Uplands

Upstream on Sage Creek there is a limestone mill and adjacent to the west is an active railroad line (effects of either, unknown). Livestock grazing occurs on adjacent private and public lands.

Information Needs

How has the highway and railroad affected the riparian ecology?

Management Needs

The dewatering of Sage Creek needs to be halted to preserve the extent of the wetland.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Carex pellita Herbaceous Vegetation	S2S3	G5?	B
Distichlis spicata Herbaceous Vegetation	S4	G5	C
Eleocharis palustris Herbaceous Vegetation	S5	G5	C
Salix exigua Temporarily Flooded Shrubland	S5	G5	B
Salix lutea / *Rosa woodsii* Shrubland	S?	G3	B
Schoenoplectus maritimus Herbaceous Vegetation	S4	G4	B
Schoenoplectus pungens Herbaceous Vegetation	S3	G3G4	B
Typha latifolia Herbaceous Vegetation	S5	G5	A

STILLWATER RIVER-FLUME CREEK

Directions

The Stillwater River-Flume Creek site is located at the base of the Beartooth Mountains is south central Montana. From Nye, travel west and then southwest on State Route 419 for approximately 5.5 miles. Cross the Stillwater River on a bridge across from the Stillwater Mine tailings pond. Park on the east side of the river; permission is needed to park on Stillwater Mine property. Take the road that switchbacks up the mountain. At the first switchback, leave the road and continue along an informal trail that parallels the Stillwater River. The site is located approximately 0.5 mile upstream at the confluence of the Stillwater River and Flume Creek.

Description

The site is located on the floodplain of the Stillwater River, where it conflues with Flume Creek. At the confluence, Flume Creek forms a long backwater slough; a *Carex utriculata* (beaked sedge) community occurs along the margin of the slough. The rest of the site is mesic and is subirrigated by groundwater. It is a mix of aspen, willow, and cottonwood communities. A *Salix boothii* / *Calamagrostis canadensis* (Booth's willow / bluejoint reedgrass) community occupies wetter sites. This community has clumped cover of willow, mostly *Salix boothii* and *Salix bebbiana* (Bebb willow), with *Cornus sericea* (red-osier dogwood) and *Symphoricarpos occidentalis* (western snowberry) also common. The herbaceous layer is divergent: under *Salix* cover, *Calamagrostis canadensis* dominates, while in herbaceous-dominated openings, *Agrostis stolonifera* (redtop) is the dominant species. Drier sites (but still seasonally saturated) along Flume Creek are characterized by a *Populus tremuloides* / *Cornus sericea* (quaking aspen / red-osier dogwood) community. This community has a vigorous overstory of *Populus tremuloides* with a diverse shrub component. *Symphoricarpos occidentalis* and *Cornus sericea* are the most abundant species. Common herbaceous species are *Equisetum arvense* (field horsetail), *Elymus glaucus* (blue wild rye), *Rudbeckia laciniata* (cutleaf coneflower), and *Heracleum maximum* (cow-parsnip). A *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) community occupies the driest, most well-drained portions of the site. The cottonwoods are mostly senescent, and sapling and pole-sized *Pinus contorta* (lodgepole pine) and *Picea engelmannii* (Engelmann spruce) are well represented. The shrub layer is heavily browsed; many shrubs, especially *Cornus sericea*, are of small stature and appear to be suppressed from browsing. The herbaceous layer has a high proportion of the exotics *Poa pratensis* (Kentucky bluegrass) and *Phleum pratense* (common timothy).

Key Environmental Factors

Fluvial dynamics associated with the Stillwater River and seasonal surface and groundwater inflow from Flume Creek are the most important influences on the vegetation. Signs of old beaver activity are apparent at the site. Browsing by wild ungulates and livestock is effecting the structure of the *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) community by suppressing palatable species, such as *Cornus sericea* (red-osier dogwood).

Rarity

No tracked or special status plant or animal species were observed. A G3? community, *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood), was documented in fair condition.

Land Use

The site is grazed by livestock; however, except for the *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) community, the site appears lightly grazed. Otherwise the site appears unmanaged.

Exotics

Several exotic species are abundant at the site. *Poa pratensis* (Kentucky bluegrass) and *Phleum pratense* (common timothy) are common on the driest sites with rocky, well-drained soil. *Agrostis stolonifera* (redtop) is abundant and *Poa palustris* (fowl bluegrass) is present in herbaceous openings in the *Salix boothii* / *Calamagrostis canadensis* (Booth's willow / bluejoint reedgrass) community. *Cirsium arvense* (Canada thistle) is present at very low cover in the *Populus tremuloides* / *Cornus sericea* (quaking aspen / red-osier dogwood) community.

Uplands

The riparian zone has been heavily impacted in this reach. Across the river and upstream of the site, livestock grazing appears to have greatly limited the development of riparian vegetation, although pockets of good condition cottonwood and willow communities are present. Downstream, the Stillwater Mine has channelized the river and developed the floodplain.

Information Needs

What are the past and current grazing practices at the site?

Management Needs

Cirsium arvense (Canada thistle) is present at the site at very low density, and it should be eradicated.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Carex utriculata Herbaceous Vegetation	S5	G5	A
Populus balsamifera ssp. *trichocarpa* / *Cornus sericea* Forest	S3?	G3?	C
Populus tremuloides / *Cornus sericea* Forest	S3	G4	A
Salix boothii / *Calamagrostis canadensis* Shrubland	S3	G3G4Q	B

TWIN LAKES

Directions

Twin Lakes are located in the Crazy Mountains in south central Montana. From Big Timber, travel north on U.S. Highway 191 for approximately 10 miles. Turn left onto County Road 25 and travel west for approximately 13 miles to Half Moon Campground. Hike west on Forest Trail 119 for approximately 3.5 miles to Upper Twin Lake.

Description

Twin Lakes occur near timberline in a glacially-formed cirque basin at the headwaters of Big Timber Creek. Wetland communities are lacustrine fringe and slope wetlands. A *Salix planifolia* / *Carex scopulorum* (planeleaf willow / Holm's Rocky Mountain sedge) community fringes the upper (western) edge of Upper Twin Lake. This community grades into an early-seral *Abies lasiocarpa* / *Streptopus amplexifolius* (subalpine

fir / clasping twisted stalk) community, which occurs on a subirrigated toeslope. A mid-seral stand of this community, with a *Picea engelmannii* (Engelmann spruce)-dominated overstory, occurs in between the two lakes. Lower Twin Lake has a very narrow lacustrine fringe with *Carex scopulorum* and *Equisetum arvense* (field horsetail) forming the dominant cover. Most of the wetlands along Lower Twin Lake are subirrigated slope wetlands with some peat development that have numerous seeps and springs. A *Carex scopulorum* community occupies most of these wetlands. This well vegetated community has high cover of *Carex scopulorum*, *Carex illota* (sheep sedge), and *Pedicularis groendlandica* (elephant head), and also has abundant brown moss cover, including *Philonotis fontana* and *Drepanocladus aduncus*. *Sphagnum* moss, including *Sphagnum squarrosum*, is locally common around seep margins. This community has numerous linear clumps and breaks of *Picea engelmannii* and *Abies lasiocarpa*. Uplands are predominantly an *Abies lasiocarpa* / *Vaccinium scoparium* (subalpine fir / grouse whortleberry) habitat type.

Key Environmental Factors

This is a subalpine site greatly influenced by glacial topography. Hydrological regime is driven by subirrigation from snowmelt.

Rarity

No special status plant or animal species or rare community types were observed.

Other Values

Rana pretiosa (spotted frog) was observed in small ponds in slope wetlands along Lower Twin Lake.

Land Use

A popular recreation trail skirts the upper boundary of the site. Campsites and informal trails are located in the spruce-fir forest between the lakes and at the head of Upper Twin Lake. Evidence of cattle use was observed in some communities.

Exotics

The only exotic noted was *Trifolium repens* (white clover). This species was localized and present at low cover. Its presence may be explained by use of pack animals.

Uplands

The setting is pristine. The area receives some livestock grazing, but it appears to be light. This is a popular recreational area and receives heavy use. Land ownership is a checkerboard pattern of National Forest and private land.

Information Needs

None were noted.

Management Needs

None were noted.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Abies lasiocarpa / *Streptopus amplexifolius* Forest	S3	G4?	A
Carex scopulorum Herbaceous Vegetation	S4	G5	A
Phleum alpinum – Carex microptera Herbaceous Vegetation	S?	G3?	B
Salix planifolia / *Carex scopulorum* Shrubland	S?	G4	A

TWO MOON PARK

Directions

Two Moon Park is located along the Yellowstone River in the unglaciated High Plains. This site is located within the city of Billings.

Description

Two Moon Park is located in the floodplain of the Yellowstone River. This site occurs between low bluffs that overlook the river and the river's active channel. The site is a mosaic of communities that occur on different fluvial landforms. On recently created mid-channel bars, the vegetation is very weedy and is dominated by *Euphorbia esula* (leafy spurge) and *Salix exigua* (sandbar willow). Recently deposited side bars and sloughs are dominated by *Salix exigua* and the exotic *Phalaris arundinacea* (reed canarygrass), with wetter microsites occupied by monospecific stands of *Phalaris arundinacea*. Higher portions of the floodplain are a mosaic of *Populus deltoides* / *Symphoricarpos occidentalis* (plains cottonwood / western snowberry) woodland and herbaceous openings. The cottonwood stands are open woodlands with a locally abundant mid-canopy of the exotic *Elaeagnus angustifolia* (Russian olive). The herbaceous layer is dominated by the exotic grasses *Poa compressa* (Canada bluegrass), *Poa pratensis* (Kentucky bluegrass), and *Bromus inermis* (smooth brome). The herbaceous openings are also largely dominated by the same exotic grasses; however, patches of *Pascopyrum smithii* (western wheatgrass) still dominate some low-lying swales, although some of these are being invaded by *Bromus tectorum* (cheatgrass). Seepy, groundwater-receiving sites at the base of the bluffs are dominated by *Typha latifolia* (broadleaf cattail) and *Phalaris arundinacea*. A small stand of *Salix amygdaloides* (peachleaf willow) occurs along one of the sloughs.

Key Environmental Factors

Flooding, and the associated erosion, deposition, and channel migration, is the dominant process influencing vegetation. Vegetation is also influenced by microtopography and by seepage from the toeslope of the bluffs.

Rarity

No special status plants or animals were observed. One G2G3 community, *Populus deltoides* / *Symphoricarpos occidentalis* (plains cottonwood / western snowberry), and one G3 community, *Salix amygdaloides* (peachleaf willow), were documented in fair to poor condition.

Other Values

This site offers habitat for many Neotropical migrant birds and other wildlife. This site is locally important because of habitat fragmentation in the greater Billings metropolitan area.

Land Use

The site is a city park and receives heavy recreational use. There are several trails and old roads through the park, and a portion of the park was mined for gravel. Most of the use appears to be limited to the trails.

Exotics

Exotic grasses dominate the ground layer of this site, especially *Poa pratensis* (Kentucky bluegrass) and *Bromus inermis* (smooth brome). *Phalaris arundinacea* (reed canarygrass) dominates many mesic portions of the site, such as sloughs. *Bromus tectorum* (cheatgrass) currently occurs as several small monospecific stands, but it is likely to spread. *Euphorbia esula* (leafy spurge) is scattered in small patches except on mid-channel bars where it is the dominant species. *Cynoglossum officinale* (hound's tongue) and *Cirsium arvense* (Canada thistle) are common throughout the site. *Elaeagnus angustifolia* (Russian olive) is well established in the cottonwood stands. It is likely that as the cottonwoods die (and many of the cottonwoods are mature or senescent), these stands will convert to an *Elaeagnus angustifolia*-dominated community. This conversion will have unknown habitat and biodiversity implications.

Uplands
The site occurs as an isolated fragment of riparian vegetation within the urban/industrial context of Billings.

Information Needs
What was the history of gravel extraction and grazing at the site?

Management Needs
Although it is unlikely that native species will reclaim the herbaceous layer, the more aggressive exotic species such as *Euphorbia esula* (leafy spurge) and *Bromus tectorum* (cheatgrass), should be controlled.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Pascopyrum smithii Herbaceous Vegetation	S4	G3G5Q	C
Phalaris arundinacea Western Herbaceous Vegetation	S4	G5	*
Poa pratensis Semi-natural Seasonally Flooded Herbaceous Alliance	SW	GW	*
Populus deltoides / *Symphoricarpos occidentalis* Woodland	S2S3	G2G3	C
Salix amygdaloides Woodland	S3	G3	C
Salix exigua Temporarily Flooded Shrubland	S5	G5	D
Typha latifolia Western Herbaceous Vegetation	S5	G5	C

* Rank not assigned

WATER BIRCH

Directions
Water Birch is located in the foothills and high plains of south central Montana. From Red Lodge, travel north on U.S. Highway 212 for approximately 8.5 miles. Access to Water Birch is signed.

Description
Water Birch is located in the floodplain of Rock Creek. In this reach, Rock Creek is braided with two or three primary channels. Channel banks are eroded and the system appears to be downcutting. The microtopography of the floodplain is complex with many swales and old channels. This microtopographic relief, augmented by *Castor canadensis* (beaver) activity, has created a mosaic of interspersed shrub and cottonwood communities that occupy most of the floodplain. Swales and old channels are occupied by an *Alnus incana* / *Calamagrostis canadensis* (mountain alder / bluejoint reedgrass) community, which also includes dense stands of *Carex utriculata* (beaked sedge) around wet margins of beaver ponds. Interspersed with these mesic areas is a *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood) community. This community includes small inclusions of sapling and pole-sized *Populus balsamifera* ssp. *trichocarpa* regenerating on point and side bars. Beaver have caused substantial mortality among these saplings. This site also supports a small *Salix bebbiana* (Bebb willow) community that is seasonally saturated from seepage from an irrigation ditch. Higher portions of the floodplain support *Populus balsamifera* ssp. *trichocarpa* / *Symphoricarpos occidentalis* (black cottonwood / western snowberry) and *Populus tremuloides* / *Calamagrostis canadensis* (quaking aspen / bluejoint reedgrass) communities. These communities are probably above the flood prone zone (twice bankfull stage height) and so may be less influenced by riverine groundwater. Moisture at these sites is probably more influenced by subirrigation from a toeslope that forms a topographic break between the active floodplain and an older glacial outwash terrace.

Key Environmental Factors
Fluvial processes, such as seasonal flooding and high groundwater, and the associated channel migration and microtopography are the primary influences on vegetation structure and composition at this site. Past and current beaver activity is also very important and has created ponded areas that support mesic sedge and alder communities.

Rarity

No special status plant and animal species were observed. Four G3 plant associations were documented in fair to very good condition: *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood), *Populus tremuloides* / *Calamagrostis* (quaking aspen / bluejoint reedgrass), *Alnus incana* / *Calamagrostis canadensis* (mountain alder / bluejoint reedgrass), and *Salix bebbiana* (Bebb willow).

Other Values

Although there are several diversion ditches upstream of and within this reach, this section of Rock Creek appears to support important hydrologic functions, such as dynamic water storage and surface water - groundwater interactions. The floodplain is still accessed by surface and subsurface flooding regimes, and native vegetation appears to be highly connected and to occupy much of the floodplain.

Land Use

Water Birch is a dedicated recreation site, and receives camping and fishing use. However, except for the parking/camping area, the site appears to be little affected from use.

Exotics

Poa pratensis (Kentucky bluegrass) is abundant throughout the site, especially on drier locations. Other exotic species were present at low cover and include *Taraxacum officinale* (common dandelion), *Leucanthemum vulgare* (ox-eye daisy), *Centaurea maculosa* (spotted knapweed), *Cirsium* spp. (thistle), *Arctium* spp. (burdock), *Cynoglossum officinale* (hound's tongue), and *Dactylis glomerata* (orchard grass). *Centaurea maculosa* has been spot sprayed around the parking/camping area.

Uplands

Native vegetation is mostly intact along the riparian corridor upstream and downstream from the site. Livestock grazes the adjacent upstream parcel. Adjacent land use is pasture and ranchettes.

Information Needs

None were noted.

Management Needs

More aggressive control of noxious weeds is needed.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Alnus incana / *Calamagrostis canadensis* Shrubland	S3Q	G3Q	A
Populus balsamifera ssp. *trichocarpa* / *Cornus sericea* Forest	S3?	G3?	B
Populus balsamifera ssp. *trichocarpa* / *Symphoricarpos occidentalis* Forest	S3?	*	C
Populus tremuloides / *Calamagrostis canadensis* Forest	S2	G3	C
Salix bebbiana Shrubland	S3?	G3?	C

* Rank not assigned

WEST BOULDER MEADOWS

Directions

The West Boulder Meadows site is located in the foothills of the Absaroka Range in south central Montana. From McLeod, travel south on State Route 298 for 0.5 mile. Turn onto the Wet Boulder Road and travel

west-southwest for approximately 12 miles to the West Boulder trailhead. Travel south on Forest Trail 41 for 3 miles to the West Boulder Meadows.

Description

This site is a large complex of riverine-associated wetlands along an unconfined reach of the West Boulder within a glaciated valley. The site is delimited both upstream and downstream by confined river reaches. In the unconfined reach, the West Boulder is low gradient and meandering. Plant associations are distributed along a topographic, soil moisture, and flood disturbance gradient. Communities range from flooded and saturated sedge and willow communities to wet spruce forests. Along the active channel, overbank deposition has created natural levees. These levees, which are higher and drier than the adjacent floodplain, are dominated by exotic species, including *Poa pratensis* (Kentucky bluegrass), *Phleum pratense* (common timothy), and *Taraxacum officinale* (common dandelion). The native *Juncus balticus* (Baltic rush) is also well represented. The lower floodplain next to these levees is semi-permanently flooded by groundwater from the West Boulder, and is dominated by a near-monospecific stand of *Carex utriculata* (beaked sedge). A *Salix boothii* / *Carex utriculata* (Booth's willow / beaked sedge) community occupies slightly higher sites that are seasonally saturated by groundwater. This community is characterized by a mosaic of clumped shrubs, dominated by *Salix boothii* and *Salix drummondiana*, interspersed with herbaceous openings dissected by many small channels. *Carex utriculata* is the dominant herbaceous species, especially in wetter microsites. *Calamagrostis canadensis* (bluejoint reedgrass) may be locally dominant in drier areas, especially where shaded by willows. Exotics, such as *Poa pratensis* and *Agrostis stolonifera* (redtop), are also common in these drier microsites. Where this community occurs near to *Picea* (spruce) forest, *Picea engelmannii* (Engelmann spruce) and *Cornus sericea* (red-osier dogwood) are colonizing higher microsites.

The driest locations at this site are occupied by *Picea engelmannii* / *Cornus sericea*. This community is characterized by an open *Picea engelmannii* canopy with a patchy shrub layer of *Alnus incana* (mountain alder) and *Cornus sericea*. The herbaceous layer has a high cover of *Phleum pratense* (common timothy), with lesser amounts of *Equisetum arvense* (field horsetail), *Rudbeckia laciniata* (cutleaf coneflower), and *Carex microptera* (small-wing sedge). Moss cover, mostly *Climaceum dendroides*, is locally very high. The adjacent uplands are dominated by *Picea engelmannii* / *Maianthemum stellatum* (Engelmann spruce / starry false Solomon's seal) and *Picea engelmannii* / *Linnaea borealis* (Engelmann spruce / twinflower) communities.

Key Environmental Factors

The unconfined river reach has allowed for floodplain development. Seasonal flooding and groundwater saturation maintains the plant communities at the site.

Rarity

No special status plant or animal species were observed. One G3 community, *Picea engelmannii* / *Cornus sericea* (Engelmann spruce / red-osier dogwood), was documented in good to fair condition.

Land Use

The site is within the Absaroka-Beartooth Wilderness Area. The meadows receive moderate recreational pressure, primarily from fishermen. No permanent trials were observed in the wet meadow. Site does not appear to be currently grazed, although one cowpie was observed.

Exotics

Pasture grasses, such as *Poa pratensis* (Kentucky bluegrass) and *Phleum pratense* (common timothy), dominate much of the drier portions of the site. Natural levees along the Boulder River are completely dominated by these grasses and *Juncus balticus* (Baltic rush). *Phleum pratense* is also the dominant herbaceous species in the wetland *Picea* (spruce) community.

Uplands

This site occurs in the Absaroka-Beartooth Wilderness Area. Similar wetland complexes occur along the West Boulder as geomorphology allows.

Information Needs

What is grazing history of the site? Is the dominance of exotic pasture grasses a legacy of past grazing? What role does imported horse feed play?

Management Needs

None were noted.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Carex utriculata Herbaceous Vegetation	S5	G5	A
Picea engelmannii / *Cornus sericea* Forest	S3	G3	B
Poa pratensis Semi-natural Seasonally Flooded Herbaceous Alliance	SW	GW	*
Salix boothii / *Carex utriculata* Shrubland	S4	G4	A

* Rank not assigned

WEST FORK ROCK CREEK FENS

Directions

West Fork Rock Creek Fens is located in the Beartooth Mountains of south central Montana. From Red Lodge, travel 10.25 miles on Forest Service Route 71 to West Fork Rock Creek Fens.

Description

This site consists of three small slope fens that occur at the toe of a slope along West Fork Rock Creek in the Beartooth Mountains. The water source for the fens is apparently groundwater discharge from the toe of the adjacent slopes. There are no surface outlets, and water apparently discharges to the creek as groundwater. The uplands are dominated by *Abies lasiocarpa* (subalpine fir) and *Pinus contorta* (lodgepole pine) forests wherein the dominant undergrowth species are *Vaccinium globulare* (globe huckleberry) and *Vaccinium scoparium* (grouse whortleberry). Each of these fens is dominated by *Salix planifolia* / *Carex aquatilis* (planeleaf willow / water sedge) and *Salix planifolia* / *Carex utriculata* (planeleaf willow / beaked sedge) communities. Other common species at these fens are *Betula glandulosa* (bog birch), *Dasiphora fruticosa* ssp. *floribunda* (shrubby cinquefoil), *Carex utriculata* (beaked sedge), *Viola macloskeyi* (small white violet), and *Sphagnum* spp. (mosses of poor fens and bogs). A small forested spruce wetland, dominated by a *Picea engelmannii* / *Calamagrostis canadensis* (Engelmann spruce / bluejoint reedgrass) plant association, occurs at one of the fens; *Sphagnum* ssp. appear to be invading this moist forest from the adjacent fen.

Key Environmental Factors

These wetlands are maintained by groundwater recharge from the adjacent uplands.

Rarity

Paludella sqaurrosa, an S1 G3G4 moss, is a component of the *Sphagnum* moss layer. An excellent example of the G3 community *Salix planifolia* / *Carex utriculata* (planeleaf willow / beaked sedge) was documented.

Other Values

The undergrowth of the willow community is extremely diverse, especially in the moss layer. One of the fens has at least 60% cover of *Sphagnum* species with limited brown moss development, another has both mosses strongly represented and yet another has reduced moss cover but high cover values for *Carex scopulorum*

(Holm's Rocky Mountain sedge). Within a limited area the varieties of expression of one plant association are well displayed.

Land Use

No land use was apparent.

Exotics

No exotic plants or animals were documented from this site.

Uplands

A well-used trail and trailhead is adjacent to the westernmost fen, and a road is adjacent to the other two fens in this complex.

Information Needs

Is the road influencing the hydrology of these fens?

Management Needs

No management considerations were identified at the initial inventory.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Picea engelmannii / *Calamagrostis canadensis* Forest	S4	G4	B
Salix planifolia / *Carex aquatilis* Shrubland	S3	G5	B
Salix planifolia / *Carex utriculata* Shrubland	S?	G3Q	B
Plant Elements			
Paludella squarrosa	S1	G3G5	*

* Rank not assigned

WEST ROSEBUD COMPLEX

Directions

Note: a portion of this site is located on private land, and landowner permission is required to access that section. The West Rosebud Complex is located in the foothills of the Beartooth Mountains in south central Montana. From Fishtail, travel west and south on State Highway 419 for approximately 1 mile to the intersection with State Highway 425. Turn onto State Highway 425 and travel south for approximately 6 miles to the intersection with Forest Route 2072. Travel south on this road for approximately 8 miles and park at the Pine Grove Campground.

Description

West Rosebud Complex occurs in the floodplain of West Rosebud Creek and on adjacent toeslopes. Wetland and riparian vegetation communities occur adjacent to the active channel, along overflow channels and swales modified by past and current beaver activity, and on toeslope swales modified by historic beaver dams. Streamside communities include *Picea engelmannii* / *Calamagrostis canadensis* (Engelmann spruce / bluejoint reedgrass), *Salix geyeriana* / *Carex utriculata* (Geyer's willow / beaked sedge), and what was historically probably *Salix geyeriana* / *Calamagrostis canadensis*. This latter community is now dominated by *Poa pratensis* (Kentucky bluegrass) and *Phleum pratense* (common timothy), due to the competitive dominance of these exotic species and grazing pressure.

Historic and current beaver dams have significantly altered portions of this site and provide habitat for many of the plant associations that are present. On the floodplain, beaver activity has raised water tables in swales and old channels, which support a *Salix boothii* / *Carex utriculata* (Booth's willow / beaked sedge) community. This community is interspersed with *Salix boothii* / *Calamagrostis canadensis*, which occurs on higher floodplain deposits. *Pinus contorta* (lodgepole pine) is well represented in this latter community. A small *Populus tremuloides* / *Calamagrostis canadensis* (quaking aspen / bluejoint reedgrass) occurs in draws on the lower hill slope and on seepy areas on the toeslope. On slope wetlands at the bottom of the adjacent toeslopes, historic beaver dams have created a series of terraces. The ponds have completely silted in and dams are visible only as well-vegetated, shrub-dominated berms. These areas now support *Salix geyeriana* / *Calamagrostis canadensis* and *Salix geyeriana* / *Carex utriculata* communities with wetter inclusions of *Carex utriculata*. There is also a small community dominated by *Salix planifolia* (planeleaf willow) and *Carex utriculata* with a continuous cover of *Sphagnum teres*.

Key Environmental Factors

Site hydrology (surface and groundwater from West Rosebud Creek and groundwater from adjacent toeslopes) and extensive modification by beaver are the primary factors supporting and maintaining the site's vegetation communities.

Rarity

No special status plant or animal species were observed. One G3 community, *Populus tremuloides* / *Calamagrostis canadensis* (quaking aspen / bluejoint reedgrass) was documented in fair condition. This site also contained a *Salix planifolia* / *Carex utriculata* (planeleaf willow / beaked sedge) with abundant cover of *Sphagnum teres*.

Other Values

Some of the beaver ponds support *Rana pretiosa* (spotted frog) populations and a breeding pair of *Grus canadensis* (sandhill crane) was observed at the site.

Land Use

Livestock actively grazes the portion of the site on private land. Drier riparian communities, such as *Salix geyeriana* / *Calamagrostis canadensis* (Geyer's willow / bluejoint reedgrass) have been altered by historic grazing and are now a grazing disclimax dominated by pasture grasses in the herbaceous layer. The northeastern portion of the site on public land also receives some current livestock use (an electric fence runs perpendicular to the channel just upstream from the Pine Grove Campground). Livestock use does not appear to be high. Wild ungulate browse appears to be moderate. *Alces alces* (moose) browse is locally heavy. The site is adjacent to a developed campground. Hiking, fishing, and hunting use has created some informal trails.

Exotics

Drier portions of the floodplain and lower toeslope are dominated by *Phleum pratense* (common timothy) and *Poa pratensis* (Kentucky bluegrass). *Poa palustris* (fowl bluegrass), *Cirsium arvense* (Canada thistle), *Phalaris arundinacea* (reed canarygrass), *Trifolium repens* (white clover), *Taraxacum officinale* (common dandelion), and *Agrostis stolonifera* (redtop) are present at low cover. The portion of the site on private land has higher cover of exotic species.

Uplands

Historic grazing has altered some upland communities, especially on the private land portion of the site. Otherwise the structure and composition of offsite vegetation communities reflects natural processes. The hydrologic regime is largely intact, except for a small hydroelectric dam upstream.

Information Needs

What is the past grazing history? Have there been recent changes in the course of the active channel? What effect has Mystic Lake dam had on the site's hydrology?

Management Needs

A management plan to control the noxious weeds at the site should be developed.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Picea engelmannii / *Calamagrostis canadensis* Forest	S4	G4	A
Populus tremuloides / *Calamagrostis canadensis* Forest	S2	G3	C
Salix boothii / *Calamagrostis canadensis* Shrubland	S3	G3G4Q	B
Salix boothii / *Carex utriculata* Shrubland	S4	G4	A
Salix geyeriana / *Calamagrostis canadensis* Shrubland	S4	G5	A
Salix geyeriana / *Carex utriculata* Shrubland	S5	G5	A, B
Salix geyeriana Dominance Type	*	*	*
Salix planifolia / *Carex utriculata* Shrubland	S?	G3Q	*

* Rank not assigned

WEST ROSEBUD MORAINE

Directions

Note: This site is located on private land, and landowner permission is needed to access this site. The West Rosebud Moraine site is located in the foothills of the Beartooth Mountains in south central Montana. From Fishtail, travel west and south on State Highway 419 for approximately 1 mile to the intersection with State Highway 425. Turn onto State Highway 425 and travel south for approximately 6 miles to the intersection with Forest Route 2072. Travel south on this road for approximately 6.75 miles until the road skirts the east shore of Reeves Lake. The rest of the site lies east of West Rosebud Creek. This portion can be accessed by a gravel road that turns off to the west approximately 0.25 mile past Reeves Lake.

Description

This site encompasses a series of kettle potholes in a recessional moraine along West Rosebud Creek. These wetlands are isolated and occur as small to medium-sized glacially-formed depressions. The water source is groundwater, and all these wetlands lack an outlet, except for Reeves Lake, which is culverted. These potholes are dominated by *Carex utriculata* (beaked sedge) communities or have an open water component with a *Carex utriculata* fringe. Mesic toeslopes adjacent to these depressions are subirrigated and in some places are dominated by willow or *Populus tremuloides* / *Calamagrostis canadensis* (quaking aspen / bluejoint reedgrass) communities. Higher, slightly less mesic portions of the toeslope are occupied by *Populus tremuloides* with a *Phleum pratense* (common timothy)-dominated ground layer. This community was once probably *Populus tremuloides* / *Calamagrostis canadensis* and now represents a grazing disclimax. One of the larger potholes has been ditched, although its fringes are still dominated by a wet and robust *Carex utriculata* community.

Reeves Lake is the largest and most diverse of these depressional wetlands. The lake has a large open water component that supports a *Nuphar lutea* ssp. *polysepala* (yellow pond-lily) aquatic community. An *Eleocharis palustris* (common spikerush) community occurs on intermittently exposed mudflats on the north end of the lake. A *Carex utriculata* community occurs on slightly higher substrate. This community is variable, with lower, wetter portions dominated by a near-monospecific stand of *Carex utriculata* with some patches of *Glyceria grandis* (American mannagrass). On drier substrate, *Carex utriculata* still dominates but species richness increases with *Agrostis scabra* (ticklegrass), *Galium trifidum* (small bedstraw), *Rorippa palustris* (marsh yellowcress), *Potentilla rivalis* (river cinquefoil), *Scutellaria galericulata* (marsh skullcap), and other species present. The exotics *Phleum pratense* and *Cirsium vulgare* (bull thistle) are also present. A *Salix bebbiana* (Bebb willow) community occurs on higher deposits that still have saturated soil conditions. *Salix bebbiana* and *Alnus incana* (mountain alder) occupy an open overstory with *Dasiphora fruticosa* ssp.

floribunda (shrubby cinquefoil) present as a low shrub. *Carex utriculata* and *Carex aquatilis* (water sedge) dominate the ground layer with *Calamagrostis canadensis* becoming important on drier portions of the community. On higher topographic positions, this community grades into a *Salix boothii* / *Calamagrostis canadensis* (Booth's willow / bluejoint reedgrass) community. Shrub cover is clumped, with *Salix boothii*, *Salix bebbiana*, and *Betula occidentalis* (water birch) all present at low cover and *Alnus incana* having the greatest individual cover. *Calamagrostis canadensis* dominates the ground layer with *Bromus ciliatus* (fringed brome) and *Heracleum maximum* (cow-parsnip) present at low cover. Uplands are dominated by *Phleum pratense* or *Populus tremuloides* / *Phleum pratense*.

Key Environmental Factors

Seasonal groundwater infiltration is the primary influence in maintaining these systems.

Rarity

No species of special concern were observed. Small examples of *Salix bebbiana* (Bebb willow), G3, and *Salix boothii* / *Calamagrostis canadensis* (Booth's willow / bluejoint reedgrass), G3G4Q, were inventoried.

Other Values

These depressions, especially Reeves Lake, provide breeding habitat for numerous bird species, including *Aythya affinis* (lesser scaup), *Branta canadensis* (Canada goose), *Fuliea americana* (American coot), *Agelaius phoeniceus* (red-winged blackbird), and *Porzana carolina* (sora). A breeding pair of *Grus canadensis* (sandhill crane) with young were also observed at this site.

Land Use

Grazing is the primary land use. Electric fencing suggests that cattle are actively moved from area to area. Although this site is not currently overgrazed, its long history of grazing (and perhaps past overgrazing) has altered the composition of many of the drier wetland and wetland-upland transitional communities. Pasture grasses, especially *Phleum pratense* (common timothy), now dominate these communities, and the historic native herbaceous dominants can only be guessed at.

Exotics

Phleum pratense (common timothy) and *Poa pratensis* (Kentucky bluegrass) are the dominant upland grasses. *Cirsium vulgare* (bull thistle) and *Phleum pratense* are present with low abundance in some of the wetland areas.

Uplands

The uplands are grazed but are largely intact.

Information Needs

None were noted.

Management Needs

The present active grazing management should be continued.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Carex aquatilis Herbaceous Vegetation	S4	G5	*
Carex utriculata Herbaceous Vegetation	S5	G5	A, B
Eleocharis palustris Herbaceous Vegetation	S5	G5	B
Nuphar lutea ssp. *polysepala* Herbaceous Vegetation	S?	G5	*
Populus tremuloides / *Cornus sericea* Forest	S3	G4	B
Salix bebbiana Shrubland	S3?	G3?	B
Salix boothii / *Calamagrostis canadensis* Shrubland	S3	G3G4Q	B
Schoenoplectus tabernaemontani Temperate Herbaceous Vegetation	S3	G4	*

* Rank not assigned

WEST ROSEBUD TRAILHEAD

Directions

The West Rosebud Trailhead site is located in the foothills of the Beartooth Mountains in south central Montana. From Fishtail, travel west and south on State Highway 419 for approximately 1 mile to the intersection with State Highway 425. Turn onto State Highway 425 and travel south for approximately 6 miles to the intersection with Forest Route 2072. Travel south on this road for approximately 12.5 miles. The site is located just before the Mystic Lake trailhead.

Description

This site occurs in the glaciated valley bottom of West Rosebud Creek. Fluvial processes and old beaver dams have created a diverse microtopography with numerous swales, low areas, and channels. Vegetation is a mosaic of intermixed willow and sedge communities distributed along a microtopographic gradient. Old beaver dams are well vegetated with willow and sedge. The wettest sites, which occupy approximately 20 percent of the site, are open water. A semipermanently flooded *Carex utriculata* (beaked sedge) community fringes this open water and also occurs on wetter microsites throughout the site. This community is dominated by *Carex utriculata* but has inclusions of *Carex buxbaumii* (Buxbaum's sedge) and *Deschampsia caespitosa* (tufted hairgrass) on drier microsites. Higher sites are occupied by a *Salix boothii* / *Calamagrostis canadensis* (Booth's willow / bluejoint reedgrass) community. This community is seasonally flooded to saturated and is characterized by high cover of *Salix boothii* and *Salix planifolia* (planeleaf willow). *Calamagrostis canadensis* is the dominant herbaceous species, but the exotic *Poa palustris* is widespread. Exotic pasture grasses are common on the highest microsites. An undescribed community, dominated by *Salix boothii* and *Carex buxbaumii*, is transitional between the *Carex utriculata* and *Salix boothii* communities. These communities have indistinct boundaries, and there is significant intergradation and many small inclusions depending on microtopography. Uplands are *Pinus contorta* (lodgepole pine) forest.

Key Environmental Factors

Seasonal flooding, floodplain development, and beaver activity are all critical in maintaining this site. No current beaver activity was observed at this site. Old beaver dams add to the diversity of this site by creating many wet and saturated microsites. Although these dams are well vegetated by willow and sedge, small headcuts are present in many places from overtop flow and subsequent erosion. Failure of these dams will alter the structure and composition of this site by increasing the extent of willow communities.

Rarity

No special status plant or animal species were observed. A fair to good example of a G3G4Q community, *Salix boothii* / *Calamagrostis canadensis* (Booth's willow / bluejoint reedgrass) was inventoried.

Land Use

The site receives moderate recreational use by fishermen. A few recreational trails are present, especially along the channel of West Rosebud Creek. Willow communities are moderately grazed, probably by deer, elk, and moose.

Exotics

Exotic grasses are well established on drier portions of this site. Species include *Poa pratensis* (Kentucky bluegrass), *Phleum pratense* (common timothy), and *Bromus inermis* (smooth brome). Wetter sites are largely free from exotics, except for *Poa palustris* (fowl bluegrass), which is present in wetter willow communities.

Uplands

The surrounding uplands are largely undisturbed. Mystic Lake, which is upstream of the site, is dammed for hydropower. The penstocks return their flow to the stream immediately upstream of the site. This undoubtedly has an effect on the site's hydrology.

Information Needs

What effect has Mystic Lake dam and associated penstocks had on the hydrology of the site? Is the large open water area a product of riverine processes or is it a depressional glacial feature?

Management Needs

None were noted.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Carex utriculata Herbaceous Vegetation	S5	G5	A
Salix boothii / *Calamagrostis canadensis* Shrubland	S3	G3G4Q	B
Salix boothii / *Carex buxbaumii* Dominance Type	*	*	A

* Rank not assigned

WHITE BIRD

Directions

White Bird Fishing Access is located in the high plains of south central Montana. From Columbus, travel south on State Highway 78 for approximately 6 miles. Turn west at the sign for White Bird Fishing Access.

Description

White Bird is located on the floodplain of the Stillwater River. Most of the site is dominated by mature stands of *Populus balsamifera* ssp. *trichocarpa* (black cottonwood). These stands are primarily grazing disclimaxes with no or minimal native shrub cover, and the understory is dominated by exotic herbaceous species, including *Poa pratensis* (Kentucky bluegrass) and *Phalaris arundinacea* (reed canarygrass). The site also supports a stand of *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood). This stand has a well-established tall shrub layer of *Prunus virginiana* (chokecherry), but the *Cornus sericea* is heavily browsed by wild ungulates and *Phalaris arundinacea* is abundant in the ground layer. Cottonwood regeneration is occurring at this site: a gravel/cobble bar supports a well-established stand of sapling-sized *Populus angustifolia* (narrowleaf cottonwood) and *Populus balsamifera* ssp. *trichocarpa*. Side channels below bankfull elevation are hydric and support a *Phalaris arundinacea* community.

Key Environmental Factors

Flooding and associated substrate deposition and proximity of groundwater are the primary abiotic factors that influence vegetation at this site. Ungulate browsing is also an important influence on the structure and composition of shrubs at the site.

Rarity

No special status plants or animals were observed. One G3 community, *Populus balsamifera* ssp. *trichocarpa* / *Cornus sericea* (black cottonwood / red-osier dogwood), was documented in fair condition.

Land Use

This site is a Department of Fish, Wildlife & Parks Fishing Access site. It receives heavy recreational use, and the roads and campsites degrade the integrity of the site. A recent fire burned a small stand of *Salix exigua* (sandbar willow).

Exotics

Exotic species are abundant. *Phalaris arundinacea* (reed canarygrass) dominates hydric sloughs and more mesic cottonwood stands. Other common exotic species include *Cynoglossum officinale* (hound's tongue), *Cirsium* spp. (thistle), *Centaurea maculosa* (spotted knapweed), *Euphorbia esula* (leafy spurge), *Poa pratensis* (Kentucky bluegrass), and *Dactylis glomerata* (orchard grass). *Euphorbia esula* has been spot sprayed along roadsides.

Uplands

Away from the riparian area, land use is primarily livestock grazing, dispersed housing, and agriculture.

Information Needs

What was land use before site was acquired by FWP?

Management Needs

Greater weed control efforts are needed, although with high public use and upstream seed source, this effort will be perpetual.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Phalaris arundinacea Western Herbaceous Vegetation	S4	G5	*
Populus angustifolia / Recent Alluvial Bar Forest	S?	*	C
Populus balsamifera ssp. *trichocarpa* / *Cornus sericea* Forest	S3?	G3?	C
Populus balsamifera ssp. *trichocarpa* / Mesic graminoids Forest	SW	*	*

* Rank not assigned

WYOMING LINE

Directions

Note: a portion of this site is located on private land, and landowner permission is needed to access that area. Wyoming Line is located east of the Beartooth Mountains in south central Montana. From Belfry, travel 8.5 miles south on State Route 72 to an intersection with a county road to the southwest. Follow this road for 0.7 mile to a junction with a county road to the west. Continue westerly on this road for approximately 1 mile to junction with an unimproved road extending north and south. Travel south on this road for approximately 0.5 mile to an intersection. Continue south on the southerly fork for 0.1 mile to another junction with another unimproved road. Travel in a general southwesterly direction for 1.5 miles to the Wyoming Line wetland.

Description

This wetland is located just east of the Beartooth Plateau in a small valley that has springy areas throughout. The wetland has a small, intermittent creek that drains the site. The uplands are dominated by *Artemisia tridentata* (big sagebrush), *Sarcobatus vermiculatus* (black greasewood), and *Leymus cinereus* (basin wildrye). *Carex pellita* (woolly sedge) dominates the marsh. Cover ranges from very high in the central portion of the marsh to moderate on the margins. The water in this community is slightly brackish, with a conductivity of 1020 µS/cm. The cover of exotics increases at the edges of this community, perhaps because this drier portion of the community receives more grazing pressure. There are small inclusions of *Typha latifolia* (broadleaf cattail) and *Schoenoplectus* sp. (bulrush) within the *Carex pellita* community. A *Pascopyrum smithii* (western wheatgrass) community forms a small patch in the driest portion of this marsh.

Key Environmental Factors

Localized groundwater upwelling and seep areas constitute, apart from scant precipitation, the only source of water in this very dry environment.

Rarity

This site consists predominately of a high quality occurrence of a *Carex pellita* (woolly sedge) community.

Land Use

Livestock grazing has been and continues to be the primary use of this landscape.

Exotics

Only two exotic/increaser species were observed: *Sonchus uliginosus* (marsh sow-thistle) and *Ambrosia artemisiifolia* (annual ragweed).

Uplands

Livestock grazing and hunting are conducted in the landscape surrounding this site.

Information Needs

The ultimate source of water for this site is unknown. Identification of this source would be useful so that any actions that threaten its continued flow could be avoided.

Management Needs

Managing livestock to minimize or avoid the spread of weeds would be beneficial.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Carex pellita Herbaceous Vegetation	S2S3	G5?	B
Pascopyrum smithii Herbaceous Vegetation	S4	G3G5Q	B

YELLOWSTONE RIVER-STILLWATER RIVER

Directions

Note: This site is located on private land, and landowner permission is required to access this site. Yellowstone River-Stillwater River site is located at the mouth of the Stillwater River in south central Montana. From Columbus, travel 1.6 miles southwesterly on State Route 78 to an unimproved road to the west. Follow the unimproved road for 0.25 mile to a side channel of the Yellowstone River. Yellowstone River-Stillwater River is approximately 0.4 mile upstream in a westerly direction.

Description

This site occurs on a terrace at the confluence of the Yellowstone and Stillwater Rivers. A well-developed *Populus deltoides* / *Symphoricarpos occidentalis* (plains cottonwood / western snowberry) community occurs at this site. The overstory is dominated by *Populus deltoides*, and there is also significant cover of *Populus angustifolia* (narrowleaf cottonwood) and *Populus balsamifera* ssp. *trichocarpa* (black cottonwood). All of these trees are 90-100 feet tall and average 20-inches or more diameter at breast height. The shrub understory is quite diverse and well developed, but is clearly dominated by *Symphoricarpos occidentalis*. Other shrubs include *Ribes aureum* (golden currant), *Toxicodendron rydbergii* (poison ivy), *Rosa* sp. (rose), *Prunus virginiana* (chokecherry), *Shepherdia argentea* (silver buffaloberry), *Cornus sericea* (red-osier dogwood), *Parthenocissus inserta* (Virginia creeper), *Clematis ligusticifolia* (western clematis), *Ribes* sp. (gooseberry), and *Juniperus scopulorum* (Rocky Mountain juniper). *Glycyrrhiza lepidota* (American licorice), *Rudbeckia laciniata* (cutleaf coneflower), and the exotic grass *Bromus inermis* (smooth brome) dominate the ground layer. Small inclusions of wetter communities like *Carex pellita* (woolly sedge) and open-water pools occur in a series of old overflow channels that wind through the cottonwood stand. The soil has a loam texture.

Key Environmental Factors

Seasonal flooding and sediment deposition are responsible for creating and maintaining this community. Fluvial processes appear to be largely intact at this site.

Rarity

A relatively old stand of a G2G3 community, *Populus deltoides* / *Symphoricarpos occidentalis* (plains cottonwood / western snowberry), in good condition was documented. *Carex tenera* (soft sedge), a watch species that is under consideration for addition to the Montana plant species of special concern list, was documented at this site. This may be only the second known documented occurrence for this species in Montana.

Other Values

This tall cottonwood stand represents highly significant habitat for fish-eating birds of prey because of its stature and location at a large confluence on the Yellowstone River. This cottonwood stand contains mature individuals of the three cottonwood species that occur in Montana. Analysis of this stand could help refine our understanding of the distribution and habitat requirements for these species. This stand represents the best condition cottonwood community documented on the Yellowstone River from Greycliff to Columbus.

Land Use

The heavy cover of *Bromus inermis* (smooth brome) in the understory suggests that historically this stand could have been grazed. A small number of cattle were present, though the stand did not show signs of regular grazing. It is not known whether these cows had escaped or management is changing.

Exotics

There is low cover of three noxious weeds, *Cynoglossum officinale* (hound's tongue), *Cirsium arvense* (Canada thistle), and *Calystegia sepium* (hedge bindweed), in this stand. Exotic pasture grasses, predominantly *Poa pratensis* (Kentucky bluegrass) and *Bromus inermis*, dominate the ground layer beneath the native shrub layer. Grass cover is relatively low because of the high shrub cover.

Uplands

Uplands are affected by agricultural and urban development.

Information Needs

Knowing the land use history of this site would be useful to understanding the present-day species composition of the stand. Both cattle and wild ungulates show a strong browsing preference for *Cornus sericea* (red-osier dogwood), and the scarcity of *Cornus sericea* in this stand may be a product of past grazing.

Stands of tall cottonwood approximately 0.5 mile upstream on the Stillwater River were noted but not surveyed. In addition, nearby islands have been documented as having nesting bald eagles. This site may be part of a larger woodland complex of significance at the Stillwater River confluence. We do not know the extent of the stand, and this affects the significance of the site.

Management Needs

A noxious weed management plan is needed for the Yellowstone River corridor. *Euphorbia esula* (leafy spurge) is established and a growing threat in the area though not currently present on this site. Coordinated efforts are needed to improve control efforts for this pernicious species. Grazing poses a threat to stand condition.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Populus deltoides / *Symphoricarpos occidentalis* Woodland	S2S3	G2G3	A

YELLOWSTONE RIVER-WORK CREEK

Directions

Note: this site is located on private land, and landowner permission is required to access this site. Yellowstone River-Work Creek is an island in the Yellowstone River in south central Montana. From Reedpoint, travel 4 miles west on Interstate 90. Yellowstone River-Work Creek is due north approximately 0.25 mile.

Description

This site is an island in the Yellowstone River. It is dominated by a well-developed *Populus angustifolia* / *Cornus sericea* (narrowleaf cottonwood / red-osier dogwood) community. The average height of the cottonwood canopy is about 80-90 feet, with the red-osier dogwood forming a dense 6-10 foot high shrub undergrowth. The shrub layer is diverse and other associated shrubs include *Symphoricarpos occidentalis* (western snowberry), *Salix exigua* (sandbar willow), *Salix lutea* (yellow willow), and *Ribes* sp. (gooseberry). There is a considerable amount of microtopography in the form of small channels. This creates habitat for a variety of forbs and graminoids, some of which are tolerant of moister conditions. The soils on this old terrace are silt loam textured with very little organic horizon.

Key Environmental Factors

Seasonal flooding and sediment deposition are responsible for creating and maintaining this community; lack of ungulate access probably is instrumental in maintaining the species composition, particularly the dominance of *Cornus sericea* (red-osier dogwood).

Rarity

Although no rare species or communities were observed at this location, it is significant because it is one of the few stands of mature cottonwood forest with an intact native shrub understory in the stretch of the river from Greycliff to Columbus. Most cottonwood stands in this river reach, and apparently elsewhere judging from casual observation, are dominated by an undergrowth of exotic pasture grasses.

Land Use

The high level of coverage by exotic pasture grasses on the island could indicate some past grazing, possibly at a time when this island was connected to the shore.

Exotics

Three noxious weeds occur at low cover in this stand: *Cirsium vulgare* (bull thistle), *Cirsium arvense* (Canada thistle), and *Euphorbia esula* (leafy spurge). Exotic pasture grasses dominate the ground layer beneath the native shrub understory. These grasses include *Agrostis stolonifera* (redtop), *Poa pratensis* (Kentucky bluegrass), *Elymus repens* (quackgrass), *Bromus inermis* (smooth brome), and *Phleum pratense* (common timothy). *Phalaris arundinacea* (reed canarygrass) is also present in wetter locations.

Uplands

Irrigated agricultural crops dominate most of the uplands, though cattle grazing occurs in the immediate riparian zone. All of fluvial processes are intact.

Information Needs

None were noted.

Management Needs

A noxious weed management plan is needed for the Yellowstone River corridor. *Euphorbia esula* (leafy spurge) is established and a growing threat in the area and coordinated efforts are needed to improve control efforts for this pernicious species.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Populus angustifolia / *Cornus sericea* Woodland	S3	G4	B

YOUNG'S POINT

Directions

Note: Young's Point is located on private land, and landowner permission is required to access this site. Young's Point is located along the Yellowstone River in south central Montana between the confluence of the Stillwater and Clark's Fork Yellowstone Rivers. The site lies between Columbus and Park City and can be accessed from a frontage road south of Interstate 90.

Description

Young's Point encompasses the floodplain and adjoining terrace of the Yellowstone River. Portions of the floodplain occupied by alluvial bars support extensive early seral stands of *Populus angustifolia* (narrowleaf cottonwood). These sapling-sized trees predate the 1996 and 1997 100-year floods. The understory of this community is depauperate – in places apparently due to herbivory, but mostly because of poor to no soil development (substrate is sand with gravel/cobble). Further from the active channel, *Castor canadensis* (beaver) have dammed a series of meander scrolls, creating semi-permanently flooded oxbows. These wet areas support dense shrub thickets of *Shepherdia argentea* (silver buffaloberry) and *Rhus trilobata* (skunkbush sumac) along their banks as well as *Eleocharis palustris* (common spikerush) in drawdown areas.

Livestock use of the site is high, and the effects of this grazing pressure are more apparent in the terrace communities. A mature to senescent stand of *Populus deltoides* (plains cottonwood), codominated by *Populus angustifolia* (a few individual *Populus balsamifera* ssp. *trichocarpa* [black cottonwood] are present as well), occurs on the terrace. Grazing has substantially modified this community, such that native shrub cover is reduced to small clumps of *Symphoricarpos occidentalis* (western snowberry) and *Rosa woodsii* (Woods rose). The herbaceous layer is dominated by *Poa pratensis* (Kentucky bluegrass), although areas with clay loam soil had standing water at the time of the site visit and support low cover of *Carex nebrascensis* (Nebraska sedge). Alkaline-tolerant communities, such as *Sarcobatus vermiculatus* / *Pascopyrum smithii* (black greasewood / western wheatgrass) also occur on the terrace. *Distichlis spicata*

(saltgrass) and *Plantago elongata* (prairie plantain) dominate small swales within this community. A prairie dog colony occurs in this community along the western edge of the site.

Areas receiving seepage from an irrigation ditch (Big Ditch) support a *Carex nebrascensis* community. The substrate of this community is clay loam underlying 4 inches of mucky-peat. The naturalness of this wetland is uncertain, as irrigation seepage and an adjacent railroad line have altered its hydrology. The area has also been tiled to facilitate drainage, although this system is no longer effective. Culvert seepage along the railroad line supports small shrub patches of *Salix boothii* (Booth's willow), *Salix bebbiana* (Bebb willow), *Salix amygdaloides* (peachleaf willow), and *Cornus sericea* (red-osier dogwood).

Key Environmental Factors

Seasonal flooding is critical for the regeneration of cottonwood communities. Beaver utilization of cottonwood and willow is localized but heavy. Beaver have also dammed a series of meander scrolls, converting temporarily and seasonally flooded wetlands into semipermanently flooded ones.

Rarity

No rare plants, animals, or communities were documented.

Other Values

This site has extensive cottonwood regeneration. A small colony of *Cynomys ludoviscianus* (black-tailed prairie dog) occurs on the terrace.

Land Use

The site is and has been extensively grazed. This has removed much of the native shrub layer from the cottonwood communities and has created soil disruption (pugging) in the wet *Carex nebrascensis* (Nebraska sedge) community. The terrace appears to have been cultivated in the past.

Exotics

Tamarix chinensis (tamarisk) occurs on open sand and gravel deposits in the floodplain. Euphorbia esula (*leafy spurge*) is abundant at this site, with patches dominating some small openings within the cottonwood stands.

Uplands

Riparian plant communities are not continuous along this reach of the Yellowstone River. However, the distance between discreet patches of cottonwood bottomland is small and provides moderate to high continuity of habitat. Much of the higher terraces have been converted to agriculture or pasture.

Information Needs

Did the wet meadow function as a wetland before the hydrologic and geomorphic modifications of the railroad and irrigation ditches? The peat accumulation in this community could reflect the results of seepage from the Big Ditch, although the underlying clay loam soil is very poorly drained.

Management Needs

This has high restoration potential.

Element Occurrence Information

Plant Association / Dominance Type	S Rank	G Rank	EO Rank
Sarcobatus vermiculatus / *Pascopyrum smithii* Shrub Herbaceous Vegetation	S4	G4	C
Carex nebrascensis Herbaceous Vegetation	S4	G4	C
Populus angustifolia / Recent Alluvial Bar Forest	S?	*	*
Populus deltoides / Mesic graminoids Forest	SW	*	*

* Rank not assigned

Appendix E – Watersheds with High Biological Diversity and Conservation Value

		Criteria				
Area	**Watershed**	**1**	**2**	**3**	**4**	**Evaluation Status**
Clark Fork, Upper	Bitterroot			x	x	
Clark Fork, Upper	Blackfoot		x	x		
Clark Fork, Upper	Upper Clark Fork			x		
Flathead	Flathead Lake	x		x	x	1998
Flathead	Lower Flathead		x	x	x	
Flathead	North Fork Flathead	x	x	x	x	1999
Flathead	Stillwater (Flathead)	x		x	x	1998
Flathead	Middle Fork Flathead	x	x	x		
Flathead	South Fork Flathead	x	x	x		
Flathead	St. Mary	x	x	x		
Flathead	Swan	x	x	x		1998
Milk	Beaver		x	x	x	1998
Milk	Cottonwood		x	x	x	
Milk	Upper Milk		x		x	
Milk	Whitewater		x	x	x	
Milk	Milk Headwaters	x	x	x		
Missouri Headwaters	Gallatin			x	x	2001
Missouri Headwaters	Madison		x	x	x	2001
Missouri Headwaters	Beaverhead			x		
Missouri Headwaters	Big Hole			x		
Missouri Headwaters	Jefferson			x		2001
Missouri Headwaters	Red Rock	x	x	x		2001
Missouri, Lower	Big Muddy		x	x	x	
Missouri, Lower	Brush Lake	x		x		
Missouri, Upper	Cut Bank		x		x	
Missouri, Upper	Sun		x		x	
Missouri, Upper	Two Medicine		x	x	x	
Missouri, Upper	Bullwacker-Dog		x	x		
Missouri, Upper	Smith			x		
Missouri, Upper	Teton		x	x		
Missouri, Upper	Willow		x	x		
Yellowstone, Lower	Little Powder		x	x		
Yellowstone, Lower	Lower Powder		x	x		
Yellowstone, Lower	Lower Yellowstone			x		
Yellowstone, Lower	Middle Powder		x	x		
Yellowstone, Upper	Bighorn Lake			x		
Yellowstone, Upper	Clark's Fork Yellowstone			x		1999/2000
Yellowstone, Upper	Upper Yellowstone	x	x	x		1999/2000

Criteria:

1. Extent and development of wetland and riparian communities
2. Quality and integrity of wetland and riparian communities
3. Presence of sensitive, endangered or threatened species, rare communities, or outstanding community examples
4. Level of threat

Staff at the Montana Natural Heritage Program and The Nature Conservancy's Montana Field Office compiled these rankings of Montana watersheds. This is a qualitative ranking based on best professional judgment. The watersheds were evaluated using the criteria listed above.