Second Draft (Jan 11, 2010) GRKO Vegetation Mapping Report

Formal First Order Headings:

i. Contents (including List of Figures and List of Tables)

ii. Executive Summary (required; a thorough abstract)

iii. Acknowledgements

1. Introduction
2. Vegetation Classification (Methods & Results)
3. Vegetation Mapping (Methods & Results)
4. Accuracy Assessment
5. Summary Discussion
6. Literature Cited
7. Appendices

General Outline:

Introduction

- General location
- Climate
- Topography, geology, and soils
- Vegetation and history
  - generalized ecological groups
  - metal contamination
  - flora references, dominants & principal indicator species
- Planning and scoping
- Census approach

Vegetation Classification (Methods & Results)

- Mueggler & Stewart 1980
- Hansen et al 1995
- Original field keys for map unit classification

Vegetation Mapping (Methods & Results)

- Base images
- Segmentation, assembly, and final modifications
- Field mapping protocol
- Initial map unit veg type classification summary & crosswalk to Association

Comment [p1]: This Appendix A7 table should be taken from libi_grko_aa_contingency_tables_011110.xls tab GRKO NVC Associations and tab GRKO Ecol Systems

ii. Executive Summary

The Grant-Kohrs Ranch National Historic Site is working ranch commemorating the western open range cattle industry that peaked in the 1890's. The Ranch is located in a broad Rocky Mountain valley in west central Montana. The principal landscape components are a shrub dominated riparian floodplain, irrigated pastures and hayfields with introduced grasses, and native bunchgrass terraces that rise above the floodplain and the intensively managed fields. There are corrals, barns, other ranch operation structures, as well as the original ranch house. . The vegetation community types were mapped in 2006. Two regional community type keys were available to provide an initial classification of most of the vegetation types. One preexisting key was applicable to the upland terraces, and the second key had been previously developed for floodplain vegetation. Both classification systems had already been evaluated for correspondence to Associations as delineated by NatureServe, so most of the initial community type classifications could be readily cross-walked to the National Vegetation Classification System and Ecological Systems as defined by NatureServe. Part of the floodplain had been contaminated my flood deposited toxic metal wastes from upstream mining and smelting. These phytotoxic deposits have impacted the plant composition in the riparian zone. The Ranch holdings are approximately 1,500 acres. There is a vehicle bridge near the center of the Ranch that crosses the Clark Fork Rivers and various points where the irrigation canals can be crossed on foot. Spectral analysis of NAIP imagery was used to delineate the boundaries of polygons with apparently similar vegetation. The segmentation of the Ranch imagery yielded approximately 650 initial polygons. Because of the small total area of the Ranch, easy on-foot accessibility, and limited number of polygons it was decided to census every polygon as to community type rather than sample a subset of polygons and conduct a supervised classification. The initial vegetation mapping recognized forty plant community types. The mapping accuracy assessment was conducted in the following year (2007). The initial fine scale classification and mapping scheme was assessed to have a pooled accuracy rate of only 29%. It was particularly difficult for the accuracy assessment team to replicate the attribution of the eleven improved grass types that the initial mapping team utilized in the original census. Consolidation of the initial 40 fine vegetation scale types to 25 final Associations or Alliances resulted in a 58% accuracy rate (90% confidence interval 53% to 63%). Eight Ecological Systems were determined to have comprised the Ranch environs with an overall map accuracy of 85% (90% confidence interval 81% to 89%).

The irrigated pastures and hayfields comprise 58% of the vegetated area of the Ranch. A provisional Ecological System "Irrigated Pasture" was assigned to these intensively managed fields of introduced grasses. The five final Associations of the upland terraces belong to the Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland Ecological System, and account for 26% of the vegetated area. *Pseudoroegneria spicata* (bluebunch wheatgrass) Associations are the largest component of these dry uplands. The composition of most of the uplands is similar to the potential natural community. The riparian floodplain is the remaining 16% of the vegetated area. Most of the floodplain belongs to the Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland Ecological System. Several *Salix* (willow) Associations and the *Betula occidentalis* (water birch) Shrubland Association dominate the floodplain. Livestock grazing and metal extraction waste deposits have altered the pre-development floodplain assemblages. Approximately one quarter of the riparian floodplain consists of wetland Associations. Although only 4% of the total vegetated area of the Ranch, these wetland Associations add considerable biological diversity to this Historic Site.

Acknowledgments

Introduction

The Grant-Kohrs Ranch National Historic Site is a working cattle ranch that commemorates the open range cattle king era from 1860 through 1890, and the subsequence evolution of the western cattle industry through the first half of the 20th century preceding the highly scientific based enterprises of today. The Park encompasses 1,618 acres. Over 80 historic ranching structures are maintained including the primary ranch house with 19th century furnishing from American and European manufacturers, cowboy bunkhouses, horse barns, a dairy, workshops, and corrals. Ongoing cattle operations, period demonstrations of cowboy life, and Ranger guided and self-guided tours of the historic structures allow visitors to understand and appreciate this major aspect of the history of the American West.

The Grant-Kohrs Ranch is on the immediate outskirts of the small rural town of Deer Lodge in west central Montana. Missoula 79 miles to the northwest and Butte 37 miles to the southeast along Interstate 90 are the two nearest cities (Figure 1).

Close to the continental divide the Deer Lodge Valley has a cold and dry continental climate (Figure 2). At the elevation of 4,530 feet the annual average high temperature is 55.9° F and the annual average low temperature is 28.1° F. The average July high is 82.0° F and the average January low is 10.1° F. Deer Lodge receives only 10.6 inches of precipitation a year. May and June are the wettest months but these two spring month of precipitation tally on average only 3.8 inches.

The high elevation 300 square mile valley is broad and wide with a long south to north axis. The Grant-Kohrs Ranch is centered on the north flowing Clark Fork River. There is only about 165 feet of elevation relief on the actual Ranch holdings. The Clark Fork River, which bisects the Ranch from south to north, is at 4,485 feet. Rising slightly above the floodplain, but still on the valley floor, about a half mile the east of the river the boundary elevation for the Ranch is at 4,520 feet. Upland benches are at an elevation of about 4,650 feet about a third of a mile to the west of the river. The Flint Creek Range on the west side of the north to south valley has peaks ranging from 8,000 to 10,400 feet. These often snow capped mountains provide a spectacular backdrop from the valley floor.

Grant-Kohrs Ranch lies within the Northern Rocky Mountains Physiographic Province, which contains metamorphic, sedimentary, and igneous rocks of Precambrian to Tertiary age as well as recent alluvial and glacial deposits (Thornberry-Ehrlich 2007). The valley floor at the Ranch consists of unconsolidated Tertiary fill. The upland benches on the west side of the Ranch are formed from Quaternary fill material. Precambrian rocks underlie the valley fill at the Ranch. Metal mining and smelting upriver of Grant-Kohrs Ranch resulted in large quantities of toxic tailings and wastes being dumped adjacent to and in the upper tributaries of the Clark Fork River. A major flood in 1908 deposited metal contaminated and acid pH sediments on top of the floodplain that comprises the Grant-Kohrs Ranch riparian zone. These metal contaminated sediments are having significant impact on the community composition of the floodplain vegetation ((Rice 2002; Rice and Hardin 2002a). Surface exposed tailings deposits lacking vegetation are called “slickens”. Bank erosion and point bar formation are periodically redistributing the contaminated sediments in the floodplain.

The soils at Grant-Kohrs are all formed from alluvial or glacial outwash deposits typical of alluvial fans and stream terraces. Soil types adjacent to the Clark Fork River are mostly deep loams of the Anaconda series and are often coarse because of pebbles. The lower bench soils east of the river are of the Beaverell series. Beaverell loams have even higher pebble content. They are generally deep and well drained with a gravelly loam surface and a clay loam to sandy clay loam substratum. Most of the irrigated hayfield/bottomland and lower elevation land west of the Clark Fork are Tetonview series soils. These fine textured loams are formed from calcareous alluvium.

They are deep but poorly drained, with a coarse pebble fraction found only at the lowest parts of the B horizon. The higher west side upland benches have shallow less developed soil.

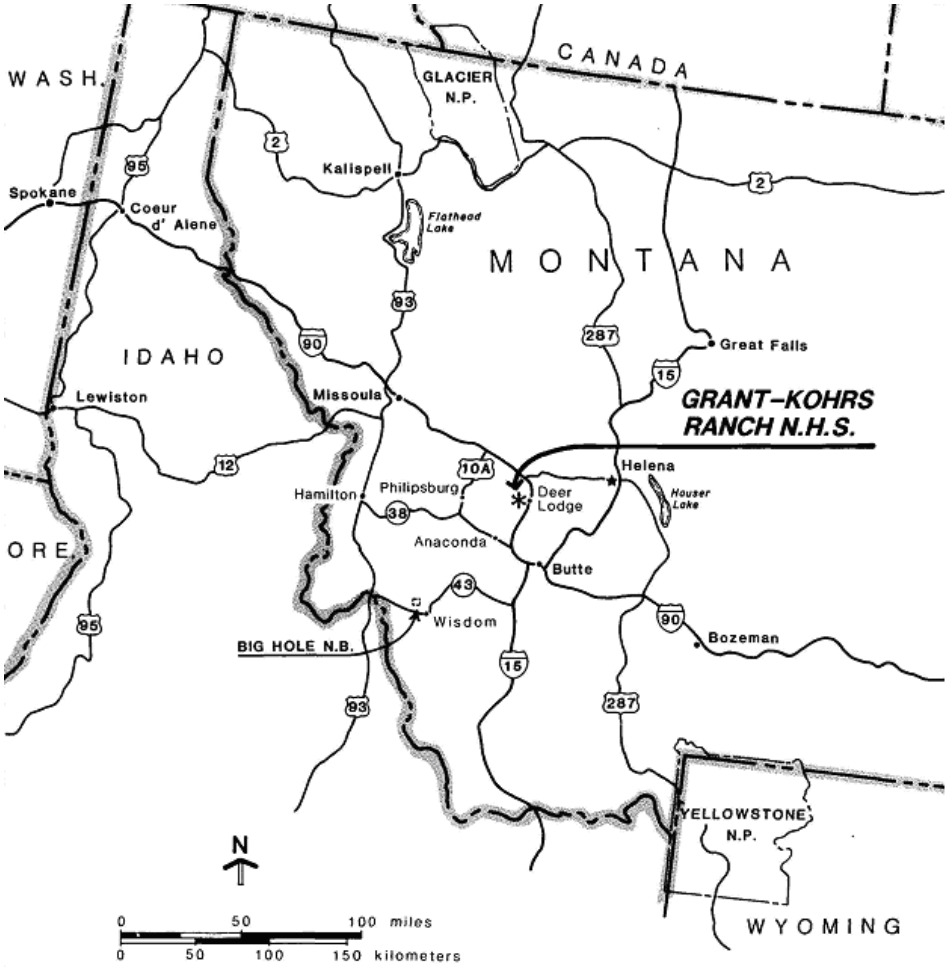

Figure 1. Location of Grant-Kohrs Ranch National Historic Site at Deer Lodge MT.

AlternateFigure 1. Location of Grant-Kohrs Ranch National Historic Site at Deer Lodge MT.

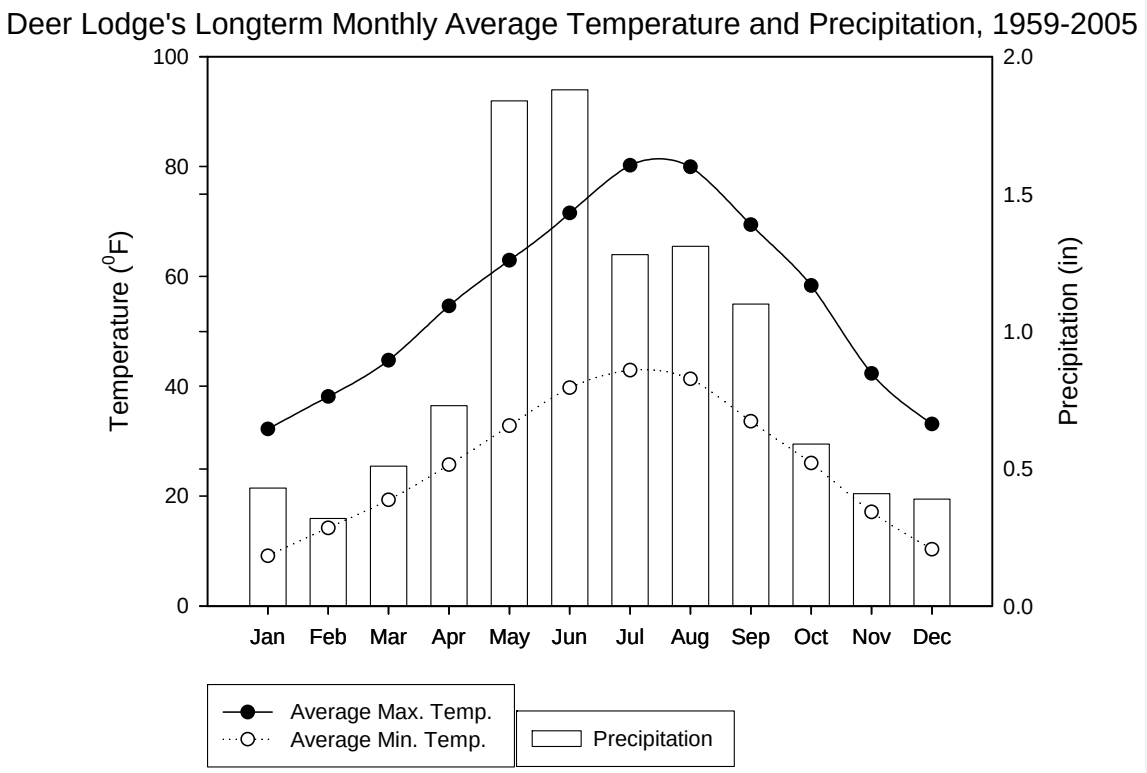

Figure 2. Monthly precipitation and temperatures for Grant-Kohrs Ranch.

The Ranch has three major topographic vegetation settings, dry upland benches with native bunchgrasses, irrigated and sub-irrigated hayfields with improved forage grasses, and a shallow groundwater floodplain dominated by tall riparian shrubs in the well drained areas and small wetland communities where the water table remains high throughout much of the year. The elevated benches on the west boundary have relatively intact native bunchgrass communities dominated by bluebunch wheatgrass (*Pseudoroegneria spicata*) and needle-and-thread grass (*Hesperostipa comata*). There is also a native bunchgrass remnant that is a railroad in-holding in the northeast quadrant of the Ranch. Lower elevation areas with more productive soils and topography suitable for flood irrigation were converted to high yield introduced grasses such as smooth brome (*Bromus inermis*) and timothy (*Phleum pratensis*). The flood irrigated hayfields on the west side of the river run the full south to north length of the Ranch and extend up broad gullies between the upland benches. Sub-irrigated meadows in the southeast also provide high quality grass hay. Abandoned farm fields in the northeast sector have been under sprinkler irrigation with municipal sewage effluent for the past decade and is consequentially also dominated by improved grasses such as smooth brome. The floodplain aspect is one of ten to twenty foot tall shrubs consisting of water birch (*Betula occidentalis*) and some seven willow species of which Geyer willow (*Salix geyeriana*) and Booth willow (*Salix boothii*) are most common. Black cottonwoods (*Populus balsamifera* ssp. *trichocarpa*) are limited to just the southeast corner Cottonwood Creek and an east side artificial slough created by excavation to build a railroad bed. The low gradient and hydraulics in this reach of the Clark Fork River are not conducive to the formation of cottonwood stands. As with any ranching operations there are areas with considerable disturbance or lacking vegetation such as corrals and the proximities to buildings.

A comprehensive vascular plant survey completed in 2002 identified 341 taxa within the Ranch boundaries ((Rice and Hardin 2002b)). Eighty-one or 25% of these plant species were exotic to North America. Of those exotic species, 11 are designated by law as noxious in the state of Montana, and a total of 57 species are considered noxious by various state and provincial governments in some portion of their North American distribution. The standard flora references for the area are (Dorn 1984) or (Hitchcock and Cronquist 1973). Also useful, but not including some prairie species found principally in central Montana and eastward, is (Lackschewitz 1991). The willow are difficult to identify to species, but this can be facilitated by reference to (Heinze 1994) and (Brunsfeld and Johnson 1985). (Lesica and Husby 2001) provides a guide to the sedges and rushes found in the wetlands.

A scoping and planning meeting which included park staff, Inventory and Monitoring Program staff, and the project Principal Investigator was held March 2006 at the Grant-Kohrs Ranch. It was decided to census every polygon and community type rather than sample and conduct a supervised classification using field data to train the remote sensing software. This is a relatively small park making it a likely target for alternative methods. Segmentation of the NAIP imagery was adjusted to create smaller polygons for the six hundred acres of natural upland and riparian vegetation but larger polygons for the seven hundred acres of hayfields. This two-level segmentation resulted in a total of 650 polygons insuring that a census could be achieved with reasonable effort. This decision is in accordance with NPS Vegetation Mapping Program guidance for small park units (National Park Service 2008).

Vegetation Classification: Methods & Results

Vegetation classification for National Park Service Vegetation Mapping Program (NPS-VMP) projects follows the National Vegetation Classification Standards, as maintained by the Federal Geographic Data Committee (FGDC). The FGDC maintains definitions of vegetation types to the hierarchical level of Formation. Units comprising the finer (floristic) levels, alliances and associations, are not currently recognized by FGDC. NatureServe (NatureServe 2007) maintains a provisional list of alliances and associations. The NPS-VMP uses this list for defining alliances and associations, to the extent practicable.

A common (recommended for large units) practice is to define local (park unit) vegetation units based on adequately replicated local observations (sample units) that represent a reasonably complete span of the floristic variability of each purported vegetation type, preferably from quantitative [releve] plot data. Vegetation types (usually, associations) are grouped by similarity to one another and by an appropriate level of floristic differences from other groups. These groups are then matched ("crosswalked") to the most similar units maintained by NatureServe (NatureServe 2007). In most cases, a suitable concept can be found.

In the case of Grant-Kohrs two applicable natural plant community typing systems had been previously developed. (Mueggler and Stewart 1980) was used for classifying the upland polygons and (Hansen and others 1995) was used for the riparian polygons. The irrigated hayfields were typed based on aspect dominance by either one or two of the introduced grasses that had been planted in these fields. These improved grass fields were mapped from June 28 through July 7, 2006 before the hay was cut. The natural vegetation areas were mapped from July 24 through August 1, 2006.

Vegetation Mapping: Methods & Results

Base images

The University of Montana Wildlife Spatial Analysis Lab (WSAL) was contracted by the NPS to assist in the vegetation mapping and inventory of Grant-Kohrs Ranch, specifically to provide GIS and Remote Sensing expertise to the project. The WSAL was provided with 2004 True Color NAIP Aerial photography with a 2 meter pixel size, as well as several GIS layers including the park boundary and soil layer.

Segmentation, assembly, and final modifications

Segmentation is the process of dividing an image into regions that are defined by greater spectral homogeneity within each segment than the spectral diversity found in the surrounding matrix. Whereas traditionally aerial photos were interpreted by manually delineating regions onto mylar overlays, this project used eCognition software (Definiens Corp.) to delineate the map unit regions using an automated algorithm. Initially we began by intersecting the Little Bighorn Battlefield park boundary layer with the soils layer. This layer was then attributed according to the complexity of the communities contained in each soil unit. We wanted less diverse areas (hayfields) to be segmented into larger regions, and more complex communities (floodplain and uplands) to be segmented into smaller regions.

Image segmentation using eCognition is an iterative process with some manual edits made between each of the automated runs. The base imagery used for this segmentation was 2004 NAIP true-color aerial photographs with a spatial resolution of 2 meters/pixel. The initial segmentation was based on this imagery but used the shapefile to force some of the region

Comment [NPS2]: Not sure which shapefile this is – the boundary-soil type layer from above?

boundaries. In subsequent segmentations the shapefile was removed and the regions were then re-segmented according to the levels of segmentation desired for each initial zone. Before the regions were exported out of eCognition, the road and water features were merged into single contiguous polygons in order to simplify them. When completed the final segmentation resulted in 561 regions within the park boundary not including water or roads. The largest vegetated region was 54.1 acres and the smallest vegetated region was .02 acres (20 pixels).

After the field mapping crew finished the initial polygon census, they entered the data into a MS access database. This data was quality checked and the final version was passed to WSAL. A crosswalk table links the initial field key types to the NVC series of hierarchical classifications and the field comments for each type. These classification attributes were then joined to the final WSAL GIS database.

Field mapping protocol

A two person botany team connected the initial polygon mapping to a field-identified vegetation type. They were provided with GPS (Garmin 63c) and Polygon Data Forms referencing each polygon number and the UTM coordinates for the approximate center of the polygon (Appendix A6). They also had printed map sheets with the NAIP base images, polygon boundaries, polygon numbers, and the approximate centroids for the polygons. The plant community mappers were assigned separate sets of polygons and mapped independently. These botanists navigated into the polygon using the GPS and reference to the printed map. Super Classes had been assigned to every polygon during segmentation based on whether that polygon was within or outside the Park boundary, upland or floodplain and hayfield topography, a vegetated or a non-vegetated polygon because of water, development, roading, or unclassified factors. The botanist confirmed or adjusted the segmentation assigned Super Class. After inspecting each vegetated polygon as a whole for dominants and indicator species the polygon was assigned to a community type based on the original keys developed by Mueggler and Stewart (1980) for uplands, Hansen, Pfister, et al (1995) for the floodplain, or the aspect dominance of the hayfields. To facilitate accuracy assessment, a reference waypoint was recorded within each polygon in a location representative of the polygon (positioning error estimated and recorded, see the geodatabase table, tblPolygonFieldAssocation). The cover class of dominant indicator species (one to three) was recorded at that representative, reference point. Cover classes were based on the traditional Braun-Blanquet cover scale: T=<1%, 1=1–5%, 2 = 6–25%, 3 = 26–50%, 4 = 51–75%, 5 = 76–95%, 6 = 96–100%. A supplemental Polygon Notes form (Appendix A6) was completed for any polygon that needed a boundary adjustment or had unusual aspects that could not be resolved immediately at the time of the initial mapping visit.

Comment [p3]: Table is in Appendix A6 of this draft)

Comment [p4]: Table is in Appendix A6 of this draft)

Initial map unit veg type classification summary & crosswalk to Association

Initial classification recognized 5 Mueggler Stewart (1980) bunchgrass habitat types in the uplands (Table1). Some polygons dominated by *Agropyron spicatum* (now *Pseudoroegneria spicata*) (bluebunch wheatgrass) could not be classified at the finest scale to species habitat type or Association level because of the lack of strong indication of a second diagnostic species. These bluebunch wheatgrass polygons were classified at the higher *Agropyron spicatum* series or NVCS *Pseudoroegneria spicata* Herbaceous Alliance level. Small areas of uplands had been seeded with *Agropyron intermedium* (now *Thinopyrum intermedium*) (intermediate wheatgrass) or *Agropyron cristatum* (crested wheatgrass) (Table 2). These two seeded grass types are recognized by NVCS as Semi-natural Herbaceous Alliances.

Twenty Hansen et al 1995 riparian floodplain habitat types were initially recognized. Tall shrub types comprise half of the riparian zone. The *Salix geyeriana* (Geyer willow) types were most

abundant. These two Geyer willow types on the Ranch are indicated by the dominance of either *Salix geyeriana* and/or *Salix boothii* (Booth willow). Well drained *Salix geyeriana* polygons were classified as *Salix geyeriana* community type having had an understory of primarily invasive introduced grasses and weedy exotic forbs such that they constitute the NVCS *Salix geyeriana*/Mesic Graminoids Shrubland Association. *Salix geyeriana* polygons with seasonal standing water or a very shallow groundwater table were *Salix geyeriana* /*Carex rostrata* (beaked sedge) habitat type in the Hansen et al 1995 classification which is subsumed by *Carex utriculata* Shrubland in the NVCS classification. The smaller statured early seral *Salix exigua* community type or *Salix exigua* Temporarily Flooded Shrubland Association was also common adjacent to the river. *Betula occidentalis* (water birch) community type or Shrubland Association accounted for only 23 acres but this very tall columnar shrub shares visual dominance with the *Salix geyeriana* types. Small clumps of two *Populus trichocarpa* (black cottonwood) types totaled less than 4 acres.

The invasive rhizomatous grass *Bromus inermis* (smooth brome) community type, a Semi-natural Herbaceous Alliance, covering 22 acres was the most extensive herbaceous association. Two other invasive rhizomatous grass but less prevalent community types were formed by *Agrostis stolonifera* (redtop) and *Poa pratensis* (Kentucky bluegrass). *Typha latifolia* (common cattail) was mapped in seven polygons for a total of 14 acres. Hansen et al 1995 designate early seral vegetation on new point bars and other exposed floodplain deposits as Unclassified Riparian which accounted for 9.5 acres. The *Eleocharis palustris* (common spikesedge) type was also present immediately adjacent to the river. Metal contaminated deposits comprised a total of 2.4 acres that were vegetated with monotypic *Deschampsia caespitosa* (tufted hairgrass), and an additional total 1 acre of bare slickens over 12 polygons. A finer resolution mapping in 2000 designated 7.9 acres of then bare slickens formed from 37 polygons (Rice and Hardin 2002a). A single 5.2 acre polygon was designated as a *Carex aquatilis* (water sedge) habitat type. Two minor sedge types were also mapped. On well drained riparian areas *Symphoricarpos occidentalis* (western snowberry) community type occupied 7 polygons for a total of 3.9 acres, and there was a single 0.1 acre polygon designated as a *Rosa woodsii* (Woods rose) community type.

The initial classification utilized eleven irrigated hayfield types. *Bromus inermis* (smooth brome) was the most prevalent (334 acres) and *Phleum pratense* (timothy) was the second most abundant introduced grass (121 acres). These two grasses are very productive in fields under flood irrigation or with high water tables. Although *Agrostis stolonifera* is most tolerant of conditions in low areas that retain surface water though longer parts of the growing season. A single 65 acre monotypic native *Juncus balticus* stand persisted in the North Meadow where there is a high water table. The common agricultural weed *Descurainia sophia* (flixweed) dominated one 1.1 acre polygon.

Table 1. Initial field mapping classification types from the original source keys and their NVCS equivalent Association or Alliance.

Type Name from Original Key	Source	NVCS Association or Alliance
UPLANDS		
Agropyron spicatum/Agropyron smithii	M&S 1980	*Pseudoroegneria spicata - Pascopyrum smithii* Herbaceous Vegetation
Agropyron spicatum/Agropyron smithii/Stipa viridula	M&S 1980	*Pseudoroegneria spicata - Pascopyrum smithii* Herbaceous Vegetation
Agropyron spicatum/Bouteloua gracilis	M&S 1980	*Pseudoroegneria spicata - Bouteloua gracilis* Herbaceous Vegetation
Agropyron spicatum/Poa secunda	M&S 1980	*Pseudoroegneria spicata - Poa secunda* Herbaceous Vegetation
Agropyron spicatum	M&S 1980	*Pseudoroegneria spicata* Herbaceous Alliance
Stipa comata/Bouteloua gracilis	M&S 1980	*Hesperostipa comata - Bouteloua gracilis - Carex filifolia* Herbaceous Vegetation
Agropyron cristatum semi-natural	NVCS	*Agropyron cristatum* Semi-natural Herbaceous Alliance
Agropyron intermedium semi-natural	NVCS	*Thinopyrum intermedium* Semi-natural Herbaceous Alliance
RIPARIAN FLOODPLAIN		
Agrostis stolonifera	H et al 1995	*Agrostis stolonifera* Seasonally Flooded Herbaceous Alliance
Betula occidentalis	H et al 1995	*Betula occidentalis* Shrubland
Bromus inermis	H et al 1995	*Bromus inermis* Semi-natural Herbaceous Alliance
Carex aquatilis	H et al 1995	*Carex aquatilis* Herbaceous Vegetation
Carex lasiocarpa	H et al 1995	*Carex lasiocarpa* Herbaceous Vegetation
Carex rostrata	H et al 1995	*Carex utriculata* Herbaceous Vegetation
Eleocharis palustris	H et al 1995	*Eleocharis palustris* Herbaceous Vegetation
Equisetum fluviatile	H et al 1995	*Equisetum fluviatile* Herbaceous Vegetation
Juncus balticus	H et al 1995	*Juncus balticus* Herbaceous Vegetation
Poa pratensis	H et al 1995	*Poa pratensis* Semi-natural Seasonally Flooded Herbaceous Alliance
Populus trichocarpa/herbaceous understory	H et al 1995	*Populus balsamifera* ssp. *trichocarpa* / Mixed Herbs Forest
Populus trichocarpa/Symphoricarpos occidentalis	H et al 1995	*Populus balsamifera* (ssp. *trichocarpa*, ssp. *balsamifera* / *Symporicarpos* (*albus, oreophilus, occidentalis*) Forest
Rosa woodsii	H et al 1995	*Rosa woodsii* Shrubland
Salix bebbiana	H et al 1995	*Salix bebbiana* Shrubland
Salix exigua	H et al 1995	*Salix exigua* Temporarily Flooded Shrubland
Salix geyeriana	H et al 1995	*Salix geyeriana* / Mesic Graminoids Shrubland
Salix geyeriana/Carex rostrata	H et al 1995	*Salix geyeriana* / *Carex utriculata* Shrubland
Symphoricarpos occidentalis	H et al 1995	*Symphoricarpos occidentalis* Shrubland
Typha latifolia	H et al 1995	*Typha* (*latifolia, angustifolia*) Western Herbaceous Vegetation
Unclassified Riparian	H et al 1995	Unclassified Riparian
Deschampsia caespitosa	Rice	*Deschampsia caespitosa* Slickens Semi-natural Sparse

Metal contaminated soil. No vegetation.	Rice	slickens
IRRIGATED HAYFIELDS		
Agropyron repens	Rice	cultural Agropyron repens
Agropyron repens/Bromus inermis	Rice	cultural Agropyron repens/Bromus inermis
Agropyron repens/Phleum pratense	Rice	cultural Agropyron repens/Phleum pratense
Agrostis stolonifera (redtop)	Rice	cultural Agrostis stolonifera
Bromus inermis/Phleum pratense	Rice	cultural Bromus inermis/Phleum pratense
Bromus inermis (smooth brome)	Rice	cultural Bromus inermis
Descurainia sophia	Rice	cultural Descurainia sophia
Festuca pratensis	Rice	cultural Festuca pratensis
Juncus balticus (Baltic rush)	Rice	cultural Juncus balticus
Phleum pratense	Rice	cultural Phleum pratense
Poa pratensis (Kentucky bluegrass)	Rice	cultural Poa pratensis
NON-VEGETATED OTHER		
Bare soil	project	Bare Soil
Developed Area	project	Developed Area
Road	project	Road
Water	project	Water

[§] Natural or semi-natural vegetation community name is for NVCS Association unless ending with Alliance

Table 2. Acreages of each initial type.

DESCRIPTION	Total Acres	# of Polygons	Smallest Polygon	Largest Polygon
UPLANDS				
Agropyron spicatum/Agropyron smithii	115.6	17	0.005	29.5
Stipa comata/Bouteloua gracilis	76.1	5	0.474	47.2
Agropyron spicatum	63.8	10	0.302	16.2
Agropyron cristatum (semi-natural)	45.3	7	0.302	35.1
Agropyron spicatum/Agropyron smithii/Stipa viridula	20.3	1	20.280	20.3
Agropyron spicatum/Poa secunda	8.3	3	0.751	5.9
Agropyron intermedium (*Thinopyrum intermedium*) (semi-natural)	1.7	1	1.651	1.7
Agropyron spicatum/Bouteloua gracilis	0.6	1	0.574	0.6
Upland Totals	331.6	45	0.005	47.2
RIPARIAN FLOODPLAIN				
Salix geyeriana	53.8	37	0.044	11.3
Salix exigua	33.8	32	0.025	10.6
Betula occidentalis	22.9	30	0.028	4.6
Bromus inermis	21	1	0	8

	.8	1	.107	.0
Salix geyeriana/Carex rostrata	19.9	11	0.069	11.7
Typha latifolia	13.8	7	0.039	8.3
Unclassified Riparian	9.5	11	0.038	4.4
Salix bebbiana	7.5	6	0.054	3.8
Agrostis stolonifera	6.3	18	0.028	1.3
Carex aquatilis	5.2	1	5.229	5.2
Symphoricarpos occidentalis	3.9	7	0.235	1.2
Juncus balticus	3.2	9	0.038	1.6
Populus trichocarpa/herbaceous understory	3.0	6	0.021	1.3
Deschampsia caespitosa on contaminated soil	2.4	6	0.109	1.4
Carex rostrata	1.7	7	0.025	0.6
Carex lasiocarpa	1.4	3	0.348	0.7
Equisetum fluviatile	1.2	1	1.238	1.2
Metal contaminated soil. No vegetation. Slickens.	1.0	12	0.030	0.2
Eleocharis palustris	0.9	6	0.009	0.5
Populus trichocarpa/Symphoricarpos occidentalis	0.6	4	0.034	0.2

Poa pratensis	**0.3**	**1**	**0.262**	**0.3**
Rosa woodsii	**0.1**	**1**	**0.119**	**0.1**
Riparian Floodplain Totals	**21 4.1**	**2 27**	**0 .009**	**1 1.7**
IRRIGATED PASTURE				
Bromus inermis (smooth brome)	**33 3.5**	**2 8**	**0 .005**	**9 1.6**
Phleum pratense	**12 1.0**	**9**	**0 .145**	**9 2.7**
Agropyron repens	**79 .4**	**1 9**	**0 .008**	**2 2.3**
Juncus balticus (baltic rush) (J.arcticus spp. *littoralis)*	**65 .0**	**1**	**6 5.049**	**6 5.0**
Poa pratensis (Kentucky bluegrass)	**60 .5**	**1**	**6 0.526**	**6 0.5**
Agropyron repens/Bromus inermis	**54 .6**	**1 2**	**0 .005**	**2 0.5**
Festuca pratensis	**24 .1**	**6**	**0 .203**	**1 1.3**
Bromus inermis/Phleum pratense	**11 .0**	**2**	**1 .872**	**9 .1**
Agropyron repens/Phleum pratense	**2.2**	**1**	**2 .184**	**2 .2**
Descurainia sophia	**1.1**	**1**	**1 .056**	**1 .1**
Agrostis stolonifera	**0.7**	**1**	**0 .739**	**0 .7**
Irrigated Pasture Totals	**75 3.0**	**8 1**	**0 .005**	**9 2.7**

OTHER				
Water	**53.7**	**42**	**0.008**	**21.9**
Road	**40.4**	**18**	**0.012**	**27.6**
Developed Area	**28.2**	**16**	**0.020**	**12.9**
Bare soil	**18.5**	**32**	**0.027**	**3.9**
Other Totals	**14** **1.0**	**108**	**0.008**	**27.6**
Grand Total Mapped	**1, 439.7**	**461**	**0.005**	**92.7**

Accuracy Assessment

AA field protocol

The accuracy assessment methods and analyses for Grant-Kohrs Ranch National Historic Site (GRKO) vegetation mapping followed the current National Park Service program standards (Environmental Systems Research Institute et al. 1994).

Accuracy assessment plot site selection

Three modifications were made to adapt the standards to the GRKO project:

(1) We modified the number of accuracy assessment (AA) sites to be allocated to each map class (Table 6 of Section 8.2.1.2 of Environmental Systems Research Institute et al. (1994)). We allocated 30 AA sites (sample units) to each map class that occupied more than 50 hectares in total area (scenario "A" of Table 6). For map classes with 50 hectares or less of total area, we allocated AA plots equal to the total map class area (in hectares) divided by 1.67. This formula allocates points per class at the same ratio as the 30 points per 50 hectares requirement. The map class area was calculated prior to buffering for field positioning error, although the buffered areas of a map class were not considered for site placement. In the cases of very small map classes, the total size of the buffered area available, combined with the requirement of sampling without replacement (to allow observers to visit plots in sequence, but also to keep individual AA plot observations independent) limited the map class allocation to the total area available for multiple AA plots of minimum mapping unit size. We did not allocate additional points for map classes merely because they were more fragmented (i.e., less than 50 hectares total area, but more than 30 polygons – scenario "B" of Table 6)

(2) A 0.1 hectare observation area (a circular plot, 18 meters in radius), centered around each AA site (point) was used. The area reduction from the normative 0.5 hectare observation area (Environmental Systems Research Institute et al. 1994) was necessary because of the very small mean polygon area (~ 0.15 hectares), and justifiable because it may be desirable for the minimum mapping unit to vary in size by class (Environmental Systems Research Institute et al. 1994). By fragmenting map classes into many small polygons, the mapper is asserting that vegetation types consistently can be identified at small scales. Finally, the vegetation at GRKO is primarily shrubland and herbaceous vegetation, in which smaller observation areas can capture an adequate number of attributes to establish class (vegetation type). In retrospect, we found 0.1 hectares to be of marginally adequate size for assessing the tall shrublands and forests in a single sample unit. However, at GRKO, we had little choice but to employ 0.1 hectares even for the tall shrub and tree-dominated vegetation, given the uniformly small map unit (polygon) size even for most forests and shrubland polygons.

(3) We did not use the polygon level stratification suggested by in Figure (Table 6 of Section 8.2.1.2 of Environmental Systems Research Institute et al. 1994).

To prepare the mapping units (polygons) for site selection:

We measured the total area of each *original* (habitat type) map class, by summing all individual polygon areas. Map classes representing water, roads, and cultural vegetation on developed areas were omitted; these are assumed to be 100% accurate or nearly so.

We assigned 30 AA sites per 1.67 hectares of the map class total area, up to a maximum allocation of 30 AA plots per map class.

We used ArcView ® 3.2 geoprocessing wizard to prepare the sampling universe for each map class, as follows:

(1) Individual polygons representing the same map class were dissolved to eliminate polygon boundaries between polygons of like map class.

(2) An 18 meter buffer inside the boundary of all polygons was created.

(3) A union theme of the original map classes and the buffer theme was created

(4) The polygons that were within the 18 meter buffer were selected and deleted from this union theme. The result of the geoprocessing steps was a polygon theme (sampling population) that was comprised of the interiors of all polygons (all areas more than 18 meters from a boundary with a different map class).

To select individual AA sites from the map the AA plot sites (plot centers) were determined by allocating the specified number of points per map class to the modified union theme derived from the operations above, using the "Select Random Features" function in the National Park Service Alaskapak tools package for ArcView® 3.2 (National Park Service 2002). This achieves the method of simple random sampling within each map class, which is appropriate for the statistical analysis of Environmental Systems Research Institute et al. (1994).

When two or more AA plot sites were near enough to one another to produce overlapping observation areas (i.e., within 36 meters of one another), one site at a time was selected randomly using the random numbers function in Microsoft® Excel and deleted. A replacement site was generated for each site so deleted, using the "Select Random Features" function as above. If the replacement site overlapped a previously determined site, it was rejected, and the process repeated, until either (1) the full complement of sites for the map class was assigned or (2) it was determined that the map class could accommodate no more sites without observation area overlap between one or more AA plots.

Accuracy assessment field methods

Three teams of one to two persons were employed to conduct the accuracy assessment. At least one person on each team was required to be familiar with all plant species mentioned in the field key and potential "look-alikes" species that might cause erroneous key decisions.

The total number of plots to be visited for each map class was stratified by observation team by having each team was assigned to visit an equal or near equal number of plots for each individual map class as the other teams. This served to minimize effects of observer bias. Such stratification is always desirable, but it precludes each site being visited sequentially by location. Thus, it is usually practical only in small projects where travel time is a minor consideration.

Accuracy assessment field observations were conducted primarily from July 31 to August 2, 2007.

The site locations and unique identifiers were loaded into Garmin® 76CSX global positioning system (GPS) units. Teams navigated to each assigned site (plot center), usually in a sequence of proximity.

The teams were not informed as to location of the map boundaries. Revealing map class boundaries creates a bias in the field calls that is especially problematic in small area projects, where compared to large area projects a larger proportion of each map class is likely to have polygons populated with multiple sites and where adjoining polygons often have AA sites. It is unreasonable to expect a ground observer to make independent assessments of adjacent sites, when it has been revealed that the mapper has declared them to be the same or if the mapper has declared them to be different if two sites are separated by a single polygon/map class boundary. The bias can be especially problematic where field calls are not entirely clear cut, which is very often the case.

Field keys are designed to work in observation areas of ecologically and floristically relatively homogeneous stands of vegetation. While gradual transition zones within the observed area are acceptable to test the key across the full gradient of described types, sharp boundaries with two or more very different vegetation types, such as wetlands and uplands, occurring in the observation area often will yield spurious key results and should be avoided. It is possible for such sharp transitions to occur within an area mapped as a single class (an error of omission). To mitigate this situation, field crews were instructed to assess whether one of more such boundary occurred within the circular 18 meter radius (0.1 hectare) observation area. The general criteria for recognizing a boundary was a transition at the Formation level of the NVC (FGDC, 1997); transitions between different alliances or associations within same Formation are generally too subtle for an observer to reliably and precisely locate on the ground; such boundaries are usually best ignored and the vegetation keyed in place.

If a sharp Formation or higher vegetation boundary were detected in the observation area from the waypoint, the observer decided what vegetation type occupied the majority of the observation area if two types are detected in the observation area, or plurality if more than two types were present. The plot center was moved the minimal distance into the majority/plurality type along a path perpendicular to an imaginary line tangent to the ecological boundary between the majority/plurality type and all other types until only one association was detected within the plot. At this point, the observer stopped and evaluated a circular observation area of 18 meters radius from this new position.

Results of accuracy assessment

Methods of accuracy rate calculation:
Data from 294 AA plots were collected. The misclassification matrix (contingency table) (Environmental Systems Research Institute et al. 1994) was created as follows:

The field position (GPS) data were converted to a point theme in ArcView ® 3.2, and each point attributed with the vegetation field call and the positioning (GPS) error recorded on the forms.

Each field point was buffered by the field positioning (GPS) error recorded on the field forms to create a polygon theme of circular polygons with radius of each polygon equal to the recorded possible. The individual polygons represent an area of possibility for the true position. For rectangular observation areas, the dimensions of the observation area and the bearing of the long axis were taken from the field forms to create rectangular polygons.

These polygons were spatially joined to the GRKO vegetation class to determine whether any polygons had multiple map class memberships, i.e. uncertainty about the map class that should be assigned to each point due to positioning error, and should be discarded from the analysis. None had significant amounts of membership above the dominant map class, and all were retained, with the dominant map class assigned as the field call (producer's column) membership (Environmental Systems Research Institute et al. 1994).

The table derived from the joined file was exported to Microsoft ® Excel 2002. A pivot table representing a misclassification matrix (contingency table) was created in Excel, with the table columns representing the AA field calls, the table rows representing original map classes (in the same order for rows and columns), and the cell totals representing the total number of plots for each possible combination of map class assignment and field class assignment. Point estimates for User's (1 – commission error rate) and producer's (1 – omission error rate) accuracy rates (Environmental Systems Research Institute et al. 1994) for each map and field class were calculated by dividing the number of sites with matching map class and field calls (i.e., each cell along the contingency table diagonal) by the row totals for user's accuracy, or the column totals for producer's accuracy by the total number of sites assigned to that map class or field call. 90% confidence intervals for these point estimates were calculated, using the formulas of Environmental Systems Research Institute et al. (1994):

90% C. I. =

$$\hat{p} \pm \left\{ z_{\alpha} \sqrt{\frac{\hat{p}(1-\hat{p})}{n} + \frac{1}{(2n)}} \right\}$$

where p^ = the point estimate of accuracy (for a map class or field call class), z_{α} = the value of the z distribution statistic at the alpha level selected for a confidence interval (a two-sided 90% ($\alpha = 0.1$) confidence interval (= 1.645) was used for all classes), and n = the total number of sites in the map class or in the field call sample.

The overall project accuracy rate was computed as the total number of plots with matches in field calls and map classes divided by the total number of plots. This accuracy rate is a "pooled" total, rather than an average accuracy by map class. A kappa (κ) index (Foody, 1992) was calculated for the overall accuracy.

Post hoc adjustment to map classes:
The original habitat type classification and mapping scheme was assessed to have a pooled accuracy rate of 28.9%. This was fairly low, considering that all the individual polygons had been attributed on the ground. The inherent limitations of remote sensing methods in attributing vegetation stands is a usually a large potential error source in most mapping projects. However, because stands, represented by individual polygons, were all attributed on the ground by field crews at GRKO, this source was probably a relatively minor cause for error. Instead, the taxonomic (thematic) resolution of the habitat type classification was

assessed to be overly fine because one set of qualified field observers, the accuracy assessment team, could not consistently repeat the observations of the original team of qualified field observers, the stand attribution team. In a strict sense, this might be termed a lack of correspondence, rather than a deficit of accuracy, but this is an academic point for the potential user, who mainly seeks to understand how often a match / mismatch between the map class and what he/she finds will be found at a given site.

We reasoned that, since errors were clustered within relatively small sets of similar habitat types, these types could be lumped into a broader treatment of NVC associations in order to increase accuracy, with a minimal loss in taxonomic (thematic) resolution, and since the confusion between these types suggested that these types were going to be difficult for a user to discern in the field.

To produce the final NVC association level classification, merges of habitat types in both the ecological classification and map classes were made.

- For the irrigated fields all of the original eleven irrigated pasture types were merged to form a single introduced pasture grass type. The *Descurainia sophia,* the *Agrostis stolonifera*, the *Agropyron repens,* the *Agropyron repens / Bromus inermis,* the *Agropyron repens / Phleum pratense,* the *Bromus inermis,* the *Bromus inermis /Phleum pretense,* the *Festuca pratensis, Phleum pretense,* the *Juncus balticus,* and the *Poa pratensis* types were merged into the NPS (provisional) NVC Association of *(Bromus inermis – Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis)* Hayfield/Irrigated Pasture Herbaceous Vegetation.

- The *Agropyron spicatum, Agropyron spicatum / Bouteloua gracilis,* the *Agropyron spicatum / Agropyron smithii / Stipa viridula,* the *Agropyron spicatum / Poa secunda* types were merged into the NVC *Pseudoroegneria spicata – Poa secunda* Herbaceous Vegetation.

- The *Salix bebbiana* and the *Salix geyeriana* types were merged into the NVC *Salix geyeriana /* Mesic Graminoids Herbaceous Vegetation.

- The *Populus trichocarpa* and the *Populus trichocarpa /* Herbaceous types were merged into the NVC *Populus balsamifera* ssp. *trichocarpa /* Mixed Herbs Forest.

- The *Symphoricarpos occidentalis* Community Type and *Rosa woodsii* Community Type were merged to create the *Symphoricarpos occidentalis* Shrubland.

We calculated the NVC association accuracy of the final 25 merged map classes and AA field call totals. This final Associations accuracy rate is 57.8% (90% confidence interval 52.9% to 62.7%), with a kappa accuracy rate (Foody, 1992) of 46.9%) (Table xxxx). When the Associations are aggregated to the thematically coarser classification scheme of Ecological Systems (Comer et al. 2003) (NatureServe 2007), the overall map accuracy is 85.0% (90% confidence interval 81.4% to 88.6%) (kappa = 80.6%) (Table xxx).
.

Comment [p5]: This Appendix A7 table should be taken from libi_grko_aa_contingency_tables_011110.xls tab GRKO NVC Associations

Comment [p6]: This Appendix A7 should be taken from libi_grko_aa_contingency_tables_011110.xls tab GRKO Ecol Systems

Final map classes

Table 3. Hierarchical summary of NVCS for Grant-Kohrs Ranch National Historic Site with final NVCS Associations and local names

FORESTS AND WOODLANDS:

Populus balsamifera (ssp. *trichocarpa*, ssp. *balsamifera*) / *Symphoricarpos* (*albus*, *occidentalis*, *oreophilus*) Forest
= Black Cottonwood / Western Snowberry Forest
Populus balsamifera ssp. *trichocarpa* / Mixed Herbs Forest
= Black Cottonwood / Mixed Herbs Forest

SHRUBLANDS:
Betula occidentalis Shrubland
=Water Birch Shrubland
Salix exigua Temporarily Flooded Shrubland
=Sandbar Willow Shrubland
Salix geyeriana / Mesic Graminoids Shrubland
=Geyer's Willow / Mesic Graminoids Shrubland
Salix geyeriana / Carex utriculata Shrubland
=Geyer's Willow / Northwest Territory Sedge Shrubland
Symphoricarpos occidentalis Shrubland
=Western Snowberry Shrubland

UPLAND HERBACEOUS VEGETATION:
Hesperostipa comata – Bouteloua gracilis – Carex filifolia Herbaceous Vegetation
= Needle-and-Thread Grass – Blue Grama Mixedgrass Prairie
Thinopyrum intermedium Semi-natural Herbaceous Vegetation
= Intermediate Wheatgrass Semi-natural Herbaceous Vegetation
Agropyron cristatum - (*Pascopyrum smithii*, *Hesperostipa comata*) Semi-natural Herbaceous Vegetation
=Crested Wheatgrass Grassland
Pseudoroegneria spicata – Pascopyrum smithii Herbaceous Vegetation
=Bluebunch Wheatgrass – Western Wheatgrass Mixedgrass Prairie
Pseudoroegneria spicata – Poa secunda Herbaceous Vegetation
=Bluebunch Wheatgrass – Curly Bluegrass Mixedgrass Prairie

WETLAND & RIPARIAN HERBACEOUS VEGETATION:
Agrostis (*gigantea*, *stolonifera*) Semi-natural Herbaceous Vegetation
=(Giant Bentgrass, Spreading Bentgrass) Semi-natural Herbaceous Vegetation
Carex aquatilis Herbaceous Vegetation
=Aquatic Sedge Wet Meadow
Carex pellita Herbaceous Vegetation
=Woolly Sedge Wet Meadow
Carex utriculata Herbaceous Vegetation
= Northwest Territory Sedge Wet Meadow
Eleocharis palustris Herbaceous Vegetation
=Marsh Spikerush Wet Meadow
Juncus balticus Herbaceous Vegetation
=Baltic Rush Sedge Wet Meadow
Bromus inermis – (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation
=Smooth Brome – (Western Wheatgrass) Semi-natural Herbaceous Vegetation

Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation
= Kentucky Bluegrass Semi-natural Seasonally Flooded Herbaceous Vegetation
Equisetum fluviatile Herbaceous Vegetation
=Water Horsetail Wet Meadow
Typha (*latifolia*, *angustifolia*) Western Herbaceous Vegetation
=Broadleaf Cattail Marsh

PLANTED/CULTIVATED (CULTURAL) HERBACEOUS VEGETATION:
(*Bromus inermis – Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis*) Irrigated Pasture Herbaceous Vegetation
=Hayfield/Pasture

SPARSE VEGETATION:
Deschampsia caespitosa Slickens Semi-natural Sparse Vegetation
=Tufted Hairgrass Slickens
Rocky Mountain Riparian Bar Sparse Vegetation
=Riparian Bar

Field key for final classification scheme (see Appendix A4)

A dichotomous field community classification key had been prepared for the accuracy assessment team. Subsequent to the accuracy assessment done in late July/early August 2007 the field key was revised to reflect the classification simplifications that became evident during the accuracy assessment. The key for the final 25 Associations is in Appendix A4

Summary Discussion

At the Association scale the 332 acres of uplands are primarily vegetated by bunchgrass types in the *Pseudoroegneria spicata* Herbaceous Alliance (Table 4). On harsher sites with stonier soil *Hesperostipa comata - Bouteloua gracilis - Carex filifolia* Herbaceous Vegetation predominates, but the abundance of *Hesperostipa comata* may reflect past cumulative grazing pressure. About 45 upland acres had been inter-seeded in the past with *Agropyron cristatum.* These areas constitute *Agropyron cristatum* - (*Pascopyrum smithii, Hesperostipa comata*) Semi-natural Herbaceous Vegetation. Average *Agropyron cristatum* canopy cover was ~33% and these stands still retained some native component. A small strip on the east side was planted to *Thinopyrum intermedium* Semi-natural Herbaceous Vegetation. Overall the Grant-Kohrs uplands consist of relatively intact native bunchgrass vegetation, particularly in contrast to many areas of the West that have been under livestock grazing pressure for over a century. Historic records for the Ranch suggest that these uplands were primarily utilized for fall grazing rather than during the spring period of active plant growth.

Half of the Ranch consisted of introduced grass pastures and hayfields that are flood, sprinkler, or subirrigated (Table 4). *Bromus inermis* (smooth brome) and *Phleum pratense* (timothy) are the predominant species in these fields but four other introduced pasture grasses can obtain

dominance over smaller areas (Table 2). Many areas of these fields have been seeded with two or more of these grass species. The amount, timing, and spatial distribution of irrigation and subsurface flow are quite variable year to year. Year to year expression of dominance or codominance is strongly influenced by the irrigation practices such that the annual species abundance is also variable. The NVCS does not currently recognize cultural vegetation types although this is the single largest component of the Ranch.

The Clark Fork riparian floodplain and small east side creeks provide the most complex environment at the Ranch. Nineteen vegetation types were ascribed to these 213 riparian acres which comprise only 13% of the Ranch holdings (Table 4). Irrigation ditches and flowback add to the hydrologic complexity and resultant vegetation in this riparian zone. *Salix geyeriana* / Mesic Graminoids Shrubland is the predominant riparian type. It occupies better drained areas while *Salix geyeriana* / *Carex utriculata* Shrubland is maintained in areas that have prolonged seasonally high water tables. *Salix exigua* Temporarily Flooded Shrubland is the second most abundant type. Although many of these *Salix exigua* polygons are immediately adjacent to the Clark Fork River, as expected there are *Salix exigua* stands that persist set back from the active channel. *Betula occidentalis* Shrubland is the third most prevalent type, but the height of this columnar shrub creates an aspect dominance that rivals the more extensive *Salix geyeriana* types. Past livestock grazing in the riparian zone allowed the formation of *Bromus inermis* - (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation as the most prevalent herbaceous type. In areas with protracted standing water *Typha* (*latifolia, angustifolia*) Western Herbaceous Vegetation, *Agrostis gigantea, stolonifera* Semi-natural Herbaceous Vegetation, and *Carex aquatilis* Herbaceous Vegetation prevail. *Populus balsamifera* types are limited in extent not only on the Ranch but are generally absent along the entire Upper Clark Fork River. Presumably the low gradient, substrate, and moderate flood regime of the upper river does not create new depositional sites favorable for the establishment of cottonwood galleries.

The ecological integrity of riparian communities on the Ranch has been impacted by floodplain deposition of phytotoxic metal loaded waste rock from mining and smelting upriver from Grant-Kohrs (Kapustka 2002; Rice 2002)Although based on aspect dominance nineteen riparian vegetation types were utilized for the final classification, many of the stands of these native types deviate in overall species composition and proportion from what would be expected based on graphic ordination and statistical contrast with the Hansen, Pfister, et al 1995 community type definitions (Rice and Hardin 2002a). The most salient example is for the *Deschampsia caespitosa* Slickens Semi-natural Sparse Vegetation which are monotypic *Deschampsia caespitosa* stands on or in a narrow band surrounding the edge of lenses of toxic metal low pH waste sediment deposits from the 1908 flood event. Stands of various types that occupy better drained contaminated soils are more deviant than contaminated soil stands of wet types as anoxic conditions retard solubilization of the phytotoxic metals. For example, while the Grant-Kohrs *Salix geyeriana* / Mesic Graminoids Shrubland stands were significantly ($p<.001$) different from the Hansen, Pfister, et al 1995 community definition stands, the two sets of stands had similar compositions for the *Typha* (*latifolia, angustifolia*) Western Herbaceous Vegetation ($p = .418$) and *Carex aquatilis* Herbaceous Vegetation ($p = .101$).

Table 4. Acreages of each final post accuracy assessment NVCS Association.

NVCS ASSOCIATION	Total Acres	# of Polygons	Smallest Polygon	Largest Polygon
UPLANDS				
Pseudoroegneria spicata - Pascopyrum smithii Herbaceous Vegetation	**135.9**	**18**	**0.005**	**29.5**
Hesperostipa comata - Bouteloua gracilis - Carex filifolia Herbaceous Vegetation	**76.1**	**5**	**0.474**	**47.2**
Pseudoroegneria spicata - Poa secunda Herbaceous Vegetation	**72.6**	**14**	**0.302**	**16.2**
Agropyron cristatum - (*Pascopyrum smithii, Hesperostipa comata*) Semi-natural Herbaceous Vegetation	**45.3**	**7**	**0.302**	**35.1**
Thinopyrum intermedium Semi-natural Herbaceous Vegetation	**1.7**	**1**	**1.651**	**1.7**
Upland Totals	**331.6**	**45**	**0.005**	**47.2**
RIPARIAN FLOODPLAIN				
Salix geyeriana / Mesic Graminoids Shrubland	**61.4**	**43**	**0.044**	**11.3**
Salix exigua Temporarily Flooded Shrubland	**33.8**	**32**	**0.025**	**10.6**
Betula occidentalis Shrubland	**22.9**	**30**	**0.028**	**4.6**
Bromus inermis - (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation	**21.8**	**11**	**0.107**	**8.0**
Salix geyeriana / *Carex utriculata* Shrubland	**19.9**	**11**	**0.069**	**11.7**
Typha (*latifolia, angustifolia*) Western Herbaceous Vegetation	**13.8**	**7**	**0.039**	**8.3**
Rocky Mountain Riparian Bar Sparse Vegetation	**9.5**	**11**	**0.038**	**4.4**

Agrostis gigantea, stolonifera Semi-natural Herbaceous Vegetation	**6.3**	**18**	**0.028**	**1.3**
Carex aquatilis Herbaceous Vegetation	**5.2**	**1**	**5.229**	**5.2**
Symphoricarpos occidentalis Shrubland	**4.0**	**8**	**0.119**	**1.2**
Juncus balticus Herbaceous Vegetation	**3.2**	**9**	**0.038**	**1.6**
Populus balsamifera / Mixed Herbs Forest	**3.0**	**6**	**0.021**	**1.3**
Deschampsia caespitosa Slickens Semi-natural Sparse Vegetation	**2.4**	**6**	**0.109**	**1.4**
Carex utriculata Herbaceous Vegetation	**1.7**	**7**	**0.025**	**0.6**
Carex pellita Herbaceous Vegetation	**1.4**	**3**	**0.348**	**0.7**
Equisetum fluviatile Herbaceous Vegetation	**1.2**	**1**	**1.238**	**1.2**
Eleocharis palustris Herbaceous Vegetation	**0.9**	**6**	**0.009**	**0.5**
Populus balsamifera (ssp. *trichocarpa*, ssp. *balsamifera*) / *Symphoricarpos* (*albus*, *occidentalis*, *oreophilus*) Forest	**0.6**	**4**	**0.034**	**0.2**
Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation	**0.3**	**1**	**0.262**	**0.3**
Riparian Floodplain Totals	**213.1**	**215**	**0.009**	**11.7**
IRRIGATED PASTURE				
(*Bromus inermis - Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis*) Irrigated Pasture Herbaceous Vegetation	**753.1**	**81**	**0.005**	**92.7**

OTHER				
Not Vegetation (Road, Water, Developed, Bare Soil)	**279.8**	**154**	**0.005**	**55.0**
Grand Total	**1,577.6**	**495**	**0.005**	**92.7**

Although a woody overstory of native indicator species still dominates the riparian zone the native herbaceous layer on well drained areas has largely been displaced by invasive species. *Bromus inermis* is the predominant graminoid. It forms the NVCS recognized semi-natural type *Bromus inermis* - (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation over 22.9 acres, and *Bromus inermis* is prevalent in most of the woody types. In some areas with higher protracted water tables invasive *Agrostis stolonifera* forms stands classified by NVCS as *Agrostis gigantea*, *stolonifera* Semi-natural Herbaceous Vegetation. Dicotyledon noxious weeds *Linaria vulgaris* (yellow toadflax), *Cirsium arvense* (Canada thistle), and *Euphorbia esula* (leafy spurge) are wide spread in the riparian zone in lieu of NVCS type expected native herbaceous species. The NVCS does not encompass most of the new types being formed by plant invasions.

The 25 Associations at Grant-Kohrs comprise six accepted NatureServe Ecological Systems and two provisional Ecological Systems (Table 5). The Provisional Irrigated Pasture accounts for over half of the vegetated area of the Ranch. The five upland bunchgrass Associations belong to the Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland Ecological System and comprise a quarter of the vegetated area. The riparian zone is split among five Ecological Systems with the majority area taller woody Associations belonging to the Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland. The Rocky Mountain Alpine-Montane Wet Meadow and North American Arid West Emergent Marsh Ecological Systems only account for 4.3% of the vegetated area but add a large increment of biological diversity to the Ranch. The 2.4 acres of *Deschampsia caespitosa* Slickens Semi-natural Sparse Vegetation was designated as Pollution Altered Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (Provisional).

Table 5. Ecological Systems.

Ecological Systems & Their Associations	**%** & Acres
Irrigated Pasture (Provisional)	**58.0%**
(*Bromus inermis - Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis*) Irrigated Pasture Herbaceous Vegetation	753.0
Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland	**25.6%**
Pseudoroegneria spicata - Pascopyrum smithiia Herbaceous Vegetation	135.9
Hesperostipa comata - Bouteloua gracilis - Carex filifolia Herbaceous Vegetation	76.1
Pseudoroegneria spicata - Poa secunda Herbaceous Vegetation	72.6
Agropyron cristatum - (*Pascopyrum smithii, Hesperostipa comata*) Semi-natural Herbaceous Vegetation	45.3
Thinopyrum intermedium Semi-natural Herbaceous Vegetation	1.7
	331.6
Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland	**10.9%**
Salix geyeriana / Mesic Graminoids Shrubland	61.4
Salix exigua Temporarily Flooded Shrubland	33.8
Betula occidentalis Shrubland	22.9
Salix geyeriana / Carex utriculata Shrubland	19.9
Populus balsamifera / Mixed Herbs Forest	3.0
Populus balsamifera (ssp. *trichocarpa*, ssp. *balsamifera*) / *Symphoricarpos* (*albus, occidentalis, oreophilus*) Forest	0.6
	141.4
Rocky Mountain Alpine-Montane Wet Meadow	**3.2%**
Bromus inermis - (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation	21.8
Agrostis gigantea, stolonifera Semi-natural Herbaceous Vegetation	6.3

Carex aquatilis Herbaceous Vegetation	5.2
Juncus balticus Herbaceous Vegetation	3.2
Carex utriculata Herbaceous Vegetation	1.7
Carex pellita Herbaceous Vegetation	1.4
Equisetum fluviatile Herbaceous Vegetation	1.2
Eleocahris palustris Herbaceous Vegetation	0.9
Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation	0.3
	42.0
North American Arid West Emergent Marsh	**1.1%**
Typha (*latifolia, angustifolia*) Western Herbaceous Vegetation	13.8
Northwestern Great Plains Riparian	**0.7%**
Rocky Mountain Riparian Bar Sparse Vegetation	9.5
Rocky Mountain Lower Montane-Foothill Shrubland	**0.3%**
Symphoricarpos occidentalis Shrubland	4.0
Pollution Altered Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (Provisional)	**0.2%**
Deschampsia caespitosa Slickens Semi-natural Sparse Vegetation	2.4
Total Vegetated Acres	1,297.7

LITERATURE CITED by Chris Leas

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, Virginia. Available: http://www.natureserve.org/library/usEcologicalsystems.pdf

Environmental Systems Research Institute, National Center for Geographic Information and Analysis (University of California), and The Nature Conservancy. 1994. Accuracy Assessment Procedures. Report prepared for: United States Department of Interior National Biological Survey and National Park Service. Redlands, CA, Santa Barbara, CA, and Arlington, VA. Available: **http://biology.usgs.gov/npsveg/aa/index.html**

Foody, G. M. 1992. On the Compensation for Chance Agreement in Image Classification Accuracy Assessment. *Photogrammetric Engineering and Remote Sensing*, 58 (10): 1459-1460.

National Park Service. 2002. NPS AlaskaPak Toolkit for ArcView 3.x. Available: http://science.nature.nps.gov/nrgis/applications/gisapps/gis_tools/3x/alaskapak3.aspx

Peter Rice's Reference List

Brunsfeld SJ, Johnson FD. 1985. Field guide to the willows of east-central Idaho. University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, ID 83843: Forest, Wildlife and Range Experiment Station; Bulletin Number 39.

Dorn, Robert D. 1984. Vascular plants of Montana. Cheyenne, Wyoming: Mountain West Publishing. 276p

Hansen, Paul L.; Pfister, Robert D.; Boggs, Keith; Cook, Bradley J.; Joy, John; Hinckley, Dan K. 1995. Classification and management of Montana's riparian and wetland sites Volume Misc. Pub. 54. School of Forestry, University of Montana, Missoula, MT 59812: Montana Forest and Conservation Experiment Station: Miscellaneous Publication No. 54. xvi + 646 pp.

Heinze DH. 1994. Willows of Montana. Riparian Technical Bulletin No. 2 ed. Billings, MT: USDI Bureau of Land Management.

Hitchcock, C. L.; Cronquist, Arthur. 1973. Flora of the Pacific Northwest an illustrated manual. Seattle WA: University of Washington Press. 730p

Kapustka, L. A. 2002. Phytotoxicity tests on soils from the Grant-Kohrs Ranch National Historic Site, Deer Lodge, Montana: National Park Service & **e**cological **p**lanning and **t**oxicology, inc. http://www.nps.gov/grko/naturescience/disturbedlands.htm. 160p

Lackschewitz, Klaus. 1991. Vascular plant of west-central Montana-identification guidebook. Ogden, UT: USDA Forest Service Intermountain Research Station; General Technical Report: GTR INT-277. 648p

Lesica P, Husby P. 2001. Field guide to Montana's wetland vascular plants. Helena, MT: Montana Wetlands Trust.

Mueggler, W. F.; Stewart, W. L. 1980. Grassland and shrubland habitat types of western Montana. Ogden, UT: U.S.D.A. Forest Service, Intermountain Forest and Range Experiment Station. General Technical Report INT-66. Peter has a copy on the shelf. 154 p.

Rice, Peter M. 2002. Toxic metals-pH impact on riparian plant community structure at Grant-Kohrs Ranch. Deer Lodge, MT: NPS Grant-Kohrs NHS. 16p

Rice, Peter M.; Hardin, Janet. 2002a. Riparian plant community structure at Grant-Kohrs Ranch. Deer Lodge, MT: NPS Grant-Kohrs NHS. 24p

Rice, Peter M.; Hardin, Janet. 2002b. Vascular plant survey of Grant-Kohrs Ranch National Historic Site Deer Lodge, MT: NPS Grant-Kohrs NHS. 11p

Thornberry-Ehrlich, T. 2007. Denver, Colorado: National Park Service. Natural Resouce Teport NPS/NRPC/GRD/NRR2007/004. 34p

Appendices

A1. Project plant species list (indicator species cross-walked to ITIS)

A2. Final (post accuracy assessment) map class descriptions, local & global plant association descriptions

A3. Ecological system descriptions

A4. Plant association key

A5. Appendix Table xx. Crosswalk for community type names

A6. Field Data Collection Forms

A7. Accuracy assessment matrix

A8. Description of project database

A1. Project plant species list (indicator species cross-walked to ITIS)

Binomial in Regional Flora	Local Common Name	ITIS Binomial	ITIS #
Agropyron cristatum	crested wheatgrass	*Agropyron cristatum*	40371
Agrostis gigantea (syn. *Agrostis stolonifera* ssp. *gigantea*)	redtop	*Agrostis gigantea*	40414
Thinopyrum intermedium (syn. *Agropyron intermedium*)	intermediate wheatgrass	*Thinopyrum intermedium*	522540
Betula occidentalis	water birch	*Betula occidentalis*	19488
Bromus inermis	smooth brome	*Bromus inermis*	40502
Bouteloua gracilis	blue grama	*Bouteloua gracilis*	41493
Carex aquatilis	water sedge	*Carex aquatilis*	39374
Carex pellita (syn. *Carex lasiocarpa* var. *latifolia*)	Woolly sedge	*Carex pellita*	507767
Carex utriculata (syn. *Carex rostrata* var. *utriculata*)	Northwest Territory sedge	*Carex utriculata*	501288
Deschampsia caespitosa	tufted hairgrass	*Deschampsia caespitosa*	40586
Descurainia sophia	flixweed	*Descurainia sophia*	22843
Eleocharis palustris	common spikesedge	*Eleocharis palustris*	40019
Elymus repens (syn. *Agropyron repens*)	quackgrass	*Elymus repens*	512839
Equisetum fluviatile	water horsetail	*Equisetum fluviatile*	17150
Hesperostipa comata (syn. *Stipa comata*)	needle and thread grass	*Hesperostipa comata*	507974
Juncus balticus (syn. *Juncus arcticus* ssp. *littoralis*)	Baltic rush	*Juncus balticus*	39223
Nassella viridula (syn. *Stipa viridula*)	green needlegrass	*Nassella viridula*	507086
Pascopyrum smithii (syn. *Agropyron smithii*)	western wheatgrass	*Pascopyrum smithii*	504124
Phleum pratense	timothy	*Phleum pratense*	41062
Poa pratensis	Kentucky bluegrass	*Poa pratensis*	41088
Poa secunda (syn. *Poa sandbergii*)	curly bluegrass	*Poa secunda*	41103
Populus balsamifera spp. *trichocarpa* (syn. *Populus trichocarpa*)	black cottonwood	*Populus balsamifera* ssp. *trichocarpa*	22455
Pseudoroegneria spicata (syn. *Agropyron spicatum*)	bluebunch wheatgrass	*Pseudoroegneria spicata*	504637
Rosa woodsii	Woods rose	*Rosa woodsii*	24847
Salix bebbiana	Bebb willow	*Salix bebbiana*	22507
Salix boothii	Booth willow	*Salix boothii*	22509
Salix exigua	sandbar willow	*Salix exigua*	22529
Salix geyeriana	Geyer willow	*Salix geyeriana*	504965
Schedonorus pratensis (syn. *Festuca pratensis*)	meadow fescue	*Lolium pratense*	507983
Symphoricarpos occidentalis	western snowberry	*Symphoricarpos occidentalis*	35336
Typha latifolia	common cattail	*Typha latifolia*	42326

A2. Final (post accuracy assessment) map class descriptions, local & global plant association descriptions

Vegetation classification for National Park Service Vegetation Inventory projects follows the format of the National Vegetation Classification Standard, as maintained by the Federal Geographic Data Committee (FGDC). The FGDC maintains definitions of vegetation types to the hierarchical level of Formation. Units comprising the finer (floristic) levels, alliances and associations, are not currently recognized by FGDC. NatureServe (NatureServe 2007) maintains a provisional list of alliances and associations. The NPSVI uses this list for defining alliances and associations, to the extent practicable.

A common (and recommended) practice is to define local (park unit) vegetation units based on adequately replicated local observations (sample units) that represent a reasonably complete span of the floristic variability of each purported vegetation type, preferably from quantitative [releve] plot data. Vegetation types (usually, associations) are grouped by similarity to one another and by an appropriate level of floristic differences from other groups. These groups are then matched ("crosswalked") to the most similar units maintained by NatureServe (NatureServe 2007). In most cases, a suitable concept can be found.

The accuracy assessment found the map classes based on the original habitat types proposed for Grant-Kohrs Ranch National Historic Site to be about 29% accurate. In crosswalking to NVC associations recognized by NatureServe (2007), we realized that the original habitat type concepts were sometimes finer than NVC associations, possibly, in part, due to the mapping methodology, which sometimes appeared to constrain the observation areas by defining very small stands, and, in part, due to our inability to duplicate the field calls made by the mapping team at better than 29% (ie, it could be assumed that there was no remote sensing "error" so that all errors made during the mapping process were due to difficulties in interpreting and repeating the original ecological treatment. Examining the accuracy assessment contingency table for repeating patterns of confusion (groups of observations) that were also types that were ecologically similar, yielded several lumpings.

The *Salix bebbiana* Community Type and the *Salix geyeriana* Community Type, were merged to create the *Salix geyeriana* / Mesic Forbs Shrubland

The *Symphoricarpos occidentalis* Community Type and *Rosa woodsii* Community Type were merged to create the *Symphoricarpos occidentalis* Shrubland.

The *Agrostis stolonifera* Community Type, the *Agropyron repens* Community Type, the *Agropyron repens – Bromus inermis* Community Type, the *Agropyron repens – Phleum pratense* Community Type, the *Festuca pratensis* Community Type, the *Phleum pratense* Community Type, the *Poa pratensis* Community Type, the *Bromus inermis* Community Type, the *Bromus inermis – Phleum pratense* Community Type and the *Descurainia pinnata* Community Type were merged into the *(Bromus inermis – Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis)* Irrigated Pasture Herbaceous Vegetation. A large North Meadows pasture polygon dominated by *Juncus balticus* but with a significant presences of introduced grasses were also assigned to this provisional Irrigated Pasture Herbaceous vegetation type.

The *Agropyron spicatum* Herbaceous Alliance, the *Agropyron spicatum – Poa sandbergii* Habitat Type, the and the *Agropyron spicatum – Boutelua gracilis* Habitat Type were merged into the *Pseudoroegneria spicata – Poa secunda* Herbaceous Vegetation.

The *Agropyron spicatum – Agropyron smithii* Habitat Type and the *Agropyron spicatum – Agropyron smithii / Stipa comata* Phase were merged into *Pseudoroegneria spicata – Pascopyrum smithiia* Herbaceous Vegetation

Hierarchical Summary of NVCS for Grant-Kohrs Ranch National Historic Site

NVCS Association and Local Name

FORESTS AND WOODLANDS:

Populus balsamifera (ssp. *trichocarpa*, ssp. *balsamifera*) / *Symphoricarpos* (*albus, occidentalis, oreophilus*) Forest
= Black Cottonwood / Western Snowberry Forest
Populus balsamifera ssp. *trichocarpa* / Mixed Herbs Forest
= Black Cottonwood / Mixed Herbs Forest

SHRUBLANDS:

Betula occidentalis Shrubland
=Water Birch Shrubland
Salix exigua Temporarily Flooded Shrubland
=Sandbar Willow Shrubland
Salix geyeriana / Mesic Graminoids Shrubland
=Geyer's Willow / Mesic Graminoids Shrubland
Salix geyeriana / Carex utriculata Shrubland
=Geyer's Willow / Northwest Territory Sedge Shrubland
Symphoricarpos occidentalis Shrubland
=Western Snowberry Shrubland

UPLAND HERBACEOUS VEGETATION:

Hesperostipa comata – Bouteloua gracilis – Carex filifolia Herbaceous Vegetation
= Needle-and-Thread Grass – Blue Grama Mixedgrass Prairie
Thinopyrum intermedium Semi-natural Herbaceous Vegetation
= Intermediate Wheatgrass Semi-natural Herbaceous Vegetation
Agropyron cristatum - (*Pascopyrum smithii, Hesperostipa comata*) Semi-natural Herbaceous Vegetation
=Crested Wheatgrass Grassland
Pseudoroegneria spicata – Pascopyrum smithii Herbaceous Vegetation
=Bluebunch Wheatgrass – Western Wheatgrass Mixedgrass Prairie
Pseudoroegneria spicata – Poa secunda Herbaceous Vegetation
=Bluebunch Wheatgrass – Curly Bluegrass Mixedgrass Prairie

WETLAND & RIPARIAN HERBACEOUS VEGETATION:

Agrostis (*gigantea, stolonifera*) Semi-natural Herbaceous Vegetation
=(Giant Bentgrass, Spreading Bentgrass) Semi-natural Herbaceous Vegetation
Carex aquatilis Herbaceous Vegetation
=Aquatic Sedge Wet Meadow
Carex pellita Herbaceous Vegetation
=Woolly Sedge Wet Meadow
Carex utriculata Herbaceous Vegetation
= Northwest Territory Sedge Wet Meadow
Eleocharis palustris Herbaceous Vegetation
=Marsh Spikerush Wet Meadow
Juncus balticus Herbaceous Vegetation
=Baltic Rush Sedge Wet Meadow
Bromus inermis – (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation
=Smooth Brome – (Western Wheatgrass) Semi-natural Herbaceous Vegetation
Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation
= Kentucky Bluegrass Semi-natural Seasonally Flooded Herbaceous Vegetation
Equisetum fluviatile Herbaceous Vegetation
=Water Horsetail Wet Meadow
Typha (*latifolia, angustifolia*) Western Herbaceous Vegetation
=Broadleaf Cattail Marsh

PLANTED/CULTIVATED (CULTURAL) HERBACEOUS VEGETATION:

(*Bromus inermis – Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis*) Irrigated Pasture Herbaceous Vegetation
=Hayfield/Pasture

SPARSE VEGETATION:
Deschampsia caespitosa Slickens Semi-natural Sparse Vegetation
=Tufted Hairgrass Slickens
Rocky Mountain Riparian Bar Sparse Vegetation
=Riparian Bar

EXPLANATION OF FIELD NAMES USED IN VEGETATION ASSOCIATION DESCRIPTIONS

The association name, using Latin names of nominal taxa as conferred by NatureServe (2007) is listed first

COMMON NAME
The association name, using common (English) names of nominal taxa as conferred by NatureServe (2007)

LOCAL NAME
An additional descriptive name for the association is listed, if available.

CLASS
1997 National Vegetation Classification Standard (NVCS) Class assignment of association.

SUBCLASS
1997 NVCS Subclass assignment of association.

GROUP
1997 NVCS Subclass assignment of association.

SUBGROUP
1997 NVCS Subclass assignment of association.

FORMATION
1997 NVCS Subclass assignment of association.

ALLIANCE
The alliance assignment of the association, as conferred by NatureServe (2007).

ASSOCIATION IDENTIFIER
The unique alphanumeric identifier of the association, as conferred by NatureServe (2007) or a unique identifier assigned by National Park Service (eg., NPSGRKO001), if described from this or other NPS projects only.

USFWS WETLAND SYSTEM
The Cowardin et al. (1979) assignment of the association, including National Wetlands Inventory (NWI) mapping code, if applicable.

NS ECOLOGICAL SYSTEM
Most likely NatureServe Ecological System assignment for association at Grant-Kohrs Ranch National Historic Site (Comer et al. 2003) (NatureServe 2007).

RANGE
The global geographic range of the association (NatureServe 2007).

ENVIRONMENTAL DESCRIPTION
The environmental setting of the association, both at Grant-Kohrs Ranch National Historic Site, as defined by this study, and global, as defined by NatureServe (2007).

MOST ABUNDANT SPECIES
The most abundant species in each vegetation stratum for the association at Grant-Kohrs Ranch National Historic Site (as defined by this study).

CHARACTERISTIC SPECIES
Characteristic species for the association at Grant-Kohrs Ranch National Historic Site (as defined by this study).

VEGETATION DESCRIPTION

A qualitative description offthe vegetation (floristic) composition of the association, both at Grant-Kohrs Ranch National Historic Site (as defined by this study) and global (NatureServe 2007).

GLOBAL CLASSFICATION CONFIDENCE

A relative ranking of the confidence in the robustness of the association concept on a global scale (1=”Strong”; 2=”Moderate”; 3=”Weak” (NatureServe 2007).

CONSERVATION RANK

A ranking of the global abundance of the association (see Grossman et al. 1998 for symbol explanations) (NatureServe 2007).

SIMILAR ASSOCIATIONS

Distinguishing characters between the association and similar and/or intergrading associations that also occur at Grant-Kohrs Ranch National Historic Site (if applicable).

CLASSIFICATION COMMENTS

Discussion of association assignments as derived at Grant-Kohrs Ranch National Historic Site (if applicable). Also, discussion of distinguishing characters between the association and similar and/or intergrading associations that also occur at Grant-Kohrs Ranch National Historic Site (if applicable).

Populus balsamifera (ssp. *trichocarpa*, ssp. *balsamifera*) / *Symphoricarpos* (*albus, occidentalis, oreophilus*) Forest

COMMON NAME	(Black Cottonwood, Balsam Poplar) / (Common Snowberry, Western Snowberry, Mountain Snowberry) Forest
LOCAL NAME	Black Cottonwood / Western Snowberry Forest
CLASS	Forest (I)
SUBCLASS	Deciduous forest (I.B)
GROUP	Cold-deciduous forest (I.B.2)
SUBGROUP	Natural/Semi-natural cold-deciduous forest (I.B.2.N)
FORMATION	Temporarily flooded cold-deciduous forest (I.B.2.N.d)
ALLIANCE	*POPULUS BALSAMIFERA* SSP. *TRICHOCARPA* TEMPORAILY FLOODED FOREST ALLIANCE
ASSOCIATION IDENTIFIER	CEGL000677
USFWS WETLAND SYSTEM	Palustrine Forested broad-leaved decidous, temporarily flooded (PFO1A)
NS ECOLOGICAL SYSTEM	Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (CES306.804)

RANGE

Grant-Kohrs Ranch National Historic Site

One stand is on the south side of Cottonwood Creek, a second stand on Johnson Creek, and the other two stands are on the Clark Fork River floodplain but set back from the current river channel.

Global

This association is known from low-elevation, large rivers in Oregon, Washington, Idaho, western Wyoming, and British Columbia. It has been reported from Montana as part of another community [see Hansen et al. (1995)].

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

Cottonwood and Johnson Creeks have a steeper gradient that the Clark Fork River at the Ranch and may have been relatively isolated from intense grazing pressure.

Global

This late-seral association typically occurs at low elevations from 579 to 2040 m (1900-6693 feet) in broad mountain valleys and canyons of low- to moderate-gradient streams and rivers. The association occupies alluvial terraces and elevated streambanks with deep silty loam soils (over cobble and gravel) on infrequently flooded sites well above the average high-water line and summer water table.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Tree	*Populus balsamifera* ssp. *trichocarpa*
Shrub	*Salix geyeriana, Salix boothii, Symphoricarpos occidentalis, Ribes sp.*
Herbaceous	*Agrostis gigantea*

CHARACTERISTIC SPECIES

Populus balsamifera ssp. *trichocarpa*

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 2 accuracy assessment observations)

Populus balsamifera ssp. *trichocarpa* (= *P. trichocarpa*) was dominant in the tree layer. *Salix geyeriana* and *Salix boothii* were present in the shrub layer in both stands observed. *Ribes* sp. was present in one stand. The herbaceous layer was variable, with one stand apparently drier and dominated by alien weedy species (*Bromus inermis, Agrostis gigantea, Cirsium* sp., and several species of *Brassicaceae*), and the other apparently wetter and dominated by *Carex aquatilis* and *Agrostis gigantea*, with *Phleum pratense* and *Alopecurus aequalis* also present.

Global

Tall and mature *Populus balsamifera ssp. trichocarpa* form the open to closed overstory canopy, with occasional understory asexual reproduction and conifers present. Conifer species, especially *Pinus ponderosa* and *Pseudotsuga menziesii*, may indicate the potential successional pathway on these relatively dry terrace sites. The shrub layer is clearly dominated by one species of *Symphoricarpos*, either *Symphoricarpos albus, Symphoricarpos oreophilus*, or *Symphoricarpos occidentalis* (usually with at least 20% cover), although a variety of other tall and medium shrubs (all with cover less than *Symphoricarpos* sp.) are usually present. The most consistently prominent shrubs are *Acer glabrum, Amelanchier alnifolia, Crataegus douglasii, Philadelphus lewisii, Prunus virginiana, Rosa* spp., and *Rubus parviflorus*, the presence of which may reflect successional relationships with other alluvial terrace associations. The herbaceous layer is diverse, but has only moderate cover, and often includes exotic species indicative of past disturbance. Perennial grasses, especially *Elymus glaucus, Phalaris arundinacea*, and *Poa pratensis*, often codominate with various tall forbs and *Equisetum* spp. The most important forbs include *Clematis ligusticifolia, Heracleum maximum, Maianthemum* spp., *Wyethia amplexicaulis, Thalictrum occidentale, Urtica dioica, Geranium viscosissimum,* and *Helianthella uniflora*.

GLOBAL CLASSFICATION CONFIDENCE 1

CONSERVATION RANK G2

CLASSIFICATION COMMENTS

Association level assignment of stands dominated by *Populus balsamifera* ssp. *trichocarpa* at Grant-Kohrs Ranch National Historic Site is difficult because of the small amount of vegetation, history of disturbance, and the apparent lack of *Populus balsamifera* ssp. *trichocarpa* types that are dominated by obligate or facultative wetland species for Montana in the current floristic content of the NVCS (NatureServe 2007).

Populus balsamifera ssp. *trichocarpa* / Mixed Herbs Forest

COMMON NAME	Black Cottonwood / Mixed Herbs Forest
LOCAL NAME	Black Cottonwood / Mixed Herbs Forest
CLASS	Forest (I)
SUBCLASS	Deciduous forest (I.B)
GROUP	Cold-deciduous forest (I.B.2)
SUBGROUP	Natural/Semi-natural cold-deciduous forest (I.B.2.N)
FORMATION	Temporarily flooded cold-deciduous forest (I.B.2.N.d)
ALLIANCE	*POPULUS BALSAMIFERA* SSP. *TRICHOCARPA* TEMPORAILY FLOODED FOREST ALLIANCE
ASSOCIATION IDENTIFIER	CEGL000675
USFWS WETLAND SYSTEM	Palustrine Forested broad-leaved decidous, temporarily flooded (PFO1A)
NS ECOLOGICAL SYSTEM	Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (CES306.804)

RANGE

Grant-Kohrs Ranch National Historic Site

The largest "natural" stands of *Populus balsamifera* ssp. *trichocarpa* are along Cottonwood Creek in the southeast corner of the Ranch. A large anthropogenic stand along the railroad track was formed as a result excavation of fill to build the elevated railroad bed along the northeast side of the Ranch.

Global

This association is reported from Montana, Nevada, and Wyoming.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

The native herbaceous component of these *Populus balsamifera* ssp. *trichocarpa* stands was depleted by historic livestock grazing. The excavation pit created by building the elevated railroad bed is filled by groundwater and perhaps irrigation excess.

Global

This cold-deciduous riparian forest is common in low mountains and foothills. It occurs from 610 to 2013 m (2000-6591 feet) elevation on alluvial terraces and floodplains of major and minor rivers and streams. Soils are poorly developed, loamy to cobbly Entisols. It is thought to be a grazing-induced type; the trees are mature and the herbaceous layer predominantly dominated by non-native graminoid species.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Tree	*Populus balsamifera* ssp. *trichocarpa*
Herbaceous	*Agrostis gigantean, Bromus inermis*

CHARACTERISTIC SPECIES

Populus balsamifera ssp. *trichocarpa*

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 2 accuracy assessment observations)

Populus balsamifera ssp. *trichocarpa* (= *P. trichocarpa*) was dominant in the tree layer. The herbaceous layer was dominated by alien weedy species (*Bromus inermis, Agrostis gigantea, Cirsium* sp., and several species of *Brassicaceae*).

Global

This association is thought to be a grazing-induced type. The trees are mature and the herbaceous layer is predominantly dominated by non-native graminoid species. The canopy cover is *Populus balsamifera ssp.*

trichocarpa (= Populus trichocarpa) with 30-60% cover. *Populus angustifolia* and *Pinus ponderosa* may also be present in low amounts. There are very few shrubs and, if present, do not form a stratum layer. Scattered shrub species include *Ribes inerme, Lonicera involucrata, Cornus sericea, Rosa woodsii,* and *Rubus idaeus.* The herbaceous layer is dominated by either non-native graminoids or increaser species such as *Phleum pratense, Poa pratensis, Bromus vulgaris,* and *Elymus glaucus.* Forbs present include *Tanacetum vulgare, Centaurea biebersteinii (= Centaurea maculosa), Urtica dioica, Thalictrum, Aconitum columbianum, Angelica arguta, Fragaria virginiana, Galium boreale, Geranium viscosissimum, Rudbeckia occidentalis,* and *Achillea millefolium.*

GLOBAL CLASSFICATION CONFIDENCE 2

CONSERVATION RANK G3?

CLASSIFICATION COMMENTS

Association level assignment of stands dominated by *Populus balsamifera* ssp. *trichocarpa* at Grant-Kohrs Ranch Natiuonal Historic Site is difficult because of the small amount of vegetation, history of disturbance, and the apparent lack of *Populus balsamifera* ssp. *trichocarpa* types that are dominated by obligate or facultative wetland species for Montana in the current floristic content of the NVCS (NatureServe 2007). The constant presence of *Salix* in the understory of both stands observed in the accuracy assessment and prevalence of wetland species in one stand seem to justify attribution of this poorly understood concept as the best fit available.

Salix exigua Temporarily Flooded Shrubland

COMMON NAME	Coyote Willow Temporarily Flooded Shrubland
LOCAL NAME	Coyote Willow Shrubland
CLASS	Shrubland (III)
SUBCLASS	Deciduous shrubland (III.B)
GROUP	Cold-deciduous shrubland (III.B.2)
SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N)
FORMATION	Temporarily flooded cold-deciduous shrubland (III.B.2.N.d)
ALLIANCE	*SALIX (EXIGUA, INTERIOR)* TEMPORARILY FLOODED SHRUBLAND ALLIANCE
ASSOCIATION IDENTIFIER	CEGL001197
USFWS WETLAND SYSTEM	Palustrine Scrub-Shrub broad-leaved deciduous, temporarily flooded (PSS1A)
NS ECOLOGICAL SYSTEM	Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (CES306.804)

RANGE

Grant-Kohrs Ranch National Historic Site

There are numerous large stands of *Salix exigua* immediately adjacent to the river and two stands along Cottonwood Creek. Additional smaller stands are scattered throughout the floodplain. Several long narrow stands parallel the railroad bed in the northeast sector of the Ranch

Global

This willow shrubland association is found along rivers and streams at lower elevations throughout the western United States and Great Plains, ranging sporadically from Oklahoma northwest to the Dakotas and Manitoba, west to Washington, and south to the Rio Grande, San Juan and Canadian River watersheds in northern New Mexico. In California, this association has been sampled along the Sacramento River, in the Central Coast Ranges, northern and central Sierra Nevada foothills, and Cascade Range foothills. Part of this type's former range in the Great Plains and eastward is actually occupied, at least in part, by *Salix interior* [see *Salix interior* Temporarily Flooded Shrubland (CEGL008562)].

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

The local common name for *Salix exigua* is sandbar willow. Although *Salix exigua* is a primary colonizer of new river deposits, at the Ranch there are areas not abutting the current river channel where irrigation flowback still provides favorable habitat for *Salix exigua*. Excavation for the railroad bed and standing water in a portion of this borrow pit promoted the development of *Salix exigua* thickets.

Global

This association 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. In New Mexico, this association occurs along wide, low-gradient streams and rivers in foothill regions and in lowland valleys and canyons at low to mid elevations of 1430 to 1910 m (4700-6250 feet). The type is common on low alluvial bars that are subject to repeated flooding (1- to 5-year recurrence intervals). Soils are poorly stratified and generally consist of a thin layer of sandy loam at the surface overlying deep deposits of sand, gravel, or cobble. Rock fragments comprise upwards of 80% of the soil profile. These well-drained soils provide good aeration and rapid movement of water through the profile. Sites composed mostly of riverwash are moist at the surface for much of the season, while high bars may be dry on the surface, but tend to be moist at depths of 15 to 30 cm (6-12 inches) during most years.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Shrub	*Salix exigua, Betula occidentalis*
Herbaceous	*Cirsium arvense*

CHARACTERISTIC SPECIES

Salix exigua

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 3 accuracy assessment observations)

Salix exigua was dominant in the shrub layer. Other shrubs present were *Betula occidentalis* (2 stands), *Salix geyeriana*, and *Ribes* sp. (1 stand each). The herbaceous layer was variable, but generally dominated by weedy alien and native facultative or upland species, including *Cirsium arvense* (2 stands), *Juncus balticus* (= *J. arcticus* ssp. *littoralis*), *Poa pratensis*, *Agrostis gigantea*, and *Euphorbia esula* (1 stand each). *Elymus repens*, *Iris missouriensis*, and *Phleum pretense* were each present in one stand at low cover.

Global

This association is dominated by shrubs, generally between 2 and 4 m tall. The most common of these is *Salix exigua* (*Salix interior* or intermediates of the two willow species may be present in the eastern part of the range). *Salix irrorata, Salix lutea*, and saplings of *Populus deltoides* or *Salix amygdaloides* are also frequently found in the shrub layer in lower elevation stands. *Populus balsamifera* seedlings become more common in northern and western stands. This stratum can have moderate to high stem density in the association 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 association are *Cenchrus longispinus, Polygonum lapathifolium, Schoenoplectus americanus (= Scirpus americanus), Triglochin maritima, Xanthium strumarium, Juncus balticus, Eleocharis palustris, Elymus repens (= Elytrigia repens), Poa pratensis, Phleum pratense, Agrostis scabra, Bromus inermis, Heracleum maximum, Achillea millefolium, Solidago* sp., *Equisetum arvense*, and *Linaria vulgaris.*

GLOBAL CLASSFICATION CONFIDENCE 1

CONSERVATION RANK G5

CLASSIFICATION COMMENTS

Without plot data with more floristic and environmental detail, the treatment and NVCS assignment of riparian shrubland stands at Grant-Kohrs Ranch National Historic Site is difficult because of mixed dominance of various *Salix* species together and with *Betula occidentalis*. Because *Salix exigua* is usually more distinct in its environmental preference from the other *Salix* present at this site (prefering active stream channels versus floodplains and less hydrologically active wetlands for other *Salix* and *B. occidentalis*), it was decided to retain this type as distinct. However, the association of *S. exigua* with upland species and other riparian shrubs at Grant-Kohrs Ranch National Historic Site may support treating these stands as a mixed willow type with patchy *S. exigua* present at high cover.

Salix geyeriana / Mesic Graminoids Shrubland

COMMON NAME	Geyer's Willow / Mesic Graminoids Shrubland
LOCAL NAME	Geyer's Willow / Mesic Graminoids Shrubland
CLASS	Shrubland (III)
SUBCLASS	Deciduous shrubland (III.B)
GROUP	Cold-deciduous shrubland (III.B.2)
SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N)
FORMATION	Temporarily flooded cold-deciduous shrubland (III.B.2.N.d)
ALLIANCE	*SALIX GEYERIANA* TEMPORARILY FLOODED SHRUBLAND ALLIANCE
ASSOCIATION IDENTIFIER	CEGL001210
USFWS WETLAND SYSTEM	Palustrine Scrub-Shrub broad-leaved deciduous, temporarily flooded (PSS1A)
NS ECOLOGICAL SYSTEM	Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (CES306.804)

RANGE

Grant-Kohrs Ranch National Historic Site

Salix geyeriana / Mesic Graminoids Shrubland is one of the most abundant types on the Clark Fork River floodplain. There are also large stands along Johnson Creek.

Global

This association is widely distributed in the West at mid to high elevations, ranging from Idaho, Wyoming, Utah, Nevada, Colorado, and possibly California, Montana and Oregon. This may be the first documentation from Montana.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

The *Salix geyeriana /* Mesic Graminoids Shrubland develops and persists on the better drained portions of the floodplain.

Global

This riparian shrubland association is found in Idaho, Oregon, Montana, Utah, Colorado, and northwestern Wyoming. Stands of this association are often found in wide mountain valleys, cirques, and troughs, at elevations from about 1525 to 3000 m (5000-9900 feet), with narrow, meandering streams or braided rivers. The association mainly occurs on seasonally saturated or flooded sites, such as streambanks, terraces, floodplains, abandoned meanders, spring-fed meadows, lake or reservoir shores, and occasionally alluvial gravel bars. Soils vary but are mostly moderately well-drained to poorly drained, silt to clay loams with organic/sedge peat horizons. Ground surface has high cover of litter and duff.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Shrub	*Salix geyeriana, Salix boothii*
Herbaceous	*Carex aquatilis, Juncus balticus* (= *J. arcticus* ssp. *littoralis*), *Agrostis gigantea*

CHARACTERISTIC SPECIES

Salix geyeriana, Salix boothii, Salix bebbiana, Carex aquatilis

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 14 accuracy assessment observations)

Salix geyeriana was the leading dominant or a co-dominant shrub, with *Salix boothii* usually present and often co-dominant. *Salix bebbiana* was dominant or co-dominant in a small number of stands. Other shrubs that may occur, usually at low cover, if present, include *Alnus incana ssp. tenuifolia, Betula occidentalis, Salix exigua, Cornus sericea,* and *Symphoricarpos occidentalis. Carex aquatilis* was usually present and important to dominant in the herbaceous layer, with *Juncus balticus* (= *J. arcticus* ssp. *littoralis*) and *Agrostis gigantea* often present to co-dominant.

Global

This plant association is a tall (2-5m), deciduous shrubland with an open to nearly closed canopy of clumped willows and a thick layer of sedges and grasses in the undergrowth. Dominance of *Salix geyeriana* (20-70% cover), occasionally intermixed with *Salix boothii* (with <20% cover), characterizes this association. Other shrubs, including *Alnus incana ssp. tenuifolia, Dasiphora fruticosa ssp. floribunda, Ribes inerme, Ribes lacustre, Rosa woodsii*, and other *Salix* spp. such as *Salix drummondiana, Salix lemmonii, Salix lucida ssp. lasiandra (= Salix lasiandra), Salix monticola, Salix planifolia*, or *Salix wolfii*, are scattered around the bases of taller *Salix* clumps. The herbaceous understory is dominated by a diverse mix of mesic graminoid species that always has greater total cover than the total cover of mesic forbs. In good-condition, mid- to late-seral stands, the most common graminoids are *Carex microptera, Carex pellita, Deschampsia caespitosa*, and occasionally *Carex nebrascensis*, but no single species consistently has high cover. Other graminoids with low to moderate cover and constancy include *Bromus porteri, Calamagrostis canadensis, Carex aquatilis, Carex athrostachya, Carex pellita (= Carex lanuginosa), Carex praegracilis, Carex rostrata, Carex simulata, Carex subnigricans, Carex utriculata, Elymus glaucus, Festuca thurberi, Hordeum jubatum, Glyceria* spp., *Juncus balticus, Juncus orthophyllus*, and *Muhlenbergia richardsonis.* Introduced grasses *Phalaris arundinacea*, *Phleum pratense*, and *Poa pratensis* are frequently present, but their cover varies depending on the amount of grazing disturbance and site desiccation. Stands in poor condition need to be codominated by a mixture of native graminoids (not a single species such as *Deschampsia caespitosa*) with the introduced graminoids and forbs. The most common forb species are sometimes indicative of grazing disturbance. Associated species include *Achillea millefolium, Antennaria* spp., *Caltha leptosepala, Cirsium* sp., *Geum macrophyllum, Iris missouriensis, Maianthemum stellatum, Pedicularis groenlandica, Penstemon* spp., *Polygonum bistortoides, Potentilla gracilis, Thalictrum* spp., *Taraxacum officinale, Trifolium* spp., *Urtica dioica, Veronica* sp., and *Vicia americana*.

GLOBAL CLASSFICATION CONFIDENCE 2

CONSERVATION RANK G3?

CLASSIFICATION COMMENTS

Classification of willow stands at Grant-Kohrs Ranch National Historic Site into types with monospecific shrub layer dominance was problematic without plot data and with the accuracy assessment showing poor success as distinguishing them. Similar problems were encountered in attempting to classify based on the herbaceous layer. Until more data from the site are available, it seems best to recognize willow types with dominance other than *Salix exigua* as one mesic and one wet type, with mixed dominance at the site scale (or variable dominance at the stand scale). *S. geyeriana* is clearly the most frequent shrub dominant, although frequent dominance to co-dominance by *S. boothii* suggests a mixed association may be warranted, rather than a strictly S. *geyeriana*-dominated type. Hansen et al 1995 are explicit that the western Montana *S. geyeriana* types often have codominant *S. boothii* or even are dominated by *S. boothii* and they consider these two as “ecologically equivalent” hence they did not classify separate *S. boothii* types. This duality is discussed in the NatureServe description for this drier *S. geyeriana* type, and *S. boothii* is at least mentioned by NatureServe for the wetter *Salix geyeriana* / *Carex utriculata* Shrubland type. This willow duality is incorpoated in the current NatureServe classification system and was not an artifact of our assessment methods. *Salix bebbiana* achieves co-dominance in a minority of stands, but its usual occurrence with *S. geyeriana* suggests that this situation is best treated as patch dominance within a *Salix geyeriana* type.

This type represents the drier (mesic) stands dominated by some combination of *Salix geyeriana, Salix bebbiana*, and/or *Salix boothii*. *Salix geyeriana, Salix bebbiana*, and/or *Salix boothii*. *Salix (boothii, geyeriana) / Carex aquatilis Shrubland* (CEGL001176), *Salix boothii - Salix geyeriana Shrubland* (CEGL001184) might also be reasonable treatments for this vegetation.

Symphoricarpos occidentalis Shrubland

COMMON NAME	Western Snowberry Shrubland
LOCAL NAME	Western Snowberry Shrubland
CLASS	Shrubland (III)
SUBCLASS	Deciduous shrubland (III.B)
GROUP	Cold-deciduous shrubland (III.B.2)
SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N)
FORMATION	Temporarily flooded cold-deciduous shrubland (III.B.2.N.d)
ALLIANCE	*SYMPHORICARPOS OCCIDENTALIS* TEMPORARILY FLOODED SHRUBLAND
ASSOCIATION IDENTIFIER	CEGL001131
USFWS WETLAND SYSTEM	Upland
NS ECOLOGICAL SYSTEM	Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)

RANGE

Grant-Kohrs Ranch National Historic Site

This minor type is found at the Ranch immediately adjacent or proximal to the Clark Fork River.

Global

This western snowberry shrubland is found in the western tallgrass, the northern Great Plains, and in the foothills of the northern Rocky Mountains of the United States and Canada.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

These *Symphoricarpos occidentalis* Shrubland polygons may flood during high water years but the sites are well drained.

Global

This association is found in mesic swales, depressions, ravines and floodplains. Some examples of this association experience intermittent and brief flooding. In Glacier National Park, it occurs at 1022-1092 m (3350-3580 feet) elevation. 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 and Walford 1995).

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Shrub	*Symphoricarpos occidentalis*, *Rosa woodsii*
Herbaceous	Variable

CHARACTERISTIC SPECIES

Symphoricarpos occidentalis

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 2 accuracy assessment observations)

Symphoricarpos occidentalis was dominant in the shrub layer. *Rosa woodsii* was present in both stands and *Salix geyeriana*, *Salix boothii*, and *Salix exigua* were present in one stand each. In the herbaceous layer, Poa pratensis was dominant in one stand. Other species present included *Juncus balticus* (= *J. arcticus* ssp. *littoralis*), *Deschampsia caespitosa*, *Equisetum fluviatile*, *Bromus inermis*, *Pascopyrum smithii*, *Thapsus* sp. and *Descurainia* sp.

Global

Throughout its range this association 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 trilobata* and *Prunus virginiana*

can be locally abundant and can grow to 2-3 m in places. *Toxicodendron rydbergii, Amelanchier alnifolia, Rubus idaeus,* and *Rosa acicularis* may also be present. Herbaceous species and smaller shrubs are most abundant at the edges of this association 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, Calamagrostis canadensis, Calamagrostis rubescens, Achnatherum nelsonii,* and *Poa pratensis*. *Achillea millefolium, Artemisia ludoviciana, Galium boreale,* and *Solidago* spp. are common forbs of this association. Woody vines sometimes occur, including *Parthenocissus vitacea*.

GLOBAL CLASSFICATION CONFIDENCE	3
CONSERVATION RANK	G4G5

Betula occidentalis Shrubland

COMMON NAME	Water Birch Shrubland
LOCAL NAME	Water Birch Shrubland
CLASS	Shrubland (III)
SUBCLASS	Deciduous shrubland (III.B)
GROUP	Cold-deciduous shrubland (III.B.2)
SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N)
FORMATION	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e)
ALLIANCE	*BETULA OCCIDENTALIS* SEASONALLY FLOODED SHRUBLAND ALLIANCE
ASSOCIATION IDENTIFIER	CEGL001080
USFWS WETLAND SYSTEM	Palustrine Scrub-Shrub broad-leaved deciduous, seasonally flooded (PSS1C)
NS ECOLOGICAL SYSTEM	Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (CES306.804)

RANGE

Grant-Kohrs Ranch National Historic Site

Betula occidentalis Shrubland is a common type along much of the upper Clark Fork. It is the major component in the Clark Fork floodplain in the south half of the Ranch. It is present but less extensive in the north half of the Ranch.

Global

This association is known from mountainous regions of Washington, Idaho, Montana, Wyoming, north into Alberta, and may extend south into Colorado and Nevada.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

Thin soils overlay river cobbles and gravel and the close proximity to the river allows the roots to reach the water table although the upper soil profile is well drained.

Global

This shrubland occupies moderately wide stream benches and floodplains in narrow to moderately wide valleys and hillside seeps in mountains and foothills, as well as on stream banks and canyon bottoms in the Colorado Plateau. It is found primarily along fast-moving, moderate- to high-gradient mountain and foothill streams, although in the Colorado Plateau it occurs more frequently on low-gradient perennial or intermittent streams. Elevation ranges from 910 to 2700 m (2975-6630 feet). Stands also occur along small floodplains of steep-gradient, narrow streams where the valley sideslope meets the stream edge. In high-gradient situations, the community often occurs as narrow, linear stringers where *Betula occidentalis* forms a closed canopy crowding the streambank. Broader stands occur around seeps adjacent to the stream channel, or along isolated springs on hillslopes away from the valley bottom, and on the floodplains of low-gradient streams. Surface water is present for extended periods during the growing season. After flooding ceases, the water table is variable and ranges from nearly saturated to well below the ground surface.

Soils are fairly shallow, ranging from 30 cm to greater than 60 cm, often overlying river cobbles. Most soils have a surface layer of 50-90% organic matter. Subsurface layers range from loam to sand with abundant gravel throughout the profile (Hansen et al. 1995). Skeletal layers, derived from alluvium, occur at a greater depth. In the northern range of Yellowstone National Park, soils typically have a large ash component. Stands along narrow, steep stream channels occur between large alluvial and colluvial boulders and have almost no soil development.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Shrub	*Betula occidentalis*
Herbaceous	Variable

CHARACTERISTIC SPECIES

Betula occidentalis

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 7 accuracy assessment observations)

Betula occidentalis was dominant or co-dominant in the shrub layer in all stands. *Salix geyeriana* (co-dominant in one stand), *Salix exigua*, and *Alnus incana* ssp. *tenuifolia* were present in at least two stands, and *Symphoricarpos occidentalis* (co-dominant), *Salix boothii, Prunus virginiana*, and *Ribes* sp. were seen in one stand each. The herbaceous layer composition was variable, with *Poa* but generally dominated by weedy alien and native facultative or upland species, including *Agrostis gigantea, Elymus repens, Poa pratensis, Cirsium arvense, Juncus balticus* (= *J. arcticus* ssp. *littoralis*), *Phleum pretense*, and *Euphorbia esula* most frequently reported. *Solidago* sp., *Bromus inermis, Carex pellita*, and *Deschampsia caespitosa* were also reported.

Global

Betula occidentalis forms a nearly continuous tall-shrub to small-tree canopy with 10-90% cover. Other shrub species include *Alnus incana, Cornus sericea, Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda), Salix exigua, Shepherdia argentea, Jamesia americana, Amelanchier utahensis, Juniperus scopulorum, Prunus virginiana, Rhus trilobata, Salix boothii*, and *Salix monticola*. Along narrow valleys at higher elevations, conifers may overhang the stream edge. At lower elevations, *Populus balsamifera ssp. trichocarpa, Populus tremuloides*, and other *Populus* species may be present. Conifer species present include *Pseudotsuga menziesii, Abies lasiocarpa*, and *Picea pungens*. If the shrub canopy is dense, herbaceous undergrowth will be limited; if open, the herbaceous layer can be abundant. Herbaceous species are typically weedy or adapted to frequent disturbance. Herbaceous-rich stands generally have equal amounts of forb and graminoid cover. Forb species can include *Maianthemum stellatum, Heracleum sphondylium, Thalictrum fendleri, Equisetum arvense, Mentha arvensis, Solidago gigantea*, and *Rudbeckia laciniata*. Graminoid species include *Calamagrostis canadensis, Poa palustris, Carex utriculata, Carex pellita (= Carex lanuginosa), Carex microptera, Carex nebrascensis, Glyceria* spp., and *Juncus balticus*. Introduced species typically present include *Cirsium arvense, Taraxacum officinale, Agrostis stolonifera*, and *Poa pratensis*.

GLOBAL CLASSFICATION CONFIDENCE 2

CONSERVATION RANK G3

Salix geyeriana / Carex utriculata Shrubland

COMMON NAME	Geyer's Willow / Northwest Territory Sedge Shrubland
LOCAL NAME	Geyer Willow / Northwest Territory Sedge Shrubland
CLASS	Shrubland (III)
SUBCLASS	Deciduous shrubland (III.B)
GROUP	Cold-deciduous shrubland (III.B.2)
SUBGROUP	Natural/Semi-natural cold-deciduous shrubland (III.B.2.N)
FORMATION	Seasonally flooded cold-deciduous shrubland (III.B.2.N.e)
ALLIANCE	*SALIX GEYERIANA* SEASONALLY FLOODED SHRUBLAND ALLIANCE
ASSOCIATION IDENTIFIER	CEGL001207
USFWS WETLAND SYSTEM	Palustrine Scrub-Shrub broad-leaved deciduous, seasonally flooded (PSS1C)
NS ECOLOGICAL SYSTEM	Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (CES306.804)

RANGE

Grant-Kohrs Ranch National Historic Site

Salix geyeriana / Carex utriculata Shrubland polygons are present on the floodplains of the Clark Fork River, Cottonwood Creek, along Spring Slough on the east side of the Ranch, and the railroad bed borrow pit area to the northeast.

Global

This association has been document in Colorado, Idaho, Montana, Nevada, Oregon, Utah and Wyoming.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

These are less well drained portions of the floodplain, often receiving flowback water from irrigation, canals, and active sloughs.

Global

Throughout its distribution, this association occurs in mountains and high valleys at elevations ranging from 1310 to 2740 m (4300-9000 feet). This is the wettest of the *Salix geyeriana*-dominated willow shrublands. It is most common on broad, level floodplains but does occur in narrow bands along smaller streams in open U-shaped valleys. Valley bottom gradients are usually low. Surface microtopography is often hummocky as a result of the irregular buildup of organic material. Hydrology of these sites is usually maintained through subirrigation, and soil moisture is maintained at or near the surface in most cases. These sites may or may not be annually flooded during high water in the spring and early summer. This association occurs on a range of soil types that are typically wet, cold, and organic or have organic surface horizons. They are generally classified as Mollisols and Histisols. Organic surface horizons, often extending to a depth of 45 cm (18 inches) or more, are riddled with fibrous roots and plant material. Soil textures are categorized as fine, generally silts and clays. Deeper alluvial mineral deposits are comprised of coarse and fine sands and gravels. The soils are usually mottled, indicating seasonal flooding and water table recession.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Shrub	*Salix geyeriana*
Herbaceous	*Carex utriculata, Typha latifolia*

CHARACTERISTIC SPECIES

Salix geyeriana, *Carex utriculata*

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 8 accuracy assessment observations)

Salix geyeriana was the leading dominant shrub. Other shrubs that may occur, usually at low cover, if present, include *Alnus incana ssp. tenuifolia, Betula occidentalis, Salix exigua*, and/or *Cornus sericea*. *Carex utriculata* was dominant or co-dominant in the herbaceous layer, with *Typha latifolia* occasionally dominant or co-dominant. Other frequent herbaceous species were *Carex aquatilis*, *Juncus balticus* (= *J. arcticus* ssp. *littoralis*) and *Agrostis gigantea*.

Global

Salix geyeriana dominates the overstory and can have large, often widely spaced clumps. *Salix geyeriana* can be as much as 3 m tall. A diversity of other shrubs may be present but usually in low amounts. Some of these subordinate shrubs are present in the upper canopy along with *Salix geyeriana*, such as *Salix boothii, Salix drummondiana, Salix monticola*, and *Alnus incana*. Often there are shorter shrubs present but usually with not more than 20% cover. Shorter shrub species include *Salix planifolia, Salix wolfii, Betula nana (= Betula glandulosa), Ribes inerme, Lonicera involucrata*, and *Dasiphora fruticosa ssp. floribunda (= Potentilla fruticosa)*. *Carex utriculata* clearly dominates the understory. Other sedges and grasses, such as *Carex aquatilis, Carex interior, Carex scopulorum, Carex simulata, Carex praegracilis*, or *Calamagrostis canadensis*, may be present, but they have low cover. Forb species are sparse, but *Geum macrophyllum* appears to be the most constant species across the range of this type.

GLOBAL CLASSFICATION CONFIDENCE 1

CONSERVATION RANK G5

CLASSIFICATION COMMENTS

Classification of willow stands at Grant-Kohrs Ranch National Historic Site into types with monospecific shrub layer dominance was problematic without plot data and with the accuracy assessment showing poor success as distinguishing them. Similar problems were encountered in attempting to classify based on the herbaceous layer. Until more data from the site are available, it seems best to recognize willow types with dominance other than *Salix exigua* as one mesic and one wet type, with mixed dominance at the site scale (or variable dominance at the stand scale). *S. geyeriana* is clearly the most frequent shrub dominant, although frequent dominance to co-dominance by *S. boothii* suggests a mixed association may be warranted, rather than a strictly S. *geyeriana*-dominated type. Hansen et al 1995 are explicit that the western Montana *S. geyeriana* types often have codominant *S. boothii* or even are dominated by *S. boothii* and they consider these two as "ecologically equivalent" hence they did not classify separate *S. boothii* types. This duality is discussed in the NatureServe description for this drier *S. geyeriana* type and *S. boothii* is at least mentioned by NatureServe for the wetter *Salix geyeriana* / *Carex utriculata* Shrubland type. This willow duality is incorpoated in the current NatureServe classification system and was not an artifact of our assessment methods. *Salix bebbiana* achieves co-dominance in a minority of stands, but its usual occurrence with *S. geyeriana* suggests that this situation is best treated as patch dominance within a *Salix geyeriana* type.

This type represents the wetter (hydric) stands with *Salix geyeriana* dominance or co-dominance.

Hesperostipa comata – Bouteloua gracilis – Carex filifolia Herbaceous Vegetation

COMMON NAME	Needle-and-Thread - Blue Grama - Threadleaf Sedge Herbaceous Vegetation
LOCAL NAME	Needle-and-Thread - Blue Grama Mixedgrass Prairie
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural (V.A.5.N)
FORMATION	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c)
ALLIANCE	*HESPEROSTIPA COMATA – BOUTELOUA GRACILIS* HERBACEOUS ALLIANCE
ASSOCIATION IDENTIFIER	CEGL002037
USFWS WETLAND SYSTEM	Upland
NS ECOLOGICAL SYSTEM	Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040)

RANGE

Grant-Kohrs Ranch National Historic Site

This *Hesperostipa comata* community is limted to the uplands in the southwest quadrant of the Ranch where it is prevalent in the Upper Northwest and Taylor Ridge Ranges, and along the crest of the Gravel Pit Range.

Global

This needlegrass - grama grass prairie community is common in the northern and central Great Plains of the United States and Canada, ranging from Manitoba west to Alberta, south to Kansas and possibly Colorado.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

These are harsh xeric sites on coarse poorly developed soil. In some areas the surface is armored with pebbles indicating the wind swept nature of these west side uplands.

Global

Stands occur on flat to rolling topography with deep (40-100 cm) sandy loam to loam soils. They are typically associated with uplands, though they may also occur lower in the landscape, such as coulee and draw bottoms, if soils are sufficiently coarse (usually sandstone derived). Even though it is a major association in the Northern Plains, it does not occur in areas dominated exclusively by shale and mudstone parent materials, from which heavy soils are derived. This type is found at elevations ranging from 600 to 1700 m (2000-5500 feet); average annual precipitation associated with these elevation parameters ranges from slightly less than 25 cm to over 50 cm (10 to 20 inches).

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Shrub (Dwarf)	*Artemisia frigida*
Herbaceous	*Hesperostipa comata*

CHARACTERISTIC SPECIES

Hesperostipa comata

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 11 accuracy assessment observations)

Hesperostipa comata is dominant in the herbaceous layer. *Pascopyrum smithii, Bouteloua gracilis,* and *Poa secunda* (= *Poa sandbergii*) are the most frequent associates. The invasive alien *Bromus tectorum* occurs at high cover in some stands. A sparse dwarf shrub layer may be present, with *Artemisia frigida, Krascheninnikovia lanata,* and *Gutierrezia sarothrae* most frequent.

Global

The vegetation is dominated by moderately dense graminoids that are usually between 0.5 and 1 m tall. For example, on 19 stands in west-central Montana the cover by the different strata was as follows: shrubs 6%, graminoids 67%, forbs 11%, bryophytes 14%, litter 55%, rock 4%, bare soil 9% (Mueggler and Stewart 1980). Thilenius et al. (1995) found that the average cover on 14 stands in eastern Wyoming was 42%. *Hesperostipa comata (= Stipa comata)* is the tallest of the dominant species, sending seed heads to a maximum height of approximately 1 m. The rhizomatous graminoids *Bouteloua gracilis* and *Carex filifolia*, the other two dominant/codominant species, do not usually exceed 0.5 m. *Calamovilfa longifolia* is often found with high cover values on sandier soils and *Koeleria macrantha* cover increases on degraded sites. There are regionalized expressions of variability with *Carex inops ssp. heliophila* surpassing *Carex filifolia* in Colorado and *Calamagrostis montanensis* being at least as important as the diagnostic species in north-central Montana. *Pascopyrum smithii* is consistently present. For woody species, subshrub forms (*Artemisia frigida, Gutierrezia sarothrae, Rosa arkansana*) have the highest cover and constancy but their total cover does exceed more than 5%, except on overgrazed sites. Cover values for forbs are low throughout the range of the type (the exception being *Selaginella densa*). Geographic setting does influence forb composition to some degree. *Sphaeralcea coccinea, Phlox hoodii, Heterotheca villosa, Gaura coccinea,* and *Liatris punctata,* have high constancy values in northern areas, whereas in the eastern and southern portions of the range *Lygodesmia juncea, Opuntia polyacantha, Artemisia dracunculus* and *Ratibida columnifera* seems to be more constant.

GLOBAL CLASSFICATION CONFIDENCE 1

CONSERVATION RANK G5

CLASSIFICATION COMMENTS

The taxonomic disposition of this vegetation at Grant-Kohrs Ranch National Historic Site is enigmatic. *Carex filifolia* was not recorded in accuracy assessment and *Bouteloua gracilis* was inconstant and generally at low cover, when present. Mueggler and Stewart 1980 split their *Stipa comata* (*Hesperostipa comata*) series into two phases, a simple *Stipa comata*/*Bouteloua gracilis* type for 7 stands where they never observed *Carex filifolia* and the constancy of *Bouteloua gracilis* was 86%; then 19 stands of an *Stipa comata*/*Bouteloua gracilis Agropyron* (*Pascopyrum*) *smithii* phase where *Carex filifolia* did have a constancy of 84%. The vegetation has elements of the *Krascheninnikovia lanata / Hesperostipa comata* Dwarf-shrubland (CEGL001327), but *Krascheninnikovia lanata* is inconstant and at low cover, when it does occur. Mueggler and Stewart recognized a *Stipa comata* phase of the *Pseudoroegneria spicata – Poa secunda* Habitat Type (= *Pseudoroegneria spicata – Poa secunda* Herbaceous Vegetation), which has elements of this vegetation; thus, the *Hesperostipa comata* dominated vegetation at vegetation Grant-Kohrs Ranch National Historic Site might be regarded as a grazing-induced variant of that type.

Thinopyrum intermedium Semi-natural Herbaceous Vegetation

COMMON NAME	Intermediate Wheatgrass Semi-natural Herbaceous Vegetation
LOCAL NAME	Intermediate Wheatgrass Grassland
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c)
ALLIANCE	*THINOPYRUM INTERMEDIUM* SEMI-NATURAL HERBACEOUS ALLIANCE
ASSOCIATION IDENTIFIER	CEGL002935.
USFWS WETLAND SYSTEM	Upland
NS ECOLOGICAL SYSTEM	Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040)

RANGE

Grant-Kohrs Ranch National Historic Site

This single polygon is a thin long strip planted along the railroad in the northeast quadrant of the Ranch

Global

This *Thinopyrum intermedium* type occurs widely throughout the northern Great Plains of the United States, at montane elevations in the Intermountain West, and perhaps more widely in the West, Midwest and Canada. It has been specifically reported for South Dakota, Utah, and Colorado (S. Menard, NatureServe, January 2009).

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

This area along the railroad tracks had been heavily disturbed.

Global

Stands can occur in a wide variety of human-disturbed habitats, and Thinopyrum intermedium (= Agropyron intermedium) is widely planted as pasture and hayland along road ditches, for CRP, and in dense-nesting-cover mixes (D. Ode pers. comm.). It is commonly found on reseeded cultivated lands planted with legumes such as sweet clover and alfalfa and may also have escaped into surrounding habitats (D. Ode pers. comm.). It is most abundant on dry, medium-textured soils, but has adapted to a broad range of soil textures and moisture conditions.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Thinopyrum intermedium*

CHARACTERISTIC SPECIES

Thinopyrum intermedium

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

Along this single narrow strip polygon the canopy cover of *Thinopyrum intermedium* range from 26 to 50%. *Bromus tectorum* was the most common second component but averaged less than 5% canopy cover.

Global

Vegetation is primarily medium-tall (0.5-1 m) graminoids and dominated by Thinopyrum intermedium, a naturalized, cool-season grass species from eastern Europe. Other weedy species such as Bromus inermis may occur as well, but native species are generally less than 20% cover.

GLOBAL CLASSFICATION CONFIDENCE ?

CONSERVATION RANK ?

CLASSIFICATION COMMENTS
The global information for this type was derived from S. Menard, NatureServe, January 2009

Agropyron cristatum - (Pascopyrum smithii, Hesperostipa comata) Semi-natural Herbaceous Vegetation

COMMON NAME	Crested Wheatgrass - (Western Wheatgrass, Needle-and-Thread Grass) Semi-natural Herbaceous Vegetation
LOCAL NAME	Crested Wheatgrass Grassland
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Medium-tall bunch temperate or subpolar grassland (V.A.5.N.d)
ALLIANCE	*AGROPYRON CRISTATUM* SEMI-NATURAL HERBACEOUS ALLIANCE
ASSOCIATION IDENTIFIER	CEGL005266
USFWS WETLAND SYSTEM	Upland
NS ECOLOGICAL SYSTEM	Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040)

RANGE

Grant-Kohrs Ranch National Historic Site

The seminatural type was sown primarily into the upland Upper Northwest Range on the west side of the Ranch and planted adjacent to the visitor center in the southeast corner of the Ranch.

Global

This association occurs in the northern Great Plains of the United States and Canada (Von Loh et al. 2000).

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

The area adjacent to the visitor center had been highly disturbed before it was rehabilitated but the Upper Northwest Range still retains much of its original native components.

Global

This type can occur in a wide variety of human-disturbed habitats, including highway rights-of-way, jeep trails, etc. It is also widely planted to revegetate pastures and rangelands (Von Loh et al. 2000).

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Shrub (Dwarf)	*Artemisia frigida*
Herbaceous	*Agropyron cristatum*

CHARACTERISTIC SPECIES

Agropyron cristatum

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 8 accuracy assessment observations)

Agropyron cristatum is strongly dominant in the herbaceous layer. *Thinopyrum intermedium, Sisymbrium altissimum,* and *Poa secunda* (= *Poa sandbergii*) are the most frequent associates. *Artemisia frigida* is often present at low cover as a dwarf shrub.

Global

The vegetation is dominated by medium-tall (0.5 - 1 m) graminoids. The dominant grass is *Agropyron cristatum,* a naturalized species from Europe. Other weedy species may occur as well, but native species are generally less than 10% cover. Native species may include mixed-grass prairie grasses, such as *Pascopyrum smithii* and *Hesperostipa comata*, as well as others (Von Loh et al. 2000).

GLOBAL CLASSFICATION CONFIDENCE 3

CONSERVATION RANK GW

CLASSIFICATION COMMENTS
The global information for this type was derived from Von Loh et al. (2000).

Bromus inermis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation

COMMON NAME	Smooth Brome – (Western Wheatgrass) Semi-natural Herbaceous Vegetation
LOCAL NAME	Smooth Brome Community Type
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Medium-tall bunch temperate or subpolar grassland (V.A.5.N.d)
ALLIANCE	*Bromus inermis* Semi-natural Herbaceous Alliance
ASSOCIATION IDENTIFIER	CEGL005264
USFWS WETLAND SYSTEM	Upland
NS ECOLOGICAL SYSTEM	Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)

RANGE

Grant-Kohrs Ranch National Historic Site

These small areas dominated by invasive *Bromus inermis* are in the riparian floodplain of the Clark Fork River.

Global

This semi-natural grassland occurs widely throughout the northern Great Plains of the United States, and perhaps more widely in the Midwest and Canada. It likely occurs throughout much of the Rocky Mountains and Intermountain West. . It has been specifically reported from Utah, Wyoming, Montana, Colorado, and North and South Dakota.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

Periodic flooding or seasonally high water tables create mesic enough conditions to allow *Bromus enermis* to act as an invasive even with the low annual precipitation rate. A prior history of grazing cattle in the riparian zone likely facilitated the displacement of native graminoids by *Bromus inermis.*

Global

In semi-arid environments, it is restricted to relatively mesic conditions such as in riparian areas or forest openings at montane elevations. Stands can occur in a wide variety of human-disturbed habitats, including highway rights-of-way, jeep trails, etc. Bromus inermis is also widely planted for cover, pasture, and hay, and has escaped into a variety of habitats.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Bromus inermis*

CHARACTERISTIC SPECIES

Bromus inermis

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

Additional riparian invaders are often present including *Agropyron repens, Phleum pratense, Cirsium arvense, and Euphorbia esula.* Remnant native include *Juncus balticus*. An occasional riparian shrub was sometimes incorporated into these *Bromus inermis* dominated polygons.

Global

This alliance is characterized by a moderately dense to dense layer of medium-tall (0.5-1 m) perennial graminoids. The dominant grass is *Bromus inermis*, a naturalized species from Eurasia. Other weedy species may occur as well, but native species are generally less than 10% cover. Native species may include mixed-grass prairie grasses, such as *Pascopyrum smithii* and *Hesperostipa comata* (= *Stipa comata*), as well as others.

GLOBAL CLASSFICATION CONFIDENCE ?

CONSERVATION RANK ?

CLASSIFICATION COMMENTS

The global information for this type was derived from D. Faber-Langendoen, mod. K. Schulz, NatureServe, January 2009

Pseudoroegneria spicata - Pascopyrum smithii Herbaceous Vegetation

COMMON NAME	Bluebunch Wheatgrass - Western Wheatgrass Herbaceous Vegetation
LOCAL NAME	Bluebunch Wheatgrass - Western Wheatgrass Mixedgrass Prairie
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Medium-tall bunch temperate or subpolar grassland (V.A.5.N.d)
ALLIANCE	*PSEUDOROEGNERIA SPICATA* HERBACEOUS ALLIANCE
ASSOCIATION IDENTIFIER	CEGL001675
USFWS WETLAND SYSTEM	Upland
NS ECOLOGICAL SYSTEM	Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040)

RANGE

Grant-Kohrs Ranch National Historic Site

The *Pseudoroegneria spicata - Pascopyrum smithii* Herbaceous Vegetation is important in the Taylor Ridge, No Name, and Gravel Pit Ranges in the upland southwest quadrant of the Ranch. This type also dominates most of the thin steep strip of uplands owned by the Ranch along the west side of its northwest quadrant.

Global

This association has been described from western and central Montana (Jorgensen 1979, Mueggler and Stewart 1980, Cooper et al. 1995), northeastern Montana (DeVelice et al. 1995), southeastern Montana (Hansen and Hoffman 1988), northwestern and west-central Wyoming (Tweit and Houston 1980), and apparently from northeastern Wyoming (Terwilliger et al. 1979).

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

These are harsh zeric sites on coarse poorly developed soil. In some areas the surface is armored with pebbles indicating the wind swept nature of these west side uplands.

Global

Stands of this grassland association grow over a broad elevation range, from 2600 feet in Great Plains to 7500 feet in the foothills of the Rocky Mountains. They occur on slopes, from gentle alluvial fans to slopes as steep as 40%, facing all aspects. Substrates are glacial deposits, alluvium, limestone, and calcareous sandstones. Soils usually are shallow, may contain a substantial volume of coarse fragments, and belong to sandy clay loam, loam, or clay loam textural classes. The sites often are exposed to strong, persistent winds.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Pascopyrum smithii*, *Pseudoroegneria spicata*

CHARACTERISTIC SPECIES

Pascopyrum smithii

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 8 accuracy assessment observations)

Agropyron smithii is dominant in the herbaceous layer. *Pseudoroegneria spicata* is usually present and sometimes co-dominant. *Bromus tectorum* and *Descurainia sophia* may occur at high cover.

Global

Grasses contribute most of the cover and production. *Pseudoroegneria spicata* dominates (usually strongly). The rhizomatous wheatgrasses *Pascopyrum smithii* or *Elymus lanceolatus* (or both) are secondary species, but the rhizomatous wheatgrasses may codominate with *Pseudoroegneria spicata*. *Hesperostipa comata (= Stipa*

comata), Koeleria macrantha, and *Poa secunda* usually are present in smaller amounts, but *Hesperostipa comata* often codominates in west-central Montana (Jorgensen 1979). *Bouteloua gracilis* is absent or is a minor species. *Nassella viridula (= Stipa viridula)* contributes substantial cover in some stands, especially in the Great Plains but also in some foothills stands (Mueggler and Stewart's (1980) *Stipa viridula* phase). Stands in the foothills often contain *Poa cusickii, Leucopoa kingii*, and *Calamagrostis montanensis*. In southeastern Montana (Hansen and Hoffman 1988) and northeastern Wyoming (Terwilliger et al. 1979), *Bouteloua curtipendula* may also occur in the vegetation. Forbs contribute little cover or production, but a number of species may be present, including *Ambrosia psilostachya* (in Great Plains stands), *Draba oligosperma, Erigeron compositus, Stenotus acaulis (= Haplopappus acaulis), Heterotheca villosa, Sphaeralcea coccinea, Phlox hoodii, Tragopogon dubius*, and *Vicia americana*. The subshrubs *Artemisia frigida* and *Gutierrezia sarothrae* usually are present in small amounts. Shrubs generally are absent or are present only as scattered individuals, but Tweit and Houston (1980) note that *Tetradymia canescens* may be common and *Chrysothamnus* spp. may form a distinct shrub layer in disturbed stands.

GLOBAL CLASSFICATION CONFIDENCE 1

CONSERVATION RANK G4

CLASSIFICATION COMMENTS

The taxonomic disposition of this type as it occurs at Grant-Kohrs Ranch National Historic Site is uncertain, as *Pascopyrum smithii* is more constant, more diagnostic of this type and usually occurs at higher cover than *Pseudoroegneria spicata. Pascopyrum smithii* Herbaceous Vegetation (CEGL001577) may be more appropriate. However Muggler and Stewart 1980 did not assign a pure *Pascopyrum smithii* type to western or southcentral Montana, but as one progresses eastward *Pascopyrum smithii* is increasingly abundant. As to the assigned association NatureServe does comment that “but the rhizomatous wheatgrasses may codominate with *Pseudoroegneria spicata*.” The original mapping team did record *Pascopyrum smithii* in 13 of the 27 of the *Pseudoroegneria spicata/Pascopyrum smithii* polygons they mapped

Pseudoroegneria spicata – Poa secunda Herbaceous Vegetation

COMMON NAME	Bluebunch Wheatgrass – Curly Bluegrass Herbaceous Vegetation
LOCAL NAME	Bluebunch Wheatgrass – Curly Bluegrass Grassland
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Medium-tall bunch temperate or subpolar grassland (V.A.5.N.d)
ALLIANCE	*PSEUDOROEGNERIA SPICATA* HERBACEOUS ALLIANCE
ASSOCIATION IDENTIFIER	CEGL001677
USFWS WETLAND SYSTEM	Upland
NS ECOLOGICAL SYSTEM	Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland (CES306.040)

RANGE

Grant-Kohrs Ranch National Historic Site

This native bunchgrass Association is present in the upland ranges in the southwest quadrant of the ranch. The east side railroad inholding in the northeast quadrant is mostly of this natural community type. These railroad owned polygons are a classic example of remant native vegetation in an otherwise human developed area.

Global

This association has been described from British Columbia, Washington, Oregon, Idaho, Utah, Colorado, Wyoming, and Montana.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

The west side upland range soils are coarse and poorly developed. In some areas the surface is armored with pebbles indicating the wind swept nature of these west side uplands. The east side railroad remnant is flat terrain.

Global

Stands of this association grow on well-drained, often shallow, and frequently gravelly or rocky soils generally of loam, clay loam, silt loam, or sandy loam textural classes. Sites usually are ridges and slopes, sometimes alluvial fans, scree slopes, sloped rocky cliff faces, and bedrock outcrops of any aspect, although southerly and westerly aspects are most common in the northwestern (British Columbia, Washington, Idaho) and northern (Montana) parts of the geographic range. In Wyoming and Colorado, many of the sites supporting this association are windswept slopes and ridges. This association grows over a very broad elevation range, from 213 to 854 m (700-2800 feet) in the northwestern part of the range, 915 to 2288 m (3000-7500 feet) in the north-central part, and 2867 to 3050 m (9400-10,000 feet) in central Colorado.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Pseudoroegneria spicata, Koeleria micrantha, Nassella viridula, Poa secunda*

CHARACTERISTIC SPECIES

Pseudoroegneria spicata, Koeleria micrantha, Nassella viridula, Poa secunda

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 61 accuracy assessment observations)

Pseudoroegneria spicata is dominant in the herbaceous layer, with *Koeleria macrantha, Nassella viridula, Poa secunda* (= *Poa sandbergii*) frequent and often co-dominant. The non-native rhizomatous grass *Thinopyrum intermedium* is occasionally the leading dominant. *Poa pratensis* and *Pascopyrum smithii* are occasional. The non-

native *Bromus tectorum* and *Centaurea stoebe* ssp. *micranthos* may be frequent. *Gutierrezia sarothrae* and *Artemisia frigida* are occasional dwarf shrubs.

Global

As would be expected for an association whose geographic range includes such a broad range of climates and prehistoric grazing regimes, the composition of the vegetation varies, but a number of traits are constant. Throughout, this is a bunch grassland with minor cover of forbs and, often, sparse shrubs. *Pseudoroegneria spicata* dominates or codominates the vegetation; *Poa secunda* and *Koeleria macrantha* usually are present in substantial amounts, and *Festuca idahoensis* is absent or present in very small amounts. *Hesperostipa comata (= Stipa comata)* often is present in substantial amounts and may codominate, due (at least in part of the range) to prolonged grazing. *Bromus tectorum, Tragopogon* spp., and *Alyssum* spp. also are common members of the vegetation, due at least in part to disturbance. The common shrubs are *Ericameria nauseosa (= Chrysothamnus nauseosus), Chrysothamnus viscidiflorus*, and *Artemisia tridentata* (subspecies unknown). In southern British Columbia (Tisdale 1947), eastern Washington (Daubenmire 1988), and northeastern Oregon (Poulton 1955, Anderson 1956), the undisturbed vegetation of this type consists of *Pseudoroegneria spicata* and *Poa secunda*, with few other vascular plants (*Lomatium macrocarpum, Draba verna, Artemisia frigida, Gutierrezia sarothrae*, and a number of annuals), and substantial cover of epigeous cryptogams. *Hesperostipa comata* is present in most stands and may codominate with *Pseudoroegneria spicata*, as a result of heavy grazing. In western Idaho (Tisdale 1986), xeric sites support open vegetation with little *Poa secunda* and with *Opuntia polyacantha, Phacelia heterophylla*, and *Scutellaria angustifolia*. Stands on mesic sites are denser and usually contain *Balsamorhiza sagittata, Lomatium triternatum*, and *Lupinus sericeus*. In Utah (Christensen 1963, Christensen and Welsh 1963), *Gutierrezia sarothrae* is a common but minor species; *Hesperostipa comata* and *Achnatherum hymenoides (= Oryzopsis hymenoides)* are now common and often contribute substantial cover, apparently in stands disturbed by prolonged grazing. Montana stands (Mueggler and Stewart 1980, Cooper et al. 1995) often contain *Artemisia frigida, Gutierrezia sarothrae, Heuchera cylindrica, Achillea millefolium, Phlox hoodii, Eriogonum flavum, Stenotus acaulis (= Haplopappus acaulis)*, and a number of other forbs as well as the fern *Cryptogramma acrostichoides*; *Hesperostipa comata* or *Hesperostipa spartea (= Stipa spartea)* often codominate with *Pseudoroegneria spicata*, apparently even in stands that have not been markedly disturbed. *Calamagrostis purpurascens* and *Festuca occidentalis* may also be present. In northwestern Wyoming (Tweit and Houston 1980), the vegetation is much like that in Montana (but without *Hesperostipa spartea*), while in central Wyoming (Williams 1961, Fisser 1964) and northeastern Wyoming (Terwilliger et al. 1979), nearer to the eastern edge of the geographic range, *Bouteloua gracilis, Rhus trilobata, Pascopyrum smithii*, and *Carex filifolia* may be present as minor species. In Colorado (Hess and Wasser 1982), species present in greater than trace amounts are *Achillea millefolium, Arenaria fendleri, Oxytropis lambertii, Potentilla gracilis*, and *Taraxacum officinale*. GLOBAL CLASSFICATION CONFIDENCE 2

CONSERVATION RANK G4?

CLASSIFICATION COMMENTS

This association has variable composition at Grant-Kohrs Ranch National Historic Site, possibly due to grazing and other land management practices. Plot data would be necessary to determine whether several types are actually represented.

Formatted: Portuguese (Brazil)

Agrostis (*gigantea*, *stolonifera*) Semi-natural Herbaceous Vegetation

COMMON NAME	(Giant Bentgrass, Spreading Bentgrass) Semi-natural Herbaceous Vegetation
LOCAL NAME	Redtop Community Type
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k)
ALLIANCE	*AGROSTIS STOLONIFERA* Seasonally Flooded Herbaceous Alliance
ASSOCIATION IDENTIFIER	CEGL001558
USFWS WETLAND SYSTEM	Palustrine Emergent persistent, seasonally flooded (PEM1C)
NS ECOLOGICAL SYSTEM	Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)

RANGE

Grant-Kohrs Ranch National Historic Site

This *Agrostis stolonifera* semi-natural type is established immediately adjacent to or proximal to the Clark Fork River as stands scattered along the entire length of the floodplain. It is also present along the eastern side of the developed area of the Ranch and Cottonwood Creek.

Global

This vegetation includes grasslands dominated by an introduced perennial sod grass native to Europe. Stands have been described from Montana, but the alliances is likely more widespread. It has also been reported in Idaho, Nevada and Colorado. *Agrostis stolonifera* has been widely planted for forage in North America and has invaded native communities from hay fields, especially more mesic areas such as riparian floodplains and seasonally flooded wetlands in the semi-arid western U.S. References for this alliance include Hansen et al. 1995.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

This grass type is present in riparian areas that have prolonged standing water in part due to irrigation flowback.

Global

This vegetation is typically found in more mesic areas such as riparian floodplains and seasonally flooded wetlands in the semi-arid western U.S. where it has escaped from cultivation.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Agrostis stolonifera*

CHARACTERISTIC SPECIES

Agrostis stolonifera

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

Phleum pratense, also tolerant of prolonged standing water or a high water table was the typically second most abundant species in these polygons. *Agropyron repens* was also often found at significant cover values. The invasive forbs *Cirsium arvense* and *Euphorbia esula* were also present in many polygons. A few polygons had scattered *Salix exigua* or *Betula occidentalis*.

Global

This alliance is characterized by a moderate to dense perennial graminoid layer dominated by *Agrostis stolonifera*. Other native species may occur as well, but they are generally less than 10% cover.

GLOBAL CLASSFICATION CONFIDENCE ?

CONSERVATION RANK ?

CLASSIFICATION COMMENTS
The global information for this type was derived from M.S. Reid, mod. K. Schulz, NatureServe, January 2009

Carex aquatilis Herbaceous Vegetation

COMMON NAME	Aquatic Sedge Herbaceous Vegetation
LOCAL NAME	Aquatic Sedge Wet Meadow
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k)
ALLIANCE	*CAREX AQUATILIS* SEASONALLY FLOODED HERBACEOUS ALLIANCE
ASSOCIATION IDENTIFIER	CEGL001802
USFWS WETLAND SYSTEM	Palustrine Emergent persistent, seasonally flooded (PEM1C)
NS ECOLOGICAL SYSTEM	Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)

RANGE

Grant-Kohrs Ranch National Historic Site

This seaonal wetland type is clearly represented by a single large (5.2 ac) polygon, the Ox Barn Pasture, immediately north of the main complex of corrals and barns.

Global

This association is common and located in mountainous areas throughout the western U.S. and Canada.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

This pasture has standing water to a very shallow water table because of a number of springs that surface in the pasture and ajoining area.

Global

This plant association occurs in a variety of valley types, but the largest expanses occur in broad, low-gradient valleys where large snowmelt-fed swales and slopes dominate the landscape. It can also grow in fine sediments at the margins of lakes and beaver ponds. These palustrine wetlands have a range of hydrologic regimes, though all stands are saturated for a significant enough period during the growing season to cause a build up of organic material in the soil. Soils are organic mucks and peats and are poorly to very poorly drained.

MOST ABUNDANT SPECIES

Grant-Kohrs Ranch National Historic Site

STRATUM	SPECIES
Herbaceous	*Carex aquatilis*

CHARACTERISTIC SPECIES

Carex aquatilis

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 3 accuracy assessment observations)

Carex aquatilis is dominant in the herbaceous layer, *Juncus balticus* (= *J. arcticus* ssp. *littoralis*), *Typha latifolia*, and *Alopecurus aequalis* were co-dominant in one accuracy assessment plot each. *Phleum pratense* was present at low cover in 2 accuracy assessment plots.

Global

This plant association is characterized by a dense rhizomatous meadow of *Carex aquatilis* (10-80% cover), usually accompanied by a few other graminoids species such as *Calamagrostis canadensis* (1-40%) or *Deschampsia caespitosa* (1-16%), *Juncus balticus*, and *Poa palustris*. *Eleocharis quinqueflora* can be abundant on organic substrates (1-49% cover) at high elevations. *Carex utriculata* (1-20% cover) may be present. When present, *Carex utriculata* is usually not more than one-third the cover of *Carex aquatilis* cover. If it is more than that, the stand may be classified as *Carex aquatilis* - *Carex utriculata* Herbaceous Vegetation (CEGL001803) or *Carex utriculata*

Herbaceous Vegetation (CEGL001562). Forbs are often present, although sometimes inconspicuous (generally <10%, but can be as high as 40%). Species include *Epilobium* spp., *Pedicularis groenlandica, Caltha leptosepala, Menyanthes trifoliata, Cardamine cordifolia,* and *Mertensia ciliata*. Shrubs and trees have been observed invading the wetland from surrounding areas, including *Betula nana, Salix maccalliana,* and *Picea engelmannii*.

GLOBAL CLASSFICATION CONFIDENCE	1
CONSERVATION RANK	G5

Carex pellita Herbaceous Vegetation

COMMON NAME	Woolly Sedge Herbaceous Vegetation
LOCAL NAME	Woolly Sedge Wet Meadow
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k)
ALLIANCE	*CAREX PELLITA* SEASONALLY FLOODED HERBACEOUS ALLIANCE
ASSOCIATION IDENTIFIER	CEGL001809
USFWS WETLAND SYSTEM	Palustrine Emergent persistent, seasonally flooded (PEM1C)
NS ECOLOGICAL SYSTEM	Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)

RANGE

Grant-Kohrs Ranch National Historic Site

Carex pellita Herbaceous Vegetation is present in the floodplain in the northwest quadrant of the Ranch between a major slough and the current river channel and as a polygon between the two parallel railroad beds where Johnson Creek enters the Ranch.

Global

This plant association is a minor wetland 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.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

Shallow groundwater and seasonally high water tables provide suitable habitat for *Carex pellita* Herbaceous Vegetation on the Clark Fork River floodplain and along Johnson Creek where the railroad beds altered the original topography and hydrology.

Global

This groundwater-supported plant association occurs in small patches along stream channels and in seasonally wet depressions and swales at low to moderate elevations in the western U.S. from Washington to Montana south to Oregon, Utah, Wyoming and Colorado. It has also been reported from British Columbia, Canada. These wetlands form small to medium-sized meadows on valley bottoms. Soils are alluvial and remain saturated through at least part of the growing season.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Carex pellita, Juncus balticus*

CHARACTERISTIC SPECIES

Carex pellita

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 1 accuracy assessment observation)

Carex pellita and *Juncus balticus* (= *J. arcticus* ssp. *littoralis*) were co-dominant in the herbaceous layer, with *Schedenorus pratensis (= Festuca pratensis)* frequent..

Global

Carex pellita, a distinctive wetland-indicator species, clearly dominates stands of this association with 30-80% cover. Low species diversity is characteristic. *Deschampsia caespitosa, Carex microptera, Carex nebrascensis, Carex simulata, Carex praegracilis, Carex utriculata, Elymus glaucus, Juncus balticus, Schoenoplectus pungens (= Scirpus pungens), Equisetum arvense*, and *Equisetum hyemale* are sometimes present with low cover. Stands that

have been degraded by grazing may have high cover by the exotic species *Agrostis stolonifera* or *Poa pratensis* or the native rush *Juncus balticus* (Jankovsky-Jones et al. 2001). Scattered shrubs and small trees may be present, including *Salix exigua, Chrysothamnus linifolius, Salix amygdaloides, Populus deltoides,* and exotic *Tamarix* spp.

GLOBAL CLASSFICATION CONFIDENCE 1

CONSERVATION RANK G3

Carex utriculata Herbaceous Vegetation

COMMON NAME	Northwest Territory Sedge Herbaceous Vegetation
LOCAL NAME	Northwest Territory Sedge Wet Meadow
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k)
ALLIANCE	*CAREX (ROSTRATA, UTRICULATA)* SEASONALLY FLOODED HERBACEOUS ALLIANCE
ASSOCIATION IDENTIFIER	CEGL001562
USFWS WETLAND SYSTEM	Palustrine Emergent persistent, seasonally flooded (PEM1C)
NS ECOLOGICAL SYSTEM	Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)

RANGE

Grant-Kohrs Ranch National Historic Site

Carex utriculata Herbaceous Vegetation polygons are found on both sides of the floodplain in the south half of the Ranch.

Global

This wetland association in found at montane and subalpine elevations throughout much of the western U.S.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

Sloughs and flowback from irrigation maintain the high water table that creates the habitat for *Carex utriculata* Herbaceous Vegetation in these set backs from the current river channel.

Global

This herbaceous wetland association is found throughout much of the western U.S. Elevation ranges from 1060 to 3230 m (3500-10,600 feet). Stands 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 (Kittel et al. 1999). Sites are flat to undulating, often with a hummocky microtopography (Kovalchik 1993). The water table is usually near the surface for most of the growing season. There are a wide variety of soil types for this association ranging from saturated organics or fine silty clays to clays over cobbles and alluvium to fine-loamy and sandy-skeletal, with an organic surface layer. Many stands occur on organic muck or peat soils. Mottling and gleying often occur near the surface because of the high water table.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Carex utriculata*

CHARACTERISTIC SPECIES

Carex utriculata

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 2 accuracy assessment observations)

Carex utriculata (*=Carex rostrata* var. *utriculata*) was dominant in the herbaceous layer, with *Juncus balticus* (*= J. arcticus* ssp. *littoralis*) and *Bromus inermis* co-dominant in one of the stands. *Typha latifolia*, *Alopecurus aequalis*, and *Agrostis gigantea* were recorded in one stand each. Various species of *Salix* may occur in a sparse shrub layer.

Global

This plant association is characterized by a moderately dense to dense perennial graminoid layer dominated or codominated by *Carex utriculata* (20-99% cover). Stands often appear to be nearly pure *Carex utriculata*, but a variety of other graminoid species may be present as well. Other *Carex* species present include *Carex aquatilis, Carex canescens, Carex lenticularis, Carex microptera, Carex nebrascensis,* and *Carex scopulorum*, but usually with low cover. Other graminoid species that may be present include *Calamagrostis canadensis, Deschampsia caespitosa, Eriophorum angustifolium, Glyceria striata*, and *Juncus balticus*. Sparse forb cover may include *Epilobium* spp., *Geum macrophyllum, Fragaria virginiana, Mentha arvensis, Mimulus guttatus*, and *Polemonium occidentale*. Scattered *Salix* spp. shrubs may be present because these riparian shrublands are often adjacent. *Salix* species vary depending on elevation and geography. *Salix monticola, Salix drummondiana, Salix geyeriana, Salix planifolia, Salix wolfii*, and *Salix exigua* are common species.

GLOBAL CLASSFICATION CONFIDENCE	1
CONSERVATION RANK	G5

Eleocharis palustris Herbaceous Vegetation

COMMON NAME	Marsh Spikerush Herbaceous Vegetation
LOCAL NAME	Marsh Spikerush Wet Meadow
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k)
ALLIANCE	*ELEOCHARIS (PALUSTRIS, MACROSTACHYA)* SEASONALLY FLOODED HERBACEOUS ALLIANCE
ASSOCIATION IDENTIFIER	CEGL001833
USFWS WETLAND SYSTEM	Palustrine Emergent persistent, seasonally flooded (PEM1C)
NS ECOLOGICAL SYSTEM	Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)

RANGE

Grant-Kohrs Ranch National Historic Site

Small linear polygons of *Eleocharis palustris* Herbaceous Vegetation are found along the active river channel.

Global

This association is found in the central Great Plains of the United States and Canada and throughout the western United States including the desert Southwest..

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

Recent bank side fine textured alluvial deposits that are seasonally inundated by the Clark Fork River provide the substrate susceptible to dominance by *Eleocharis palustris.*

Global

This wetland occurs across the central and northwestern Great Plains and western United States. Elevations range from near sea level to 3050 m (0-10,000 feet). In the western mountains, it occurs in valleys and canyon bottoms on the banks and in the overflow channels of low-gradient streams, as well as along the margins of ponds and lakes. On the Great Plains, this community occurs in small depressions in intermittent streambeds, depression ponds that flood early in the season and dry out by summer, and small prairie potholes. It can also occur in the bottom of ephemeral ponds or playas on floodplain terraces of large rivers, and around semipermanently flooded beaver ponds and stock tanks. In wet years, stands may remain ponded throughout the growing season. Soils range from organic to silty clay to fine loam formed from weathered siltstone and shale or eolian loess. Soils are reported as slightly alkaline

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Eleocharis palustris*

CHARACTERISTIC SPECIES

Eleocharis palustris

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

Eleocharis palustris was dominant in the herbaceous layer.

Global

This wetland association is dominated by submersed and emergent rooted vegetation under 1 m tall. The species composition can be quite variable, but this community is easy to recognize by the bright green, nearly pure stands of *Eleocharis palustris*. Vegetation cover can be sparse to dense (10-90%), but *Eleocharis palustris* is the dominant species, and the only species with 100% constancy. Other species, when present, can contribute as much

as 40% cover, but never exceed that of the *Eleocharis palustris* cover. Some of this variation is described from Colorado (Baker and Kennedy 1985, Kittel et al. 1999b). Co-occurring species in low-elevation stands on the western slope can include *Phalaris arundinacea (= Phalaroides arundinacea), Juncus balticus, Hordeum jubatum, Equisetum* spp., *Pascopyrum smithii, Schoenoplectus americanus (= Scirpus americanus), Sparganium angustifolium*, species of *Lemna* and *Potamogeton*, as well as the introduced *Melilotus officinalis* and *Bromus inermis*. On the eastern plains of Colorado co-occurring species can include *Leersia oryzoides, Schoenoplectus pungens (= Scirpus pungens), Panicum virgatum, Carex pellita (= Carex lanuginosa),* and *Spartina pectinata*. At montane elevations, other graminoids, such as *Carex aquatilis, Carex utriculata*, and *Deschampsia caespitosa*, are present. Forb cover is typically low but can be occasionally abundant (30%) in some stands. Forb species include *Pedicularis groenlandica, Rhodiola integrifolia*, and *Caltha leptosepala*.

In stands from eastern Washington, associates include *Carex utriculata, Cicuta douglasii*, and species of *Glyceria* and *Potamogeton*. In northwestern Nebraska, stands are dominated by *Eleocharis acicularis* and *Eleocharis palustris* which 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 2000). 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). In lower elevation Utah stands, *Glaux maritima, Distichlis spicata*, and *Juncus balticus* are important associates (Brotherson and Barnes 1984).

Few stand data are available for Colorado examples. Generally, it appears that this community is dominated by *Eleocharis palustris*, forming a scattered to dense overstory, often with few associated species. Commonly associated graminoids include *Hordeum jubatum* and *Pascopyrum smithii*. Forbs present may include *Atriplex argentea, Polygonum aviculare*, and *Rorippa sinuata* (Baker and Kennedy 1985). The higher elevation stands may include a slightly different suite of species, but no stand data are available. Ramaley (1942) described a *Distichlis spicata*-dominated salt meadow on a lakeshore in the San Luis Valley which was ringed by *Eleocharis palustris*. Communities in Utah include *Eleocharis acicularis* and *Alopecurus aequalis* as likely associates (Padgett et al. 1989).

GLOBAL CLASSFICATION CONFIDENCE	1
CONSERVATION RANK	G5

Juncus balticus Herbaceous Vegetation

COMMON NAME	Baltic Rush Herbaceous Vegetation
LOCAL NAME	Baltic Rush Wet Meadow
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k)
ALLIANCE	*JUNCUS BALTICUS* SEASONALLY FLOODED HERBACEOUS ALLIANCE
ASSOCIATION IDENTIFIER	CEGL001838
USFWS WETLAND SYSTEM	Palustrine Emergent persistent, seasonally flooded (PEM1C)
NS ECOLOGICAL SYSTEM	Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)

RANGE

Grant-Kohrs Ranch National Historic Site

There are a number of smaller *Juncus balticus* stands in the vicinity of the southwest portions of the North Meadows. A disjunct stand of *Juncus balticus* developed between the two parallel railroad beds from the south fork to the north fork of Johnson Creek. A large (38 acres) polygon in the North Meadow was originally attributed to *Juncus balticus* Herbaceous Vegetation but subsequent to the accuracy assessment was reassigned to the provisional (*Bromus inermis – Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis*) Irrigated Pasture Herbaceous Vegetation because of the significant presence of introduced grasses.

Global

This Baltic rush wet meadow community is found widely throughout the western United States, ranging from South Dakota and Nebraska west to Washington, south to California, and east to New Mexico. It also occurs in western Canada.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

Standing water and prolonged high seasonal water tables promote dominance by *Juncus balticus* in these wet meadows. Spring Slough and adjacent springs provide sufficient water to the North Meadows.

Global

This broadly defined and widespread herbaceous wetland community is found throughout western North America. Elevation ranges from 138 to 3500 m (454-11,475 feet). Far northern stands in the Boreal Plains are at about 800 m (2625 feet). Stands usually occur as small, dense patches on flat to gently sloping sites near seeps and streams. Stream channels are highly variable in size and type, ranging from narrow to moderately wide, and from deeply entrenched to very sinuous (Kittel et al. 1999). In the boreal regions, this community occurs more commonly on gradual sandy shorelines. Soils are also variable and range from sandy and well-drained to poorly drained silty clay loam or silty clay alluvium to organic muck; however, soils tend to be finer-textured, alkaline and may be saline (Brotherson and Barnes 1984, Padgett et al. 1989, Kittel et al. 1999). Sites with sandy soils are usually saturated for part of the growing season or have high water tables. Cobbles and gravel are common on many sites, and gleyed and mottled horizons are often present because of flooding or high water tables (Kittel et al. 1999).

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Juncus balticus, Schedonorus pratensis*

CHARACTERISTIC SPECIES

Juncus balticus

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 22 accuracy assessment observations)

Juncus balticus (= *J. arcticus* ssp. *littoralis*) is dominant in the herbaceous layer, with other species mentioned here occasionally co-dominant – most often *Schedonorus pratensis (= Festuca pratensis*). Other species present may include *Carex utriculata, Alopecurus aequalis, Pascopyrum smithii, Agrostis gigantea, Carex pellita, Poa pratensis, Cirsium arvense, Elymus repens, Iris missouriensis,* and *Carex aquatilis*. Various species of *Salix* or *Symphoricarpos occidentalis* may occur in a sparse shrub layer.

Global

This broadly defined association is characterized by a low (<50 cm), open to typically dense graminoid layer dominated by the rhizomatous perennial *Juncus balticus*. In montane zones and the Great Basin, minor cover of *Carex* species, including *Carex aquatilis, Carex praegracilis, Carex microptera, Carex nebrascensis,* or *Carex utriculata,* is often present. Other common graminoids include *Deschampsia caespitosa, Distichlis spicata, Glyceria striata, Hordeum brachyantherum, Hordeum jubatum, Muhlenbergia andina, Muhlenbergia asperifolia, Pascopyrum smithii, Poa nemoralis ssp. interior, Phleum alpinum*, and *Sporobolus airoides*. Forb cover is generally low but may include *Achillea millefolium, Artemisia ludoviciana, Caltha leptosepala, Cirsium scariosum (= Cirsium tioganum), Dodecatheon pulchellum, Glaux maritima, Iris missouriensis, Maianthemum stellatum, Rumex aquaticus, Polygonum bistortoides, Potentilla plattensis,* and *Solidago canadensis*. Shrubs and dwarf-shrubs are not common; however, *Artemisia frigida* cover may be significant in some stands, and occasional *Artemisia cana, Artemisia tridentata ssp. tridentata, Dasiphora fruticosa ssp. floribunda, Ericameria nauseosa, Populus* spp., *Rosa woodsii, Salix* spp., or *Sarcobatus vermiculatus* shrubs may occur. Some stands may be codominated by the introduced perennial sod grasses *Poa pratensis, Bromus inermis,* or *Agrostis stolonifera*. Other introduced species, such as *Cirsium arvense, Cirsium vulgare, Erodium cicutarium, Iva axillaris, Lactuca serriola, Phleum pratense, Taraxacum officinale, Thinopyrum intermedium, Trifolium* spp., *Tragopogon dubius*, and *Xanthium strumarium,* may occur in disturbed stands.

GLOBAL CLASSFICATION CONFIDENCE 1

CONSERVATION RANK G5

CLASSIFICATION COMMENTS

This vegetation may intergrade with and be difficult to separate from other wetland types or from irrigated pastures that have been disturbed and invaded by *Juncus balticus.*

Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation

COMMON NAME	Kentucky Bluegrass Semi-natural Seasonally Flooded Herbaceous Vegetation
LOCAL NAME	Kentucky Bluegrass Community Type
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k)
ALLIANCE	*POA PRATENSIS* SEASONALLY FLOODED HERBACEOUS ALLIANCE
ASSOCIATION IDENTIFIER	CEGL003081.
USFWS WETLAND SYSTEM	Palustrine Emergent persistent, seasonally flooded (PEM1C)
NS ECOLOGICAL SYSTEM	Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)

RANGE

Grant-Kohrs Ranch National Historic Site

This single small quarter acre polygon is the southeast corner of the Ranch on the historic floodplain but now on the east side of the Kohrs-Manning Ditch south of the confluence of Cottonwood Creek with the Clark Fork River.

Global

This semi-natural grassland is widespread in the western U.S. and northern Great Plains where it has invaded natural meadows and riparian areas. It is reported from Washington, Oregon, Montana, Wyoming, Idaho, Utah, and California, but is likely widespread in the western U.S. and northern Great Plains.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

This invasive grass type is present in the riparian area but only forms a semi-natural stand in this one floodplain location.

Global

This alliance has invaded natural prairies, meadows and riparian areas. Elevation ranges from 1100-2625 m (3600-8600 feet). Sites are generally flat to moderately sloping and occur on all aspects. Stands typically occur on pastures found in the plains, montane meadows, stream benches and terraces. In the semi-arid regions it is restricted to relatively mesic sites. Soils are variable, but *Poa pratensis* grows best on moist, fertile sandy to clayey alluvium with high organic content (Hansen et al. 1995). It does not tolerate prolonged flooding, high water tables or poor drainage well. However, it can tolerate mildly alkaline and saline soils, and some drought (Hansen et al. 1995, Hall and Hansen 1997, Kovalchik 1987, Manning and Padgett 1995, Padgett et al. 1989).

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Poa pratensis*

CHARACTERISTIC SPECIES

Poa pratensis

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

Although *Poa pratensis* is frequently found in the riparian zone of the Ranch it only had contiguous cover in one polygon. This polygon also had and abundance of *Agropyron repens* ns *Equisetum arvense*.

Global

This widespread, semi-natural plant association is characterized by a moderate to dense herbaceous canopy that is strongly dominated by the introduced perennial, sod-forming graminoid *Poa pratensis*. *Poa pratensis* has invaded many other natural plant associations, but the diagnostic character in this association is that there is

typically not enough of the native grassland left to classify it as a poor-condition natural type. Associates are often those early-seral and weedy species that tolerate historic heavy livestock grazing or other disturbance well, such as *Achillea millefolium, Cirsium arvense, Elymus repens, Equisetum* spp., *Fragaria virginiana, Hordeum* spp., *Juncus balticus, Linaria vulgaris, Potentilla gracilis, Taraxacum officinale*, and introduced forage species such as *Agrostis stolonifera, Bromus inermis*, and *Phleum pratense*. Remnant native *Pascopyrum smithii, Deschampsia caespitosa*, and *Carex* spp. are often present in low cover. Occasional trees and shrubs may also be present.

GLOBAL CLASSFICATION CONFIDENCE ?

CONSERVATION RANK ?

CLASSIFICATION COMMENTS

The global information for this type was derived from M.S. Reid, mod. K. Schulz, NatureServe, January 2009

Equisetum fluviatile Herbaceous Vegetation

COMMON NAME	Water Horsetail Herbaceous Vegetation
LOCAL NAME	Water Horsetail Marsh
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.l)
ALLIANCE	*EQUISETUM FLUVIATILE* SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
ASSOCIATION IDENTIFIER	CEGL002746
USFWS WETLAND SYSTEM	Palustrine Emergent persistent, semipermanently flooded (PEM1F)
NS ECOLOGICAL SYSTEM	Rocky Mountain Alpine-Montane Wet Meadow (CES306.812)

RANGE

Grant-Kohrs Ranch National Historic Site

One polygon proximal to the north boundary of the Ranch and the Deer Lodge sewage ponds was designated as a *Equisetum fluviatile* type.

Global

This emergent wetland herbaceous vegetation is known from the Columbia River tidal surge plain in western Washington, and non-tidal locations in eastern Washington, as well as in Oregon, Idaho, Montana and possibly British Columbia.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

This polygon is just west of the Kohrs-Manning Ditch and abuts the east bank of Clark Fork River so it has a high water table.

Global

This is an emergent wetland community occurring on seasonally to permanently flooded edges of lakes and ponds, along tidally influenced plains of larger rivers, calm backwater areas of rivers and streams, and in watered abandoned channels. It occurs from sea level to 1340 m (0-4390 feet) in elevation. Water depths range from below the soil surface to 0.5 m (1.5 feet) deep. Soils are fine-textured silts, clays and muck. Mineral soils often have layers of organic accumulation. Along the Columbia River Gorge, stands occur on river and slough channels on sand and silt and are flooded by freshwater during most high tides. Inland, stands occur at the edges of slow-moving meander curves in rivers and in shallow water and wet ground on the margins of lakes and ponds, stock ponds and reservoirs.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Equisetum fluviatile*

CHARACTERISTIC SPECIES

Equisetum fluviatile

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

No stands visited during accuracy assessment. The original mapping team reported that after the dominant *Equisetum fluviatile* with up to 25% canopy cover, *Poa pratensis* was the second most abundant species followed by *Agrostis stolonifera.*

Global

Stands are characterized by *Equisetum fluviatile* with 30-100% cover. Stands tend to be species-poor. Other species present can include *Glyceria grandis, Alopecurus aequalis, Carex* spp., *Eleocharis palustris, Typha* spp.,

and *Scirpus* and/or *Schoenoplectus* spp. Stands at lower elevations (Columbia River Surge Plain) had higher species diversity (n=18 for all sampled stands combined) than those at higher elevations (n=3 eastern Washington and Montana). In Alberta, it often forms open monotypic stands in the deepest zone of emergent vegetation, developing a denser cover moving in shore. Typically there then follows a transition zone of mixed *Equisetum fluviatile* and *Carex* spp. that leads to a zone of shoreline sedges, usually *Carex aquatilis, Carex rostrata*, and/or *Carex utriculata*.

GLOBAL CLASSFICATION CONFIDENCE 1

CONSERVATION RANK G4

CLASSIFICATION COMMENTS

The presence of this type at Grant-Kohrs Ranch National Historic Site may be in question. Stands of *Equisetum fluviatile* might better be treated as wet meadows invaded by clones of *E. fluviatile*, as the mapped stand\ was found to be mixed with other vegetation and not distinguishable. The concept of *Equisetum fluviatile* Herbaceous Vegetation (CEGL002746) appears to be a deeper water marsh type than the one stand mapped at Grant-Kohrs Ranch National Historic Site.

Typha (*latifolia, angustifolia*) Western Herbaceous Vegetation

COMMON NAME	(Broadleaf Cattail, Narrowleaf Cattail) Western Herbaceous Vegetation
LOCAL NAME	Broadleaf Cattail Marsh
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N)
FORMATION	Semipermanently flooded temperate or subpolar grassland (V.A.5.N.l)
ALLIANCE	*TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCHOENOPLECTUS* SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
ASSOCIATION IDENTIFIER	CEGL002010
USFWS WETLAND SYSTEM	Palustrine Emergent persistent, semipermanently flooded (PEM1F)
NS ECOLOGICAL SYSTEM	North American Arid West Emergent Marsh (CES300.729)

RANGE

Grant-Kohrs Ranch National Historic Site

The largest *Typha latifolia* stand is adjacent to the railroad beds in the northeast corner of the Ranch. The second largest stand is along Spring Slough in the North Meadows. Several smaller stands are on the west side floodplain.

Global

This association is widely distributed, occurring across the western United States and western Great Plains.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

There are numerous (21) occurrences of *Typha latifolia* at the Ranch because of irrigation ditches and flowback as well as the natural sloughs and a man made depression but only 7 polygons were designated as *Typha latifolia* Herbaceous Vegetation type. The largest stand is in a standing water excavation pit dug to provide material for the elevated railroad beds. A large natural stand follows the Spring Slough. Several smaller stands abut a natural slough on the west side of the river in the south half of the Ranch. This west side slough receives irrigation flowback from Lower Meadow #1.

Global

This widespread community is found along streams, rivers, canals, and the banks of ponds and lakes. Elevations range from near sea level to 2000 m. Sites are nearly level. The soil is saturated or flooded for much of the year from freshwater sources such as springs or streams. The alluvial soils have variable textures ranging from sand to clay and usually with a high organic content.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Typha latifolia*

CHARACTERISTIC SPECIES

Typha latifolia

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 7 accuracy assessment observations)

Typha latifolia is dominant in the herbaceous layer, with *Carex aquatilis* sometimes important or co-dominant. Few other species are present, with *Juncus balticus* (= *J. arcticus* ssp. *littoralis*) most often recorded. Various species of *Salix* may occur in a sparse shrub layer.

Global

This community is dominated by hydrophytic macrophytes, especially *Typha latifolia* or *Typha angustifolia*, which grow from approximately 2-3 m tall. *Typha latifolia* and *Typha angustifolia* often form dense,

near-monotypic stands (70-98% cover), almost to the exclusion of other species. In some stands the two *Typha* species are codominant. Other species typical of wetlands may be found in lesser amounts in this community; among these are shallower water emergents such as *Carex* spp., *Eleocharis macrostachya, Eleocharis palustris, Glyceria* spp., *Juncus balticus, Juncus torreyi, Mentha arvensis, Schoenoplectus acutus,* and *Veronica* spp. In deeper water, *Lemna minor, Potamogeton* spp., *Sagittaria* spp., *Azolla filiculoides,* and other aquatics may be present in trace amounts. Trace amounts of grasses like *Agrostis stolonifera, Beckmannia syzigachne, Hordeum jubatum, Muhlenbergia asperifolia,* and *Phalaris arundinacea* may also be present.

GLOBAL CLASSFICATION CONFIDENCE	2
CONSERVATION RANK	G5

(*Bromus inermis - Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis*) Hayfield/Irrigated Pasture Herbaceous Vegetation [NPS Provisional]

COMMON NAME	(Smooth Brome – Timothy – Kentucky Bluegrass – Meadow Fescue) Hayfield/Irrigated Pasture Cultural Herbaceous Vegetation
LOCAL NAME	Hayfield/Pasture
CLASS	Herbaceous Vegetation (V)
SUBCLASS	Perennial graminoid vegetation (V.A)
GROUP	Temperate or subpolar grassland (V.A.5)
SUBGROUP	Planted/Cultivated (V.A.5.C)
FORMATION	Perennial grass crops (hayland, pastureland) (V.A.5.C.a)
ALLIANCE	None defined
ASSOCIATION IDENTIFIER	NPSGRKO001 (described from this project)
USFWS WETLAND SYSTEM	Upland
NS ECOLOGICAL SYSTEM	Irrigated Pasture (Provisional)

RANGE

Grant-Kohrs Ranch National Historic Site

These improved grass pastures occupy half (753 acres) of the Ranch. On the west side and proximal to the Clark Fork River floodplain they are designated as Lower Meadows 1 through 4. In the southwest quadrant of the Ranch 3 broad gulches (Big Gulch, Little Gulch, and Taylor Field) lie between the dry bunchgrass upland ranges. Stuart Field is the major hayfield in the southeast quadrant. In the northeast quadrant there are large improved pastures east of the railroad tracks.

Global

Unknown. This vegetation is likely to be widespread as it is typical of irrigated improved grass pastures in the northwest states.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

The west side pastures and hayfields are flood irrigated. Stuart Field and the smaller Johnson Creek Field in the southeast quadrant are subirrigated by adjoining Johnson and Cottonwood Creeks. The fields east of the railroad tracks in the northeast quadrant were sprinkler irrigated using effluent from the Deer Lodge sewage plant.

Global

Unknown. Environmental setting is likely to be similar to that at Grant-Kohrs Ranch National Historic Site.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Bromus inermis, Elymus repens, Phleum pratense, Poa pratensis, Juncus balticus, Schedenorus pratensis*

CHARACTERISTIC SPECIES

Bromus inermis, Elymus repens, Phleum pratense, Poa pratensis, Schedenorus pratensis

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

(from 122 accuracy assessment observations)

This type is characterized by either monospecific or various patterns of mixed dominance by non-native, rhizomatous pasture grasses, primarily *Bromus inermis, Elymus repens, Phleum pratense, Poa pratensis,* and/or *Schedenorus pratensis (= Festuca pratensis). Juncus balticus (=Juncus arcticus* ssp. *littoralis)* may be co-dominant with the grasses, especially in heavily grazed pastures. Other grasses that may be present and occasionally contribute significant cover are *Agrostis gigantea*, *Pascopyrum smithii, Alopecurus aequalis, Agropyron cristatum, Hesperostipa comata*, and/or *Dactylis glomerata*. Annual weeds, mostly in the family *Brassicaceae*, are often present and may occasionally be seasonally co-dominant: these include *Descurainia sophia, Alyssum spp., Lepidium*

latifolium, *Thlaspi arvense*, and *Medicago sativa*. Other frequent weeds present at low cover are *Cirsium* spp., *Taraxacum* spp., and *Trifolium* spp.. In wetter settings, *Iris missouriensis*, *Carex* spp. and/or *Equisetum fluviatile* may be present at low cover. Shrubs are generally absent, but may be present at low cover (usually *Salix* spp.), especially where the type intergrades with natural vegetation.

Global

Unknown. Composition may depend on how the variable dominance seen at Grant-Kohrs Ranch National Historic Site is treated.

GLOBAL CLASSFICATION CONFIDENCE Not defined

CONSERVATION RANK None (Planted/Cultivated vegetation)

CLASSIFICATION COMMENTS

Because of variable monospecific and mixed dominance patterns in similar settings, probably due to historic management patterns, it proved intractable to recognize this type as individual monospecific types. Without plot data and more detailed analysis a single and variable irrigated pasture/hayfield type seems warranted. This vegetation is treated as Planted/Cultivated Vegetation in the sense of the 1997 FGDC standard for the NVCS (to be defined as Cultural Vegetation in the [2008] revision of the FGDC standard).

Deschampsia caespitosa Slickens Semi-natural Sparse Vegetation [NPS Provisional]

COMMON NAME	Tufted Hairgrass Slickens Semi-natural Sparse Vegetation
LOCAL NAME	Tufted hairgrass Slickens
CLASS	Sparse Vegetation (VII)
SUBCLASS	Unconsolidated material sparse vegetation (VII.C)
GROUP	Sparsely vegetated soil slopes (VII.C.3)
SUBGROUP	Natural/Semi-natural (VII.C.3.N)
FORMATION	Moist slopes (VII.C.3.N.a)
ALLIANCE	Undefined
ASSOCIATION IDENTIFIER	NPSGRKO002(described from this project)
USFWS WETLAND SYSTEM	Upland
NS ECOLOGICAL SYSTEM	Pollution Altered Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (Provisional)

RANGE

Grant-Kohrs Ranch National Historic Site

These semi-natural polygons are located on the Clark Fork River floodplain.

Global

This vegetation is known only from Grant-Kohrs Ranch National Historic Site in western Montana.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

A major flood in 1908 deposited toxic metal mine and smelter spoils on top of the historic floodplain of the upper Clark Fork River. These spoils were generated by copper mining and smelting upriver at Anaconda and Butte. The pre 1908 flood floodplain at the Ranch was elevated about one foot by these deposits and many sloughs and other depressions were filled in. The phytotoxicity and plant community level impacts of these deposits have been confirmed by various studies conducted as part of a natural resource damage assessment (Rice 2002; Kapustka 2002; Rice and Hardin 2002a). *Deschampsia caespitosa* is known to be tolerant of heavy metals and low pH soils and has colonized smelter and mine deposits around the globe.

Global

Same as for Grant-Kohrs Ranch National Historic Site.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	*Deschampsia caespitosa*

CHARACTERISTIC SPECIES

Deschampsia caespitosa

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

This type is virtually unvegetated to sparsely vegetated with clumps of *Deschampsia caespitosa* which may form a thin ring around an unvegetated center area, or consists of more or less continuous cover of monotypic *Deschampsia caespitosa*.

.

Global

Same as for Grant-Kohrs Ranch National Historic Site.

GLOBAL CLASSFICATION CONFIDENCE Not Ranked

GLOBAL CONSERVATION RANK Probably GW.

CLASSIFICATION COMMENTS

Classification of ruderal, semi-natural vegetation at alliance and association levels is very under-developed in the NVCS. This vegetation was mapped as unclassifiable from any existing floristic descriptions. It was determined to the lowest determinable level of the NVCS (the Formation, as defined by the 1997 standard) and given a provisional (project-specific description) as a “placeholder” to classify mapped stands for the Grant-Kohrs National Historic Site project and as an occurrence record for future work.

Rocky Mountain Riparian Bar Sparse Vegetation [NPS Provisional]

COMMON NAME	Rocky Mountain Riparian Bar Sparse Vegetation
LOCAL NAME	Riparian Bar
CLASS	Sparse Vegetation (VII)
SUBCLASS	Unconsolidated material sparse vegetation (VII.C)
GROUP	Sparsely vegetated sand flats (VII.C.2)
SUBGROUP	Natural/Semi-natural sparsely vegetated sand flats (VII.C.2.N)
FORMATION	Temporarily flooded sand flats (VII.C.2.N.c)
ALLIANCE	Rocky Mountain Riparian Bar Sparsely Vegetated Alliance (NPS Provisional)
ASSOCIATION IDENTIFIER	NPSGRKO003(described from this project)
USFWS WETLAND SYSTEM	Riverine Upper Perennial Unconsolidated Shore Cobble-Gravel, temporarily flooded (R3US1A)
NS ECOLOGICAL SYSTEM	Northwestern Great Plains Riparian (CES303.677)

RANGE

Grant-Kohrs Ranch National Historic Site

Some of these polygons are immediately adjacent to the Clark Fork River channel although others are on portions of the floodplain set back from the current channel.

Global

Unknown.

ENVIRONMENTAL DESCRIPTION

Grant-Kohrs Ranch National Historic Site

These polygons are recent deposits along the river channel or older deposits of coarse material that precluded succession to recognized climax communities.

Global

Unknown.

MOST ABUNDANT SPECIES

STRATUM	SPECIES
Herbaceous	Unknown

CHARACTERISTIC SPECIES

Unknown

VEGETATION DESCRIPTION

Grant-Kohrs Ranch National Historic Site

Introduced invasive grasses are a principal component of these early succession polygons. They include *Bromus inermis, Agrostis stolonifera,* and *Phleum pratense*. Invasive forbs including *Centaurea maculosa,* and *Euphobia esula* are found in these polygons. Native components at low constancy included *Juncu balticus* and a few riparian shrubs. No stands were visited during accuracy assessment.

Global

Unknown.

GLOBAL CLASSFICATION CONFIDENCE N/A

CONSERVATION RANK N/A

CLASSIFICATION COMMENTS

This type is a placeholder to represent sparsely vegetated riparian bars at Grant-Kohrs Ranch National Historic Site. It is a Rocky Mountain analogue to the generalized Riverine Sand Flats - Bars Sparse Vegetation (CEGL002049).

LITERATURE CITED

Anderson, W. E. 1956. Some soil-plant relationships in eastern Oregon. Journal of Range Management 9:171-175.

Baker, W. L., and S. C. Kennedy. 1985. Presettlement vegetation of part of northwestern Moffat County, Colorado, described from remnants. Great Basin Naturalist 45(4):747-777.

Brotherson, J. D., and S. J. Barnes. 1984. Habitat relationships of *Glaux maritima* in central Utah. Great Basin Naturalist 44(2):299-309.

Christensen, E. M. 1963. The foothill bunchgrass vegetation of central Utah. Ecology 44(1):156-158.

Christensen, E. M., and S. L. Welsh. 1963. Presettlement vegetation of the valleys of western Summit and Wasatch counties, Utah. Proceedings of the Utah Academy of Science, Arts and Letters 40:163-174.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, Virginia.

Cooper, S. V., P. Lesica, R. L. DeVelice, and T. McGarvey. 1995. Classification of southwestern Montana plant communities with emphasis on those of Dillon Resource Area, Bureau of Land Management. Montana Natural Heritage Program, Helena, MT. 154 pp.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. Publication FWS/OBS-79/31. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, D.C. 131 pp.

Daubenmire, R. 1988. Steppe vegetation of Washington. Washington State University Cooperative Extension Service Publication EB1446. (Revised from and replaces Washington Agricultural Experiment Station Publication XT0062.) 131 pp.

DeVelice, R.L., S.V. Cooper, J.T. McGarvey, J. Lichthardt, and P.S. Bourgeron. 1995. Plant communities of northeastern Montana: A first approximation. Montana Natural Heritage Program, Helena, MT. 116 p.

Fisser, H. G. 1964. Range survey in Wyoming's Big Horn Basin of Wyoming. Wyoming Agricultural Experiment Station Bulletin 424.

Grossman, D. H., D. Faber-Langendoen, A. S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K. D. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume I. The National Vegetation Classification System: development, status, and applications. The Nature Conservancy, Arlington, Virginia, USA.

Hansen, P.L. and G.R. Hoffman. 1988. The vegetation of the Grand River/Cedar River, Sioux, and Ashland Districts of the Custer National Forest: a habitat type classification. USDA Forest Service General Technical Report RM-157, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Hansen, P. L., R. D. Pfister, K. Boggs, B. J. Cook, J. Joy, and D. K. Hinckley. 1995. Classification and management of Montana's riparian and wetland sites. Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Miscellaneous Publication No. 54.

Hess, K., and C. H. Wasser. 1982. Grassland, shrubland, and forest habitat types of the White River-Arapaho National Forest. Unpublished final report 53-82 FT-1-19. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO.

Jones, G. P., and G. M. Walford. 1995. Major riparian vegetation types of eastern Wyoming. A Report Submitted to the Wyoming Department of Environmental Quality, Water Quality Division. Grant 9-01136. 244 pp.

Jorgensen, H. E. 1979. Vegetation of the Yellow Water Triangle, Montana. Montana Department of Fish and Game, in cooperation with the Bureau of Land Management. Helena, MT. 57 pp.

Kittel, G., E. Van Wie, M. Damm, R. Rondeau, S. Kettler, A. McMullen, and J. Sanderson. 1999. A classification of riparian and wetland plant associations of Colorado: A user's guide to the classification project. Colorado Natural Heritage Program, Colorado State University, Fort Collins CO. 70 pp. plus appendices.

Kovalchik, B. L. 1993. Riparian plant associations on the national forests of eastern Washington - Draft version 1. USDA Forest Service, Colville National Forest, Colville, WA. 203 pp.

Mueggler, W. F. and W. L. Stewart. 1980. Grassland and shrubland habitat types of western Montana. USDA Forest Service General Tech. Report INT-66. Intermountain Forest & Range Experiment Station, Ogden, Utah. 155 pp.

NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.2. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: February 26, 2008).

Padgett, W. G., A. P. Youngblood, and A. H. Winward. 1989. Riparian community type classification of Utah and southeastern Idaho. USDA Forest Service, Intermountain Region. Report R4-ECOL-89-01. Ogden, UT. 191 pp.

Poulton, C. E. 1955. Ecology of the non-forested vegetation in Umatilla and Morrow counties, Oregon. Unpublished dissertation. State College of Washington, Pullman. 166 pp.

Ramaley, F. 1942. Vegetation of the San Luis Valley in southern Colorado. University of Colorado Studies, Series D, 1:231-277.

Rice, Peter M. 2002. Toxic metals-pH impact on riparian plant community structure at Grant-Kohrs Ranch. Deer Lodge, MT: NPS Grant-Kohrs NHS. 16p

Rice, Peter M.; Hardin, Janet. 2002a. Riparian plant community structure at Grant-Kohrs Ranch. Deer Lodge, MT: NPS Grant-Kohrs NHS. 24p

Rice, Peter M.; Hardin, Janet. 2002b. Vascular plant survey of Grant-Kohrs Ranch National Historic Site Deer Lodge, MT: NPS Grant-Kohrs NHS. 11p

Steinauer, G., and S. Rolfsmeier. 2000. Terrestrial natural communities of Nebraska. Unpublished report of the Nebraska Game and Parks Commission. Lincoln, NE. 143 pp.

Terwilliger, C., K. Hess, and C. Wasser. 1979a. Key to the preliminary habitat types of Region 2. Addendum to initial progress report for habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO.

Thilenius, J. F., G. R. Brown, and A. L. Medina. 1995. Vegetation on semi-arid rangelands, Cheyenne River Basin, Wyoming. General Technical Report RM-GTR-263. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 60 pp.

Tisdale, E. W. 1947. The grasslands of the southern interior of British Columbia. Ecology 28(4):346-382.

Tisdale, E. W. 1986. Canyon grasslands and associated shrublands of west-central Idaho and adjacent areas. Bulletin No. 40. Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow. 42 pp.

Tweit, S., and K. Houston. 1980. Grassland and shrubland habitat types of the Shoshone National Forest. USDA Forest Service, Rocky Mountain Region, Shoshone National Forest.

Von Loh, J., D. Cogan, D. J. Butler, D. Faber-Langendoen, D. Crawford, and M. J. Pucherelli. 2000. USGS-NPS Vegetation Mapping Program, Theodore Roosevelt National Park, North Dakota. U.S. Bureau of Reclaimation Technical Service Center. U.S. Department of the Interior, Bureau of Reclamation's Remote Sensing and GIS Group, Denver Federal Center, Denver, CO.

Williams, C. S. 1961. Distribution of vegetation in the Wind River Canyon, Wyoming. Unpublished thesis, University of Wyoming, Laramie.

A3. Ecological system descriptions

The accuracy assessment indicated that the eight Ecological Systems would provide a map accuracy of 85.0%. Two are provisional for environmental situations and plant assemblages found at Grant-Kohrs Ranch.

Appendix Table XX. Final (post accuracy assessment) most likely NatureServe Ecological System assignments for associations at the Grant-Kohrs Ranch (Comer et al. 2003) (NatureServe 2007).

Post Accuracy Assessment NatureServe Ecological Systems
Irrigated Pasture (Provisional)
North American Arid West Emergent Marsh
Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland
Pollution Altered
Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (Provisional)
Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland
Northwestern Great Plains Riparian
Rocky Mountain Alpine-Montane Wet Meadow
Rocky Mountain Lower Montane-Foothill Shrubland

The following six Ecological Systems descriptions were obtained from NatureServe Explorer http://www.natureserve.org/explorer/ on January 7, 2010.

Scientific Name: North American Arid West Emergent Marsh
Unique Identifier: CES300.729
Classification Confidence: 1 – Strong

This widespread ecological system occurs throughout much of the arid and semi-arid regions of western North America, typically surrounded by savanna, shrub steppe, steppe, or desert vegetation. Natural marshes may occur in depressions in the landscape (ponds, kettle ponds), as fringes around lakes, and along slow-flowing streams and rivers (such riparian marshes are also referred to as sloughs). Marshes are frequently or continually inundated, with water depths up to 2 m. Water levels may be stable, or may fluctuate 1 m or more over the course of the growing season. Water chemistry may include some alkaline or semi-alkaline situations, but the alkalinity is highly variable even within the same complex of wetlands. Marshes have distinctive soils that are typically mineral, but can also accumulate organic material. Soils have characteristics that result from long periods of anaerobic conditions in the soils (e.g., gleyed soils, high organic content, redoximorphic features). The vegetation is characterized by herbaceous plants that are adapted to saturated soil conditions. Common emergent and floating vegetation includes species of *Scirpus* and/or *Schoenoplectus, Typha, Juncus, Potamogeton, Polygonum, Nuphar*, and *Phalaris*. This system may also include areas of relatively deep water with floating-leaved plants (*Lemna, Potamogeton*, and *Brasenia*) and submergent and floating plants (*Myriophyllum, Ceratophyllum*, and *Elodea*).

Classification Comments: This ecological system occurs in the arid and semi-arid regions of western North America, where semipermanently flooded habitats are found as small patches in

the matrix of a relatively dry landscape. Except for stands in the semi-arid portions of the western Great Plains, emergent marsh found in the Great Plains should be classified into one of the Western Great Plains depressional wetland systems.

Scientific Name: Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland
Unique Identifier: CES306.804
Classification Confidence: 2 - Moderate

This ecological system of the northern Rocky Mountains and the east slopes of the Cascades consists of deciduous, coniferous, and mixed conifer-deciduous forests that occur on streambanks and river floodplains of the lower montane and foothill zones. Riparian forest stands are maintained by annual flooding and hydric soils throughout the growing season. Riparian forests are often accompanied by riparian shrublands or open areas dominated by wet meadows. *Populus balsamifera* is the key indicator species. Several other tree species can be mixed in the canopy, including *Populus tremuloides, Betula papyrifera, Betula occidentalis, Picea mariana,* and *Picea glauca*. *Abies grandis, Thuja plicata,* and *Tsuga heterophylla* are commonly dominant canopy species in western Montana and northern Idaho occurrences, in lower montane riparian zones. Shrub understory components include *Cornus sericea, Acer glabrum, Alnus incana, Betula papyrifera, Oplopanax horridus,* and *Symphoricarpos albus*. Ferns and forbs of mesic sites are commonly present in many occurrences, including such species as *Athyrium filix-femina, Gymnocarpium dryopteris,* and *Senecio triangularis*.

Classification Comments: This system is from the Canadian Rockies ecoregion project and represents lower montane riparian in Montana north into Canada. In the Okanagan, this is defined as all the cottonwood-dominated or -codominated riparian systems below subalpine and above the Ponderosa pine zone. This system occurs in fire-dominated landscapes, which distinguishes it from North Pacific and subalpine/alpine landscapes that have significantly different fire regimes. This system is distinguished from the similar Rocky Mountain Subalpine-Montane Riparian Woodland (CES306.833) by the floristic component of northern Rocky Mountain species, both in the woody layers and in the herbaceous taxa. This system may occur in northwestern Wyoming where *Populus balsamifera* dominates or codominates some woodlands, but those woodlands may be better placed into Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821), which lists *Populus balsamifera* as a possible dominant.

Scientific Name: Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland
Unique Identifier: CES306.040
Classification Confidence: 3 - Weak

This ecological system of the northern Rocky Mountains is found at lower montane to foothill elevations in the mountains and large valleys of northeastern Wyoming and western Montana, west through Idaho into the Blue Mountains of Oregon, and north into the Okanagan and Fraser plateaus of British Columbia and the Canadian Rockies. They also occur to the east in the central Montana mountain "islands," foothills, as well as the Rocky Mountain Front and Big and Little

Belt ranges. These grasslands are floristically similar to Inter-Mountain Basins Big Sagebrush Steppe (CES304.778), Columbia Basin Foothill and Canyon Dry Grassland (CES304.993), and Columbia Basin Palouse Prairie (CES304.792), but are defined by shorter summers, colder winters, and young soils derived from recent glacial and alluvial material. These northern lower montane and valley grasslands represent a shift in the precipitation regime from summer monsoons and cold snowy winters found in the southern Rockies to predominantly dry summers and winter precipitation. In the eastern portion of its range in Montana, winter precipitation is replaced by a huge spring peak in precipitation. They are found at elevations from 300 to 1650 m, ranging from small meadows to large open parks surrounded by conifers in the lower montane, to extensive foothill and valley grasslands below the lower treeline. Many of these valleys may have been primarily sage-steppe with patches of grassland in the past, but because of land-use history post-settlement (herbicide, grazing, fire suppression, pasturing, etc.), they have been converted to grassland-dominated areas. Soils are relatively deep, fine-textured, often with coarse fragments, and non-saline, often with a microphytic crust. The most important species are cool-season perennial bunch grasses and forbs (>25% cover), sometimes with a sparse (<10% cover) shrub layer. *Pseudoroegneria spicata, Festuca campestris, Festuca idahoensis*, or *Hesperostipa comata* commonly dominate sites on all aspects of level to moderate slopes and on certain steep slopes with a variety of other grasses, such as *Achnatherum hymenoides, Achnatherum richardsonii, Hesperostipa curtiseta, Koeleria macrantha, Leymus cinereus, Elymus trachycaulus, Bromus inermis ssp. pumpellianus (= Bromus pumpellianus), Achnatherum occidentale (= Stipa occidentalis), Pascopyrum smithii*, and other graminoids such as *Carex filifolia* and *Danthonia intermedia*. Other grassland species include *Opuntia fragilis, Artemisia frigida, Carex petasata, Antennaria* spp., and *Selaginella densa*. Important exotic grasses include *Phleum pratense, Bromus inermis*, and *Poa pratensis*. Shrub species may be scattered, including *Amelanchier alnifolia, Rosa* spp., *Symphoricarpos* spp., *Juniperus communis, Artemisia tridentata*, and in Wyoming *Artemisia tripartita ssp. rupicola*. Common associated forbs include *Geum triflorum, Galium boreale, Campanula rotundifolia, Antennaria microphylla, Geranium viscosissimum*, and *Potentilla gracilis*. A soil crust of lichen covers almost all open soil between clumps of grasses; *Cladonia* and *Peltigera* are the most common lichens. Unvegetated mineral soil is commonly found between clumps of grass and the lichen cover. The fire regime of this ecological system maintains a grassland due to rapid fire return that retards shrub invasion or landscape isolation and fragmentation that limits seed dispersal of native shrub species. Fire frequency is presumed to be less than 20 years. These are extensive grasslands, not grass-dominated patches within the sagebrush shrub steppe ecological system. *Festuca campestris* is easily eliminated by grazing and does not occur in all areas of this system.

Classification Comments: This is the same as the Interior Plateau Grassland also called "Northern Plateau Grassland" of the Okanagan Ecoregional Plan. In Wyoming, this is distinguished from Northwestern Great Plains Mixedgrass Prairie (CES303.674) by the presence of *Festuca idahoensis* or *Carex rossii*, the lack of *Bouteloua gracilis* (which is common in CES303.674), or the presence of *Artemisia nova* or *Artemisia tripartita ssp. rupicola*, neither of which occur in CES303.674.

Scientific Name: Northwestern Great Plains Riparian
Unique Identifier: CES303.677
Classification Confidence: 3 - Weak

This system is found in the riparian areas of medium and small rivers and streams throughout the northwestern Great Plains. It is likely most common in the Northern Great Plains Steppe. This system occurs in the Upper Missouri and tributaries starting at the Niobrara, White, Cheyenne, Belle Fourche, Moreau, Grand, Heart, Little Missouri, Yellowstone, Powder, Tongue, Bighorn, Wind, Milk, Musselshell, Marias, and Teton rivers; and in Canada, the Southern Saskatchewan, Red Deer and Old Man rivers to where they extend into Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland (CES306.821) or Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland (CES306.804). These are found on alluvial soils in highly variable landscape settings, from deep cut ravines to wide, braided streambeds. Hydrologically, these tend to be more flashy with less developed floodplain than on larger rivers, and typically dry down completely for some portion of the year. Dominant vegetation shares much with generally drier portions of larger floodplain systems downstream, but overall abundance of vegetation is generally lower. Communities within this system range from riparian forests and shrublands to gravel/sand flats. Dominant species include *Populus deltoides*, *Populus balsamifera ssp. trichocarpa*, *Salix* spp., *Artemisia cana ssp. cana*, and *Pascopyrum smithii*. These areas are often subjected to heavy grazing and/or agriculture and can be heavily degraded. Another factor is that groundwater depletion and lack of fire have created additional species changes.

Classification Comments: This system needs to be more clearly delineated from Northwestern Great Plains Floodplain (CES303.676). The component plant association list is incomplete. All the riparian/floodplain/alluvial systems of the Great Plains region need to be revisited for naming conventions, along with better definitions of conceptual boundaries. There is much apparent overlap in their concepts and distribution, and the names add to the confusion. In particular, the difference between "riparian" and "floodplain" usage in the names needs revisiting and possible changing. These systems include Northwestern Great Plains Floodplain (CES303.676), Northwestern Great Plains Riparian (CES303.677), Western Great Plains Floodplain (CES303.678), and Western Great Plains Riparian (CES303.956).

Scientific Name: Rocky Mountain Alpine-Montane Wet Meadow
Unique Identifier: CES306.812
Classification Confidence: 2 - Moderate

These are high-elevation communities found throughout the Rocky Mountains and Intermountain regions, dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. They range in elevation from montane to alpine (1000-3600 m). These types occur as large meadows in montane or subalpine valleys, as narrow strips bordering ponds, lakes, and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on sub-irrigated sites with slopes up to 10%. In alpine regions, sites

typically are small depressions located below late-melting snow patches or on snowbeds. Soils of this system may be mineral or organic. In either case, soils show typical hydric soil characteristics, including high organic content and/or low chroma and redoximorphic features. This system often occurs as a mosaic of several plant associations, often dominated by graminoids, including *Calamagrostis stricta, Caltha leptosepala, Cardamine cordifolia, Carex illota, Carex microptera, Carex nigricans, Carex scopulorum, Carex utriculata, Carex vernacula, Deschampsia caespitosa, Eleocharis quinqueflora, Juncus drummondii, Phippsia algida, Rorippa alpina, Senecio triangularis, Trifolium parryi*, and *Trollius laxus*. Often alpine dwarf-shrublands, especially those dominated by *Salix*, are immediately adjacent to the wet meadows. Wet meadows are tightly associated with snowmelt and typically not subjected to high disturbance events such as flooding.

Classification Comments: Similar systems to this one include Temperate Pacific Subalpine-Montane Wet Meadow (CES200.998) and Boreal Wet Meadow (CES103.873). Rocky Mountain Alpine-Montane Wet Meadow (CES306.812) occurs to the east of the coastal and Sierran mountains, in the semi-arid interior regions of western North America. Boreal wet meadow systems occur farther north and east in boreal regions where the climatic regime is generally colder than that of the Rockies or Pacific Northwest regions. Floristics of these three systems are somewhat similar, but there are differences related to biogeographic affinities of the species composing the vegetation.

Scientific Name: Rocky Mountain Lower Montane-Foothill Shrubland
Unique Identifier: CES306.822
Classification Confidence: 2 - Moderate

This ecological system is found in the foothills, canyon slopes and lower mountains of the Rocky Mountains and on outcrops and canyon slopes in the western Great Plains. It ranges from southern New Mexico, extending north into Wyoming, and west into the Intermountain West region. These shrublands occur between 1500 and 2900 m elevation and are usually associated with exposed sites, rocky substrates, and dry conditions, which limit tree growth. It is common where *Quercus gambelii* is absent, such as the northern Colorado Front Range and in drier foothills and prairie hills. This system is generally drier than Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818) but may include mesic montane shrublands where *Quercus gambelii* does not occur. *Cercocarpus montanus* dominates pure stands in parts of Wyoming and Colorado. Scattered trees or inclusions of grassland patches or steppe may be present, but the vegetation is typically dominated by a variety of shrubs, including *Amelanchier utahensis, Cercocarpus montanus, Purshia tridentata, Rhus trilobata, Ribes cereum, Symphoricarpos oreophilus*, or *Yucca glauca*. Grasses are represented as species of *Muhlenbergia, Bouteloua, Hesperostipa*, and *Pseudoroegneria spicata*. Fires play an important role in this system as the dominant shrubs usually have a severe die-back, although some plants will stump sprout. *Cercocarpus montanus* requires a disturbance such as fire to reproduce, either by seed sprout or root-crown sprouting. Fire suppression may have allowed an invasion of trees into some of these shrublands, but in many cases sites are too xeric for tree growth. In Wyoming, stands where *Cercocarpus montanus* is a component of mixed shrublands are placed in Northern

Rocky Mountain Montane-Foothill Deciduous Shrubland (CES306.994).

Classification Comments: Some reviewers have requested that this system be renamed in such a way as to more strongly indicate that it is dominated primarily by *Cercocarpus montanus*. However, while *Cercocarpus montanus* is an important shrub in this system, it is not the only dominant, and in many occurrences is not found at all.

A4. Plant association key

Comment [p7]: When I inserted the key to this document the tabbing altered the original layout in parts of the key itself. The original file is GRKO Associations key Jan 2010.doc

Key to Plant Associations & Alliances at Grant-Kohrs Ranch
Peter Rice, University of Montana

This dichotomous key is specific to the 25 final (post-accuracy assessment) natural vegetation types at the at the Grant-Kohrs Ranch. Choices are made from paired couplets with the same number. After a choice is made from the couplet, the user either goes to the next higher numbered couplet, or if the selected choice is ended with a "go to #" statement the user skips to that even higher number. The key uses topographic position or land use and life form before considering specific indicator species.

To effectively use this key you should be able to identify the following 31 indicator species based on their growth form and vegetative characteristics. Nomenclature in the indicator species list follows USDA PLANTS, except for *Juncus balticus*.

Agropyron cristatum	crested wheatgrass
Agrostis gigantea (syn. *Agrostis stolonifera* ssp. *gigantea*)	redtop
Thinopyrum intermedium (syn. *Agropyron intermedium*)	intermediate wheatgrass
Betula occidentalis	water birch
Bromus inermis	smooth brome
Bouteloua gracilis	blue grama
Carex aquatilis	water sedge
Carex pellita (syn. *Carex lasiocarpa* var. *latifolia*)	Woolly sedge
Carex utriculata (syn. *Carex rostrata* var. *utriculata*)	Northwest Territory sedge
Deschampsia caespitosa	tufted hairgrass
Descurainia sophia	flixweed
Eleocharis palustris	common spikesedge
Elymus repens (syn. *Agropyron repens*)	quackgrass
Equisetum fluviatile	water horsetail
Hesperostipa comata (syn. *Stipa comata*)	needle and thread grass
Juncus balticus (syn. *Juncus arcticus* ssp. *littoralis*)	Baltic rush
Nassella viridula (syn. *Stipa viridula*)	green needlegrass
Pascopyrum smithii (syn. *Agropyron smithii*)	western wheatgrass
Phleum pratense	timothy
Poa pratensis	Kentucky bluegrass
Poa secunda (syn. *Poa sandbergii*)	curly bluegrass
Populus balsamifera spp. *trichocarpa* (syn. *Populus trichocarpa*)	black cottonwood
Pseudoroegneria spicata (syn. *Agropyron spicatum*)	bluebunch wheatgrass
Rosa woodsii	Woods rose
Salix bebbiana	Bebb willow
Salix boothii	Booth willow
Salix exigua	sandbar willow
Salix geyeriana	Geyer willow
Schedonorus pratensis (syn. *Festuca pratensis*)*	meadow fescue
Symphoricarpos occidentalis	western snowberry
Typha latifolia	common cattail

[1]*Schedonorus pratensis* (syn: *Festuca pratensis*) (meadow fescue) cultivar on Grant-Kohrs Ranch difficult to identify from most floral keys.

This indicator species nomenclature, at least the synonyms, is also in concurrence with that used by the two standard floras covering Montana.

- Dorn, Robert D. 1984. Vascular plants of Montana. Cheyenne, Wyoming: Mountain West Publishing. 276pp.

- Hitchcock, C. L.; Cronquist, Arthur. 1973. Flora of the Pacific Northwest an illustrated manual. Seattle WA: University of Washington Press. 730pp.

Two useful references with illustrations for identifying willow species found on the Grant-Kohrs Ranch are:

- Brunsfeld, S. J.; Johnson F.D. 1985. Field guide to the willows of east-central Idaho. University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, ID 83843: Forest, Wildlife and Range Experiment Station; Bulletin Number 39. 95pp.

- Heinze, D.H. 1994. Willows of Montana. Riparian Technical Bulletin No. 2. Billings, MT: USDI Bureau of Land Management. 71pp.

A useful illustrated key for indicator species sedges on the Grant-Kohrs Ranch is:

- Lesica P, Husby P. 2001. Field guide to Montana's wetland vascular plants. Helena, MT: Montana Wetlands Trust. 92pp.

1. Dry upland grasslands

2. Introduced grasses *Agropyron cristatum* (crested wheatgrass) or *Thinopyrum (Agropyron) intermedium* (intermediate wheatgrass) more abundant than just an occasional plant

3. *Agropyron cristatum* (crested wheatgrass) prevalent

***Agropyron cristatum* - *(Pascopyrum smithii, Hesperostipa comata)* Semi-natural Herbaceous Vegetation**

Crested Wheatgrass - (Western Wheatgrass, Needle-and-Thread Grass) Semi-natural Herbaceous Vegetation

3. *Thinopyrum intermedium* (intermediate wheatgrass) prevalent

***Thinopyrum intermedium* Semi-natural Herbaceous Vegetation**

Intermediate Wheatgrass Semi-natural Herbaceous Vegetation

2. Native grasses dominate and introduced grasses lacking (go to 4)

4. *Hesperostipa comata* (needle and thread grass) dominant

***Hesperostipa comata* - *Bouteloua gracilis – Carex filifolia* Herbaceous Vegetation**

Needle and thread grass - Blue grama – Threadleaf sedge Herbaceous Vegetation

4. *Pseudoroegneria spicata* (bluebunch wheatgrass) abundant

5. *Bouteloua gracilis* (blue grama) with more than 5% canopy cover

***Pseudoroegneria spicata – Poa secunda* Herbaceous Vegetation**

Bluebunch wheatgrass – Curly bluegrass Herbaceous Vegetation

5. *Bouteloua gracilis* (blue grama) lacking

6. *Pascopyrum smithii* (western wheatgrass) present

7. *Nassella viridula* (green needle grass) absent

***Pseudoroegneria spicata – Pascopyrum smithii* Herbaceous Vegetation**

Bluebunch wheatgrass – Western wheatgrass Herbaceous Vegetation

7. *Nassella viridula* (green needle grass) present

***Pseudoroegneria spicata – Poa secunda* Herbaceous Vegetation**

Bluebunch wheatgrass – Curly bluegrass Herbaceous Vegetation

6. *Pascopyrum smithii* (western wheatgrass) absent

***Pseudoroegneria spicata – Poa secunda* Herbaceous Vegetation**

Bluebunch wheatgrass – Curly bluegrass Herbaceous Vegetation

1. Irrigated pasture/hayfields (go to 8 below) or riparian floodplain (go to 8 on p. 8)

8. Irrigated pasture/hayfields including irrigated gullies

9. The forb *Descurainia sophia* (flixweed) is dominate

(Bromus inermis – Elymus repens - Phleum pratense - Poa pratensis – Schedonorus pratensis) **Irrigated Pasture Herbaceous Vegetation**
Hayfield/Irrigated Pasture (disturbed)

9. Grasses and/or *Juncus balticus* (Baltic rush) dominate

10. *Juncus balticus* (Baltic rush) dominates with significant presence of introduced grasses

(Bromus inermis – Elymus repens - Phleum pratense - Poa pratensis – Schedonorus pratensis) **Irrigated Pasture Herbaceous Vegetation**
Hayfield/Irrigated Pasture

10. Grasses dominate

11. Native grass *Pseudoroegneria spicata* is dominant (usually pasture areas that are not receiving supplemental water)

Pseudoroegneria spicata – Pascopyrum smithii **Herbaceous Vegetation**
Bluebunch wheatgrass – Western wheatgrass Herbaceous Vegetation

11. Introduced perennial grasses (*Agrostis gigantea, Bromus inermis, Elymus repens, Phleum pretense, Poa pratensis*, and/or *Schedonorus pratensis*) dominant

(Bromus inermis – Elymus repens - Phleum pratense - Poa pratensis – Schedonorus pratensis) **Irrigated Pasture Herbaceous Vegetation**
Hayfield/Irrigated Pasture

8. Riparian floodplain (go to 20)

20. Bare soil polygon, often with blue-green salts on surface and surface objects

Slicken

20. Vegetated polygon

21. Herbaceous aspect, trees and tall shrubs absent, may have an occasional short shrub but shrubs not distributed throughout the polygon

22. Sedges with a combined canopy cover of at least 25%

23. *Carex utriculata* (Northwest Territory sedge) with at least 25% canopy cover

***Carex utriculata* Herbaceous Vegetation**

Northwest Territory sedge Herbaceous Vegetation

23. *Carex utriculata* (Northwest Territory sedge) with less than 25% canopy cover

24. *Carex aquatilis* (aquatic sedge) with at least 25% canopy cover

***Carex aquatilis* Herbaceous Vegetation**

Aquatic sedge Herbaceous Vegetation

24. *Carex pellita* (woolly sedge) with at least 25% canopy cover

***Carex pellita* Herbaceous Vegetation**

Woolly sedge Herbaceous Vegetation

22. Sedges with a combined canopy cover of less than 25% (go to 26)

25. *Typha latifolia* (common cattail) with at least 25% canopy cover

***Typha latifolia* Herbaceous Vegetation**

Broadleaf cattail Herbaceous Vegetation

25. *Typha latifolia* (common cattail) with less than 25% canopy cover

26. *Equisetum fluviatile* (water horsetail) with at least 25% canopy cover

Equisetum fluviatile **Herbaceous Vegetation**

Water horsetail Herbaceous Vegetation

26. *Equisetum fluviatile* (water horsetail) with less than 25% canopy cover

27. *Eleocharis palustris* (common spikesedge) with at least 25% canopy cover

***Eleocharis palustris* Herbaceous Vegetation**

Marsh Spikerush Wet Meadow

27. *Eleocharis palustris* (common spikesedge) with less than 25% canopy cover

28. *Juncus balticus* (Baltic rush) with more canopy cover than any other species

***Juncus balticus* Herbaceous Vegetation**

Baltic rush Herbaceous Vegetation

28. One individual grass species with more canopy cover than any other herbaceous life form

29. *Agrostis gigantea* (redtop) with more canopy cover than any other individual herbaceous species

***Agrostis* (*gigantea, stolonifera*) Semi-natural Herbaceous Vegetation**
(Giant Bentgrass, Spreading Bentgrass) Semi-natural Herbaceous Vegetation

29. Other individual herbaceous species with more canopy cover than *Agrostis gigantea* (redtop)

30. *Bromus inermis* (smooth brome) with more canopy cover than any other herbaceous species

***Bromus inermis* – (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation**
Smooth Brome – (Western Wheatgrass) Semi-natural Herbaceous Vegetation

30. Other individual herbaceous species with more canopy cover than *Bromus inermis* (smooth brome)

31. *Deschampsia caespitosa* (tufted hairgrass) dominant

***Deschampsia caespitosa* Slickens Semi-natural Sparse Vegetation**
Tufted Hairgrass Slickens Semi-natural Sparse Vegetation

31. Other individual herbaceous species with more canopy cover than *Deschampsia caespitosa* (tufted hairgrass)

32. *Poa pratensis* (Kentucky bluegrass) with more canopy cover than any other herbaceous species

***Poa pratensis* Semi-natural Seasonally Flooded Herbaceous Vegetation**
Kentucky Bluegrass Semi-natural Seasonally Flooded Herbaceous Vegetation

32. Does not fit with any type above, often early seral vegetation on new bar or otherwise disturbed area

Rocky Mountain Riparian Bar Sparse Vegetation
Riparian Bar

21. Woody species present and distributed throughout the polygon (go to 33)

33. Large trees (when mature) with canopy cover greater than 25%; these are all *Populus trichocarpa* (black cottonwood)

34. Understory consist of herbaceous species, shrubs lacking

***Populus balsamifera* ssp. *trichocarpa* / Mixed Herbs Forest**
Black Cottonwood / Mixed Herbs Forest

34. *Symphoricarpos occidentalis* (western snowberry) present in understory

***Populus balsamifera* (ssp. *trichocarpa*, ssp. *balsamifera*)**

***/ Symphoricarpos* (*albus, occidentalis, oreophilus*) Forest**

33. Large tree species lacking, shrubs distributed throughout the polygon (go to 36)

35. Short shrubs (less than 6 ft tall when mature, usually *Symphoricarpos occidentalis* (western snowberry) or *Rosa woodsii* (Woods' rose), prevalent, tall shrubs or *Salix exigua* (sandbar willow) lacking.

***Symphoricarpos occidentalis* Shrubland**

Western snowberry Shrubland

35. Tall shrubs (six ft or taller when mature) or *Salix exigua* sandbar willow prevalent

36. Willows with less than 10% canopy cover, *Betula occidentalis* (water birch) with at least 15% canopy cover and with the greatest canopy cover in the tallest layer

***Betula occidentalis* Shrubland**

Water birch Shrubland

36. Willows with at least 10% canopy cover

37. *Salix exigua* (sandbar willow) with greater canopy cover than other individual willows

***Salix exigua* Temporarily flooded Shrubland**

Sandbar willow Temporarily flooded Shrubland

37. Taller willows (mostly *S. geyeriana, Salix boothii, Salix bebbiana* (Geyer, Booth, Bebb willows) dominate shrub layer

38. Taller *Salix* species with a *Carex utriculata* (Northwest Territory sedge) understory component

***Salix geyeriana / Carex utriculata* Shrubland**

Geyer's Willow / Northwest Territory Sedge Shrubland

38. Taller *Salix* species where wet site sedges are lacking in understory

***Salix geyeriana* / Mesic Graminoids Shrubland**
Geyer's Willow / Mesic Graminoids Shrubland

A5. Appendix Table xx. Crosswalk for community type names

Original Field Code	Original Type Description	Source
AGCR	Agropyron_cristatum(semi-natural)	NVCS
Final NVCS Association	Agropyron cristatum - (Pascopyrum smithii, Hesperostipa comata) Semi-natural Herbaceous Vegetation	
AGIN	Agropyron_intermedium(Thinopyrum_intermedium)(semi-natural)	NVCS
Final NVCS Association	Thinopyrum intermedium Semi-natural Herbaceous Vegetation	
AGSP	Agropyron_spicatum	M&S 1980
Final NVCS Association	Pseudoroegneria spicata - Poa secunda Herbaceous Vegetation	
AGSP/AGSM	Agropyron_spicatum/Agropyron_smithii	M&S 1980
Final NVCS Association	Pseudoroegneria spicata - Pascopyrum smithiia Herbaceous Vegetation	
AGSP/AGSM/STVI	Agropyron_spicatum/Agropyron_smithii/Stipa_viridula	M&S 1980
Final NVCS Association	Pseudoroegneria spicata - Pascopyrum smithiia Herbaceous Vegetation	
AGSP/BOGR	Agropyron_spicatum/Bouteloua_gracilis	M&S 1980
Final NVCS Association	Pseudoroegneria spicata - Poa secunda Herbaceous Vegetation	
AGSP/POSE	Agropyron_spicatum/Poa_secunda	M&S 1980
Final NVCS Association	Pseudoroegneria spicata - Poa secunda Herbaceous Vegetation	
AGST	Agrostis_stolonifera	H et al 1995
Final NVCS Association	Agrostis gigantea, stolonifera Semi-natural Herbaceous Vegetation	
BALTIC_RUSH	Juncus_balticus(baltic_rush)(J.arcticus_spp.littoralis)	Rice
Final NVCS Association	(Bromus inermis - Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis) Irrigated Pasture Herbaceous Vegetation	
BEOC	Betula_occidentalis	H et al 1995
Final NVCS Association	Betula occidentalis Shrubland	
BRIN	Bromus_inermis	H et al 1995
Final NVCS Association	Bromus inermis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation	
CAAQ	Carex_aquatilis	H et al 1995
Final NVCS Association	Carex aquatilis Herbaceous Vegetation	
CALA	Carex_lasiocarpa	H et al 1995
Final NVCS Association	Carex pellita Herbaceous Vegetation	
CARO	Carex_rostrata	H et al 1995
Final NVCS Association	Carex utriculata Herbaceous Vegetation	
DECE	Deschampsia_caespitosa	Rice
Final NVCS Association	Deschampsia caespitosa Slickens Semi-natural Sparse Vegetation	
ELPA	Eleocharis_palustris	H et al 1995
Final NVCS Association	Eleocahris palustris Herbaceous Vegetation	
EQFL	Equisetum_fluviatile	H et al 1995
Final NVCS Association	Equisetum fluviatile Herbaceous Vegetation	
JUBA	Juncus_balticus	H et al 1995
Final NVCS Association	Juncus balticus Herbaceous Vegetation	
KENTUCKY_BLUEGRASS	Poa_pratensis(Kentucky_bluegrass)	Rice
Final NVCS Association		
MEADOW_FESCUE	Festuca_pratensis	Rice
Final NVCS Association	(Bromus inermis - Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis) Irrigated Pasture Herbaceous Vegetation	
POPR	Poa_pratensis	H et al 1995
Final NVCS Association	Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation	
POTR/HERBACEOUS	Populus_trichocarpa/herbaceous_understory	H et al 1995
Final NVCS Association	Populus balsamifera / Mixed Herbs Forest	
POTR/SYOC	Populus_trichocarpa/Symphoricarpos_occidentalis	H et al 1995
Final NVCS Association	Populus balsamifera (ssp. trichocarpa, ssp. balsamifera) / Symphoricarpos (albus, occidentalis, oreophilus) Forest	
QUACKGRASS	Agropyron_repens	Rice

Final NVCS Association	(Bromus inermis - Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis) Irrigated Pasture Herbaceous Vegetation	
QUACKGRASS/SMOOTH_BROME	Agropyron_repens/Bromus_inermis	Rice
Final NVCS Association	(Bromus inermis - Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis) Irrigated Pasture Herbaceous Vegetation	
QUACKGRASS/TIMOTHY	Agropyron_repens/Phleum_pratense	Rice
Final NVCS Association	(Bromus inermis - Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis) Irrigated Pasture Herbaceous Vegetation	
REDTOP	Agrostis_stolonifera	Rice
Final NVCS Association	(Bromus inermis - Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis) Irrigated Pasture Herbaceous Vegetation	
ROWO	Rosa_woodsii	H et al 1995
Final NVCS Association	Symphoricarpos occidentalis Shrubland	
SABE	Salix_bebbiana	H et al 1995
Final NVCS Association	Salix geyeriana / Mesic Graminoids Shrubland	
SAEX	Salix_exigua	H et al 1995
Final NVCS Association	Salix exigua Temporarily Flooded Shrubland	
SAGE	Salix_geyeriana	H et al 1995
Final NVCS Association	Salix geyeriana / Mesic Graminoids Shrubland	
SAGE/CARO	Salix_geyeriana/Carex_rostrata	H et al 1995
Final NVCS Association	Salix geyeriana / Carex utriculata Shrubland	
SLICKEN	Metal_contaminated_soil.No_vegetation.	Rice
Final NVCS Association	Not Vegetation	
SMOOTH_BROME	Bromus_inermis(smooth_brome)	Rice
Final NVCS Association	(Bromus inermis - Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis) Irrigated Pasture Herbaceous Vegetation	
SMOOTH_BROME/TIMOTHY	Bromus_inermis/Phleum_pratense	Rice
Final NVCS Association	(Bromus inermis - Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis) Irrigated Pasture Herbaceous Vegetation	
STCO/BOGR	Stipa_comata/Bouteloua_gracilis	M&S 1980
Final NVCS Association	Hesperostipa comata - Bouteloua gracilis - Carex filifolia Herbaceous Vegetation	
SYOC	Symphoricarpos_occidentalis	H et al 1995
Final NVCS Association	Symphoricarpos occidentalis Shrubland	
TANSY_MUSTARD	Descurainia_sophia	Rice
Final NVCS Association	(Bromus inermis - Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis) Irrigated Pasture Herbaceous Vegetation	
TIMOTHY	Phleum_pratense	Rice
Final NVCS Association	(Bromus inermis - Elymus repens - Phleum pratense - Poa pratensis - Schedonorus pratensis) Irrigated Pasture Herbaceous Vegetation	
TYLA	Typha_latifolia	H et al 1995
Final NVCS Association	Typha (latifolia, angustifolia) Western Herbaceous Vegetation	
UNCLASSIFIED_RIPARIAN	Unclassified_Riparian	H et al 1995
Final NVCS Association	Rocky Mountain Riparian Bar Sparse Vegetation	

A6. Field Data Collection Forms

Crew: Year: GPS Unit #:

Poly ID	Super class	Owner	Date mm/dd	13 North - NAD83 UTM E	UTM N	WP #	# pts	err	New Super Class	New Owner	Association	D1	D1-CC	D2	D2-CC	D3	D3-CC	T-CC	See Notes
0105	med	MIXED																	☐
0106	high	MIXED																	☐
0107	high	MIXED																	☐
0118	high	MIXED																	☐
0119	high	MIXED																	☐
0129	high	MIXED																	☐
0147	high	MIXED																	☐
0149	high	MIXED																	☐
0150	med	MIXED																	☐
0180	med	MIXED																	☐
0190	med	MIXED																	☐
0192	med	MIXED																	☐
0204	med	MIXED																	☐
0239	high	MIXED																	☐
0240	high	MIXED																	☐
0243	low	MIXED																	☐
0244	low	MIXED																	☐
0252	med	MIXED																	☐
0287	high	MIXED																	☐
0294	low	MIXED																	☐
0295	low	MIXED																	☐
0297	low	MIXED																	☐
0298	high	MIXED																	☐

Grant-Kohrs Ranch NHS - Rocky Mountain Network I&M *Version: June 22, 2006* Page 1 of 25

supplemental notes for polygon observations

Polygon ID	Date	Dominant	Cover Class	Notes

A7. Accuracy assessment matrix

Comment [p8]: This Appendix A7 tables should be taken from libi_grko_aa_contingency_tables_011110.xls tab GRKO NVC Associations and tab GRKO Ecol Systems

A8. Description of project database

National Park Service – Rocky Mountain Network

Inventory and Monitoring Program

GRKO Vegetation Map Geodatabase Documentation

Version: 1.0
Revision Date: May 1, 2008
Authors: Brent Frakes, Dan Manier

Table of Contents

1. Introduction

This document describes the relationships and entities of the relational geodatabase model used to house the GRKO vegetation map data. This model was developed for ArcGIS 9.2 using the personal geodatabase Microsoft Access JET engine.

The structure of this database differs from many of the other NPS Vegetation Maps. Because intensive field sampling was not involved, this vegetation map did not use the NatureServe Plots database. Thus, only a limited set of information was collected in the field. Records of dominant species composition are preserved in this geodatabase as a feature class, and in tables; these tables and data are identified with “Field” and “AA” (Accuracy Assessment) in their headings.

2. Entity Relationships

Figure 1 provides a diagram showing the relationships among the primary entities, both spatial and tabular. In total, there are three feature classes that contain geographic information, six main tables, and two lookup tables used for reference.

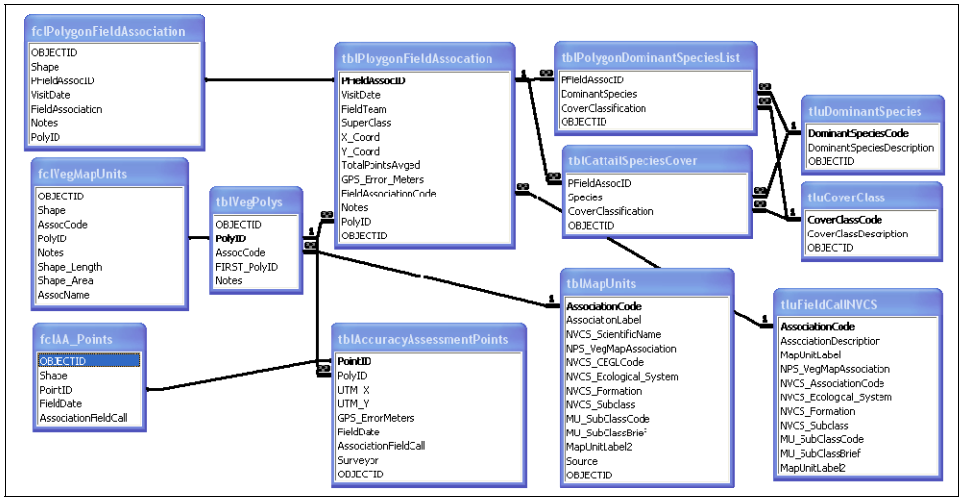

Figure 1. Relationships Among Core Tables in the Geodatabase Model

Referential integrity is enforced among the main tables (tbl) through MS Access. Due to the limitations of the geodatabase model, referential integrity is not enforced among the look-up (tlu) tables and the related feature classes (fcl).

This structure reflects a compromise between normalization and functionality. In general, all spatial information (especially polygons) was represented in the feature classes while all tabular information was housed in relational tables. However, there is sometimes redundancy between the two. For instance, the feature class containing the accuracy assessment points is partially redundant with the table tblAccuracyAssessmentPoints. This simultaneously ensures that one can work in ArcGIS without having to plot x-y points while another can work in Access without the risk of corrupting the feature classes.

3. Table and Attribute Descriptions

Details for each table and data field (see Figure 1) are provided.

3.1. fclVegMapUnits

Contains the geographic location of all vegetation map polygons, their associated classifications and labels. The Map Unit Association code field ('AssocCode') is a four letter code derived from the standard scientific name (i.e. the first two letters of the Genus and specific epitaph; some of the entries recognize two dominant species (separated by '/'). Most of these codes match the NVC standards (i.e. may be based on former nomenclature, as in the case of *Pseudoroegaria spicata* which is coded 'AGSP'); a few of the codes are custom names for this map (e.g. those other than natural vegetation types). Map Unit Label includes the common names for the dominant species (same species identified in 'AssocCode'.

Attribute	Description	Type
OBJECTID	Autonumber. Internal to ESRI	Long
Shape	Shape. Internal to ESRI	Blob
AssocCode	Map Unit Association code	Text 25
PolyID	Unique polygon identifier	Text 5
Notes	Polygon-specific notes	text 254
Shape_Length	Length in meters. Internal to ESRI	Double
Shape_Area	Area in square meters. Internal to ESRI	Double
AssocName	Association code full name	Text 75

3.2. fclPolygonFieldAssociation

Point locations used as reference to assign the polygons an association. Additional details of the original "field call" related to these point features are included in 'tblPolygonFieldAssocation'.

Attribute	Description	Type
OBJECTID	Autonumber. Internal to ESRI	Long
Shape	Shape. Internal to ESRI	Blob
FieldCallID	Field code from field census	Text 50
Invent_Date	Date the point was visited	Date
FieldAssociationCode	Association given to the point	Text 50

3.3. fclAA_Points

Contains the geographic location of all accuracy assessment points. This feature class is a spatial representation of 'tblAccuracyAssessmentPoints' and contains a subset of the full tabular information documenting the accuracy assessment process.

Attribute	Description	Type
OBJECTID	Unique record assigned by ESRI	Autonumber
Shape	Shape. Internal to ESRI	Blob
PointID	Unique point ID for each AA point	Double
FieldDate	Date of field call	Date
AssociationFieldCall	Association determined from the field	Text 255

3.4. tblVegPolys

Table containing supplementary information about each map unit polygon. Some of this information is found in the feature class.

Attribute	Description	Type
OBJECTID	Autonumber. Internal to ESRI	Long
PolyID	Unique polygon identifier	Integer
AssocCode	Map Unit Association code	Text 25
Notes	Polygon-specific notes	text 254

3.5. tblPolygonFieldAssociation

Contains the data collected in the field to determine the association for each polygon.

Attribute	Description	Type
PFieldAssocID	Code uniquely identifying each field association call	Text 50
VisitDate	Date the polygon was visited	Date
FieldTeam	Identifier initials from the field team	Text 2
SuperClass	Relevant to the sampling design	Text 50

X_Coord	UTM Easting, 12 North, NAD 83	Double
Y_Coord	UTM Northing, 12 North, NAD 83	Double
TotalPointsAvged	The number of points collected in recording the waypoint	Long
GPS_Error_Meters	The estimated accuracy of the point in meters	Text 50
FieldAssociationCode	Community type assigned to the polygon during the fieldwork	Text 50
Notes	Notes from the field sheet	Memo
PolyID	Polygon where the point is located	Integer
OBJECTID	Autonumber. Unique to ESRI	Long

3.6. tblAccuracyAssessmentPoints

Contains the locations and field identification call made by the accuracy assessment team; these data were used to assess correlation between original field calls, assigned polygon associations and user accuracy.

Attribute	Description	Type
PointID	Unique point ID	Double
PolyID	Polygon Unit from fclMapUnit	Integer
UTM_X	UTM NAD 83, 12 North	Long Integer
UTM_Y	UTM NAD 83, 12 North	Long Integer
GPS_ErrorMeters	Estimated GPS positional error in meters	Double
FieldDate	Date the point was visited	Date/Time
AssociationFieldCall	Association observed in the field	Text 255
Surveyor	Name of the surveyor making the field call	Text 255
OBJECTID	Autonumber. Unique to ESRI.	Long Integer

3.7. tblCattailSpeciesCover

As a park request, cattails were observed separately for invasive species detection. This information was not used for developing the final map classes.

Attribute	Description	Type
PFieldAssocID	Numerical code identifying the related polygon	Text 10
Species	Species code for one of the dominant species in a polygons	Text 10
CoverClassification	The cover classification code for the species	Text 10

OBJECTID	Autonumber. Internal to ESRI	Long Integer

3.8. tblMapUnits

This table of classes represents the final crosswalk for the NVCS associations; it includes codes, scientific nomenclature and class hierarchy assignments.

Attribute	Description	Type
AssociationCode	Unique code identifying each association	Text 50
AssociationLabel	Label for aggregated map units	
NPS_VegMapAssociation	NVCS with Manier modified names for non-natural types	Text 200
NVCS_ScientificName	Accepted scientific nomenclature with a few custom classes for non-standard types	Text 255
NVCS_CEGLCode	Unique NCVS alpha-numeric from NVC (NatureServe): Association Code (CEGL######), Alliance Code (A.####) or project specific NPS code (NPS.GRKO#) for non-natural types (Manier per Chris Lea recs.)	Text 100
NVCS_Ecological_System	NVC nomenclature for Ecological Systems	Text 100
NVCS_Formation	NVC nomenclature for Formation	Text 255
NVCS_Subclass	NVC nomenclature for Subclass	Text 50
MU_subClassCode	Alpha-numeric derived from NVC Subclass	Text 5
MU_SubClassLabel	One-word label for NVC Subclass	Text 10
Source		Text 255
OBJECTID	Autonumber. Internal to ESRI	Long Integer

3.9. tblPolygonDominantSpecies

Dominant species found for each polygon based on a survey around the point of reference. These are the original field calls recorded by botanists during the polygon census.

Attribute	Description	Type
PFieldAssocID	Code identifying each polygon	Text 10
DominantSpecies	Species code for one of the dominant species in a polygon	Text 10
CoverClassification	Percent cover for the particular species	Text 10
OBJECTID	Autonumber. Unique to ESRI.	Long

3.10. tluCoverClass

Cover classes used to identify dominant species in each polygon.

Attribute	Description	Type
CoverClassCode	Shorthand code	Text 50
CoverClassDesciption	Description of each cover class	Text 200
ObjectID	Autonumber. ESRI	Long

3.11. tluDominantSpecies

Reference table connecting 4-letter species codes to the proper scientific name. Note that a species code can represent more than a single species.

Attribute	Description	Type
DominantSpeciesCode	Shorthand code	Text 50
DominantSpeciesDesciption	Description of each cover class	Text 200
ObjectID	Autonumber. ESRI	Long

3.12. tluFieldCallNVCS

This table preserves the original Association assigned by botanists mapping in the field; these are connected to the appropriate NVC hierarchical classes. Note that some codes change between the original field call and the final classification, which is why this information is preserved.

Attribute	Description	Type
FieldAssociationCode	Field mapping association codes	Text 50
FieldAssociationDescription	Formal community type name assigned by field level classification	Text 255
MapUnitLabel	Common Name Association Label	Text 100
NPS_VegMapAssociation	Association from NatureServe Explorer web site (Oct 2006). NA = field typed only to alliance level, or Association does not exist	Text 100
NVCS_AssociationCode	4 letter coded Association from NatureServe Explorer Web site (Oct 2006)	Text 255
NVCS_EcologicalSystem	Ecological System from NatureServe Explorer (Oct 2006)	Text 100
NVCS_Formation	Formation from from NatureServe Explorer (Oct 2006)	Text 255
NVCS_Subclass	Subclass from NatureServe Explorer Web site (Oct 2006)	Text 100
MU_SubclassCode	Alpha-numeric based on NVC Subclass	
MU_SubClassBrief	One-word description of Subclass	