



Vegetation Classification and Mapping Project Report, Golden Spike National Historic Site

Natural Resource Technical Report NPS/NCPN/NRTR—2011/508



ON THE COVER

Trestle, Golden Spike National Historic Site

Photograph by: Janet Coles

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Summary

The Northern Colorado Plateau Inventory and Monitoring Network worked with the support of the U.S. Geological Survey - National Park Service Vegetation Mapping Program to describe and map vegetation at Golden Spike National Historic Site (GOSP, or NHS). This collaborative effort involved many project partners, particularly engineering-environmental Management (e²M), the Western Region office of NatureServe, and other cooperators.

The mapping area is 1,144 hectares (2,826 acres), encompassing public and private lands within the NHS administrative boundary. Project partners identified plant associations for GOSP and determined an effective mapping approach using 1:12,000-scale, true color orthophotography. The team collected vegetation and environmental data from three vegetation classification plots and 46 observation points located within the GOSP boundary. Fieldwork and mapping were completed during 2007.

Analysis of the classification plot data revealed 18 National Vegetation Classification (NVC) plant associations or park special vegetation types within GOSP. Several additional plant associations for which map units were developed were not sampled with classification plots, but were instead documented by extensive field notes and photographs.

Vegetation and land use were delineated in the field on base maps of 1:12,000 orthophotography acquired in 2006. This was possible because of the small size of the NHS and because virtually every part of the unit is accessible on foot. Because GOSP is relatively small, the program standard minimum mapping unit of 0.5 ha (1.24 ac) was not used, and polygons were delineated down to approximately 0.1 ha. In addition, GOSP staff requested that significant occurrences (patches and stands) of native grasses be recorded, which was accomplished by using a separate point layer. Ten unvegetated land use/land cover types were delineated, including roads, NPS facilities, and one sparsely vegetated geologic exposure unit.

A total of 552 map polygons representing 29 natural and semi-natural vegetation map classes, nine land use classes, and one sparsely vegetated geologic exposure map class were interpreted for the GOSP mapping project. Average polygon size across all map classes is 1.1 ha (2.6 acres). Natural and semi-natural vegetation, and sparsely vegetated map classes are represented by 514 polygons covering 1,108 ha (2,738 acres). Land use/land cover polygons within GOSP include cultivated fields, roadways, railroad beds, and NPS facilities that total 38 polygons and cover 35.7 ha (88.2 acres) of the NHS. The most common map class was Big Sagebrush / Cheatgrass Shrubland (S-BSCG) with 141 polygons covering 27.8% of the mapping area.

Because each polygon was visited and delineated in the field, a traditional thematic accuracy assessment of the 29 vegetated map classes was not employed.

Products resulting from the GOSP vegetation classification and mapping project include:

Available in this report:

- project summary of methods and results
- illustrated dichotomous field key to the plant associations

- illustrated guide to the map classes
- detailed descriptions of documented plant associations
- samples of completed field forms
- field manual used to guide plot and observation point data collection

Available elsewhere¹:

- geodatabase containing map polygon attribute, land use, classification plot data, and NHS and project boundaries
- land use, digital orthophotograph, and project boundaries
- ground photography of vegetation classification plots and observation points in hard copy and digital formats
- all field data (plots and observation points) stored in a Microsoft Access database
- hard copy vegetation maps
- metadata for all digital products

Geospatial products are in Universal Transverse Mercator (UTM) projection, Zone 12, using the North American datum of 1983.

¹ This document and most of the digital products are available on the internet at: <http://biology.usgs.gov/npsveg/>. Hard copies of the digital orthophotos, and original data forms are retained by NCPN and the NHS.

Acknowledgments

This project was completed through the effort and dedication of numerous individuals and organizations. Angela Evenden coordinated the NCPN Vegetation Mapping Program in its early years and guided the development of the methodologies used for this unit. Karl Brown and Tammy Hamer (USGS/NPS) and Mike Mulligan (USGS) provided program oversight and coordination. Funding for this project was provided through the USGS-NPS National Vegetation Mapping Program and the Northern Colorado Plateau Inventory and Monitoring Network.

Bruce Condie and Pete Williams collected classification plot and observation point data and drew the first draft of the vegetation map in the field. Bruce also helped develop the map unit concepts employed in the final vegetation map. Keith Schulz of the Western Region office of NatureServe prepared the final vegetation classification. Jim Von Loh, Senior Biologist with engineering-environmental Management, Inc. prepared draft local descriptions, a preliminary draft report, and provided final draft report editing. Database management and support were skillfully performed by Helen Thomas and Russ DenBleyker of the Northern Colorado I&M Network. Aneth Wight created the geodatabase and tested it extensively within in a GIS environment.

The staff of Golden Spike NHS made us welcome when we arrived to collect the field data, and provided helpful advice as to the best way to access different parts of the NHS. Special thanks to Tammy Benson who allowed Bruce Condie and Pete Williams to review GOSP management files for vegetation information and provided field assistance on a cold, windy spring day.

We are grateful to these and other contributors for the success of the project.

Acronyms and Abbreviations

AA	Accuracy Assessment
BLM	United States Bureau of Land Management
CEGL	Community Element Code
DEM	Digital Elevation Model
DOQQ	Digital Orthophotograph Quarter Quadrangle
e ² M	engineering-environmental Management, Incorporated
ES	Ecological System
ESRI	Environmental Systems Research Institute
FGDC	Federal Geographic Data Committee
GIS	Geographic Information System
GOSP	Golden Spike National Historic Site
GPS	Global Positioning System
I&M	Inventory and Monitoring Program
ITIS	Integrated Taxonomic Information System
LC/LU	Land Cover/Land Use
MMU	Minimum Mapping Unit
NAD	North American Datum
NCPN	Northern Colorado Plateau Network
NHS	National Historic Site
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NVC	National Vegetation Classification
NVCS	National Vegetation Classification Standard
QA/QC	Quality Assurance/Quality Control
TNC	The Nature Conservancy
TSN	Taxonomic Serial Number
UNESCO	United Nations Education, Science, and Cultural Organization
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
WRCC	Western Region Climate Center

Introduction

Vegetation Classification and Mapping Project, Golden Spike National Historic Site

The Golden Spike National Historic Site (GOSP or NHS) Vegetation Classification and Mapping Project was organized and coordinated by the Northern Colorado Plateau Network (NCPN) Inventory and Monitoring (I&M) Program between 2007 and 2008, with assistance from several cooperators. The purpose of this project was to describe and map existing plant associations on 1,144 hectares (2,826 acres) within GOSP, and to provide this information in written, tabular, digital, and spatial formats useful to NPS resource managers, the NCPN I&M Program, and others. The basic project components consisted of vegetation classification, description, imagery interpretation, and spatial database development. No accuracy assessment was conducted for this project because each polygon was visited and delineated in the field.

In 2001, the NCPN I&M Program launched a multi-year project to complete vegetation classifications and maps for 16 network park units. Funding was provided by the USGS-NPS Vegetation Mapping Program and the NCPN. The GOSP Vegetation Classification and Mapping Project was completed by the NCPN, engineering-environmental Management, Incorporated (e²M), and NatureServe. Vegetation classification plot and observation point data collection occurred in 2007. The draft vegetation and land use map was created in 2007 and refined in 2008.

Project methods, results, and products are documented in this report. This introductory section describes the NPS I&M Program and the USGS-NPS Vegetation Mapping Program, as well as the GOSP project area. Later sections document the methods and results for each of the major steps in the project: scoping, vegetation classification and description, and vegetation mapping.

The USGS-NPS Vegetation Mapping Program

The National Vegetation Mapping Program is a cooperative project between the USGS and the NPS to inventory, classify, describe, and map vegetation in more than 270 national park units within the United States. Consistent vegetation classification, mapping, and accuracy assessment protocols and standards are applied across projects supported by this program. The National Vegetation Mapping Program is administered by the USGS Center for Biological Informatics in cooperation with the NPS I&M Program. Through implementation of the NPS Natural Resource Challenge (NPS 1999a), significant funding became available for completing important natural resource baseline inventories in park units, including vegetation classification and mapping. This support provided the NPS with the opportunity to move forward with dozens of new park unit vegetation classification and mapping projects, including GOSP. Vegetation classification and mapping products produced by this program are incorporated into the USGS National Biological Information Infrastructure Program, which serves as an information-sharing network (<http://biology.usgs.gov/npsveg/>).

Northern Colorado Plateau Network Inventory and Monitoring Program

The National Park Service developed an inventory and long-term monitoring program for park natural resources over the last two decades of the twentieth century. This effort was enhanced by the NPS Natural Resource Challenge (NPS 1999a); as a part of this initiative, the NCPN was

formed in 2000 to develop an integrated inventory and monitoring program for 16 park units in Utah, Colorado, Arizona, and Wyoming.

A goal of the NPS I&M Program is to complete baseline inventories of biological and geophysical resources for each park unit. These inventories cover 12 basic data sets needed by park staff to guide resource management. Vegetation classification and mapping constitute one data set. Early in the development of its I&M program, the NCPN made completing vegetation maps for each network park unit a priority. In addition to assisting park management, vegetation maps and classification information were seen as contributing significantly to NCPN long-term monitoring efforts. In 2001, the network began implementation of a strategy to complete vegetation mapping in all network park units. The GOSP vegetation mapping project is the thirteenth of the network-coordinated projects to be completed.

Vegetation Mapping Program Standards

The NPS I&M Program established guidance and standards for all vegetation mapping projects in a series of documents:

Protocols

- National Vegetation Classification System (TNC and ESRI 1994a, NatureServe 2003a)
- Field methods and mapping procedures (TNC and ESRI 1994b)
- Statistically rigorous and consistent accuracy assessment procedures (ESRI and TNC 1994)
- Guidelines for using existing vegetation data (TNC 1996)

Standards

- National Vegetation Classification Standard (FGDC 1997)
- Spatial Data Transfer Standard (FGDC 1998b)
- Content Standard for Digital Geospatial Metadata (FGDC 1998a)
- United States National Map Accuracy Standards (USGS 1999)
- Integrated Taxonomic Information System
- Program-defined standards for map attribute accuracy and minimum mapping unit

These documents are available on the USGS-NPS Vegetation Program Web site (<http://biology.usgs.gov/npsveg/standards.html>).

National Vegetation Classification Standard

The National Vegetation Classification (NVC) is the system used in NCPN vegetation mapping projects (TNC and ESRI 1994a), and is based on the National Vegetation Classification Standard adopted by the Federal Geographic Data Committee (FGDC 1997). The NVC evolved from work conducted primarily by The Nature Conservancy (TNC), NatureServe, and the Natural Heritage Program network over more than two decades (Grossman et al. 1998). The structure of the NVC is based in part on an earlier international vegetation classification produced by the

United Nations Educational, Cultural, and Scientific Organization (UNESCO 1973, Driscoll et al. 1984). Use of a standardized classification system helps ensure data compatibility throughout the NPS and other agencies. The FGDC Vegetation Subcommittee provides oversight to keep this standard current and relevant. The substantial revisions to the upper levels of the NVC hierarchy adopted by the Vegetation Subcommittee as Version 2 (FGDC 2008) are not used in this project.

Vegetation classification systems attempt to recognize and describe repeating assemblages of plants in similar habitats. The NVC is a hierarchical system that incorporates physiognomic characters and floristic data to define seven levels of terrestrial vegetation classification. The five upper levels (class, subclass, group, subgroup, and formation) are based on physiognomic features. The two lower levels (alliance and association) are distinguished by variability in floristic composition. The physiognomic units have a broad geographic perspective and the floristic units have utility in local and site-specific applications (Grossman et al. 1998). The physiognomic levels of the NVC are based on physical, structural, and environmental characteristics identifiable from satellite imagery, digital orthoimagery, aerial photography, or ground observations (Table 1). Specific criteria defining these physiognomic units are based on ecologic characteristics that vary among major vegetation groups (FGDC 1997).

The alliance and association levels form the base of the NVC hierarchy and are determined by the most abundant or diagnostic species comprising the various layers of a homogenous vegetation community. An association is here defined as a plant community type with a consistent species composition, uniform physiognomy, and similar habitat conditions (Flahault and Schroter 1910). Species composition differentiates associations (TNC and ERSI 1994a). An alliance is "a physiognomically uniform group of plant associations sharing one or more dominant or diagnostic species which, as a rule, are found in the uppermost strata of the vegetation." (Reid and Comer 1998). NatureServe coordinates plant association data for the NCPN vegetation mapping projects. Associations are added to the NVC and older concepts are refined as new data become available.

Table 1. National Vegetation Classification System hierarchy for terrestrial vegetation.

Level	Criteria Delineating Level	Example
Class	Structure (height, cover) of dominant vegetation strata	Shrubland
Subclass	Growth form characters including leaf type (evergreen, deciduous) for woody plants and persistence (perennial, annual) for herbaceous species	Evergreen shrubland
Group	Leaf morphology (broad leaf, microphyllous, xeromorphic), leaf phenology, and climatic conditions	Microphyllous evergreen shrubland
Subgroup	Relative degree of human disturbance	Natural/Semi-natural microphyllous evergreen shrubland
Formation	Additional physiognomic characteristics, general environmental conditions, relative landscape position, and hydrologic regimes	Lowland microphyllous evergreen shrubland
Alliance	Dominant or diagnostic species of uppermost or dominant stratum	<i>Artemisia tridentata</i> (ssp. <i>tridentata</i> , ssp. <i>xericensis</i>) Shrubland Alliance

Level	Criteria Delineating Level	Example
Association	Other dominant or diagnostic species from any stratum	<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Poa secunda</i> Shrubland

Other Standards

In addition to vegetation classification, the FGDC sets standards for map spatial accuracy and for metadata employed in NPS vegetation classification and mapping projects. Standards for map products stipulate map scales of 1:24,000 or finer, and minimum polygon size of 0.5 ha (1.24 acres). Positional accuracy for vegetation maps must meet National Map Accuracy Standards, which specify horizontal errors of less than 10.2 m (33.5 ft.) on the ground for 1:12,000-scale maps.

All digital vegetation products resulting from this project are accompanied by FGDC-compliant metadata. Metadata are “data about the data,” and describe the content, quality, condition, and other characteristics of the spatial dataset. Metadata are critical elements that expedite the interpretation and exchange of information among users.

Project Area Description

Location and Setting

Golden Spike NHS is located in Box Elder County in northern Utah, 52 km (32 miles) west of Brigham City, 80.5 km (50 miles) northwest of Ogden, and 136.8 km (85 miles) northwest of Salt Lake City (NPS 1999b; Figure 1). GOSP is accessible via Utah highways 13 and 83 from Brigham City, the county seat. The county is sparsely populated, with three people per square kilometer (8 / mi²). Land use surrounding the NHS is primarily agricultural, including dry-farmed cropland and livestock grazing.

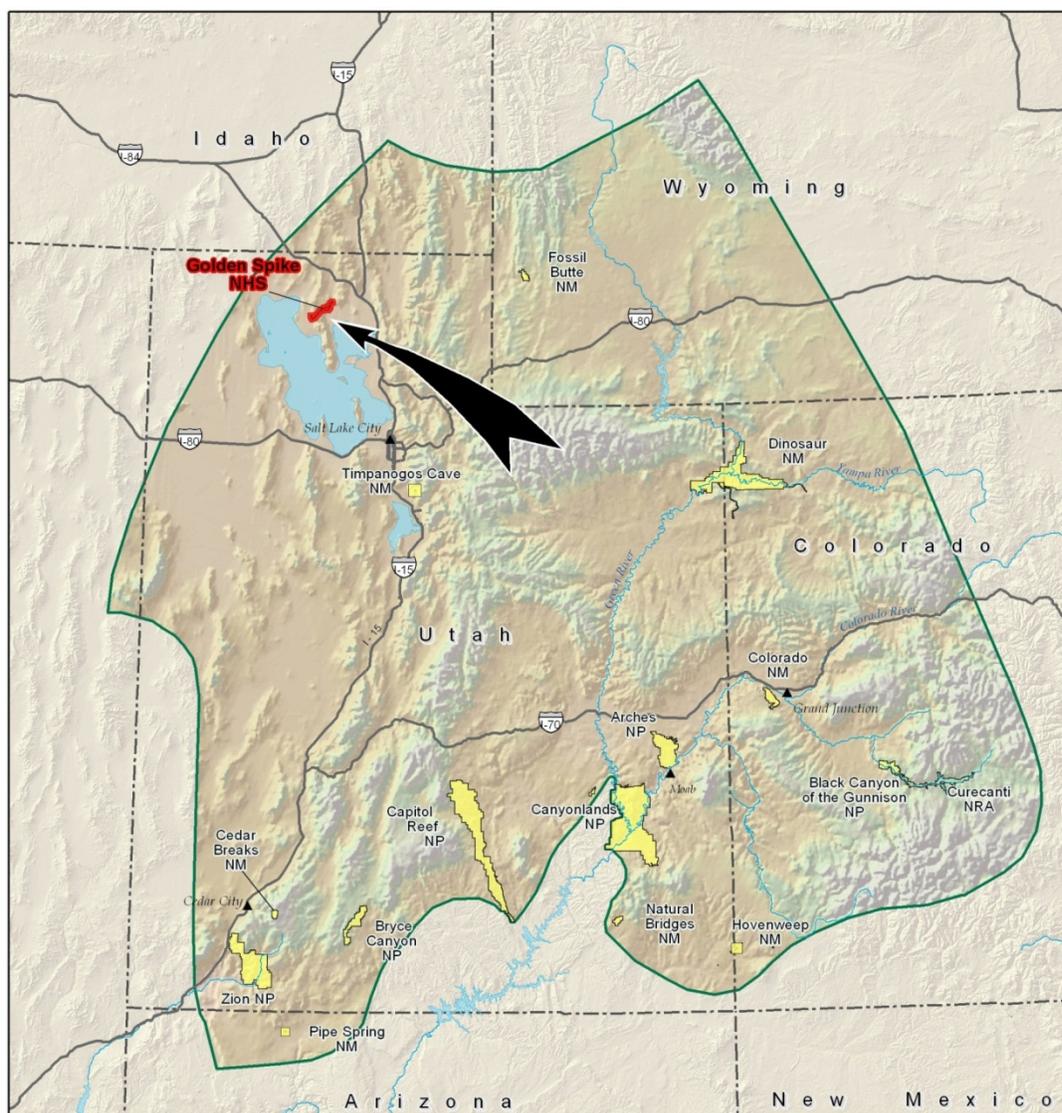


Figure 1. Location of GOSP in northern Utah.

GOSP was established on approximately 2.8 ha (7 acres) in 1957 under non-federal ownership (Hanover 1996). In 1965 Congress authorized the Department of Interior to acquire 1,107 ha (2,735 acres) to be managed by the National Park Service (Public Law 89-102 July 30, 1965).

(Figure 2). Approximately 894.8 ha (approximately 2,211 acres) of the NHS are currently in federal ownership and approximately 212.5 ha (approximately 525 acres) remain in private ownership (NPS 1999b). The NHS was established “*To commemorate the construction and completion of the first transcontinental railroad, and its historical consequences for our nation. Dedicated to commemorating this historic work, Golden Spike National Historic Site preserves and interprets historic resources and values for the enjoyment, education, and inspiration of this and future generations*” (NPS 1999b). The NHS preserves the site where the Central Pacific Railroad and the Union Pacific Railroad tracks, constructed by as many as 20,000 immigrant and post-Civil War laborers, were joined on Promontory Summit, Utah in 1869. GOSP manages approximately 25 km (15.5 miles) of the original railroad grade, much of it within a 122-meter (400-foot) wide right-of-way acquired from the Southern Pacific Railroad. Visitation to the NHS averages 55,000 annually (NPS 1999b).

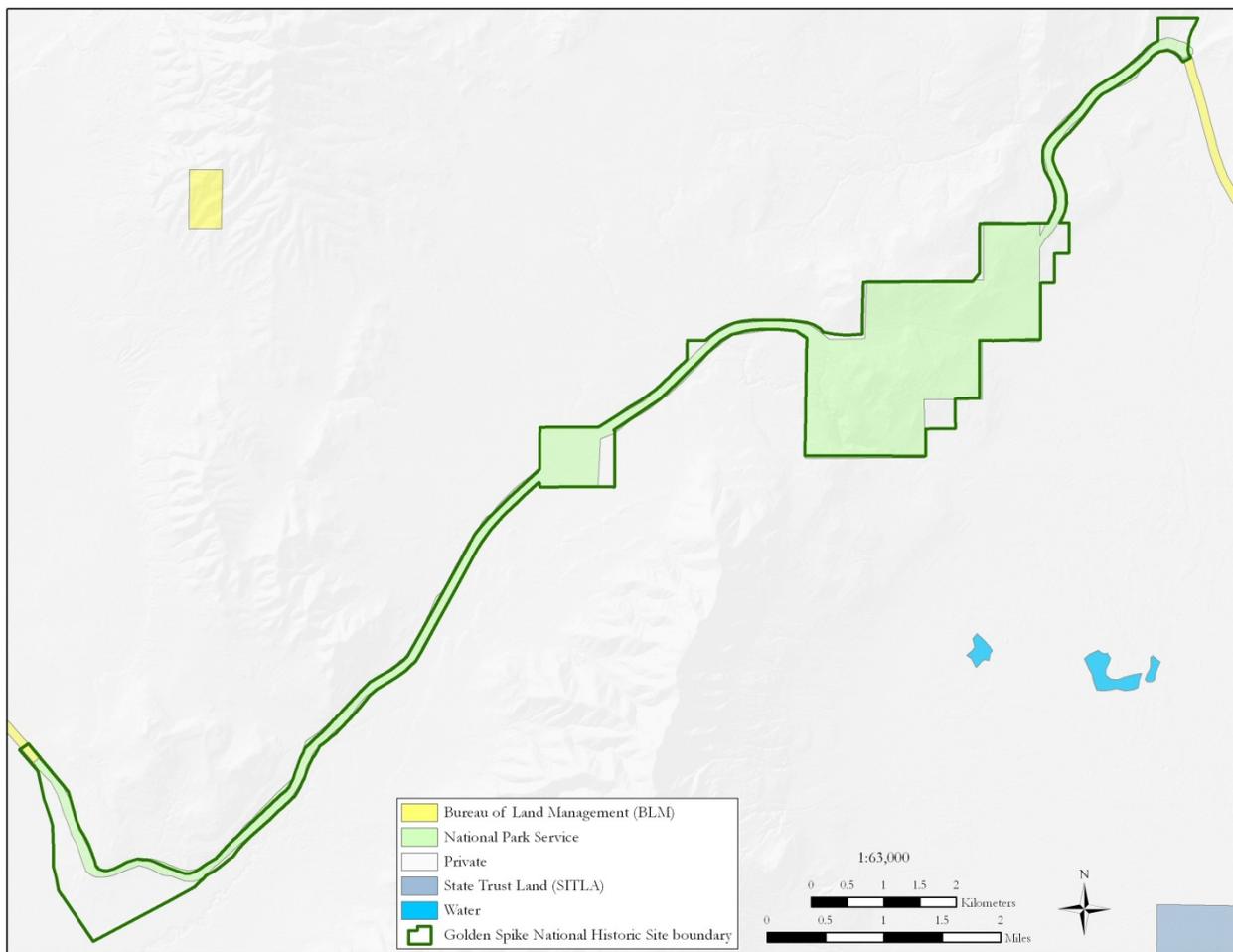


Figure 2. Map of the GOSP vegetation mapping project area showing adjacent land ownership.

GOSP is bordered by private lands and only the area within the GOSP administrative boundary is included in the vegetation classification and mapping project (Figure 2).

Topography

GOSP occupies Promontory Summit, a pass between the Promontory Mountains and the North Promontory Mountains. This low point was an obvious route for the transcontinental railway, as it avoided both the Great Salt Lake and the high mountains. The NHS occupies the northeastern corner of the Great Basin section of the Basin and Range physiographic province (Figure 3). The name “Great Basin” refers to the fact that surface waters in this region have no outlet to the Pacific Ocean. The Great Basin includes approximately 30 million ha (113,144 mi²) and includes most of Nevada and adjacent parts of California, Oregon, Idaho, and Utah. It is bordered by the Sierra Nevada to the west, the Rocky Mountains and the Colorado Plateau to the east, the Mojave Desert to the south, and the Columbia Plateau to the north.

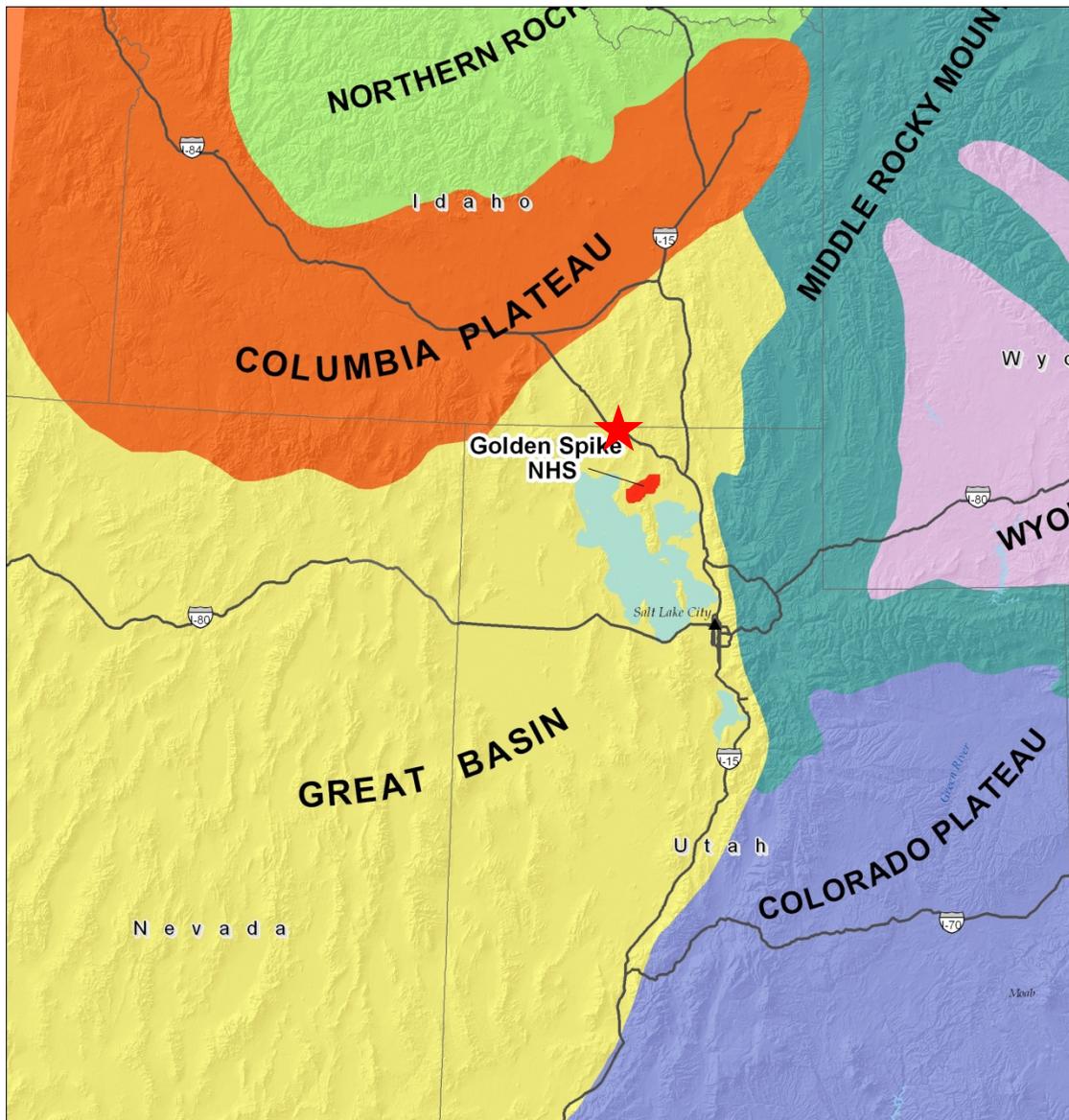


Figure 3. Location of Golden Spike NHS within the Great Basin.

The Great Salt Lake and its associated marshes lie south of GOSP, at the foot of the Promontory Mountains. To the east are the Blue Spring Hills; the North Promontory Mountains are to the north. Landscapes within the NHS are characterized by ridges, hills, valleys, and a small canyon. Long hill slopes are interrupted by wave-cut terraces formed by various elevations of the glacial Lake Bonneville shoreline (Figure 4). Elevations within GOSP range from 1,317 m (4,320 feet) to 1,609 m (5,280 feet) near the East Auto Tour route. Blue Creek flows across the east end of the NHS near Utah Highway 83. Construction of railroad grades with associated cuts, fills, and borrow areas have substantially altered topography within and adjacent to the rail corridor.



Figure 4. Terraces cut by the glacial lake Bonneville shoreline are visible from GOSP.

Climate

Records of climatic conditions have been maintained continuously since 1962 at the Thiokol Plant 78 located immediately east of GOSP (Western Regional Climate Center 2008). GOSP is characterized by a semiarid climate, averaging 35.8 cm (14.1 inches) of precipitation annually. Precipitation is lowest during the hot summer months and highest during the spring and fall (Figure 5). Most precipitation falls as rain; total annual snowfall averages only 54.1 cm (21.3 inches) with an average of only a few centimeters (1 to 2 inches) of snow on the ground at any one time.

Conditions within the NHS are typical of moderate elevations in the continental interior. Summers are long with hot days averaging 33.2°C (91.8 °F) and warm nights averaging 16.3°C (61.4°F) in July. Winters are cold, with an average maximum temperature of 2.6°C (36.6°F) and an average minimum temperature of -10.8°C (12.6 °F) in January. The sun shines 78% of the time during the summer and 55% of the time during winter. Prevailing winds are from the west and are light to moderate throughout the year (NRCS 1975).

The climate of northern Utah is characterized by hot, dry summers, unlike southern Utah, where the Arizona Monsoon contributes significant summer precipitation in the form of afternoon thunderstorms. The proximity of the Great Salt Lake raises precipitation at GOSP above what would normally be expected. Lucin, Utah, located at a similar latitude and elevation but 210 km (130 miles) west of GOSP, receives only 17.7 cm (7.0 inches) of annual precipitation. Winter precipitation is derived from Pacific air masses; the heaviest snowfall occurs when one of these relatively warm, moist air masses intersects an Arctic cold front pushed over northern Utah by the jet stream.

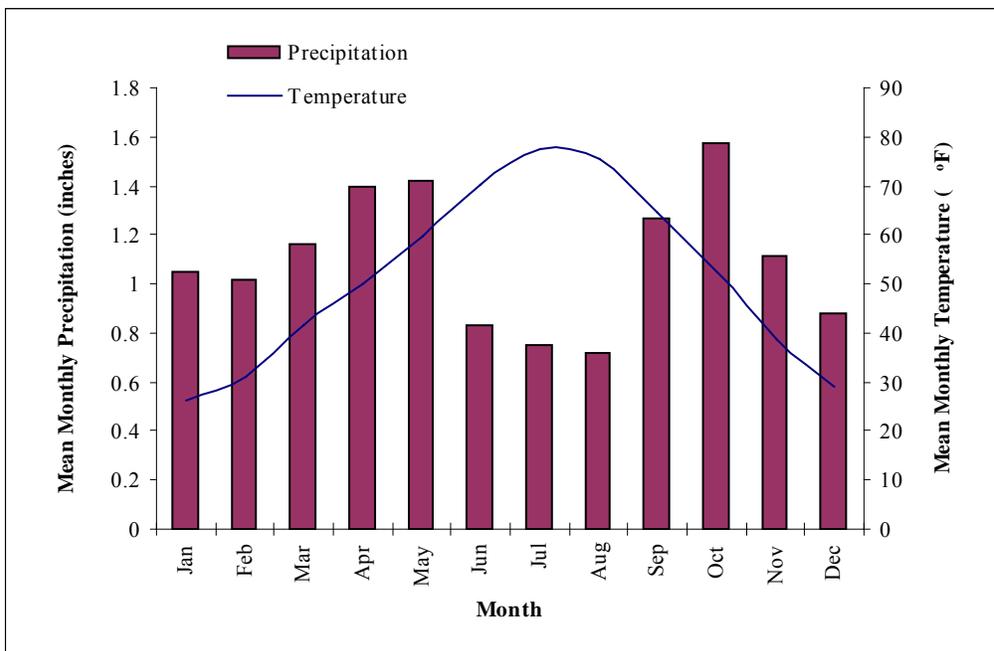


Figure 5. Climate data for GOSP (Western Regional Climate Center 2008).

Geology and Vegetation

GOSP lies near the edge of the Basin and Range physiographic province; the Wasatch Front occurs 25 miles (40 km) east of the NHS and forms part of the province's eastern edge. The Basin and Range physiographic province represents a large area of the continental interior west that has been stretched until pieces of crust have split apart and tilted. The uplifted sides of the affected crustal mass form the many parallel ranges of the province, while the lower sides were buried by sediments to form the basins.

Quaternary alluvium and lacustrine deposits overlie and obscure most of the older bedrock units (Figure 6). The best-exposed rock unit is rough, gray limestone of the Oquirrh Formation (Figure 7). This formation was deposited about 300 million years ago on the floor of a shallow sea and remained buried until raised to near the surface by the Sevier Orogeny approximately 100 million years ago. Less than 17 million years ago, crustal movements and erosion associated with formation of the Basin and Range topography brought the Oquirrh Formation to the surface by exposing the overlying sediments to erosion as the ranges formed (Thornberry-Ehrlich 2006).

GOSP lies within the Sagebrush Basins and Slopes section of the Central Basin and Range Ecoregion (Woods et al. 2001). The vegetation of GOSP can be broadly classified as temperate shrub-steppe (Bailey 2001, West 1988). Although sagebrush shrublands dominate the vegetation, a variety of grasslands occupy burned sites. On deeper, fine textured soils the non-native annual cheatgrass is prevalent; on rockier, drier slopes, native bunchgrasses persist and occasionally dominate. The distribution of vegetation is driven by soil type, land use and disturbance history, and to a lesser extent, by aspect.

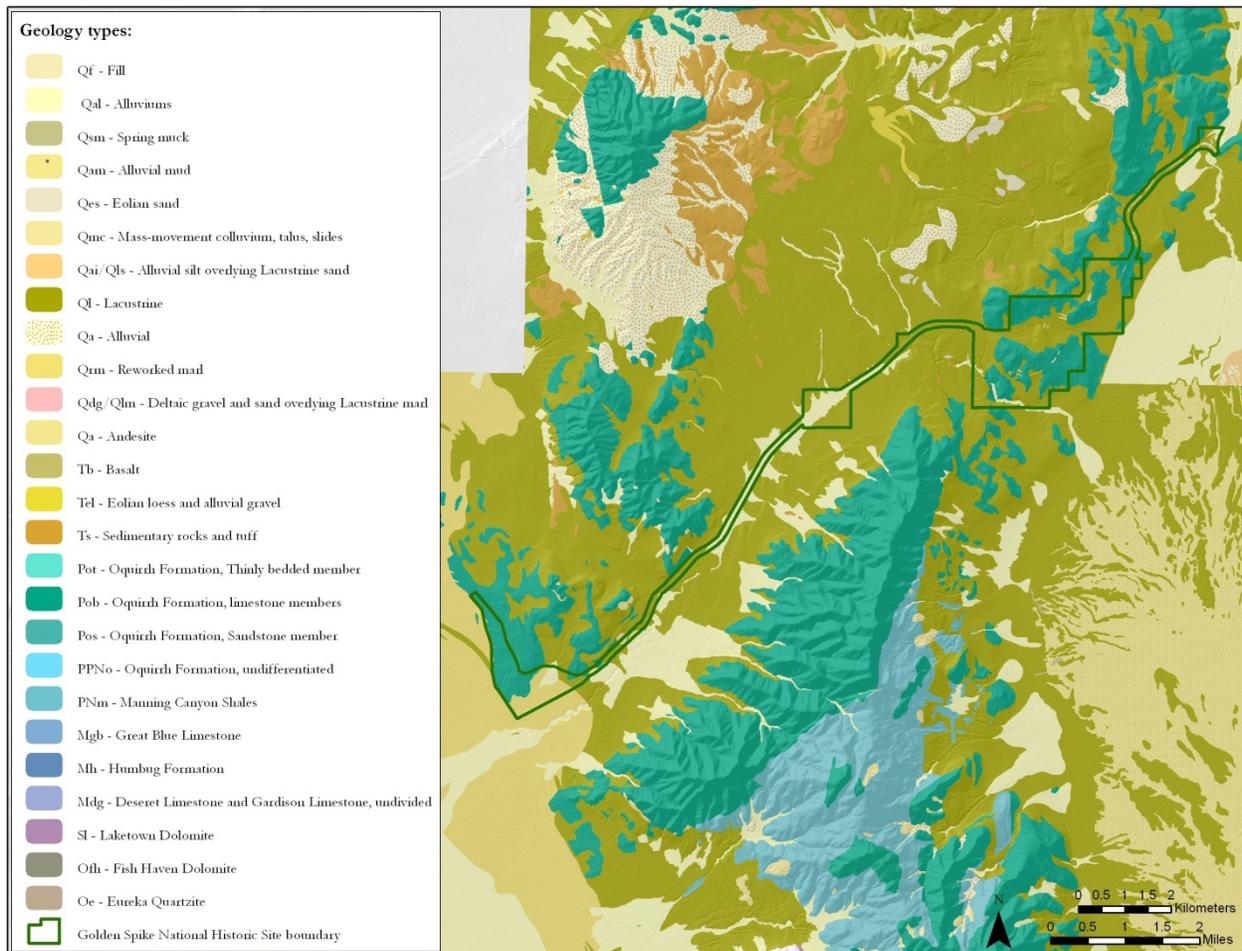


Figure 6. Geology map of GOSP and vicinity.

The remainder of this section is a general description of the distribution of vegetation within GOSP, organized by oldest to youngest geologic unit.

Oquirrh Formation (Upper Pennsylvanian to Lower Permian). This geologic unit forms bluffs and outcrops within the NHS. It is composed of limestone and sandstone more than 3,000 m (10,000 ft.) thick which preserve abundant fossils. Oquirrh Formation exposures are generally sparsely vegetated; they may be delineated as a geology map unit or more typically support mixed forbs and cushion plants such as granite prickly-phlox (*Leptodactylon pungens*) and hairy golden-aster (*Heterotheca villosa*) (Figure 8).



Figure 7. Outcrops of rough, gray Oquirrh Limestone are common throughout GOSP.



Figure 8. Granite prickly-phlox (*Leptodactylon pungens*) growing on the Oquirrh Limestone.

Much of the NHS is covered by unconsolidated sediments deposited on the floor and shoreline of Pleistocene Lake Bonneville. Lake Bonneville reached its maximum surface elevation (1,565 m / 5,135 ft.) approximately 16,800 years ago. The most consistent water level remained at approximately 4,800 ft. (1,463 m); both levels of Lake Bonneville placed most of the site of the future NHS underwater. Quaternary deposits range from heavy lake-bottom clays near the visitor center to alluvial gravels deposited by streams draining into the lake. After the shoreline retreated below the elevation of the NHS, wind and water erosion reshaped the lake sediments, both depositing loess and cutting through the sediment deposits.

Because there has been significant anthropogenic disturbance within GOSP, the vegetation established on Quaternary deposits is more closely related to disturbance type and intensity than it is to substrate. Shrublands dominated by big sagebrush (representing unburned sites) or rabbitbrush and exotic annual grasses (representing recently burned sites) are the most widespread communities on unconsolidated sediments (Figure 9).



Figure 9. Characteristic plant communities (rabbitbrush and big sagebrush /cheatgrass shrublands) of unconsolidated Pleistocene and recent deposits.

Soils

In areas of similar climate and topography, differences in the kind and amount of potential natural vegetation are closely related to soils. Ecological sites are defined to describe this relationship among soils, hydrology, and vegetation types (NRCS 1975). Ecological sites described for GOSP include:

- Semidesert Loam
- Upland Loam
- Upland Stony Hills (Juniper)
- Upland Stony Loam

Most of the soil types correlate to Lake Bonneville deposits. Twenty-four soil types are known to occur in the NHS (Table 1, Figure 10), varying widely in erodibility and productivity depending on topographic position, parent material, hydrology, slope, and other factors. Table 2 summarizes the major characteristics of Golden Spike's soils.

Table 2. Soil Types Mapped within GOSP (NRCS 1975).

Soil Type	Description
Abela gravelly loam (ABE)	Alluvium on medium to long slopes; well drained alluvial fans and lake terraces; 10-20% slopes; sheet and rill erosion is common as are deep drainages with steep side slopes
Hansel silt loam (HaB)	Alluvium on slightly convex slopes; well drained; lake terraces; 1-6% slopes; moderate erosion hazard
Hupp gravelly silt loam (HpB)	Alluvium on slightly convex slopes; well drained; alluvial fans; 1-6% slopes; slight erosion hazard
Hupp gravelly silt loam (HpD)	Alluvium on slightly convex slopes; well drained; alluvial fans; 6-10% slopes; moderate erosion hazard
Kearns silt loam (KeB)	Alluvium on slightly convex slopes; moderately well drained; alluvial fans and lake terraces; 1-3% slopes; slight erosion hazard
Kearns silt loam (KeC)	Alluvium on gentle slopes; moderately well drained; lake terraces and broad, long alluvial fans; 3-6% slopes; slight erosion hazard
Kearns-Stingal complex (KgD)	Alluvium on lake terraces; well drained; convex knolls and ridges (Stingal soil) and concave areas between knolls and ridges (Kearns soil); 6-10% slopes; moderate erosion hazard
Kidman loam (KmB)	Alluvium on slightly convex slopes; moderately well drained; lake terraces; 1-6% slopes; slight erosion hazard
Palisade silt loam (PAB)	Alluvium on slightly convex slopes; moderately well drained; lake terraces; 1-6% slopes; slight erosion hazard
Pomat silt loam (PwE)	Alluvium on slightly convex slopes; well drained; intermediate and high lake terraces, escarpments, and slopes into drainages; 10-30% slopes; high erosion hazard
Pomat silt loam (PwG2)	Alluvium on steep slopes; rapidly drained; intermediate and high lake-terrace escarpments and side slopes into drainages; 30-40% slopes; erosion hazard is very high, severe sheet and rill erosion is common, many shallow gullies and a few deep gullies occur
Rock Land (RS)	Rock outcrop, rock rubble, talus, extremely stony land, and very shallow soils; rapidly drained; very steep mountain slopes, ridges, and canyon walls; rocks are mainly limestone
Sandall cobbly silt loam (SEE)	Alluvium on moderately steep, slightly convex slopes; well drained; mountains or mountain footslopes; 10-30% slopes; moderate erosion hazard; sheet erosion and shallow gullies are common
Sandall cobbly silt loam (SEG)	Alluvium on medium length, steep, slightly convex slopes; well drained; mountains or mountain footslopes; 30-60% slopes; moderate erosion hazard; sheet erosion and shallow gullies are common
Sandall-Rock outcrop complex (SHE)	Alluvium on short to medium length, gentle to steep, slightly convex slopes; well drained; mountain foot slopes and lake terraces; 3-30% slopes; moderate erosion hazard
Sandall-Rozlee association, steep (SJG)	Alluvium on very steep and slightly convex (Sandall soil) and very steep and slightly concave (Rozlee soils) slopes; well drained; mountains and mountain foot slopes; 30-70% slopes; high erosion hazard is high; sheet and rill erosion is common
Sanpete gravelly silt loam, high rainfall (SID)	Alluvium on medium length slightly convex slopes; well drained; lake terraces and terrace escarpments; 6-10% slopes; moderate erosion hazard
Sterling gravelly loam (SsB)	Alluvium; moderately well drained; lake terraces and alluvial fans; 1-6% slopes; slight erosion hazard
Sterling gravelly loam (SsD)	Alluvium on slightly convex slopes; well drained; alluvial fans, lake terraces, and mountain slopes; 6-20% slopes; moderate erosion hazard
Stingal loam (SvB)	Alluvium on medium length convex slopes; well drained; lake terraces; 1-6% slopes; moderate erosion hazard
Thiokol silt loam (ThB)	Alluvium on long slightly convex slopes; well drained; lake terraces; 1-6% slopes; moderate erosion hazard

Thiokol silt loam (ThD)	Alluvium on medium-long slightly convex slopes; well drained; lake terraces; 6-10% slopes; moderate erosion hazard
Windmill gravelly loam (WnD)	Alluvium on short to medium-long convex slopes; well drained; dissected lake terraces, offshore bars, and alluvial fans; 6-10% slopes; erosion hazard is moderate; rill erosion and gullyng common
Windmill gravelly loam (WnE)	Alluvium on short to medium-long convex slopes; well drained; dissected lake terraces, offshore bars, and alluvial fans; 10-20% slopes; moderate erosion hazard; sheet erosion and gullyng occur

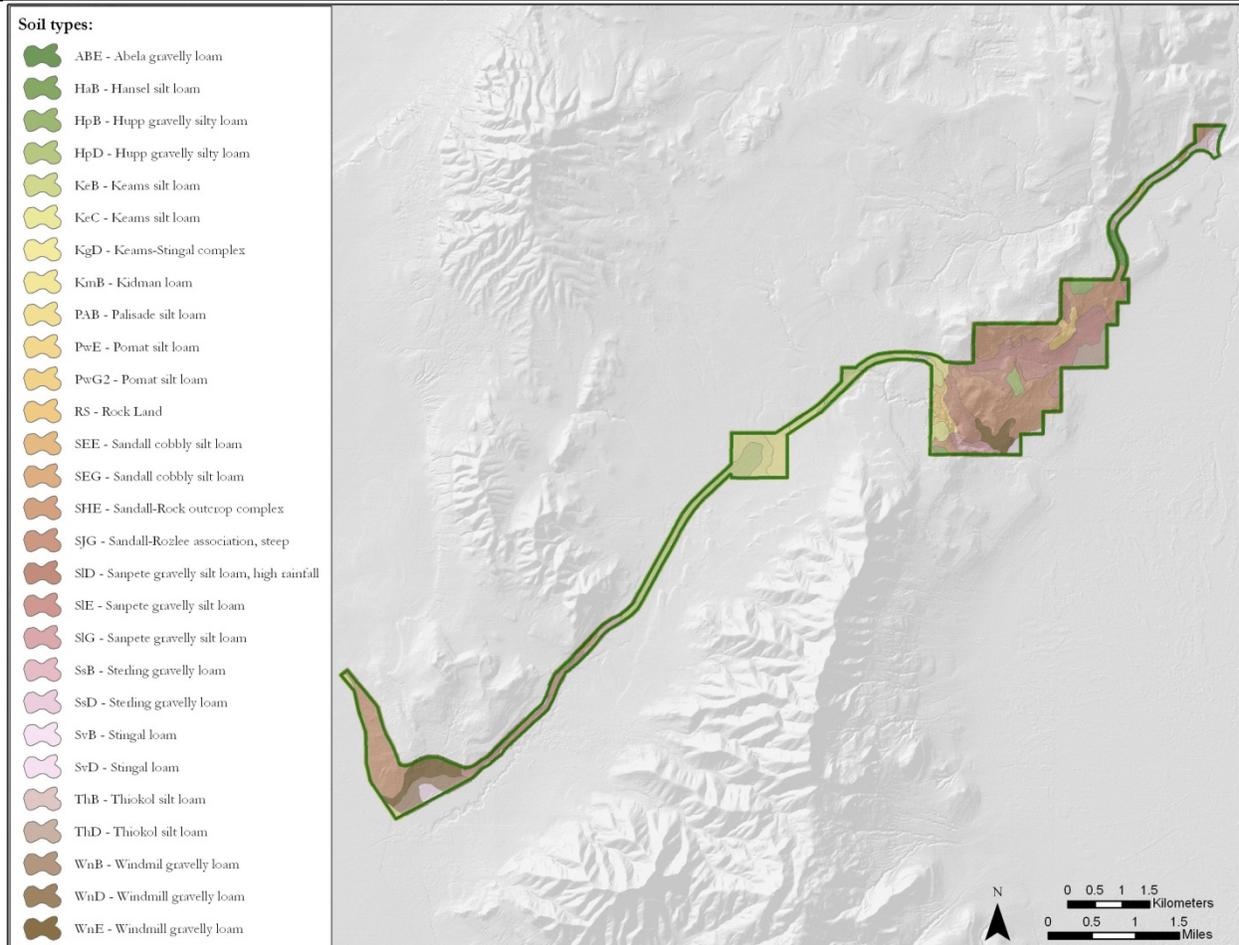


Figure 10. Soil associations within the GOSP vegetation mapping project area.

Hydrology and Water Resources

GOSP is located in a gap or pass between the Promontory Mountains and the North Promontory Mountains. A small reach of Blue Creek flows across the NHS near Utah Highway 83 and represents the only surface water within the boundary (NPS 1999b). The ground water well supplying drinking water to Promontory Summit was completed at 130.2 m (427 feet) deep. Most of the NHS is upland and runoff is collected in intermittent drainages that drain into Blue Creek or Promontory Hollow then to the Lower Bear River and ultimately into the Great Salt Lake (UDEQ-DWQ 2002). As a result, mesic vegetation within the NHS occurs in drainages, on north-facing slopes, and in small depressions. Characteristic mesic plant species include

greasewood (*Sarcobatus vermiculatus*), Great Basin wildrye (*Leymus cinereus*), and Baltic rush (*Juncus balticus*).

Land Use and Settlement History

As a National Historic Site, Golden Spike emphasizes the historical and cultural landscapes associated with the golden age of railroads in its management, interpretive, and educational programs. Secondary themes include settlement of the western U.S. and local history.

Prehistorically, the GOSP region was inhabited by tribes that practiced a semi-nomadic hunting-gathering culture. During historic times, the area was used for hunting and/or was occupied principally by bands of Northwestern Shoshone (Polk et al. 1998). Europeans first explored the area in the winter of 1824; the Weber trapping party, which included Jim Bridger, followed the Bear River to the Great Salt Lake (NRCS 1975). The Great Salt Lake islands were explored by the Fremont expedition in the 1840s.

The area was colonized by members of the Church of Jesus Christ of Latter-Day Saints in 1851 when eight families settled in Brigham City; in 1854 an additional 50 families settled in this area. Ranching began in the late 1800s. The current major land uses surrounding GOSP include dryland winter wheat production and cattle grazing.

Prior to settlement, the vegetation of northern Utah was described as a panorama of sagebrush and waving bunchgrass (NRCS 1975). Human activities in the 150 years since settlement changed the distribution and abundance of native vegetation as well as contributed to the introduction and spread of nonnative plant species. Railroad construction, livestock grazing, and fire suppression were the main activities that increased the frequency of basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), snakeweed (*Gutierrezia sarothrae*), and cheatgrass (*Bromus tectorum*) and decreased the abundance of native bunchgrasses.

Before settlement, lightning-ignited fires occurred in this part of the Great Basin at 10-75 year intervals (Howard 1999). Regular fire intervals tended to support a highly productive sagebrush-bunchgrass steppe. After settlement, fires were suppressed quickly in order to protect fences, livestock, and homesteads. As a result, sagebrush density increased and cover of grasses decreased in the understory. Native bunchgrasses were also reduced in cover by continuous livestock grazing. Once exotic annual grasses were introduced in the area in the late 1800s (Mack 1981), they quickly outcompeted the native bunchgrasses and dominated large areas of northern Utah. Invasive annual grasses are efficient in using precipitation to produce fine fuels that decrease the average fire return interval to less than five years (Zouhar 2003).

During the railroad construction era, the GOSP landscape was extensively disturbed by the construction of two railroad grades, camps built to house railroad workers, and shelters constructed to house construction materials (Polk et al. 1998). Spoil piles, borrow pits, and hand-stacked rock foundations are evidence of this land use.

Previous Vegetation Studies

GOSP supports semiarid shrubland and herbaceous vegetation on moderate topography dissected by drainages. The homogeneous habitat and uniform disturbance history of this landscape results in low diversity of plant communities and high cover by nonnative species. The documented

vascular flora of GOSP includes 144 species. One plant species of special concern, the Passey onion (*Allium passeyi*) occurs on a rocky knoll in the Blue Creek drainage. This species is endemic to Box Elder County and is considered globally imperiled by NatureServe (NatureServe Explorer 2009).

Partly because GOSP is a relatively recent addition to the National Park system and partly because it is managed as a historic site, there has not been a long history of vegetation studies within the NHS. A study of vegetation dynamics within GOSP identified existing vegetation types and the environmental factors driving vegetation structure, composition and distribution (Monaco 2002). This study also compared existing plant communities to what would have existed prior to European settlement. Vegetation types identified by this study included combinations of Annual Forb, Perennial Forb, Shrub, Cheatgrass, Perennial Grass, and Roadside Grasses. The study provided a state-transition model to show the dynamics among these types.

Monaco followed up the vegetation study with a wildfire risk and noxious weed assessment (2004) for GOSP that identified seven species of noxious weeds occurring within the NHS: saltlover (*Halogeton glomeratus*), jointed goatgrass (*Aegilops cylindrica*), scotch thistle (*Onopordum acanthium*), dyer's woad (*Isatis tinctoria*), field bindweed (*Convolvulus arvensis*), Dalmatian toadflax (*Linaria dalmatica*), and salt cedar (*Tamarix ramosissima*). The assessment recommended an integrated management approach to control these species. To reduce fire frequency, the report recommended controlling annual weeds, planting less-flammable perennial species, and installing fuel breaks to isolate areas with high fire risk.

An issue paper produced by the GOSP Superintendent in 2000 identified vegetation management as a "significant and pressing resource management issue". That paper identified preparation of a Vegetation Management Plan with a complete inventory of NHS vegetation resources as a natural resource need (GOSP 2008). Another natural resource need identified at that time was the completion of a study detailing the environmental history and evolution of vegetation conditions in GOSP. The primary driver of this need was the desire to replicate the natural and cultural landscape of the late 19th century through management and interpretation. Historic photographs from 1869 suggest a landscape with little shrub cover and high cover by grass species. Although the VMP is not complete, vegetation management planning is underway to address nonnative plant species and noxious weeds within the NHS. Management of these species is coordinated with adjacent landowners and Box Elder County Weed Abatement officials to the extent possible (NPS 1999b).

In 1997, GOSP approved a Fire Management Plan that recommended a prescribed burn program to reduce vegetation cover around historic resources, including railroad grades and archeological sites.

Project Overview

Partner Roles and Timeline

The goals of this project were to inventory, describe, and map the existing vegetation within Golden Spike National Historic Site. The project at GOSP is part of a larger effort undertaken by the NCPN to classify and map vegetation in all 16 network parks. As part of the network-wide coordinated effort, the NCPN developed standardized databases, mapping and reporting standards, and naming conventions to ensure that data across parks can be collated or compared.

Table 3 is a timeline for completion of the major project tasks. No formal scoping or preparation was performed for this project. GOSP staff were contacted in early 2007 and a permit secured to conduct field work (vegetation sampling and mapping) that was completed in July by NCPN and e²M ecologists.

The draft vegetation map was created by NCPN ecologists in October 2007 at the same time as the preliminary vegetation classification was completed by NCPN and the data were presented to NatureServe ecologists. NatureServe submitted a final vegetation classification in March, 2008. e²M ecologists prepared local plant association descriptions; global plant association descriptions were completed by NatureServe ecologists in 2008. An illustrated field key to GOSP plant associations was developed in 2009 by the NCPN.

NCPN ecologists created the GOSP vegetation map from 2007 field data and notes. Most map classes were defined for the project on a 1:1 basis, e.g., one plant association = one map class. Polygon attribution followed standards developed by the NCPN for all park mapping projects (Evenden 2004). A draft vegetation and land use/land cover map and associated spatial database were completed in 2007. Final revisions were made to the vegetation classification, map and spatial database during 2009.

Table 3. Project timeline for GOSP vegetation mapping project tasks: 2007 – 2009.

TASK DESCRIPTION	2007	2008	2009
Field Data Collection	■		
Photo Interpretation	■		■
Vegetation Classification		■ ■	
Local & Global Descriptions			■
Map Verification and Revision			■
Spatial Database		■	■
Field Key to Plant Associations			■
Final Report & Products			■

Aerial Photography

Because of budget limitations, the NCPN used available imagery rather than fly new stereo pairs and orthophotography for the GOSP classification and vegetation mapping project. NCPN staff and partners worked with 2006 true-color orthophotographs available through the State of Utah to delineate polygons. Imagery available for the field phase of the project was 1-m resolution, true-color digital orthophotography. Another set of imagery with 1-ft resolution was available for on-screen interpreting and digitization (Figure 11).

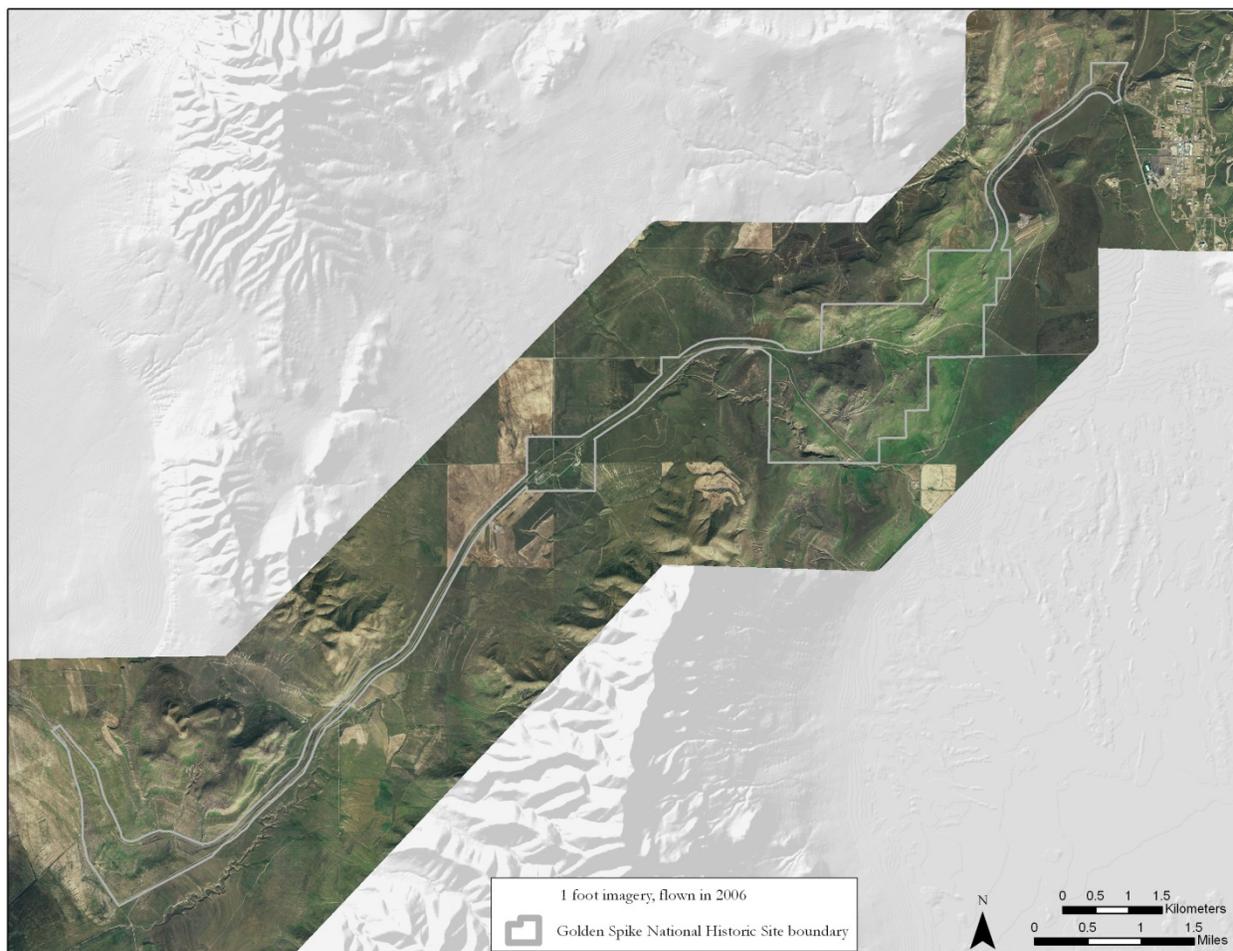


Figure 11. Example of the orthoimagery used as the base image for the GOSP Vegetation Classification and Mapping Project.

Project Boundary and Map Extent

GOSP vegetation was sampled, plant communities and land use interpreted, and the data mapped to the actual (fenced) boundaries of each unit. Areas authorized by Congress for acquisition but still privately owned were not sampled or mapped. The mapping area is approximately 1,144 hectares (2,826 acres). The privately owned lands surrounding GOSP (Figure 3), were not included in the classification or mapping. Logistical and budget considerations limited the vegetation mapping project boundary to the GOSP administrative boundary, which includes a few areas still in private ownership.

Minimum Mapping Unit

The standard 0.5 ha (1.24 acre) minimum mapping unit (MMU) was not used in the GOSP classification and vegetation mapping project. Because the NHS is relatively small and much of it consists of a narrow right-of-way that is only a few hundred meters wide (Figure 2), it was possible to visit and interpret plant communities and land use types on the entire landscape. The less detailed MMU standard would have reduced the utility of the map. Using 1:12,000 scale orthoimagery, it is possible to identify distinct features as small as 0.1 ha (0.25 acres). GOSP staff expressed interest in having NCPN map the locations of significant populations of native grasses, especially Great Basin wildrye (*Elymus cinereus*) and bluebunch wheatgrass (*Pseudoroegneria spicata*). Point data for native bunchgrasses were recorded during the field phase of this project; point data are available in a separate feature class within the project geodatabase.

Ecological System Classification

The NCPN decided to use the ecological system (ES) classification structure developed by NatureServe (Comer et al. 2003, NatureServe 2003b) as a framework for organizing and presenting plant community data. An ES is defined as a group of plant associations from two or more alliances that tend to co-exist in a given landscape due to similar ecologic processes, substrates, and/or environmental gradients. The ES classification was developed to provide larger scale classification units for application to resource management, mapping, and conservation. Current estimates are that Utah contain more than 60 ecological systems (NatureServe Explorer 2009). This approach complements the NVC where the finer-scale plant association units provide a basis for interpreting larger-scale ES patterns and concepts. A description of each of these units appears in Appendix A.

The ecological system classification addresses natural landscapes. Land-use categories used to organize developed areas are described elsewhere in this report. Eight ecological system units were used for the GOSP vegetation mapping project (with their NatureServe identifying codes) as follows:

- Great Basin Pinyon-Juniper Woodland (CES304.773)
- Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
- Inter-Mountain Basins Cliff and Canyon (CES304.779)
- Inter-Mountain Basins Greasewood Flat (CES304.780)
- Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
- Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)
- Inter-Mountain Basins Wash (CES304.781)
- Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)

Vegetation Classification and Description

Field Methods

The primary purpose of classification plot data was to derive quantitative information documenting the composition and structure of GOSP vegetation types and the associated environmental conditions. These data became the basis for classifying the vegetation of the NHS. Field methods followed national program standards (e.g., TNC and ESRI 1994a, 1994b) for vegetation classification sampling and mapping. The method used to sample classification plots (also known as relevé sampling) is widely used by ecologists. The plot dataset was enhanced by collecting observation point data, whose primary purpose was to support aerial photo interpretation. Data gathered during this project can contribute to understanding vegetation relationships across landscapes beyond the NHS boundary.

In addition to the basic vegetation data collected at each plot, the NCPN defined additional data fields to meet needs of network managers. Plot forms and individual data field descriptions appear in Appendix B. This section is a summary of the vegetation data collection methods used at GOSP.

Field Sampling Approach

The sampling area included the entire NHS within the management boundary. Given the relatively small project area and ease of accessibility and landscape viewing, ecologists visited most potential map polygons in the field and recorded vegetation information on paper maps of aerial imagery. This reduced the need for a large number of quantitative plots and observation points. Sampling locations were determined by examining vegetation patterns on aerial imagery for distinctive signatures and other features, annotating the field maps with extensive notes, acquiring ground photographs, and by walking the NHS in a systematic grid pattern.

The NHS was accessed to the degree possible by field crews hiking across the landscape, mapping and sampling simultaneously. The few areas that could not be accessed directly were inspected with binoculars and the dominant species and polygon boundaries were noted on the base imagery. The sampling was completed in July 2007 by NCPN vegetation mapping program and e²M staff. Three vegetation classification plots and 46 observation points were sampled and detailed field notes recorded on field maps of the imagery during the 2007 field visit (Figure 12).

Classification Plot and Observation Point Data Collection

Field crews placed classification plots and located observation points subjectively within stands in order to represent accurately the plant association being sampled. Ecotones (areas where two or more plant communities intermix) and highly disturbed sites were avoided unless they covered at least 0.5 hectares. Classification plots and observation points were located in stands as small as 0.1 hectares (0.23 acres), especially if they represented distinctive or rare species aggregations, such as greasewood stands or relict patches of native bunchgrasses. Plot size and shape requirements were consistent with national Vegetation Mapping Program guidelines (TNC and ESRI 1994a). Plot size was determined by the physiognomy of the community being sampled (Table 4). GOSP plots were typically circular, but plot shape was adjusted as needed to sample linear bands of vegetation in drainage bottoms. Plot size and shape were recorded for all GOSP plots.

Table 4. Plot sizes used for vegetation classification sampling at GOSP.

Vegetation Class	Area (m ²)	Radius (m)
Shrubland	400	22.6
Herbaceous	100	11.3

Data collected at observation points reflected the vegetation of an undefined area around the point rather than a measured plot, and were less detailed due to the use of field annotation (Appendix B). These data were intended primarily to describe plant associations and extensive field notes were used to annotate polygon features on the project imagery. Field crews could choose to sample an observation point instead of a classification plot when:

- the vegetation was highly disturbed, altered, ecotonal, or otherwise anomalous
- they wished to document a specific photo-signature or area
- they wished to document special features or vegetation occurring in stands smaller than 0.5 ha (1.24 ac).

Location and Plot Identifiers. The bounds of each classification plot were marked using measuring tapes. The Universal Transverse Mercator (UTM) XY coordinates at the center of each plot/point were recorded (zone 12, NAD83) on Trimble hand-held GPS receivers. Other data fields documenting the location of each classification plot/point are listed in Table 4 and are described in detail in Appendix C.

GOSP staff requested that the vegetation classification plot/point locations not be permanently marked. Locations were recorded on topographic maps and the aerial imagery during the field trip to avoid duplication of effort and ensure that the NHS was adequately sampled.

Within each classification plot/observation point, researchers estimated and recorded an array of vegetation and environmental data using the field forms in Appendix B and data definitions in Appendix C. Three categories of data were collected for vegetation classification (Table 5):

- location and plot identifiers
- environmental description
- vegetation description

Table 5. General plot/point data categories and specific data components collected at each vegetation classification plot/observation point.

Plot Data Category	Data Components
Location and Plot Identifiers	Plot code, park name, site name, state, county, quad name, quad code, GPS unit, GPS file ID, UTM coordinates, UTM zone, GPS error, 3D differential, survey date, surveyor names, directions to plot, plot dimensions, photograph documentation
Environmental Description	Elevation, slope, aspect, topographic position, landform, geology, Cowardin wetland type, hydrologic regime, ground cover, soil texture, soil drainage, evidence of disturbance and animal use
Vegetation Description	Height and cover of all strata, cover by species, physiognomic type, provisional association name, plot representativeness

Environmental Description. The physical characteristics of each classification plot/observation point were documented in both categorical and narrative fields (Table 5; Appendix B, Appendix C). These included topographic site features (elevation, slope, aspect, topography), hydrology, geology, and soils. Characterization of the ground surface was made by estimating the cover of rocks, sand, litter, bare soil, biological soil crust, moss, and lichen. A narrative field was provided for a general description of the plot/point setting and the influence of physical factors on the vegetation.

Vegetation Description. Every vascular plant species in each classification plot/point was assigned to one of 14 physiognomic strata (Appendix B). Within each stratum, the investigator recorded average height and percent canopy cover for all species (plots) and dominant species (points) using the scales in Table 6. Consistent and repeatable cover estimates were obtained by relating the area occupied by an individual species to the area of the entire plot/point. When it was not possible to identify a species in the field, plant material was collected and pressed for later identification. All plant material collected for identification was destroyed in analysis. Provisional plant association names were assigned to each plot/point using the preliminary association list and professional judgment.

Descriptive Information. Field crews were encouraged to record general observations on how well the plot/point represented the stand, the relationship of site conditions to vegetative patterns, and site disturbance history. The overall character of the vegetation and features of each plot were recorded in two 35 mm color slide photographs and notes on the field copies of the digital imagery.

Table 6. Vegetation cover and height classes used in the GOSP vegetation mapping project.

Species and Strata Canopy Cover Classes				Strata Height Classes			
Code	Range	Code	Range	Code	Range	Code	Range
T	0-1%	5	> 45-55%	01	<0.5 m	06	>10-15 m
P	>1-5%	6	>55-65%	02	0.5-1 m	07	>15-20 m
1	>5-15%	7	>65-75%	03	>1-2 m	08	>20-35 m
2	>15-25%	8	>75-85%	04	>2-5 m	09	>35-50 m
3	>25-35%	9	>85-95%	05	>5-10 m	10	> 50 m
4	>35-45%	10	>95%				

Data Processing and Analysis

Plot and observation point data were manually entered into the GOSP Vegetation Classification and Mapping Project Database. This database is compatible with the data standards of the PLOTS Database System developed for the USGS-NPS Vegetation Mapping Program by TNC (1997). The NCPN database offers greater flexibility in overall data management than does the NatureServe PLOTS database, and is designed to accommodate all project data recorded in plots, observation points, and field photographs. Data standards were established by NCPN for all network vegetation mapping projects, allowing compatibility of data across network park units. Fields associated with the GOSP plots database are described in Appendix C.

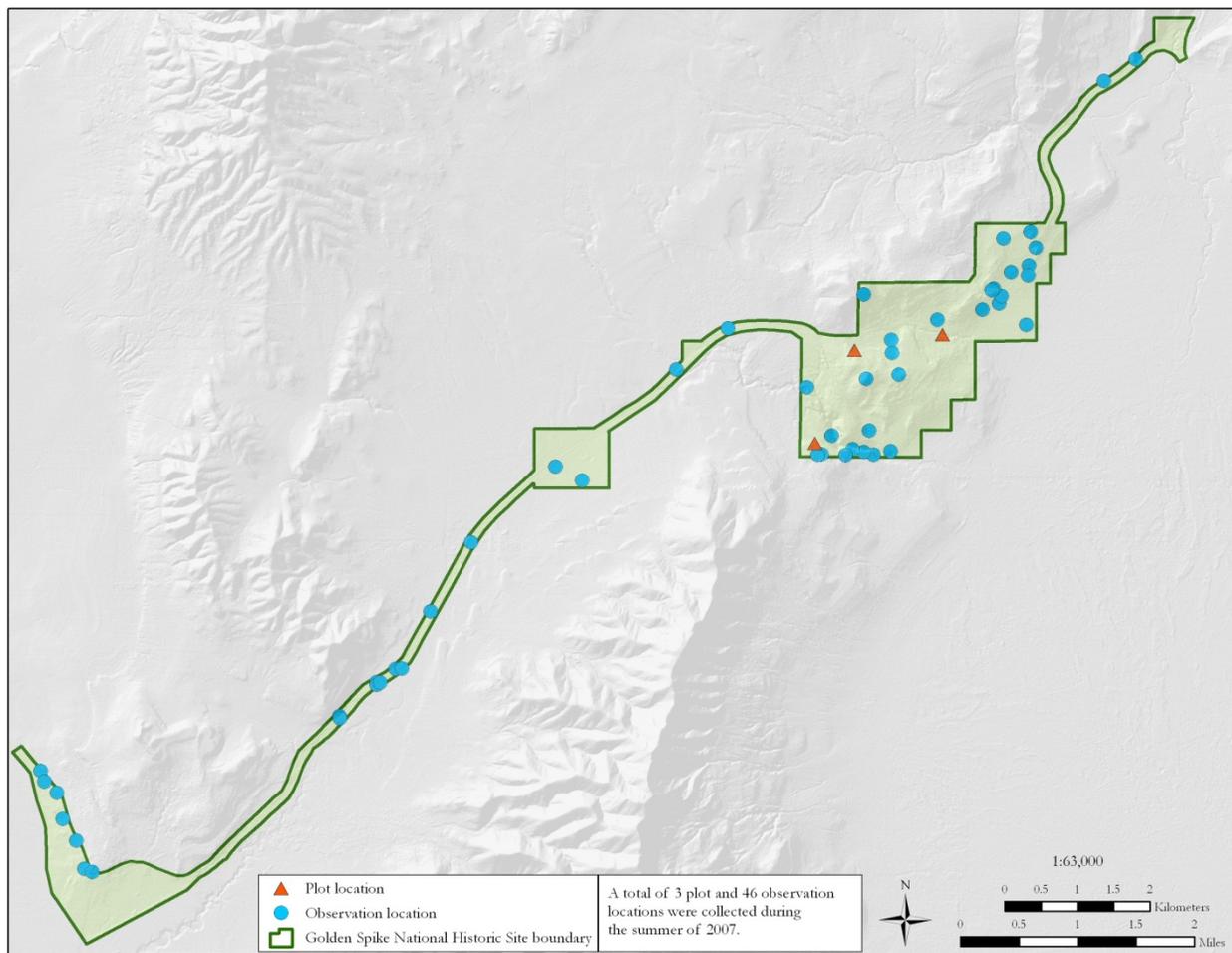


Figure 12. Locations of sample plots (vegetation plots and observation points) in the GOSP vegetation mapping project area.

Each 35 mm slide associated with the project was scanned into digital format. The 51 digital images acquired were stored in a photograph database. Additional scenic photos acquired using digital cameras are not included in the project database, as they were taken primarily for the purpose of illustrating this report. A unique identifier allows each photograph to be linked with the classification plots, observation points, and the spatial databases.

A thorough quality assessment and quality check (QA/QC) was performed on all classification plot and observation point data following entry to the project MS Access database. Individual data records were reviewed manually by comparison with the individual field data sheets. Additional QA/QC was performed using a set of queries designed to identify inconsistencies across data fields and check for missing data. NCPN technicians standardized the scientific names in the database and noted name changes on the field forms. The primary authority used for plant names for the GOSP vegetation mapping project and all other NCPN I&M projects is *A Utah Flora* (Welsh et al. 2003). NatureServe, a primary project partner, uses Kartesz (1999) as its primary nomenclatural authority. As a result, nomenclature used in the body of this report

follows Kartesz (1999), whereas nomenclature in the project database is that of Welsh et al. (2003). Differences between the two nomenclatural authorities are reconciled in a crosswalk table (Appendix D).

Following completion of QA/QC procedures, the lead NCPN ecologist inspected the data and assigned preliminary plant association names following the conventions of the NVC. Photographic slide labels were printed from the database. A GIS data layer (point data) was developed to document classification plot and observation point locations.

Classification Data Analysis

Because of the small number of classification plots and observation points sampled at GOSP, we did not conduct a quantitative vegetation classification. Instead, NCPN staff ecologists compared the plot/point data with information available from the NatureServe Explorer website (www.natureserve.org/explorer) and with classification plot data from other NCPN vegetation mapping projects with similar plant communities. Most vegetation plots and observation points fit within existing NVC association concepts (Table 6). NatureServe ecologists reviewed the assignments of NVC associations and alliances and concurred with most of the NCPN determinations. In a few cases, classification plots/observation points appeared to represent types that are unique to GOSP or that were anomalous situations, such as old fields. These plots/points were assigned “park special” status and were not incorporated into the NVC. The classification for GOSP was finalized in February 2008.

Classification Results

The documented vegetation of the GOSP mapping project area was classified into 18 plant associations in 12 NVC alliances and eight ecological systems (Table 7). Four of these plant communities were described as ‘park specials’ because they occur as small patches or stands, are not included in the NVC, and appear to be unique to the NHS. The vegetation includes six shrubland, two shrub-herbaceous, and ten herbaceous plant associations or park special vegetation types. Eight of the classified types are dominated by non-native herbaceous species; the other ten associations describe predominantly native vegetation.

Table 7. Plant associations identified within the GOSP vegetation classification and mapping project area*.

NVC Association	Common Name	CEGL Code [†]
UPLAND ASSOCIATIONS		
SHRUBLANDS AND SHRUB-HERBACEOUS VEGETATION		
Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)[‡]		
<i>Artemisia tridentata</i> - (<i>Ericameria nauseosa</i>) / <i>Bromus tectorum</i> Semi-natural Shrubland	Basin Big Sagebrush - (Rubber Rabbitbrush) / Cheatgrass Semi-natural Shrubland	CEGL002699
<i>Artemisia tridentata</i> (ssp. <i>tridentata</i> , ssp. <i>xericensis</i>) / <i>Pseudoroegneria spicata</i> Shrub Herbaceous Vegetation	(Basin Big Sagebrush, Foothill Big Sagebrush) / Bluebunch Wheatgrass Shrub Herbaceous Vegetation	CEGL001018
<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Agropyron cristatum</i> Semi-natural Shrubland	Basin Big Sagebrush / Crested Wheatgrass Semi-natural Shrubland	Park Special
<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Poa secunda</i> Shrubland	Basin Big Sagebrush / Curly Bluegrass Shrubland	CEGL001008
Inter-Mountain Basins Greasewood Flat (CES304.780)		
<i>Sarcobatus vermiculatus</i> Disturbed Shrubland	Greasewood Disturbed Shrubland	CEGL002699
Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)		
<i>Chrysothamnus viscidiflorus</i> Shrub Herbaceous Vegetation	Green Rabbitbrush Shrub Herbaceous Vegetation	CEGL002530
<i>Ericameria nauseosa</i> / <i>Bromus tectorum</i> Semi-natural Shrubland	Rubber Rabbitbrush / Cheatgrass Semi-natural Shrubland	CEGL002937
<i>Lycium barbarum</i> / <i>Bromus tectorum</i> Semi-natural Shrubland	Common Matrimony Vine / Cheatgrass Shrubland	Park Special
GRASSLANDS		
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)		
<i>Agropyron cristatum</i> - (<i>Pascopyrum smithii</i> , <i>Hesperostipa comata</i>) Semi-natural Herbaceous Vegetation	Crested Wheatgrass - (Western Wheatgrass, Needle-and-Thread) Semi-natural Herbaceous Vegetation	CEGL005266
<i>Agropyron cristatum</i> - <i>Bromus tectorum</i> Semi-natural Herbaceous Vegetation	Crested Wheatgrass - Cheatgrass Semi-natural Herbaceous Vegetation	Park Special
<i>Aristida purpurea</i> Herbaceous Vegetation	Purple Three-awn Herbaceous Vegetation	CEGL005800
<i>Bromus tectorum</i> Semi-natural Herbaceous Vegetation	Cheatgrass Semi-natural Herbaceous Vegetation	CEGL003019

Table 7. Plant associations identified within the GOSP vegetation classification and mapping project area*.

NVC Association	Common Name	CEGL Code[†]
<i>Hesperostipa comata</i> Great Basin Herbaceous Vegetation	Needle-and-Thread Great Basin Herbaceous Vegetation	CEGL001705
<i>Poa secunda</i> Herbaceous Vegetation	Curly Bluegrass Herbaceous Vegetation	CEGL001657
<i>Pseudoroegneria spicata</i> - <i>Hesperostipa comata</i> Herbaceous Vegetation	Bluebunch Wheatgrass - Needle-and-Thread Herbaceous Vegetation	CEGL001679
<i>Pseudoroegneria spicata</i> - <i>Poa secunda</i> Herbaceous Vegetation	Bluebunch Wheatgrass - Curly Bluegrass Herbaceous Vegetation	CEGL001677
<i>Pseudoroegneria spicata</i> Herbaceous Vegetation	Bluebunch Wheatgrass Herbaceous Vegetation	CEGL001660
<i>Thinopyrum ponticum</i> Semi-natural Herbaceous Vegetation	Eurasian Quack Grass Semi-natural Herbaceous Vegetation	CEGL001679

* Plant associations determined from the vegetation plot and observation point data. Associations are ordered by physiognomy and grouped by ES. Identification codes are provided for plant associations and ecological systems. Associations documented by field notes only are not included in this table.

[†] The CEGL code is assigned by NatureServe to track NVC associations within their databases. Park Specials are not part of the NVC and therefore do not have a CEGL code.

[‡] The NatureServe codes following each Ecological System unit name provide a means of tracking the evolution of the concept in NatureServe's Biotics Tracking Database.

Plant Community Descriptions

This section provides a summary of GOSP vegetation by physiognomic group. Appendix F provides detailed local and global descriptions of the 18 plant associations and park special vegetation types found within the NHS. Local descriptions are based on plot and observation point data from the NHS. Global descriptions characterize the plant association across its range and are based primarily on published and unpublished literature. Most of the plant associations at GOSP fit into defined NVC concepts. Four park special vegetation types are not classified within the NVC.

Shrubland and Shrub-Herbaceous Associations

Immediately prior to settlement, the area around GOSP would likely have been a dynamic habitat with a mosaic of grassland, sagebrush shrubland, and sagebrush steppe plant communities. Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and rubber rabbitbrush (*Ericameria nauseosa*) are the most common and consistent shrub dominants. The density, relative dominance of sagebrush versus rabbitbrush, and size of the shrubs indicates the time that has passed since the last stand-replacing fire. The shrubland and shrub-herbaceous plant associations within GOSP include:

- *Artemisia tridentata* - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland
- *Artemisia tridentata* (ssp. *tridentata*, ssp. *xericensis*) / *Pseudoroegneria spicata* Shrub Herbaceous Vegetation
- *Artemisia tridentata* ssp. *tridentata* / *Agropyron cristatum* Semi-natural Shrubland
- *Artemisia tridentata* ssp. *tridentata* / *Poa secunda* Shrubland
- *Chrysothamnus viscidiflorus* Shrub Herbaceous Vegetation
- *Ericameria nauseosa* / *Bromus tectorum* Semi-natural Shrubland
- *Lycium barbarum* / *Bromus tectorum* Semi-natural Shrubland
- *Sarcobatus vermiculatus* Disturbed Shrubland

Herbaceous Associations

Most of the herbaceous plant communities established within GOSP are the result of fire removing the big sagebrush canopy. Charred stumps are visible in many stands. Burn sites are usually invaded by the non-native annual cheatgrass, sometimes with rattlesnake brome (*Bromus briziformis*) or Japanese brome (*Bromus japonicus*). Two exotic grasses deliberately introduced in the mid-1900s for soil stabilization, crested wheatgrass (*Agropyron cristatum*) and tall wheatgrass (*Thinopyrum ponticum*), persist in areas where they were planted. Relict stands and patches of native bunchgrasses persist within the NHS, including bluebunch wheatgrass (*Pseudoroegneria spicata*) and Great Basin wildrye (*Leymus cinereus*). Most native bunchgrass patches were too small to sample, and are documented only from field notes and photographs.

Sparse herbaceous to shrub-herbaceous vegetation occurs as relatively small landscape patches on outcrops of Oquirrh Limestone. The outcrops support scattered individual plants characteristic of the surrounding vegetation, but also include a unique suite of species that are limited to these limestone outcrops, particularly rockspiraea (*Petrophyton caespitosum*), hairy goldenaster (*Heterotheca villosa*), and littleleaf brickellbush (*Brickellia microphylla*).

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

- *Agropyron cristatum* - *Bromus tectorum* Semi-natural Herbaceous Vegetation
- *Aristida purpurea* Herbaceous Vegetation
- *Bromus tectorum* Semi-natural Herbaceous Vegetation
- *Hesperostipa comata* Great Basin Herbaceous Vegetation
- *Poa secunda* Herbaceous Vegetation
- *Pseudoroegneria spicata* - *Hesperostipa comata* Herbaceous Vegetation
- *Pseudoroegneria spicata* - *Poa secunda* Herbaceous Vegetation
- *Pseudoroegneria spicata* Herbaceous Vegetation
- *Thinopyrum ponticum* Semi-natural Herbaceous Vegetation

Riparian Vegetation

Riparian vegetation within GOSP is limited to a very short reach of Blue Creek that crosses the extreme eastern end of the NHS. This reach is extensively gullied, entrenched approximately 8 m (25 ft.), and is re-establishing a narrow floodplain in sediments deposited on the bottom of the gully. This floodplain supports mesic herbaceous vegetation that is tolerant of wet-dry cycles and alkaline soils, including Baltic rush, bottlebrush squirreltail (*Elymus elymoides*), and spikerush (*Eleocharis* spp.). Higher terraces and the steep, eroding gully banks support a sparse community of non-native tamarisk (cut in 2007) and native greasewood shrubs.

Field Key Preparation

An illustrated dichotomous field key to plant associations of the GOSP mapping area was developed for this project (Appendix G). The key is designed to assist users in identifying vegetation associations in the field. The key is organized roughly by physiognomy of the vegetation, i.e., woodland, shrubland, or herbaceous. The couplets focus on the dominant species' canopy cover. Brief environmental descriptions are included with the floristic descriptions to assist in identifying plant associations. To increase the utility of the key, individual plant associations are cross-referenced to map classes.

The field key was constructed from data collected specifically for this mapping project and from field observations of the entire NHS. Because the key is based on a sample of the vegetation, it may not include all associations occurring within the NHS, nor does it describe the full range of variation of all associations as they appear in the site.

The field key was tested by NatureServe using the GOSP vegetation classification plot and observation point data. A NatureServe ecologist selected random plots/points representing each plant association, removed the association identifier from the data and attempted to run each selection through the key using information contained in the project database. Additional field testing of the key occurred during the map verification phase of this project. Areas where the key was confusing or unclear were identified and solutions proposed. The field key in Appendix G is the final version containing revisions based on these suggestions.

Fuels Data Collection

Fuels data were not analyzed as part of this project and data pertinent only to fuels modeling were not collected. The plot photographs and some of the data collected for vegetation classification may be useful for fuels management. Data collected in the vegetation plots at

GOSP that are potentially useful for fuels modeling include shrub density and canopy cover of shrub and grass species. Plot photographs may also be useful for modeling the spread of fire.

Vegetation Mapping

Methods

The process of mapping vegetation and land uses of NCPN park units consists of four steps:

- Field reconnaissance
- Map class and attribute development
- Mapping
- Spatial database development

Field reconnaissance is intended to familiarize the photointerpreter with the NHS, the patterns of vegetation distribution, and environmental factors. During map class and attribute development, the photointerpreter uses all available information, professional experience, and an inspection of the aerial imagery to develop map classes and appropriate attributes. Mapping is the process during which the photointerpreter uses field data, field notes, and characteristic photo signatures to draw consistent, homogenous polygons on the base photography. During spatial database development, polygon-specific attributes (e.g., vegetation height, land use category) and ancillary datasets (e.g., photos, map class descriptions) are linked to each point or polygon in the spatial layer. Because GOSP is a small park, the first three steps were accomplished simultaneously during the classification plot and observation point data collection visit in June and July of 2007.

Field Reconnaissance

Reconnaissance was conducted concurrently with vegetation classification plot and observation point data collection. NCPN field staff walked the entire NHS over two days. The reconnaissance focused on comparing site-based vegetation conditions with signatures on a paper plot of the orthoimage, understanding environmental drivers influencing vegetation patterns, and identifying what information could be extracted from the project imagery. Field notes were written directly on the orthoimage and were used to guide digitization of the final map.

Map Class and Polygon Attribute Development

The goal of mapping was to identify meaningful units to represent existing vegetation and land uses for the GOSP vegetation mapping project area. Map classes specific to this project were developed to characterize vegetation types within the NHS. Standard land-use map classes (Anderson et al. 2002) were used to map developed parts of the NHS such as buildings and roads.

Interpretation and attribution of map classes for vegetation addressed all types observed within GOSP regardless of size. Most map classes include polygons smaller than the 0.5 ha (1.24 ac) program MMU. Because GOSP is a small unit, it was possible to map much of the vegetation and land use types in the field to the level of plant association or finer, where differences in disturbance history and soils contributed to variations in plant association structure, density, and composition.

In order to facilitate use of vegetation maps and mapping data across multiple parks, the NCPN adopted a convention for naming and presenting map classes. For each map class representing an NVC plant association or vegetation alliance, a translated common name (e.g., Matrimony Vine Shrubland) was used. To facilitate tracking and management of vegetation map class information, a coding system was developed. The original map class coding system used by the photo interpreter consisted of a unique but arbitrary number for each map class. These numeric codes have been retained within the spatial database and map class key (Appendix J). A complementary, five-letter alphacode system for map classes was created for all NCPN vegetation mapping projects. Each alphacode begins with the first letter of the corresponding NVC Class (W = Woodland, S = Shrubland, and H = Herbaceous). The subsequent four letters generally abbreviate the map class name. For example, the Big Sagebrush / Floodplain Shrubland map class is represented by the alphacode “S-BSFL”. Map classes representing coarser levels of the NVC, geologic exposures, and other non-vegetated features, were assigned generic names incorporating vegetation and landscape features. Map classes representing developments such as roads or buildings were assigned alphacodes with the prefix L = land use. The map class used to represent limestone outcrops was assigned an alphacode with the prefix G = geologic.

Photointerpretation, polygon labeling, and attribution procedures were standardized for all NCPN vegetation mapping projects (Evenden 2004). After a map class was assigned to each polygon, the polygon was assigned attributes to characterize vegetation structure (density, pattern, height; Table 8), land use, and disturbance. All map polygons were assigned to a land cover / land use type (Anderson et al. 2002; Appendix H). In addition, all polygons were assigned to higher levels of the NVC hierarchy, with the exception of non-vegetated map classes, which were coded as ‘unclassified’ or ‘unvegetated’ in the NVC columns.

Table 8. Physiognomic attributes assigned to polygons during mapping. When appropriate, these attributes were assigned to individual polygons. Otherwise they were assigned to an entire map class.

Category	Attribute	Description
Vegetation Canopy Density (Applied to forest, woodland, and shrub-dominated map classes)	A	Closed Tree Canopy/Continuous (> 60% cover)
	B	Open Tree Canopy/Discontinuous (25- 60% cover)
	C	Dispersed – Sparse Tree Canopy (10-25% cover)
	D	Dense Shrub Canopy (> 40% cover)
	E	Light Shrub Canopy (10 – 40% cover)
Vegetation Pattern (Applied to all vegetation map classes)	1	Clumped/Bunched
	2	Linear
	3	Gradational/Transitional
	4	Regularly Alternating
	5	Homogeneous
Vegetation Height (Applied to woody terrestrial vegetation map classes only)	F	Forest and Woodlands > 30 meters tall
	G	Forest and Woodlands 15 – 30 meters
	H	Forest and Woodlands 5 – 15 meters
	I	Forest and Woodlands 1 – 5 meters
	J	Forest and Woodlands < 0.5 meters
	K	Shrublands 1 – 5 meters
	L	Shrublands 0.5 – 1 meters
M	Shrublands 0 – 0.5 meters	

NCPN photo interpretation standards defined a suite of polygon modifiers to describe altered vegetation, landforms, transportation, and utilities (Evenden 2004). Table 9 is a list of the modifiers used in the GOSP project.

Table 9. Modifiers used to provide additional information for land-use polygons in the GOSP vegetation mapping project area.

Category	Code	Name	Description
Transportation Modifiers	e	East Auto Tour	A driving tour available to the public that follows the historic railroad grade on the east side of the NHS
	t	Paved road	A transportation corridor consisting of a roadbed topped by an asphalt or concrete surface. Right-of-way typically extends to the limit of the cut and fill slopes
	u	Gravel/dirt road	A transportation corridor consisting of a roadbed of imported gravel or graded native soil. Cut and fill slopes may or may not be present
	w	West Auto Tour	A driving tour available to the public that follows the historic railroad grade on the west side of the NHS
	v	Railroad	A transportation corridor consisting of a roadbed or imported rock and gravel currently or historical overlain by wooden ties and steel rails

Natural Features of Special Interest

NHS staff requested that NCPN field crews note and map where possible locations of native bunchgrasses, especially Great Basin wildrye (*Leymus cinereus*).

Mapping

The mapping component of the GOSP project used a combination of methods to interpret and delineate vegetation polygons. The initial set of polygons was drawn and annotated in the field on a 1:3500-scale print of the base true-color orthoimagery. The lines were transferred to a digital environment in an ArcMap personal geodatabase using on-screen digitizing methods.

Spatial Database Development

Each polygon was assigned a map class number, alpha code and name, Anderson land use class, and vegetation density, pattern, and height attributes. In order to improve the utility of the map and related data, the spatial database was moved into a geodatabase format, the general structure of which is illustrated in Figure 13. This format allows text and image information to be incorporated and linked to spatial coordinates. Detailed documentation of the geodatabase is provided in Appendix C. All geospatial products associated with this project are in the UTM projection, NAD83, Zone 12.

Map Classes

The relationships between the map classes and plant associations are often complex. In most cases, the GOSP map classes were derived on a one association to one map class basis. Due to the limitations of the imagery some of the plant associations could not be consistently recognized. Mapping ambiguity was addresses as necessary by combining similar associations

into complexes when two or more plant associations could not distinguished from each other on the digital imagery.

Forty map classes were developed to describe the GOSP vegetation classification and mapping project area (Table 10, Appendix J). Of these, 29 are natural or semi-natural vegetation map classes, one is a sparsely vegetated geologic exposure class, and ten represent land-use map classes. Twenty-seven of the natural or semi-natural vegetation map classes represent single NVC plant associations. The two map classes that represent multiple NVC associations are complexes of closely related associations that are indistinguishable using true-color remote imagery.

Ecological systems (Comer et al. 2003) are used to organize the vegetation map classes. They were developed by NatureServe to complement the finer-scale NVC by creating a mappable classification unit representing groups of biologic communities in similar environments and shaped by similar ecologic processes. Ecological systems typically occur in patches of tens to thousands of hectares and are expected to persist for 50 or more years. The timeframe allows successional dynamics to be integrated into the concept of each ecological system.

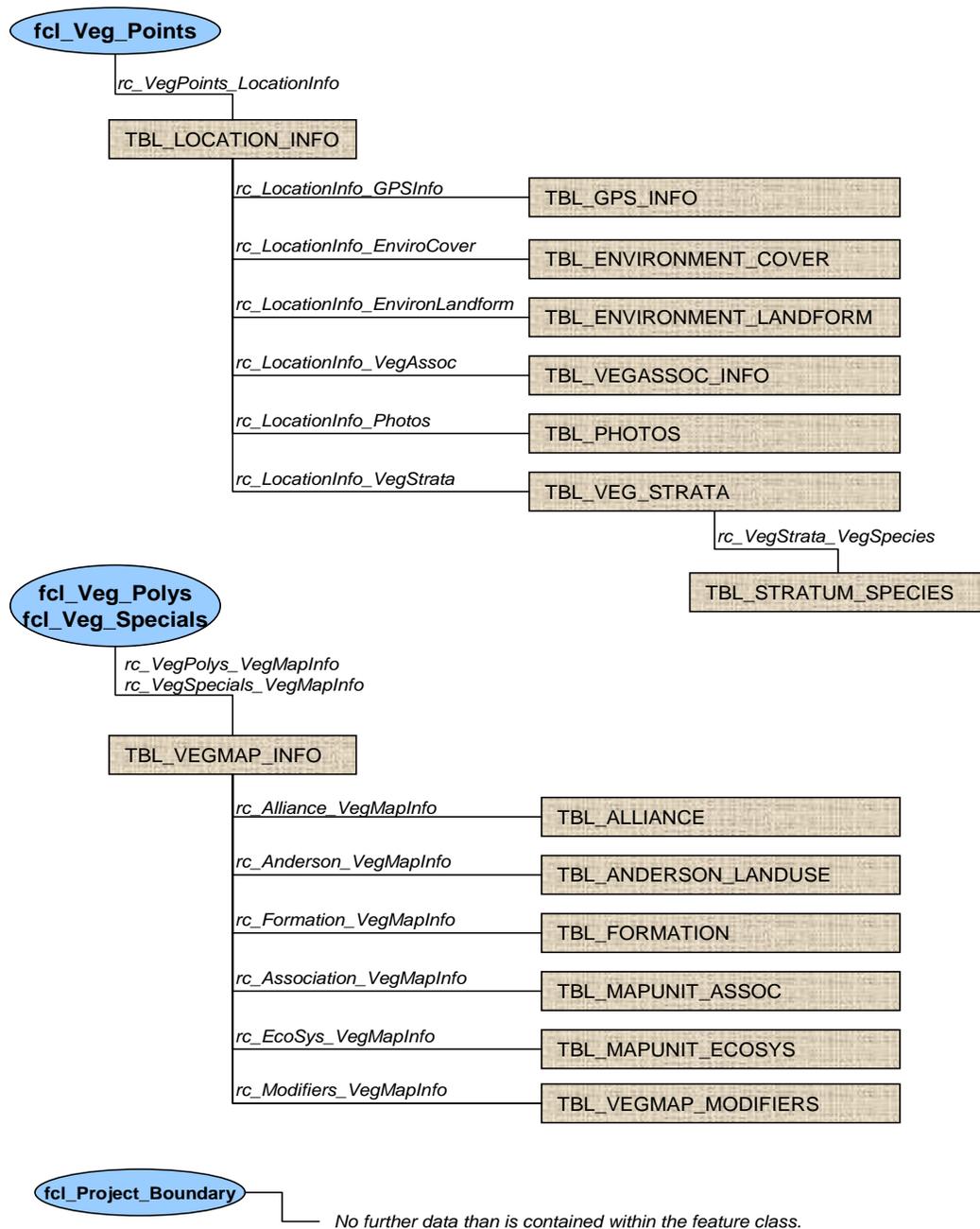


Figure 13. Structure of the GOSP geodatabase.

Results

Table 10 shows the relationship of vegetation map classes to ecological systems. Appendix A provides summary descriptions of each ecological system. The geologic exposures and the Anderson et al. (2002) land use map classes could not be placed within the ecological system classification.

Table 10. Map classes used in the GOSP vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. GOSP vegetation map classes are arranged using the NatureServe ecological systems classification.

Map Class #	Map Class Code	Map Class Name	Associations Assigned to Map Class	Relation
Great Basin Pinyon-Juniper Woodland (CES304.773)				
31	W-UJCG	Juniper / Cheatgrass Open Woodland	<i>Juniperus osteosperma</i> / <i>Bromus tectorum</i> Semi-natural Woodland (not sampled)	1 : 1
Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)				
24	S-PRVI	Chokecherry Shrubland	<i>Prunus virginiana</i> - (<i>Prunus americana</i>) Shrubland	1 : 1
Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)				
20	S-BSFL	Big Sagebrush / Floodplain Shrubland	<i>Artemisia tridentata</i> - (<i>Ericameria nauseosa</i>) / <i>Bromus tectorum</i> Semi-natural Shrubland <i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Agropyron cristatum</i> Semi-natural Shrubland	1 : many
21	S-BSCW	Big Sagebrush / Crested Wheatgrass Shrubland	<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Agropyron cristatum</i> Semi-natural Shrubland	1 : 1
22	S-BSCG	Big Sagebrush / Cheatgrass Shrubland	<i>Artemisia tridentata</i> - (<i>Ericameria nauseosa</i>) / <i>Bromus tectorum</i> Semi-natural Shrubland	1 : 1
23	S-BSTW	Big Sagebrush / Tall Wheatgrass Shrubland	Not an NVC type – not sampled	N/A
27	S-BSBW	Big Sagebrush / Great Basin Wildrye Shrubland	<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Leymus cinereus</i> Shrubland (not sampled)	1 : 1
28	S-BSCB	Big Sagebrush / Curly Bluegrass Shrubland	<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Poa secunda</i> Shrubland	1 : 1
29	S-BSBB	Big Sagebrush / Bluebunch Wheatgrass Shrubland	<i>Artemisia tridentata</i> (ssp. <i>tridentata</i> , ssp. <i>xericensis</i>) / <i>Pseudoroegneria spicata</i> Shrub Herbaceous Vegetation	1 : 1
Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)				
26	S-LYBA	Matrimony Vine Shrubland	<i>Lycium barbarum</i> / <i>Bromus tectorum</i> Semi-natural Shrubland	1 : 1
51	S-RRCW	Rubber Rabbitbrush / Crested Wheatgrass Shrubland	Not an NVC type – not sampled	N/A
52	S-RRCG	Rubber Rabbitbrush / Cheatgrass Shrubland	<i>Ericameria nauseosa</i> / <i>Bromus tectorum</i> Semi-natural Shrubland	1 : 1
55	S-YRCG	Yellow Rabbitbrush / Cheatgrass Shrubland	Not an NVC type – not sampled	N/A
56	S-YRNB	Yellow Rabbitbrush / Native Bunchgrass Shrubland	<i>Chrysothamnus viscidiflorus</i> Shrub Herbaceous Vegetation	1 : 1
Inter-Mountain Basins Greasewood Flat (CES304.780)				
17	H-LECI	Great Basin Wildrye Grassland	<i>Leymus cinereus</i> Herbaceous Vegetation (not sampled)	1 : 1
Inter-Mountain Basins Wash (CES304.781)				
25	S-SAVE	Greasewood Disturbed	<i>Sarcobatus vermiculatus</i> Disturbed Shrubland	1 : 1

Table 10. Map classes used in the GOSP vegetation map, with map class number, code and name, crosswalk to NVC association, and the relationship of map class to plant associations. GOSP vegetation map classes are arranged using the NatureServe ecological systems classification.

Map Class #	Map Class Code	Map Class Name	Associations Assigned to Map Class	Relation
		Shrubland		
53	S-TCSV	Tamarisk – Greasewood Floodplain Shrubland	<i>Tamarix</i> spp. Temporarily Flooded Semi-natural Shrubland (not sampled)	1 : 1
61	H-FLPN	Saltgrass – Squirreltail Floodplain Grassland	<i>Distichlis spicata</i> Herbaceous Vegetation (not sampled)	1 : 1
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)				
11	H-CWCG	Crested Wheatgrass – Cheatgrass Grassland	<i>Agropyron cristatum</i> - (<i>Pascopyrum smithii</i> , <i>Hesperostipa comata</i>) Semi-natural Herbaceous Vegetation <i>Agropyron cristatum</i> - <i>Bromus tectorum</i> Semi-natural Herbaceous Vegetation	1 : many
12	H-BRTE	Cheatgrass Grassland	<i>Bromus tectorum</i> Semi-natural Herbaceous Vegetation	many : 1
13	H-THPO	Tall Wheatgrass Grassland	<i>Thinopyrum ponticum</i> Semi-natural Herbaceous Vegetation	1 : 1
14	H-CGNB	Cheatgrass – Native Bunchgrass Grassland	<i>Bromus tectorum</i> Semi-natural Herbaceous Vegetation <i>Aristida purpurea</i> Herbaceous Vegetation	1 : many
15	H-HECO	Needle-and-Thread Grassland	<i>Hesperostipa comata</i> Great Basin Herbaceous Vegetation	1 : 1
16	H-NABU	Mixed Native Bunchgrass Grassland	<i>Aristida purpurea</i> Herbaceous Vegetation	1 : 1
18	H-POSE	Curly Bluegrass Grassland	<i>Poa secunda</i> Herbaceous Vegetation	1 : 1
19	H-PSSP	Bluebunch Wheatgrass Grassland	<i>Pseudoroegneria spicata</i> - <i>Hesperostipa comata</i> Herbaceous Vegetation <i>Pseudoroegneria spicata</i> - <i>Poa secunda</i> Herbaceous Vegetation <i>Pseudoroegneria spicata</i> Herbaceous Vegetation	1 : many
40	H-ANNF	Annual Forbs Disturbed Vegetation	Not an NVC type – not sampled	N/A
41	H-CGRT	Cheatgrass – Russian Thistle Disturbed Vegetation	<i>Bromus tectorum</i> Semi-natural Herbaceous Vegetation	many : 1
42	H-CGSW	Cheatgrass – Snakeweed Disturbed Vegetation	<i>Bromus tectorum</i> Semi-natural Herbaceous Vegetation	many : 1
Inter-Mountain Basins Cliff and Canyon (CES304.779)				
301	G-LIME	Sparsely Vegetated Limestone Outcrop	Not an NVC type – not sampled	N/A

Map Class Descriptions

Appendix J provides detailed descriptions of the map classes used in the final version of the GOSP vegetation classification and mapping project. Each map class description includes:

- a summary of the ecological concept of the map class; reference is made to the abundance of the map class within the project area
- the relevant ecological system, a list of plant associations, and common plant species occurring within the map class
- a qualitative description of the photographic signature with representative samples from the orthophotography
- ground photographs (if available)
- statistics for polygons of the map class (frequency, area)

Map Polygons

Five hundred and fifty-two polygons totaling 1,144 hectares (2,826 acres) were interpreted and mapped within GOSP. Average polygon size was 1.1 ha (2.6 acres). Of the total, 514 polygons (93%) represent natural or semi-natural vegetation, or sparsely vegetated geologic map classes covering 97% of the mapping project area. Map classes representing cultivated fields, non-vegetated roads, railroads, ranch structures, facilities and borrow pits account for the remaining 38 polygons (8% of polygons and 3% of the area).

The polygon total includes adjacent polygons that have the same map class code but different density or pattern attributes. The most common map class was Big Sagebrush / Cheatgrass Shrubland (S-BSCG) with 141 polygons covering 27.8% of the mapping area. The Needle-and-thread Grassland (H-HECO) map class had the largest average polygon size at 5.9 ha (14.8 acres) per polygon.

Figure 14 is an example of a map of the vegetation/land use of GOSP created from the GIS spatial database. Because a geodatabase was used to store and organize spatial information, there is far more data in the spatial database than can be conveyed in a two-dimensional map. Maps can be produced with vegetation polygons labeled in many different ways at different levels of resolution. Table 11 provides summary statistics for GOSP vegetation and land use map polygons.

Table 11. Summary statistics for polygons of each map class developed for the GOSP vegetation mapping project.

Map Code	Map Class Common Name	# Polygons	Area (ha / acres)
Great Basin Pinyon-Juniper Woodland (CES304.773)			
W-UJCG	Juniper / Cheatgrass Open Woodland	1	0.8 / 2.0
	<i>Subtotal</i>	1	0.8 / 2.0
Rocky Mountain Lower Montane-Foothill Shrubland (CES306.822)			
S-PRVI	Chokecherry Shrubland	3	0.4 / 1.1
	<i>Subtotal</i>	3	0.4 / 1.1
Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)			
S-BSBB	Big Sagebrush / Bluebunch Wheatgrass Shrubland	5	15.3 / 37.7
S-BSCG	Big Sagebrush / Cheatgrass Shrubland	141	317.8 / 785.3
S-BSCW	Big Sagebrush / Crested Wheatgrass Shrubland	40	29.4 / 72.8
S-BSCB	Big Sagebrush / Curly Bluegrass Shrubland	1	0.1 / 0.3

Table 11. Summary statistics for polygons of each map class developed for the GOSP vegetation mapping project.

Map Code	Map Class Common Name	# Polygons	Area (ha / acres)
S-BSFL	Big Sagebrush / Floodplain Shrubland	3	4.4 / 11.0
S-BSBW	Big Sagebrush / Great Basin Wildrye Shrubland	1	0.1 / 0.3
S-BSTW	Big Sagebrush / Tall Wheatgrass Shrubland	2	0.7 / 1.8
	<i>Subtotal</i>	193	
Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)			
S-LYBA	Matrimony Vine Shrubland	6	1.2 / 2.9
S-RRCG	Rubber Rabbitbrush / Cheatgrass Shrubland	37	38 / 93.8
S-RRCW	Rubber Rabbitbrush / Crested Wheatgrass Shrubland	2	0.7 / 1.7
S-YRCG	Yellow Rabbitbrush / Cheatgrass Shrubland	8	5.7 / 14.1
S-YRNB	Yellow Rabbitbrush / Native Bunchgrass Shrubland	7	5.9 / 14.5
	<i>Subtotal</i>	60	51.4 / 127
Inter-Mountain Basins Greasewood Flat (CES304.780)			
H-LECI	Great Basin Wildrye Grassland	3	0.5 / 1.3
	<i>Subtotal</i>	3	0.5 / 1.3
Inter-Mountain Basins Wash (CES304.781)			
S-SAVE	Greasewood Disturbed Shrubland	3	1.1 / 2.8
H-FLPN	Saltgrass - Squirreltail Floodplain Grassland	1	0.5 / 1.1
S-TCSV	Tamarisk - Greasewood Floodplain Shrubland	3	1.1 / 2.6
	<i>Subtotal</i>	7	2.6 / 6.5
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)			
H-ANNF	Annual Forbs Disturbed Vegetation	2	0.6 / 1.5
H-PSSP	Bluebunch Wheatgrass Grassland	13	23.8 / 58.9
H-CGNB	Cheatgrass - Native Bunchgrass Grassland	28	75.1 / 185.5
H-CGRT	Cheatgrass - Russian Thistle Disturbed Vegetation	4	1.0 / 2.4
H-CGSW	Cheatgrass - Snakeweed Disturbed Vegetation	29	152 / 375.5
H-BRTE	Cheatgrass Grassland	95	250.6 / 619.2
H-CWCG	Crested Wheatgrass - Cheatgrass Grassland	43	160.3 / 396.0
H-POSE	Curly Bluegrass Grassland	2	0.9 / 2.1
H-NABU	Mixed Native Bunchgrass Grassland	1	0.1 / 0.3
H-HECO	Needle-and-Thread Grassland	2	12.0 / 29.6
H-THPO	Tall Wheatgrass Grassland	15	4.1 / 10.1
	<i>Subtotal</i>	234	680.4 / 1681.2
Inter-Mountain Basins Cliff and Canyon (CES304.779)			
G-LIME	Sparsely Vegetated Limestone Outcrop	12	3.9 / 9.6
	<i>Subtotal</i>	12	3.9 / 9.6
Land Use /Geologic Map Classes			
L-CULT	Cultivated Field	5	2.1 / 5.2

Table 11. Summary statistics for polygons of each map class developed for the GOSP vegetation mapping project.

Map Code	Map Class Common Name	# Polygons	Area (ha / acres)
L-BORR	Borrow Pit	3	0.8 / 2
L-ACNE	Box Elder Tree	1	0.1 / 0.03
L-CORR	Corral	1	0.04 / 0.1
L-FACI	NPS Facilities	5	2.4 / 5.9
L-RAIL	Railroad	2	1.4 / 3.6
L-RNCH	Ranch Development	2	2.3 / 5.7
L-ROAD	Road	15	25.9 / 64.1
L-FILL	Rock Fill	4	0.5 / 1.3
L-TANK	Stock Tank	1	0.2 / 0.4
	<i>Subtotal</i>	39	35.7 / 88.2
	Total All Map Classes	552	1143.7 / 2826.1

* Note: Total polygon area may be less in the full mapping project area because of cumulative rounding error.

Discussion

Vegetation classification and mapping for GOSP was highly successful; a map verification exercise conducted in March 2009 identified few errors in map attribution or polygon boundary location. This success was due largely to the availability of detailed field notes and high-quality base imagery.

Field notes and plot / observation point data were extremely important sources used by the photointerpreter to delineate map classes and develop map class concepts. Detailed notes made on prints of the base imagery and representative ground photographs acquired by field crew members were also valuable.

Quality base data is essential to high quality scientific work. For the vegetation mapping at GOSP, 1-m resolution, true color orthophotography flown in 2006 by the State of Utah served as the base imagery to guide mapping by field crews and support digital interpretation. This imagery had relatively low contrast, and did not show differences in herbaceous vegetation that would have been visible on infrared imagery. As a result, the final map was developed using 1-foot-resolution true color imagery also flown by the State of Utah. This imagery was of very high quality; individual bunchgrass clumps and snakeweed shrubs were clearly visible with magnification. Because of this increased resolution, the photointerpreter was able to refine map polygon boundaries with a high degree of confidence.

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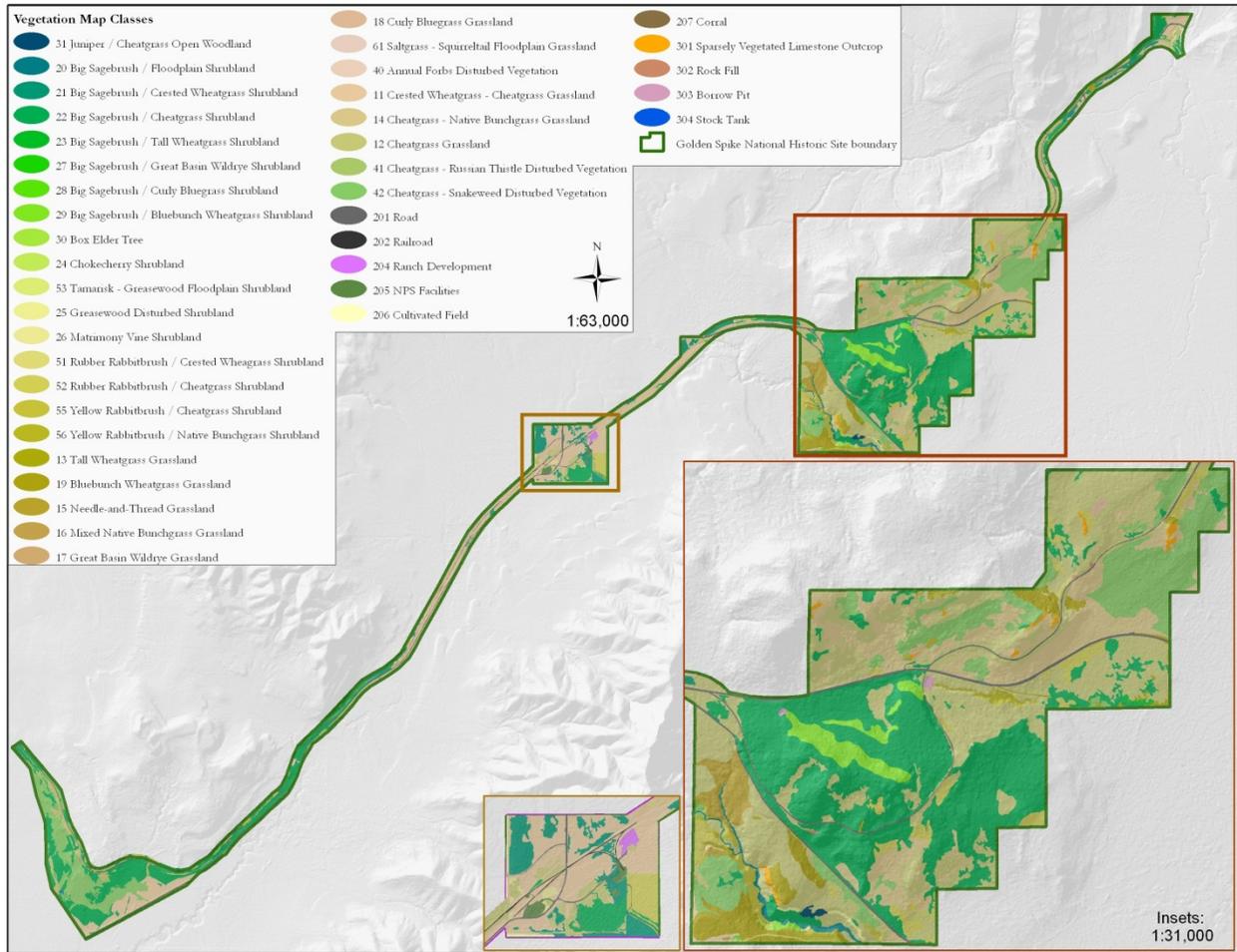


Figure 14. The GOSP vegetation map.

Accuracy Assessment

Methods

The GOSP vegetation map was not verified by means of the USGS-NPS standard accuracy assessment protocol (ESRI and TNC 1994). Although the NHS totals 1,130 ha (2,793 acres), most of the terrain is level to moderate and easy to access by walking. Three field crew members were able to map and sample the entire site during a three-day session. In contrast, the standard procedure for mapping larger parks is to have four types of field visits spread over the duration of the project: (1) reconnaissance, (2) vegetation plot sampling, (3) map verification, and (4) accuracy assessment.

Because of the relatively small project size and ease of access, and because of the potential for redundancy in multiple field visits, NCPN ecologists and project partners agreed that it would be more efficient to invest time in the field at the beginning of the project delineating and attributing vegetation polygons in the field as they were observed. The initial map was created in 2007 from detailed field notes recorded on photocopies of the aerial imagery and from classification plot/point data.

The principal issue with this procedure is a less rigorous degree of user confidence in the vegetation/land use map. A map verification exercise in March 2009 demonstrated a high degree of accuracy and detail in the draft map product, although the verification points were not selected as stratified random samples. The authors will therefore certify that virtually every acre and management unit within GOSP was walked or observed from close range, and that (as of May, 2009) this map is within the USGS-NPS guidelines for accuracy (80% for each map class).

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Appendix A.

Ecological Systems of Golden Spike National Historic Site

Introduction

This appendix contains summary descriptions of eight terrestrial ecological system (ES) units (NatureServe 2003b, Comer et al. 2003) occurring at Golden Spike National Historic Site. Each ecological system represents one or more National Vegetation Classification (NVC) plant associations (Table 7 within the main report). Map classes were also crosswalked to ES units (Table 10 within the main report).

The ecological systems classification was developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. One purpose of ecological systems is to provide a coarse-scale mapping unit that can be applied across management boundaries.

UPLAND ECOLOGICAL SYSTEMS

CES304.777 INTER-MOUNTAIN BASINS BIG SAGEBRUSH SHRUBLAND

Division 304 (Inter-Mountain Basins); Shrubland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Lowland; Alluvial Plain; Shrub-dominated; Temperate Continental; Toeslope / Valley Bottom; Deep Soil; Alkaline Soil; Aridic; Xeromorphic Shrub; *Artemisia tridentata* ssp. *tridentata*

Concept Summary: This ecological system occurs throughout much of the western U.S., typically in broad basins between mountain ranges, plains and foothills between 1500 and 2300 m elevation. Soils are typically deep, well-drained and non-saline. These shrublands are dominated by *Artemisia tridentata* ssp. *tridentata* (not as common in Wyoming or Montana but possibly on stabilized part of Killpecker Dunes in Wyoming) and/or *Artemisia tridentata* ssp. *wyomingensis* (predominant in Wyoming and Montana). Scattered *Juniperus* spp., *Sarcobatus vermiculatus*, and *Atriplex* spp. may be present in some stands. *Ericameria nauseosa*, *Chrysothamnus viscidiflorus*, *Purshia tridentata* (not commonly in Montana or Wyoming), or *Symphoricarpos oreophilus* may codominate disturbed stands (e.g., in burned stands, these may become more predominant). Perennial herbaceous components typically contribute less than 25% vegetative cover. Common graminoid species can include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus lanceolatus*, *Festuca idahoensis* (not in Montana or Wyoming), *Hesperostipa comata*, *Leymus cinereus*, *Pleuraphis jamesii* (not present in northeastern portions of the range), *Pascopyrum smithii*, *Poa secunda*, or *Pseudoroegneria spicata* (not in Wyoming). Some semi-natural communities are included that often originate on abandoned agricultural land or on other disturbed sites. In these locations, *Bromus tectorum* or other annual bromes and invasive weeds can be abundant. Most *Artemisia tridentata* ssp. *wyomingensis* communities in Wyoming are placed in Inter-Mountain Basins Big Sagebrush Steppe (CES304.778); the shrubland system is more restricted in environmental setting than the steppe. Dunes in the Red Desert have areas of large basin big sage with very dense canopies. In Wyoming, this system is likely to only contain *Artemisia tridentata* ssp. *tridentata*.

Range: This system occurs throughout much of the western U.S., typically in broad basins between mountain ranges, plains and foothills between 1500-2300 m elevation. It occurs as far east as central and eastern Montana, although much of the sagebrush in this region is more steppe in physiognomy.

Subnations: CA, CO, ID, MT, NV, OR, UT, WA, WY

CES304.787 INTER-MOUNTAIN BASINS SEMI-DESERT GRASSLAND

Division 304(Inter-Mountain Basins); Herbaceous

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Lowland, Foothill; Herbaceous; Temperate Xeric; Alkaline Soil; Aridic; Graminoid

Concept Summary: This widespread ecological system includes the driest grasslands throughout the intermountain western U.S. It occurs on xeric sites over an elevation range of approximately 1450 to 2320 m (4750-7610 feet) on a variety of landforms, including swales, playas, mesas, alluvial flats, and plains. This system may constitute the matrix over large areas of intermountain basins, and also may occur as large patches in mosaics with shrubland systems dominated by *Artemisia tridentata ssp. tridentata*, *Artemisia tridentata ssp. wyomingensis*, *Atriplex* spp., *Coleogyne* spp., *Ephedra* spp., *Gutierrezia sarothrae*, or *Krascheninnikovia lanata*. Grasslands in areas of higher precipitation, at higher elevation, typically belong to other systems. Substrates are often well-drained sandy or loam soils derived from sedimentary parent materials but are quite variable and may include fine-textured soils derived from igneous and metamorphic rocks. The dominant perennial bunch grasses and shrubs within this system are all drought-resistant plants. Dominant or codominant species are *Achnatherum hymenoides*, *Aristida* spp., *Bouteloua gracilis*, *Hesperostipa comata*, *Muhlenbergia* spp., or *Pleuraphis jamesii*. Scattered shrubs and dwarf-shrubs often are present, especially *Artemisia tridentata ssp. tridentata*, *Artemisia tridentata ssp. wyomingensis*, *Atriplex* spp., *Coleogyne* spp., *Ephedra* spp., *Gutierrezia sarothrae*, and *Krascheninnikovia lanata*. Grasslands in the basins of south-central and southwestern Wyoming, dominated by *Pseudoroegneria spicata* and *Poa secunda* and containing cushion-form forbs and other species typical of dry basins, are included in this system.

Range: This system occurs throughout the intermountain western U.S. on dry plains and mesas, at approximately 1450 to 2320 m (4750-7610 feet) elevation. In the Bighorn Basin of north-central Wyoming, there may be some desert grasslands, but this is uncertain.

Subnations: AZ, CA, CO, ID, MT?, NM, NV, OR, UT, WA, WY

CES304.788 INTER-MOUNTAIN BASINS SEMI-DESERT SHRUB-STEPPE

Division 304 (Inter-Mountain Basins); Steppe/Savanna

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Lowland [Foothill]; Woody Herbaceous; Temperate Xeric; Alkaline Soil; Aridic; Very Short Disturbance Interval; G-Landscape/High Intensity; Grassland

Concept Summary: This ecological system occurs throughout the intermountain western U.S., typically at lower elevations on alluvial fans and flats with moderate to deep soils, and extends into south-central Montana between the Pryor and Beartooth ranges where a distinct rainshadow effect occurs. This semi-arid shrub-steppe is typically dominated by graminoids (>25% cover) with an open shrub to moderately dense woody layer with a typically strong graminoid layer. The most widespread (but not dominant) species is *Pseudoroegneria spicata*, which occurs from the Columbia Basin to the northern Rockies. Characteristic grasses include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Distichlis spicata*, *Poa secunda*, *Poa fendleriana*, *Sporobolus airoides*, *Hesperostipa comata*, *Pleuraphis jamesii*, and *Leymus salinus*. The woody layer is often a mixture of shrubs and dwarf-shrubs, although it may be dominated by a single species. Characteristic species include *Atriplex canescens*, *Artemisia tridentata*, *Chrysothamnus Greenei*,

Chrysothamnus viscidiflorus, *Ephedra* spp., *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Krascheninnikovia lanata*. *Artemisia tridentata* or *Atriplex canescens* may be present but do not dominate. Annual grasses, especially the exotics *Bromus japonicus* and *Bromus tectorum*, may be present to abundant. Forbs are generally of sparse and are highly variable across the range but may be diverse in some occurrences. The general aspect of occurrences may be either open shrubland with patchy grasses or patchy open herbaceous layers. Disturbance may be important in maintaining the woody component. Microphytic crust is very important in some stands.

Range: This system occurs throughout the intermountain western U.S., typically at lower elevations, and extends into Wyoming and Montana across the Great Divide Basin. It barely gets as far north into north-central Montana (mapzone 20) but is unlikely to be mapped.

Subnations: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WY

CES304.780 INTER-MOUNTAIN BASINS GREASEWOOD FLAT

Division 304 (Inter-Mountain Basins); Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Toeslope/Valley Bottom; Alkaline Soil; Deep Soil; Xeromorphic Shrub

Concept Summary: This ecological system occurs throughout much of the western U.S. in Intermountain basins and extends onto the western Great Plains. It typically occurs near drainages on stream terraces and flats or may form rings around more sparsely vegetated playas. Sites typically have saline soils, a shallow water table and flood intermittently, but remain dry for most growing seasons. The water table remains high enough to maintain vegetation, despite salt accumulations. This system usually occurs as a mosaic of multiple communities, with open to moderately dense shrublands dominated or codominated by *Sarcobatus vermiculatus*. *Atriplex canescens*, *Atriplex confertifolia*, or *Krascheninnikovia lanata* may be present to codominant. Occurrences are often surrounded by mixed salt desert scrub. The herbaceous layer, if present, is usually dominated by graminoids. There may be inclusions of *Sporobolus airoides*, *Distichlis spicata* (where water remains ponded the longest), or *Eleocharis palustris* herbaceous types.

Range: Occurs throughout much of the western U.S. in Intermountain basins and extends onto the western Great Plains.

Subnations: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

CES304.773 GREAT BASIN PINYON-JUNIPER WOODLAND

Division 304 (Inter-Mountain Basins); Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Lowland [Foothill]; Montane [Lower Montane]; Forest and Woodland; Ridge/Summit/Upper Slope; Aridic; Woody Herbaceous; Long Disturbance Interval

Concept Summary: This ecological system occurs on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada south in scattered locations throughout southern California. It is typically found at lower elevations ranging from 1600-2600 m. These woodlands

occur on warm, dry sites on mountain slopes, mesas, plateaus and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Woodlands dominated by a mix of *Pinus monophylla* and *Juniperus osteosperma*, pure or nearly pure occurrences of *Pinus monophylla*, or woodlands dominated solely by *Juniperus osteosperma* comprise this system, but in some regions of southern California, *Juniperus osteosperma* is replaced by *Juniperus californica*. *Cercocarpus ledifolius* is a common associate. On the east slope of the Sierras in California, *Pinus jeffreyi* and *Juniperus occidentalis var. australis* may be components of these woodlands. Understory layers are variable. Associated species include shrubs such as *Arctostaphylos patula*, *Artemisia arbuscula*, *Artemisia nova*, *Artemisia tridentata*, *Cercocarpus ledifolius*, *Cercocarpus intricatus*, *Coleogyne ramosissima*, *Yucca brevifolia*, *Quercus gambelii*, *Quercus turbinella*, *Quercus john-tuckeri*, *Juniperus californica*, *Quercus chrysolepis*, and bunch grasses *Hesperostipa comata*, *Festuca idahoensis*, *Pseudoroegneria spicata*, *Leymus cinereus* (= *Elymus cinereus*), and *Poa fendleriana*. This system occurs at lower elevations than Colorado Plateau Pinyon-Juniper Woodland (CES304.767) where sympatric..

Range: This system occurs on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada, typically at lower elevations ranging from 1600-2600 m. It extends southwest in California to the northern Transverse Ranges (Ventura County) and San Jacinto Mountains (Riverside County).

Subnations: CA, ID, NV, UT

CES304.779 INTER-MOUNTAIN BASINS CLIFF AND CANYON

Division 304 (Inter-Mountain Basins); Barren

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland

Diagnostic Classifiers: Cliff; Rock Outcrops/Barrens/Glades; Lowland; Montane; Canyon; Sideslope; Sedimentary Rock; Temperate Continental; Very Shallow Soil

Concept Summary: This ecological system is found from foothill to subalpine elevations and includes barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included is vegetation of unstable scree and talus slopes that typically occurs below cliff faces. Widely scattered trees and shrubs may include *Abies concolor*, *Pinus edulis*, *Pinus flexilis*, *Pinus monophylla*, *Juniperus* spp., *Artemisia tridentata*, *Purshia tridentata*, *Cercocarpus ledifolius*, *Ephedra* spp., *Holodiscus discolor*, and other species often common in adjacent plant communities.

Subnations: CA, ID, NV, OR, UT, WA, WY

CES304.781 INTER-MOUNTAIN BASINS WASH

Division 304 (Inter-Mountain Basins); Barren

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland

Diagnostic Classifiers: Lowland; Shrubland; Wash; Toeslope/Valley Bottom; Riverine/Alluvial; Alkaline Soil; Xeromorphic Shrub; *Sarcobatus vermiculatus*

Concept Summary: This barren and sparsely vegetated (generally <10% plant cover) ecological system is restricted to intermittently flooded streambeds and banks that are often lined with shrubs such as *Sarcobatus vermiculatus*, *Ericameria nauseosa*, *Fallugia paradoxa*, *Artemisia tridentata* ssp. *tridentata*, and/or *Artemisia cana* ssp. *cana* (in more northern and mesic stands) that form relatively dense stringers in open dry uplands. *Grayia spinosa* may dominate in the Great Basin. Shrubs form a continuous or intermittent linear canopy in and along drainages but do not extend out into flats. Typically it includes patches of saltgrass meadow where water remains for the longest periods. In parts of Wyoming, stringers or patches of *Artemisia tridentata* ssp. *tridentata* are large and distinct enough from surrounding upland vegetation due to the influence of the wash that they can be classified separately. However, small intermittent washes may also be included with adjacent uplands if vegetation is not different enough floristically or structurally from uplands (e.g., just a little denser canopy). Soils are variable but are generally less alkaline than those found in the playa system. Desert scrub species (e.g., *Acacia greggii*, *Prosopis* spp.) that are common in the Mojave, Sonoran and Chihuahuan desert washes are not present. This type can occur in limited portions of the southwestern Great Plains.

Comments: Where the stringers or patches of *Artemisia tridentata* ssp. *tridentata* are large enough to be mapped separately from both the wash and from the adjacent upland, then they should be mapped as Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777) or Inter-Mountain Basins Big Sagebrush Steppe (CES304.778). Compare this wash system with Inter-Mountain Basins Greasewood Flat (CES304.780); the wash should be restricted to the periphery of the wash and distinct from adjacent vegetation. If not, consider including with greasewood flat. Invasive, exotic shrubs shrub as *Tamarix* spp. or *Chamaebatiaria millefolium* may be present to dominant in these washes where disturbed.

Range: This system occurs throughout the Intermountain western U.S. extending east into the western Great Plains.

Subnations: AZ, CA, CO, ID, MT, NV, OR, UT, WA, WY

CES306.822 ROCKY MOUNTAIN LOWER MONTANE-FOOTHILL SHRUBLAND

Division 306 (Rocky Mountain); Shrubland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Lowland [Foothill]; Montane [Lower Montane]; Shrubland; Very Shallow Soil; Aridic; Intermediate Disturbance Interval

Concept Summary: 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).

Range: This 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.

Subnations: CO, MT, NE?, NM, SD, UT, WY

Appendix B.

Plot and Observation Point Instructions and Data Forms

Introduction

This appendix contains the forms and instruction manuals used in collecting field data for the NCPN Vegetation Mapping Project. Two types of data were collected: vegetation plot and observation point. Vegetation plots were used primarily in developing the NVC classification for the NHS. They were also used by photointerpreters to help recognize aerial photo signatures. Observation points were used primarily for assisting with photo interpretation, and secondarily for supporting NVC association descriptions and documenting non-standard vegetation types

B.1. Plot and Observation Point Field Sampling Manual

Golden Spike National Historic Site A Basic Guide for Field Work Modified for the 2007 Field Season

This document is intended to give you general instructions and guidelines for conducting your field work at Golden Spike National Historic Site. Detailed, field-by-field coding conventions for the primary form you'll be completing in the field (the Plot Survey form) are provided in the 'cheat sheet' at the back of this guide. You will also be taking Observation Points on a form reduced from and similar to the Plot Survey form.

OVERVIEW

The data that you collect this year will be used to create a relatively fine-scale delineation of vegetation pattern in this Northern Colorado Plateau Network (NCPN) park and its environs. The range of habitats and the corresponding diversity of vegetation types, found in this park are complex. The understanding of finer-scale, ecologically distinct vegetation types that you will help create may be used by the park to plan appropriate management activities, monitor the results of these activities, track long-term changes in vegetation, direct searches for rare species, model fire behavior, and portray the wealth of natural diversity on park lands to the public.

Plot location will be guided by aerial photographs, staff advice, and topographic maps, with the goal of adequately sampling the vegetation. A classification based on this sampling will result in interpretation of aerial photos to produce a vegetation map. A combination of manual and electronic digitizing approaches will be used for Golden Spike National Historic Site to delineate polygons and label the vegetation types. The vegetation "types" the photo interpreters will choose to name their polygons are included within the U.S. National Vegetation Classification System (Grossman et al. 1998).

The field crew will evaluate the field data, assign a preliminary vegetation type based on a list of potential vegetation types developed from the existing literature, and update the tally of vegetation types by number of plots still needed. The goal is to use your time as efficiently as possible: we are trying our best to avoid oversampling of some types and undersampling of others. Deciding where to sample to capture the full range of diversity throughout the site is an iterative process.

GETTING THERE

You will have a copy of the 1:6,000-scale orthophotography to guide you. You will navigate towards each selected photo-signature using your NHS road and trail map, USGS 7.5 mm. topographic map, the photo, and/or GPS.

Before you leave... check that you have all the materials needed to complete your field work (Please see the checklist and 'considerations for mission planning' at the end of this document to help you).

Every single morning... check your GPS receiver to make sure it is set to NAD 83.

Along the way... look around. The goal of this field work is to sample all the different vegetation types that occur in Golden Spike National Historic Site. If, on the way to one vegetation type, you see an assemblage of plants that seems unique, please sample if time allows.

ONCE THERE

Establishing a Plot

1) Figure out where to place your plot. This is a subjective process. You'll want to place your plots in areas that seem to be both relatively **homogenous** and **representative** of the vegetation of the signature as a whole. Avoid areas where the vegetation appears to be transitioning from one type to another (ecotones) and areas with anomalous or heterogeneous structure or species composition. Look at *all* the vegetation strata to determine if the area is structurally and floristically uniform and generally try to place your plots at least 30 m from what you see as the 'boundary' between this vegetation type and any neighboring, distinctly different types. During the training period this step will be emphasized and discussed in detail. However, the rule-of-thumb is to conduct a reconnaissance of the plot area if time and topography allows.

Note: In cases where a signature is very heterogeneous, more than one plot or a plot and observation points may be needed. Again, look around, use that human perception.

- 2) Using your GPS (Global Positioning System) receiver, record the UTM (Universal Transverse Mercator) coordinates in the center of the plot under the Field UTM X and Field UTM Y on the field form. Also mark and label the location of the plot on a USGS 7.5 min. topographic map and/or on an aerial photo. If you cannot obtain a GPS reading, estimate UTM's from the USGS topographic map and note on the form that you had to resort to this method. Plots may be circular, rectangular or square. Note shape and dimensions on the field form. If the plot is rectangular or square, record the azimuth of the long side (any side if square) to help relocate the plot. It may make more sense to establish rectangular plots in linear vegetation types (e.g. riparian or ridgeline types). Standard plot sizes should be as follows:

If you're in a ...	You should usually make your plot...	Giving you a plot area of...
Forest (trees have overlapping crowns usually forming 60-100% cover)	11.3 m radius OR 20 m x 20 m	400 m ² 400 m ²
Woodland (open stands of trees with crowns usually not touching. Canopy tree cover is 10-60% OR exceeds shrub, dwarf-shrub, herb, & nonvascular cover).	11.3 m radius OR 20 m x 20 m	400 m ² 400 m ²
Shrubland (shrubs greater than 0.5 m tall are dominant, usually forming more than 10% cover OR exceeding tree, dwarf shrub, herb, & nonvascular cover)	11.3 m radius OR 20 m x 20 m	400 m ² 400 m ²
Dwarf-shrubland (shrubs less than 0.5 m tall are dominant, usually forming more than 10% cover OR exceeding tree, shrub, herb, & nonvascular cover).	5.65 m radius OR 10 m x 10 m	100 m ² 100 m ²
Herbaceous (herbs dominant, usually forming more than 10 percent cover OR exceeding tree, shrub, dwarf-shrub, & nonvascular cover).	5.65 m radius OR 10 m x 10 m	100 m ² 100 m ²
Nonvascular (lichen or moss cover dominant, usually more than 10% cover).	2.82 m radius OR 5 m x 5 m	25 m ² 25 m ²

Note: You can deviate from the standard plot *shapes* where that makes sense, but the total plot *area* encompassed by the boundaries should be as listed above for each major class of vegetation. For example, forested riparian vegetation may be sampled in a more linear 10 x 40 m (400 m²) plot; herbaceous riparian or ridgeline vegetation in a 2 x 50 m (100m²) plot. You may also increase the size of the plot to the next standard size if necessary to sample the heterogeneity of the vegetation. Forests, woodlands and shrublands can be increased to 1000 m². Please make a note on plot form.

3) Once the plot is established, it is generally a good time to fill out the **Identifiers/Locators** part of your Plot Survey Form (see the cheat sheet) and take the plot photos.

Taking photographs

Two color photos will be taken of each plot using slide film. The purpose is to obtain a good representation of the vegetation of the plot, not individual species. A piece of paper (or a chalk board or dry erase board) should be placed in the plot, with the plot number recorded on it, so that the photo includes the plot number. Preprinted plot numbers could be printed or copied onto colored paper (white has such strong contrast as to be unreadable in the photo) and attached to the back of a clipboard. This saves having to write plot numbers in the field. Take the photograph looking across the contour if the slope is steep. Record roll #, frame # and azimuth on plot form.

Data Collection

Environmental Description

See the coding instructions at the end of this document for guidance on the specific fields.

Vegetation Description

For guidance on the specific fields on the second page of the form, see the coding instructions.

As you begin to collect the species, DBH (diameter at breast height – 4.5'), and cover information, keep these rules in mind they will speed your data collection considerably:

1) Except in very diverse plots, don't spend more than **20 minutes** looking for new species to record. Remember that these plot data are to be used to classify the overall vegetation of the NHS, not to make a complete species list for it. If you had to spend much more than 20 minutes *to find* a species, it probably isn't going to be important in characterizing the vegetation type. For diverse plots with over 25 taxa you may take up to 30 minutes on the listing process.

2) If you can't identify a plant to species, record it on your form as "unknown species 1," "unknown species 2," "*Carex* unknown sp. 1", etc. Record associated cover class and other data for the unknown as you would for any other species. Then do one of two things:

If you need the species identified right away because it appears to be dominant or diagnostic (you're seeing it all over the place or you're seeing much more in this particular vegetation type than in others), take a sample of the species with as much of the plant as possible, especially intact sexual parts (flowers and fruits), if present. Place the sample in a baggie, and label the baggie (or specimen) with the plot code and the name you gave it on the data form.

If you don't need the plant keyed right away, press it. Mark the pressed specimen with the plot code and the name you gave it on the data form.

Store specimens in a cool, dry place. Bagged specimens will keep fresh longer in the refrigerator or ice chest until pressed or identified. You can key some of these out yourself if you want to, but don't let plant keying get in the way of your primary responsibility: field data *collection*. No one expects you to identify every plant but you should make an effort to learn at least the common species that keep recurring in plots. A quick prioritization of what to key and what to press may be made based on the recurrence of the species in samples and on the cover-class estimate of the species in a particular plot. If the species has a high cover value (>1%) it is more of a priority to identify. Field crews should mark the specimen tag with its cover class estimate as well as its unique identifying number for the vegetation sample.

Observation Point Form

When you have sampled one particular vegetation type thoroughly, but want to further define its distribution or when you encounter small but unique vegetation patches that are below the minimum mapping unit in size (<1.5 ha), record the site on an Observation Point form. This is an abbreviated Plot Survey form and usually takes about 15 minutes to fill in the data. The major difference is that an Observation Point is unbounded and includes an area roughly equal to that of the minimum mapping unit (20 m radius around the observer) or it encompasses the entirety of a small but unique vegetation patch. The data fields are the same as those on the Plot Survey form, so use the above instructions. Minor differences in the Observation Point form from the Plot Survey form include the elimination of some data fields, more general cover classes for ground cover estimates, and only the dominant or diagnostic species are recorded. In addition, only one photo is taken to record the Observation Point plant community.

Accuracy Assessment Point Form

You will navigate to pre-selected coordinates within polygons, scout out the polygon briefly to get a feel for what it is like, and record some general data to characterize it on an Accuracy Assessment Point form. This is also an abbreviated version of the Plot Survey form, much like the Observation Point form, and the same cheat sheet can be used to help with filling it out. A sample completed Accuracy Assessment Point form is provided at the end of this document.

We hope your field season on the northern Colorado Plateau enjoyable and rewarding. Good luck!

LITERATURE CITED

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- The Nature Conservancy [TNC]. 1998. An environmentally-driven approach to vegetation sampling and mapping at Yosemite National Park. Report prepared for the U.S. Department of the Interior, National Biological Survey and National Park Service. The Nature Conservancy, Arlington, Virginia.

INSTRUCTIONS FOR FILLING OUT PLOT AND OBSERVATION POINT SURVEY FORMS

PLOT DESCRIPTION

Plot Code

Code indicating the specific plot within the vegetation polygon. For the 2007 field season, the codes will be in the following format “PARK ACRONYM.XXX” (i.e., Golden Spike National Historic Site = “GOSP.XXX”). Begin with GOSP.001 and go from there. If another team is working, decide which plot numbers each team will use to identify the data they gather. For example, if a second team is working at Golden Spike National Historic Site and approximately 100 plots have already been collected, they may number their plots GOSP.125 through GOSP.150.

Provisional Community Name

Using the provisional classification of the parks with which you’ve been provided, assign the name of the vegetation type that most closely resembles this type. Enter the finest level of the classification possible. In fact, *none* of the names may be a good fit; you may have found a new type. If that is the case, create a provisional name with the dominant and diagnostic species. The ‘provisional community name’ that is assigned will be used to update the tally of types x number of plots needed.

State UT

Park Name GOSP

Park Site Name

Provisional name assigned by field worker that describes where the data were collected. It should represent an identifiable feature on a topographic or park map.

Quad Name

Appropriate name/scale from survey map used; use 7.5-minute quadrangle if possible.

Quad Code

Code of quadrangle map.

Field UTM X

Use GPS, but if you can’t obtain a GPS reading, estimate coordinates from a topographic map and note on the form that this method was used.

Field UTM Y

Use GPS, but if you can’t obtain a GPS reading, estimate coordinates from a topographic map and note on the form that this method was used.

GPS Error

Note the error in the GPS reading off the unit.

Survey Date

Date the survey was taken; year, month, day.

Surveyors

Names of surveyors, with principal surveyor (usually the Lead Ecologist) listed first.

Directions to Plot

Precise directions to the site using a landmark (e.g., a named point on the topographic map, a major highway, using park naming conventions for roads) readily locatable on a 7.5 minute topographic or park map as the starting point. Use clear sentences that will be understandable to someone who is unfamiliar with the area and has only your directions to follow. Give distances as closely as possible to the 0.1 mile and use compass directions. Give additional directions to the plot within the site. Do not take more than a couple of minutes to fill this out.

Plot Length and Plot Width

Enter diameter for circular plots and width and length dimensions for square or rectangular plots. Choose the appropriate plot size based on the following:

Vegetation Class	Standard Plot Dimensions	PLOT AREA
Forest	11.3 m radius or 20 m x 20 m	400 m ²
Woodland	11.3 m radius or 20 m x 20 m	400 m ²
Shrubland	11.3 m radius or 20 m x 20 m	400 m ²
Dwarf-shrubland	5.65 m radius or 10 m x 10m	100 m ²
Herbaceous	5.65 m radius or 10 m x 10 m	100 m ²
Nonvascular	2.82 m radius or 5 m x 5 m	25 m ²

Plot Photos/ Roll Number/Frame Numbers

Indicate (Y or N) if photos of the plot were taken at the time of sampling, and their roll and frame numbers. Also record azimuth of the photo if not taken in the standard direction.

Plot Permanent (if/when applicable)

Check off that the plot has been permanently marked.

Plot Representativeness

Does this plot represent the full variability of the photo signature? If not, were additional plots taken? Note additional species not seen in the plot in the space provided below. Note: we distinguish in this section the plot's ability to represent the stand or polygon you are sampling as one component and the ability of this sample to represent the range of variability of the association in the entire mapping area. The former comment may be ascertained by reconnaissance of the stand. The latter comment comes only after some familiarity with the vegetation type throughout the mapping area and may be left blank.

ENVIRONMENTAL DESCRIPTION

Elevation

Elevation of the plot. Specify whether in feet or meters. We have determined that the reading you obtain from a topographic map, provided you are certain where you are, is more accurate than the average reading from the GPS unit. Thus, please attempt to estimate your elevation with the topographic map.

Slope

Measure the slope in degrees using a clinometer.

Aspect

Measure the slope aspect using a compass (be sure to correct for the magnetic declination). Note: all compasses should be pre-set to an average declination for the park and thus, readings from the compasses carried by the field crews may be directly noted.

Topographic Position

Topographic position of the plot. Choose one:

INTERFLUVE (crest, summit, ridge). Linear top of ridge, hill, or mountain; the elevated area between two fluves (drainageways) that sheds water to the drainageways.

HIGH SLOPE (shoulder slope, upper slope, convex creep slope). Geomorphic component that forms the uppermost inclined surface at the top of a slope. Includes the transition zone from backslope to summit. Surface is dominantly convex in profile and erosional in origin.

HIGH LEVEL (mesa). Level top of a plateau.

MIDSLOPE (transportational midslope, middle slope). Intermediate slope position.

BACKSLOPE (dipslope). Midslopes that are steep, linear, and may include cliff segments.

STEP IN SLOPE (ledge, terracette). Level shelf interrupting a steep slope, rock wall, or cliff face.

LOWSLOPE (lower slope, foot slope, colluvial footslope). Gently inclined surface at the base of a slope. Surface profile is usually concave and transitions between midslope and toeslope.

TOESLOPE (alluvial toeslope). Outermost gently inclined surface at base of a slope. In profile, commonly gentle and linear and characterized by alluvial deposition.

LOW LEVEL (terrace). Valley floor or shoreline representing the former position of an alluvial plain, lake, or shore.

CHANNEL WALL (bank). Sloping side of a channel.

CHANNEL BED (narrow valley bottom, gully, arroyo, wash). Bed of single or braided watercourse commonly barren of vegetation and formed of modern alluvium.

BASIN FLOOR (depression). Nearly level to gently sloping, bottom surface of a basin.

Landform

Enter the landform that describes the site where the plot was taken. Note on the code sheet the landform choices are listed at different scales. Thus, one can select more than one for plot if appropriate (e.g., mountain could be macro and ridge could be meso scale). Please be consistent so we can analyze by landform. Appendix A provides definitions for these landforms and more.

Surficial Geology

Note the geologic substrate influencing the plant community (bedrock or surficial materials). Accurately recording the geology at the plot is especially important if the plot is on an inclusion in the type on the geology map. The list below provides general types from the GOSP geology map.

- Obscured by soil
- Recent alluvium
- Quaternary alluvium
- Lake Bonneville sediments
- Wave-cut Bonneville terrace
- Oquirrh Formation
- Colluvium / Talus / Landslides

Cowardin System

If the system is a wetland, check off the name of the USFWS system which best describes its hydrology and landform. Indicate “upland” if the system is not a wetland.

Assess the hydrologic regime of the plot using the descriptions below (from Cowardin et al. 1979).

SEMI-PERMANENTLY FLOODED - Surface water persists throughout growing season except during periods of drought. Land surface is normally saturated when water level drops below soil surface. Includes Cowardin’s Intermittently Exposed and Semipermanently Flooded modifiers.

SEASONALLY FLOODED - Surface water is present for extended periods during the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is very variable, extending from saturated to a water table well below the ground surface. Includes Cowardin’s Seasonal, Seasonal-Saturated, and Seasonal-Well Drained modifiers.

SATURATED - Surface water is seldom present, but substrate is saturated to surface for extended periods during the growing season. Equivalent to Cowardin’s Saturated modifier.

TEMPORARILY FLOODED - Surface water present for brief periods during growing season, but water table usually lies well below soil surface. Often characterizes flood-plain wetlands. Equivalent to Cowardin’s Temporary modifier.

INTERMITTENTLY FLOODED - Substrate is usually exposed, but surface water can be present for variable periods without detectable seasonal periodicity. Inundation is not predictable to a given season and is dependent upon highly localized rain storms. This modifier was developed for use in the arid West for water regimes of playa lakes, intermittent streams, and dry washes but can be used in other parts of the U.S. where appropriate. This modifier can be applied to both wetland and non-wetland situations. Equivalent to Cowardin’s Intermittently Flooded modifier.

PERMANENTLY FLOODED - Water covers the land surface at all times of the year in all years. Equivalent to Cowardin’s “permanently flooded.”

UNKNOWN - The water regime of the area is unclear. The unit is described as a non-tidal wetland.

Environmental Comments

Enter any additional noteworthy comments on the environmental setting. This field can be used to describe site history such as fire events (date since last fire or evidence of severity) as well as other disturbance or reproduction factors.

Unvegetated Surface

Estimate the approximate percentage of the *total* surface area covered by each category. Only include categories with more than 5% cover.

Soil Texture

Using the key below, assess average soil texture (Brewer and McCann 1982)

- A1 Soil does not remain in a ball when squeezed sand
- A2 Soil remains in a ball when squeezed B

- B1 Squeeze the ball between your thumb and forefinger, attempting to make a ribbon that you push up over your finger.

	Soil makes no ribbon	loamy sand
B2	Soil makes a ribbon; may be very short.....	C
C1	Ribbon extends less than 1 inch before breaking.....	D
C2	Ribbon extends 1 inch or more before breaking.....	E
D1	Add excess water to small amount of soil Soil feels at least slightly gritty.....	loam or sandy loam
D2	Soil feels smooth.....	silt loam
E1	Soil makes a ribbon that breaks when 1 2 inches long; Cracks if bent into a ring.....	F
E2	Soil makes a ribbon 2+ inches long; does not crack when bent into a ring	G
F1	Add excess water to small amount of soil; Soil feels at least slightly gritty.....	sandy clay loam or clay loam
F2	Soil feels smooth.....	silty clay loam or silt
G1	Add excess water to a small amount of soil; Soil feels at least slightly gritty.....	sandy clay or clay
G2	Soil feels smooth.....	silty clay

Soil Drainage

The soil drainage classes are defined in terms of (1) actual moisture content (in excess of field moisture capacity) and (2) the extent of the period during which excess water is present in the plant-root zone. We recognize that permeability, level of groundwater, and seepage are factors affecting moisture status. However, because these are not easily observed or measured in the field, they cannot be used as criteria of moisture status. We also know that soil profile morphology, such as mottling, normally but not always reflects soil moisture status; however, it should not be the overriding criterion. Soil drainage classes cannot be based solely on the presence or absence of mottling. Topographic position and vegetation as well as soil morphology are useful field criteria for assessing soil moisture status.

RAPIDLY DRAINED - The soil moisture content seldom exceeds field capacity in any horizon except immediately after water addition. Soils are free from any evidence of gleying throughout the profile. Rapidly drained soils are commonly coarse textured or soils on steep slopes.

WELL DRAINED - The soil moisture content does not normally exceed field capacity in any horizon (except possibly the C) for a significant part of the year. Soils are usually free from mottling in the upper 3 feet, but may be mottled below this depth. B horizons, if present, are reddish, brownish, or yellowish.

MODERATELY WELL DRAINED - The soil moisture in excess of field capacity remains for a small but significant period of the year. Soils are commonly mottled (chroma <2) in the lower B and C horizons or below a depth of 2 feet. The Ae horizon, if present, may be faintly mottled in fine-textured soils and in medium-textured soils that have a slowly permeable layer below the solum. In grassland soils the B and C horizons may be only faintly mottled and the A horizon may be relatively thick and dark.

SOMEWHAT POORLY DRAINED - The soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year. Soils are commonly mottled in the B and C horizons; the Ac horizon, if present, may be mottled. The matrix generally has a lower chroma than in the well-drained soil on similar parent material.

POORLY DRAINED - The soil moisture in excess of field capacity remains in all horizons for a large part of the year. The soils are usually very strongly gleyed. Except in high-chroma parent materials the B, if present and upper C horizons usually have matrix colors of low chroma. Faint mottling may occur throughout.

VERY POORLY DRAINED - Free water remains at or within 12 inches of the surface most of the year. The soils are usually very strongly gleyed. Subsurface horizons usually are of low chroma and yellowish to bluish hues. Mottling may be present but at the depth in the profile. Very poorly drained soils usually have a mucky or peaty surface horizon.

VEGETATION DESCRIPTION

Leaf Phenology

Select the value that best describes the leaf phenology of the dominant stratum. The dominant stratum is the uppermost stratum that contains at least 10% cover.

EVERGREEN - Greater than 75% of the total woody cover is never without green foliage.

COLD DECIDUOUS - Greater than 75% of the total woody cover sheds its foliage in connection with an unfavorable season mainly characterized by winter frost.

MIXED EVERGREEN - COLD DECIDUOUS - Evergreen and deciduous species generally contribute 25-75% of the total woody cover. Evergreen and cold-deciduous species admixed.

PERENNIAL - Herbaceous vegetation composed of more than 50% perennial species.

ANNUAL - Herbaceous vegetation composed of more than 50% annual species.

Leaf Type

Select one value that best describes the leaf form of the dominant stratum. The dominant stratum is the uppermost stratum that contains at least 10% cover.

BROAD-LEAVED - Woody vegetation primarily broad-leaved (generally contributes greater than 50% of the total woody cover).

NEEDLE-LEAVED - Woody vegetation primarily needle-leaved (generally contributes greater than 50% cover).

MICROPHYLLOUS - Woody cover primarily microphyllous.

GRAMINOID - Herbaceous vegetation cover more than 50% graminoid species.

FORB (BROAD-LEAF-HERBACEOUS) - Herbaceous vegetation cover more than 50% broad-leaf forb species.

PTERIDOPHYTE - Herbaceous vegetation cover more than 50% species with frond or frond-like leaves.

Physiognomic Class. Choose one:

Forest: Trees with their crowns overlapping (generally forming 60-100% cover).

Woodland: Open stands of trees with crowns not usually touching (generally forming 25-60% cover). Canopy tree cover may be less than 25% in cases where it exceeds shrub, dwarf-shrub, herb, and nonvascular cover, respectively.

Shrubland: Shrubs generally greater than 0.5 m tall with individuals or clumps overlapping to not touching (generally forming more than 10% cover, trees generally less than 10% cover). Shrub cover may be less than 10% where it exceeds tree, dwarf-shrub, herb, and nonvascular cover, respectively. Vegetation dominated by woody vines is generally treated in this class.

Dwarf-shrubland: Low-growing shrubs usually under 0.5 m tall. Individuals or clumps overlapping to not touching (generally forming more than 10% cover, trees and tall shrubs generally less than 10% cover). Dwarf-shrub cover may be less than 10% where it exceeds tree, shrub, herb, and nonvascular cover, respectively.

Herbaceous: Herbs (graminoids, forbs, and ferns) dominant (generally forming at least 10% cover; trees, shrubs, and dwarf-shrubs generally with less than 10% cover). Herb cover may be less than 10% where it exceeds tree, shrub, dwarf-shrub, and nonvascular cover, respectively.

Nonvascular: Nonvascular cover (bryophytes, non-crustose lichens, and algae) dominant (generally forming at least 25% cover). Nonvascular cover may be less than 25% where it exceeds tree, shrub, dwarf-shrub, and herb cover, respectively.

Sparse Vegetation: Abiotic substrate features dominant. Vegetation is scattered to nearly absent and generally restricted to areas of concentrated resources (total vegetation cover is typically less than 10% and greater than 0%).

Strata/Lifeform, Height, Cover, Diagnostic Species

Visually divide the community into vegetation layers (strata). Indicate the average height class of the stratum in the first column, using the Height Scale on the form. Enter the average percent cover class of the whole stratum in the second column, using the Cover Scale on the form. Height and Cover classes are also listed below.

Trees are defined as single-stemmed woody plants, generally 5 m in height or greater at maturity and under optimal growing conditions. Shrubs are defined as multiple-stemmed woody plants generally less than 5 m in height at maturity and under optimal growing conditions.

Herbaceous layers are: Ht = total, H1 = Graminoids (grass, sedge, rush), H2 = Forbs (Dicot herbaceous), H3 = Ferns and Fern allies, and H4 = tree seedlings. List the dominant species in each stratum. If a species present is known to be diagnostic of a particular vegetation type, list these as well, marking them with an asterisk.

Cover Scale for Strata		Height Scale for Strata	
T	<1%	01	<0.5 m
P	1-5%	02	0.5-1 m
1	5-15%	03	1-2 m
2	15-25%	04	2-5 m
3	25-35%	05	5-10 m
4	35-45%	06	10-15 m
5	45-55%	07	15-20 m
6	55-65%	08	20-35 m

Cover Scale for Strata		Height Scale for Strata	
7	65-75%	09	35-50 m
8	75-85%	10	>50 m
9	85-95%		
10	95+		

Animal Use Evidence

Comment on any evidence of use of the plot/polygon by non-domestic animals (i.e., tracks, scat, gopher mounds, etc.). Notes on domestic animals should be made in the field below.

Natural and Anthropogenic Disturbance

Comment on any evidence of natural or anthropogenic disturbance and specify the source.

Other Comments

Any other comments.

Species/DBH/Percent Cover Table

Starting with the uppermost stratum, list all the species present and cover class (using the 12 point scale) and percent cover of each species in that particular stratum. Indicate strata in the left-hand columns. If in the tree layer (single-stemmed woody plants, generally 5 m in height or greater at maturity), note in the "T" column if T1 (emergent tree), T2 (tree canopy), or T3 (tree sub-canopy). If in the shrub layer, note in the "S", column if S1 (tall shrub, > 2m), S2 (short shrub, <2m), or S3 (dwarf-shrub <0.5m). If in the ground layer, note in the "G" column if H1 (herbaceous - graminoid), H2 (herbaceous - forb), H3 (herbaceous - fern), H4 (tree seedlings) N (nonvascular other than ferns), V (vine/liana), or F (epiphyte).

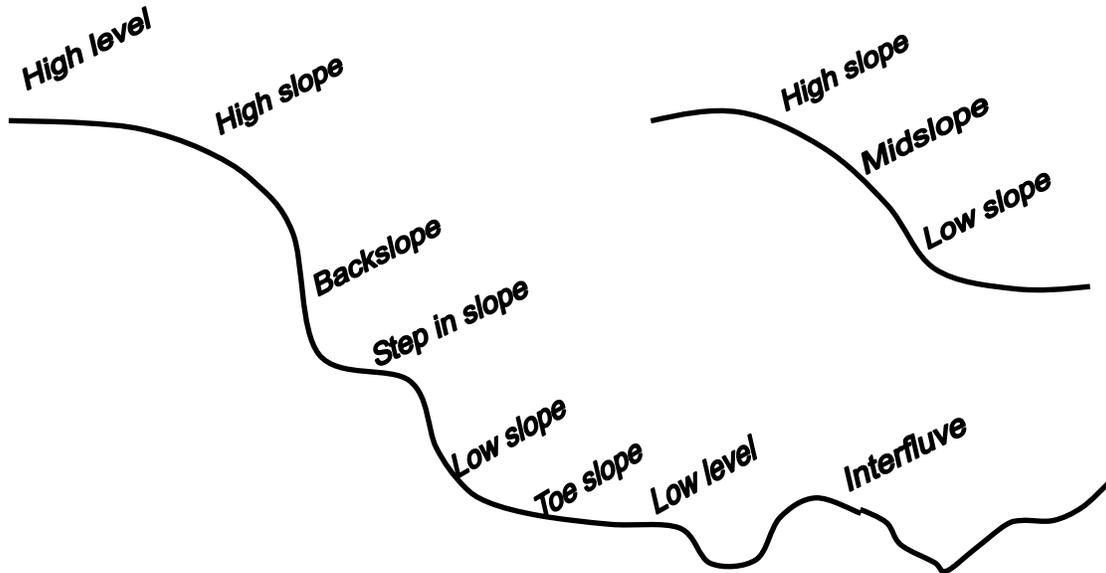
*For plots with trees, estimate cover of seedlings, saplings, mature (all others), and total cover for each tree species. Use a separate line for each and assign the most appropriate strata class (by height). Seedlings are generally less than 1.5 m, but that may vary by species.

Also record the DBH (in cm) of all trees above 5 cm diameter. Separate the measurements with a comma. For plots with very high tree density DBH measurements will be done in a subplot. If the number of trees with a DBH greater than 5 cm is more than about 25, divide the plot into quarters and measure the DBH of trees in the southeast quadrant, or the quadrant nearest southeast. CLEARLY NOTE on the form that this is what you've done.

GOLDEN SPIKE NATIONAL HISTORIC SITE – CHEAT SHEET

LANDFORMS		TOPOGRAPHIC POSITION	SURFICIAL GEOLOGY
alluvial fan	gravel pit	SEE THE ATTACHED DIAGRAM	Obscured by soil
alluvial flat	gulch		Recent alluvium
alluvial plain	gully		Quaternary alluvium
remnant	hill	VEGETATIVE STRATA	Lake Bonneville sediments
alluvial terrace	hillslope	T1 = emergent tree	Wave-cut Bonneville terrace
alluvium	interdune	T2 = tree canopy	Oquirrh Formation
artificial levee	interfluv	T3 = tree sub-canopy	Colluvium / Talus / Landslides
backslope	intermittent stream	S1 = tall shrub > 2m	
bajada	knob	S2 = short shrub < 2m	
ballena	knoll	S3 = dwarf shrub < 0.5m	
basin	ledge	H = herbaceous	DISTURBANCE
basin floor	levee	H4 = Tree seedlings	Water gullies
bench	mesa	N = nonvascular other than ferns	Mass wasting
blowout	natural levee		Spruce budworm damage
bluff	overflow channel		Flash flooding
borrow pit	pediment		Grazing evidence
bottomland	plain	PHYSIOGNOMIC CLASS	Development, historic structures
braided stream	plateau	Forest: Crowns touching	Recreation
break	playa	Woodland: Trees>10%, crowns not touching	Wildlife concentration
butte	pool	Shrubland: Shrubs> grass, forbs or trees	Fire
canyon	quarry	Dwarf Shrubland: Shrubland <0.5 m tall	
channel	ravine	Shrub Herbaceous: Shrubs = Forbs/grasses	
cliff	ridge	Herbaceous: Grass/forbs > trees or shrubs	
closed depression	rise	Wooded Herbaceous: Trees= grass/forbs	
colluvium	rim	Sparsely Vegetated: Total veg<5-7%	
crest	rockfall		
cuesta	saddle	ASPECT	GPS SETTINGS
deflation basin	sand ramp	Flat	NAD1983
depression	sand sheet	Azimuth (deg.)	WAAS on
desert pavement	scarp	Variable	
dip	shoulder		
ditch	slope		
divide	slope alluvium		
drainageway	slope wash		
draw	stream terrace		
dune	summit		
eolian deposit	swale		
eolian sands	talus slope		
ephemeral stream	tank		
escarpment	terrace		
finger ridge	toeslope		
flat	valley		
flood plain	valley floor		
foothills	valley side		
gorge	wash		

TOPOGRAPHIC POSITION - CHEAT SHEET



CONSIDERATIONS FOR PLANNING

Planning for the day:

1. Safety and sustenance: Plenty of food, water, first-aid kit, raingear, sunscreen.
2. Field communications:
 - a. Develop a plan with other team(s) for radio check-in time.
 - b. Do you have a radio and are batteries charged? If you have a walkie-talkie, do you have extra batteries for it? Does park staff know the area in which you will be working?
3. Make sure you have the right maps and photos.
4. Check your GPS (Datum set to NAD83? WAAS on? Needs new batteries?).
5. Plan the day's mission before departing using a) USGS quads, b) aerial photos, c) BLM maps.
6. Considerations for mission planning:
 - a. Plan travel based on topography, best access routes, density and complexity of vegetation
 - b. Communicate with the other team member(s) to make sure you aren't duplicating effort.

Planning for the Week (do this on the first day of the trip)

1. Do you have all appropriate maps, photos?
2. Develop a reasonable estimate of the number of points for each team broken up by day and based on an estimate of individual team's travel logistics for the week.
3. Develop plan of attack for the week to capture all AA points in the work area.
4. Balance points two and three above with the expected work schedule of the teams and ensure adequate time-off and reduce over-time concerns.
5. Do you have all necessary information and backups for the week's planning? E.g., blank field forms, film, plenty of batteries.

Wrap-up (Do this on the last day of the trip, after you have returned to base)

1. Clean, recharge and repair equipment.
2. Hold brief meeting to discuss data collection issues, things that came up during the work week, and plan for next work hitch.
3. Edit field forms and file them systematically. File observation points separately.
4. Re-file the aerial photos and maps.
5. Send exposed rolls of film to be developed.
6. Key unknown plants.
7. Enter edited data into database.

Communicate among teams / Topics for wrap-up meetings.

1. What were your questions about the polygons visited during the week?
2. Do you have any questions about the forms or fields?
3. What was accomplished, what was not accomplished?
4. Pass on developments and questions after every trip. Don't let them build up. For example, should we sample the new types we saw? Were there problems with interpreting the aerial photos, or are there personnel issues, problems in consistency in interpreting the forms, or with park-related logistics?

Materials Checklist

- Monument research permit
- Topo maps
- Monument and BLM maps for general navigation
- DOQQ photos of AA point locations
- Geology map
- Compass with adjustable declination
- Clinometer
- GPS receiver
- Extra AA batteries for walkie-talkie
- Radio or walkie-talkie and/or cell phone
- 35 mm camera & slide film (allow at least 2 exposures per point)
- Baggies for temporary storage of unknown plants, and masking tape for labeling
- Plant press & paper
- Plant Keys / Flora(s)
- Pencils / sharpies
- Forms: plot and observation point
- Clipboard/forms holder
- Pens, pencils, pencil lead, slate board, chalk, and chalkboard eraser or supply of clean rags
- Key to the plant associations of the park
- All ancillary information (cheat sheet, species list, floras, sampling priority list for zone, main sampling protocol).
- First aid kit, personal gear (food, water, rain gear, etc.)

APPENDIX A: Landform Glossary

(from <http://soils.usda.gov/technical/handbook/contents/part629.html#00>)

alluvial fan - A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes, shaped like an open fan or a segment of a cone, deposited by a stream (best expressed in semiarid regions) at the place where it issues from a narrow mountain or upland valley; or where a tributary stream is near or at its junction with the main stream. It is steepest near its apex which points upstream and slopes gently and convexly outward (downstream) with a gradual decrease in gradient.

alluvial flat (a) (colloquial: western US) A nearly level, graded, alluvial surface in bolsons and semi-bolsons which commonly does not manifest traceable channels, terraces or floodplain levels. (b) (**not preferred**) A general term for a small flood plain bordering a river, on which alluvium is deposited during floods.

alluvial terrace - (not preferred) refer to stream terrace.

alluvium - Unconsolidated, clastic material subaerially deposited by running water, including gravel, sand, silt, clay, and various mixtures of these.

arroyo - (colloquial: southwest A.) The channel of a flat-floored, ephemeral stream, commonly with very steep to vertical banks cut in unconsolidated material; sometimes called a wash. It is usually dry but can be transformed into a temporary watercourse or short-lived torrent after heavy rain within the watershed. Where arroyos intersect zones of ground-water discharge, they are more properly classed as intermittent stream channels.

backslope - The hillslope profile position that forms the steepest and generally linear, middle portion of the slope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below. They may or may not include cliff segments (i.e. free faces). Backslopes are commonly erosional forms produced by mass movement, colluvial action, and running water.

basin - (a) Drainage basin; (b) A low area in the Earth's crust, of tectonic origin, in which sediments have accumulated. (c) (colloquial: western US) A general term for the nearly level to gently sloping, bottom surface of an intermontane basin (bolson). Landforms include playas, broad alluvial flats containing ephemeral drainageways, and relict alluvial and lacustrine surfaces that rarely, if ever, are subject to flooding. Where through-drainage systems are well developed, flood plains are dominant and lake plains are absent or of limited extent. Basin floors grade mountainward to distal parts of piedmont slopes.

bench - (not preferred) refer to structural bench.

bluff - (a) A high bank or bold headland, with a broad, precipitous, sometimes rounded cliff face overlooking a plain or body of water, especially on the outside of a stream meander; ex. a river bluff. (b) (not preferred) use cliff. Any cliff with a steep, broad face.

borrow pit - An excavated area from which earthy material has been removed typically for construction purposes offsite; also called barrow pit.

bottomland - (not recommended) use flood plain. An obsolete, informal term loosely applied to a flood plain.

break - An abrupt change or inflection in a slope or profile, or a marked variation of topography, or a tract of land distinct from adjacent land, or an irregular or rough piece of ground.

breaks - (colloquial: western US) A landscape or large tract of steep, rough or broken land dissected by ravines and gullies and marks a sudden change in topography as from an elevated plain to lower hilly terrain, or a line of irregular cliffs at the edge of a mesa or a river (e.g., the Missouri River breaks).

butte - An isolated, generally flat-topped hill or mountain with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments, commonly topped by a caprock of resistant material and representing an erosion remnant carved from flat-lying rocks.

channel - (a) The hollow bed where a natural body of surface water flows or may flow. The deepest or central part of the bed of a stream, containing the main current and occupied more or less continuously by water. (b) (colloquial: western US.) The bed of a single or braided watercourse that commonly is barren of vegetation and is formed of modern alluvium. Channels may be enclosed by banks or splayed across and slightly mounded above a fan surface and include bars and mounds of cobbles and stones. (c) Small, trough-like, arcuate or sinuous channels separated by

small bars or ridges, caused by fluvial processes; common to flood plains and young alluvial terraces; a constituent part of *bar and channel* topography.

colluvium - Unconsolidated, unsorted material being transported or deposited on sideslopes and/or at the base of slopes by mass movement (e.g. direct gravitational action) and by local, unconcentrated runoff.

deflation basin - A topographic basin excavated and maintained by wind erosion which removes unconsolidated material and commonly leaves a rim of resistant material surrounding the depression. Unlike a blowout, a deflation basin does not include adjacent deposits derived from the basin.

depression - Any relatively sunken part of the Earth's surface; especially a low-lying area surrounded by higher ground. A closed depression has no natural outlet for surface drainage (e.g. a sinkhole). An open depression has a natural outlet for surface drainage.

desert pavement - A natural, residual concentration or layer of wind-polished, closely packed gravel, boulders, and other rock fragments, mantling a desert surface. It is formed where wind action and sheetwash have removed all smaller particles or where coarse fragments have migrated to the surface. It usually protects the underlying, finer-grained material from further deflation. The coarse fragments commonly are cemented by mineral matter.

ditch - An open and usually unpaved (unlined), channel or trench excavated to convey water for drainage (removal) or irrigation (addition) to or from a landscape; smaller than a canal; some ditches are modified natural waterways.

drainageway - (a) A general term for a course or channel along which water moves in draining an area. (b) a term restricted to relatively small, roughly linear or arcuate depressions that move concentrated water at some time, and either lack a defined channel (e.g. head slope, swale) or have a small, defined channel (e.g. low order streams).

draw - A small, natural watercourse cut in unconsolidated materials, generally more open with a broader floor and more gently sloping sides than an arroyo, ravine or gulch, and whose present stream channel may appear inadequate to have cut the drainageway that it occupies.

eolian deposit - Sand, silt or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess. Conventionally, primary volcanic deposits (e.g. tephra) are handled separately.

ephemeral stream - Generally a small stream, or upper reach of a stream, that flows only in direct response to precipitation. It receives no protracted water supply from melting snow or other sources and its channel is above the water table at all times.

eroded fan remnant - All, or a portion of an alluvial fan that is much more extensively eroded and dissected than a fan remnant; sometimes called an *erosional fan remnant*. It consists primarily of a) eroded and highly dissected sides (*eroded fan-remnant sideslopes*) dominated by hillslope positions (shoulder, backslope, etc.), and b) to a lesser extent an intact, relatively planar, relict alluvial fan "summit" area best described as a tread.

escarpment - A continuous, steep slope or cliff produced by erosion or faulting and that topographically interrupts or breaks the general continuity of more gently sloping land surfaces. The term is most commonly applied to cliffs produced by differential erosion. Synonym = scarp.

flat - (a) (adjective) Said of an area characterized by a continuous surface or stretch of land that is smooth, even, or horizontal, or nearly so, and that lacks any significant curvature, slope, elevations, or depressions. (b) (noun) An informal, generic term for a level or nearly level surface or small area of land marked by little or no local relief.

flood plain - The nearly level plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is usually a constructional landform built of sediment deposited during overflow and lateral migration of the streams.

gulch - (colloquial: western US.; not preferred - refer to ravine) A small stream channel, narrow and steep-sided in cross section, and larger than a gully, cut in unconsolidated materials. General synonym - ravine.

gully - A small channel with steep sides caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water usually during and immediately following heavy rains or ice / snow melt. A gully generally is an obstacle to wheeled vehicles and too deep (e.g., > 0.5 m) to be obliterated by ordinary tillage; (a rill is of lesser depth and can be smoothed over by ordinary tillage).

hill - A generic term for an elevated area of the land surface, rising at least 30 m (100 ft.) to as much as 300 meters (approx. 1000 ft.) above surrounding lowlands, usually with a nominal summit area relative to bounding slopes, a

well-defined, rounded outline and slopes that generally exceed 15 percent. A hill can occur as a single, isolated mass or in a group. A hill can be further specified based on the magnitude of local relief: *low hill* (30 - 90 m) or *high hill* (90 - 300 m). Informal distinctions between a hill and a mountain are often dependent on local convention.

hillslope - A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of the hill.

intermittent stream - A stream, or reach of a stream, that does not flow year-round (commonly dry for 3 or more months out of 12) and whose channel is generally below the local water table; it flows only when it receives a) base flow (i.e. solely during wet periods), or b) ground-water discharge or protracted contributions from melting snow or other erratic surface and shallow subsurface sources.

landslide - A general, encompassing term for most types of mass movement landforms and processes involving the

mesa - A broad, nearly flat-topped, and usually isolated landmass bounded by steep slopes or precipitous cliff and capped by layers of resistant, nearly horizontal, rocky summit width greater than the height of bounding escarpments. (Colloquial: western US; not preferred) Also used to designate broad structural benches and alluvial terraces that occupy intermediate levels in stepped sequences of platforms bordering canyons and valleys.

overflow channel - A watercourse that is generally dry but conducts flood waters that have overflowed the banks of a river, commonly from large storms or annual meltwater.

plain - A general term referring to any flat, lowland area, large or small, at a low elevation. Specifically, any extensive region of comparatively smooth and level gently undulating land. A plain has few or no prominent hills or valleys but sometimes has considerable slope, and usually occurs at low elevation relative to surrounding areas. Where dissected, remnants of a plain can form the local uplands. A plain may be forested or bare of trees and may be formed by deposition or erosion.

plateau - A comparatively flat area of great extent and elevation; specifically an extensive land region considerably elevated (more than 100 meters) above adjacent lower-lying terrain, and is commonly limited on at least one side by an abrupt descent, has a flat or nearly level surface. A large part of a plateau surface is near summit level.

pool - A small, natural body of standing water, usually fresh; e.g. a stagnant body of water in a marsh, or a transient puddle in a depression following a rain.

ravine - A small stream channel; narrow, steep-sided, commonly V-shaped in cross section and larger than a gully, cut in unconsolidated materials. General synonym (not preferred) - gulch.

rim - The border, margin, edge, or face of a landform, such as the curved brim surrounding the top part of a crater or caldera; specifically the rimrock of a plateau or canyon.

rockfall - The process, associated sediments (rockfall deposit) or resultant landform characterized by a very rapid type of *fall* dominated by downslope movement of detached rock bodies which fall freely through the air or by leaps and bounds (lacks an underlying slip face); also spelled rock fall.

saddle - A low point on a ridge or interfluvium, generally a divide (pass, col) between the heads of streams flowing in opposite directions.

sand sheet - (a) A sand-covered plain which may originate by deflation of sand dunes, and whose lower limit of erosion is governed by the ground-water level. Also spelled *sandplain*. (b) (not preferred - refer to *sandy* outwash plain) A small outwash plain composed chiefly of sand deposited by meltwater streams flowing from a glacier.

scarp - An escarpment, cliff, or steep slope of some extent along the margin of a plateau, mesa, terrace, or structural bench. A scarp may be of any height.

shoulder - The hillslope profile position that forms the convex, erosional surface near the top of a hillslope. If present, it comprises the transition zone from summit to backslope.

slope - (also called slope gradient or gradient) The inclination of the land surface from the horizontal. Percent slope is the vertical distance divided by the horizontal distance, then multiplied by 100.

slope alluvium - Sediment gradually transported down mountain or hill slopes primarily by non-channel alluvial processes (i.e., slope wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of coarse

fragments and may be separated by stone lines. Sorting of pebbles or cobbles and burnished peds distinguish these materials from unsorted colluvial deposits.

slope wash - A collective term for non-fluvial, incipient alluvial *processes* (e.g. overland flow, minor rills) that detach, transport, and deposit sediments down hill and mountain slopes. Related sediments (*slope alluvium*) exhibit nominal sorting or rounding of particles, peds, etc., and lateral sorting downslope on long slopes; stratification is crude and intermittent and readily destroyed by pedoturbation and frost action. Also called *slope wash processes*.

stream terrace - One or a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream, and representing the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition (i.e., currently very rarely or never floods; inactive cut and fill and/or scour and fill processes). Erosional surfaces cut into bedrock and thinly mantled with stream deposits (alluvium) are called "strath terraces." Remnants of constructional valley floors thickly mantled with alluvium are called alluvial terraces.

swale - (a) A shallow, open depression in unconsolidated materials which lacks a defined channel but can funnel overland or subsurface flow into a drainageway. Soils in swales tend to be more moist and thicker (cummulic) compared to surrounding soils. (b) A small, shallow, typically closed depression in an undulating ground moraine formed by uneven glacial deposition. (c) (not preferred; refer to interdune) A long, narrow, generally shallow, trough-like depression between two beach ridges, and aligned roughly parallel to the coastline.

talus - Rock fragments of any size or shape (usually coarse and angular) derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of loose broken rock formed chiefly by falling, rolling, or sliding.

tank - (colloquial: southwestern US) A natural depression or cavity in impervious rocks in which water collects and remains for the greater part of the year.

terrace - A step-like surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, or lake or sea shore. The term is usually applied to both the relatively flat summit surface (tread), cut or built by stream or wave action, and the steeper slope (scarp, riser), descending to a lower base level. Practically, terraces

toeslope - The hillslope position that forms the gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear, and are constructional surfaces forming the lower part of a hill-slope continuum that grades to valley or closed-depression floors.

valley - An elongate, relatively large, externally drained depression of the Earth's surface that is primarily developed by stream erosion or glacial activity.

valley floor - A general term for the nearly level to gently sloping, lowest surface of a valley. Landforms include axial stream channels, the flood plain, flood-plain steps, and, in some areas, low terrace surfaces.

valley side - The sloping to very steep surfaces between the valley floor and summits of adjacent uplands. Well-defined, steep valley sides have been termed valley walls (not recommended). Note: Scale, relief, and perspective may require use of closely related terms such as hill slope or mountain slope.

wash (dry wash) - (colloquial: western US.) The broad, flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium. Note: When channels reach intersect zones of ground-water discharge they are more properly classed as "intermittent stream" channels. Synonym - arroyo.

B.2. Example of a Vegetation Plot Data Form

NATIONAL PARK VEGETATION MAPPING PROGRAM: PLOT SURVEY FORM
IDENTIFIERS/LOCATORS

Plot Code (Please Circle One) <u>GOSP-DISP-TICA</u> <u>B-10</u> <u>210</u>	
Provisional Community Name <u>ELYSPI - POASEC</u>	
State <u>UT</u> Park Name (Circle One) <u>Golden Spike</u> Pipe Spring, Timpanogos Park Site Name <u>CENTRAL</u>	Quad Code _____ Aerial Photo # _____
GPS file name _____ DATUM _____	Field UTM X <u>374462</u> m E UTM Zone: 12
Comments/GPS device used: _____	Field UTM Y <u>4608862</u> m N Error +/- _____ m 3D Differential? Y / N
Survey Date <u>7 2 07</u> Surveyors <u>CONDIS</u>	
Directions to Plot <u>THE PLOT IS ON THE NE SIDE OF THE LOWEST LAKE BENCH IN THE SW CORNER OF THE PARK</u>	
Plot Permanent: <u>NO</u>	
Plot length(m) _____ Azimuth _____ Plot width(m) _____ Diameter if circle _____	Plot Photos (y/n) _____ Roll # <u>BC 10</u> Frame # <u>10</u> Digital camera frame # _____
Photo Comments: _____	Cryptogamic Soils Photos (y/n) _____ Roll # _____ Frame # _____ Digital camera frame # _____
Plot representativeness (discuss plot placement and explain non-representativeness)	
a. Representativeness of association compared with occurrences outside park (if known):	
b. Representativeness of plot in stand: <u>THIS PLOT REPRESENTS THE COMMUNITY FOUND ON THE COOLER SLOPES IN THIS AREA. AS THE SLOPES FLATTEN, THE WEEDS CREEP IN.</u>	

ENVIRONMENTAL DESCRIPTION

Elevation: <u>1451</u> ft/m(circle one)	Slope: <u>17</u> deg.	Aspect: <u>27</u> deg.
Topographic Position (see cheat sheet) <u>MID SLOPE</u>		
Landform (see cheat sheet) <u>BENCH SIDE</u>		
Surficial Geology (see cheat sheet/map)		

<input checked="" type="checkbox"/> Upland <input type="checkbox"/> Riverine	Cowardin System <input type="checkbox"/> Palustrine <input type="checkbox"/> Lacustrine	Hydrology <input type="checkbox"/> Permanently Flooded <input type="checkbox"/> Semipermanently Flooded	<input type="checkbox"/> Unknown <input type="checkbox"/> Seasonally Flooded <input type="checkbox"/> Saturated <input type="checkbox"/> Temporarily Flooded <input type="checkbox"/> Intermittently Flooded
---	---	---	--

Environmental Comments (factors controlling community/plant distribution, seral stage, fire history etc): <u>THIS PLOT IS ON THE SIDE OF ONE OF THE ANCIENT LAKE BENCHES. THE SOIL IS QUITE GRAVELLY. A FEW CHARRED SHRUB PARTS ARE EVIDENCE OF AN ALL-CONSUMING FIRE SOME YEARS AGO.</u>	Ground Cover: (please estimate to the nearest percentage. Sum = 100%) <table style="width:100%;"> <tr> <td><u>10</u> Bare soil</td> <td><input type="checkbox"/> Large rocks (>10 cm)</td> </tr> <tr> <td><input type="checkbox"/> Bedrock</td> <td><input type="checkbox"/> Lichen</td> </tr> <tr> <td><input type="checkbox"/> Sand (0.1-2 mm) dune/alluvium</td> <td><input type="checkbox"/> Wood (>1 cm)</td> </tr> <tr> <td><input type="checkbox"/> Moss</td> <td><u>40</u> Small rocks (0.2-10 cm)</td> </tr> <tr> <td><input type="checkbox"/> Other (describe):</td> <td><input type="checkbox"/> Water</td> </tr> <tr> <td><u>50</u> Litter / duff</td> <td><input type="checkbox"/> Cryptogam</td> </tr> </table>	<u>10</u> Bare soil	<input type="checkbox"/> Large rocks (>10 cm)	<input type="checkbox"/> Bedrock	<input type="checkbox"/> Lichen	<input type="checkbox"/> Sand (0.1-2 mm) dune/alluvium	<input type="checkbox"/> Wood (>1 cm)	<input type="checkbox"/> Moss	<u>40</u> Small rocks (0.2-10 cm)	<input type="checkbox"/> Other (describe):	<input type="checkbox"/> Water	<u>50</u> Litter / duff	<input type="checkbox"/> Cryptogam
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<input type="checkbox"/> Other (describe):	<input type="checkbox"/> Water												
<u>50</u> Litter / duff	<input type="checkbox"/> Cryptogam												
Soil Texture (see cheat sheet): <input type="checkbox"/> sand <input type="checkbox"/> loamy sand <input type="checkbox"/> sandy loam <input type="checkbox"/> loam <input type="checkbox"/> silt loam <input type="checkbox"/> silt <input checked="" type="checkbox"/> clay loam <input type="checkbox"/> silty clay <input type="checkbox"/> sandy clay <input type="checkbox"/> clay <input type="checkbox"/> peat <input type="checkbox"/> muck	Soil Drainage: <input checked="" type="checkbox"/> Rapidly drained <input type="checkbox"/> Well drained <input type="checkbox"/> Moderately well drained <input type="checkbox"/> Somewhat poorly drained <input type="checkbox"/> Poorly drained <input type="checkbox"/> Very poorly drained												

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic Class	Height Scale for Strata	Cover Scale for Strata
<u>Trees and Shrubs</u>	<input type="checkbox"/> Broad-leaved	<input type="checkbox"/> Forest	01 <0.5 m	T 0-1%
<input type="checkbox"/> Evergreen	<input type="checkbox"/> Needle-leaved	<input type="checkbox"/> Woodland	02 0.5-1m	P >1-5%
<input type="checkbox"/> Cold-deciduous	<input type="checkbox"/> Microphyllous	<input type="checkbox"/> Shrubland	03 1-2 m	1 >5-15%
<input type="checkbox"/> Mixed evergreen-cold-deciduous	<input checked="" type="checkbox"/> Graminoid	<input type="checkbox"/> Dwarf Shrubland	04 2-5 m	2 >15-25%
	<input type="checkbox"/> Forb	<input type="checkbox"/> Shrub Herbaceous	05 5-10 m	3 >25-35%
	<input type="checkbox"/> Pteridophyte	<input checked="" type="checkbox"/> Herbaceous	06 10-15 m	4 >35-45%
<u>Herbs</u>	<input type="checkbox"/> Non-vascular	<input type="checkbox"/> Nonvascular	07 15-20 m	5 >45-55%
<input type="checkbox"/> Annual	<input type="checkbox"/> Mixed (describe)	<input type="checkbox"/> Sparsely Vegetated	08 20-35 m	6 >55-65%
<input checked="" type="checkbox"/> Perennial			09 35 - 50 m	7 >65-75%
			10 >50 m	8 >75-85%
				9 >85-95%
				10 >95%

	Height Class	Cover Class	Dominant Species (mark Diagnostic species with *)
T1 Emergent	_____	_____	_____
T2 Canopy	_____	_____	_____
T3 Sub-canopy	_____	_____	_____
S1 Tall shrub	_____	_____	_____
S2 Short Shrub	_____	_____	_____
S3 Dwarf-shrub	_____	_____	_____
Ht Herbaceous	_____	_____	_____
H1 Graminoids	01	3	ELYSPI, POA FEN
H2 Forbs	_____	_____	_____
H3 Ferns	_____	_____	_____
H4 Tree seedlings	_____	_____	_____
N Non-vascular	_____	_____	_____
V Vine/liana	_____	_____	_____
E Epiphyte	_____	_____	_____

Animal Use Evidence (including scat, browse, burrows, bedding sites, etc)
I SAW A DEER RUN BY AND FLUSHED A COUPLE OF CHUKKARS.

Natural and Anthropogenic Disturbance Comments (see cheat sheet for examples; describe intensity and effect on the vegetation, also whether disturbance is current, chronic, episodic or historic)
THE FIRE THAT CAME THROUGH REMOVED ALL THE SHRUBS AND APPARENTLY MADE FERTILE GROUND FOR THE NATIVE GRASSES. I DON'T KNOW WHEN THIS HAPPENED.

Other Comments/Continuation from previous sections. Describe surrounding communities and how they relate to the plot.
ABOVE, TO THE SOUTH, THERE'S MORE BROTEC MIXED IN WITH THE NATIVES, TO THE NORTH ON THE FLATS BELOW IT'S MOSTLY BROTEC WITH SOME GUTSAR AND A FEW SCATTERED CHUKKAR. THE SHORT PLANT LIST IS COMPLETE.

Plot Code (Please Circle One):

GOSP PISP-TICA . B-10

Species/percent cover: Starting with the uppermost stratum, list all species with % cover for each species in the stratum. For each tree species estimate seedling, sapling, and total cover indicating stratum. List species outside the plot at the end of the table and designate with a 0 in Cover Class column.

Stratum	Species Name	Original		Species Name	Cover Class	Stratum	Species Name	Cover Class	TOTALS
		Class	Stratum						
H1	ELY SPI	20							
	POA SEC	10							T1 =
	BRO TEC	T							T2 =
	BR2 BRIZIFORMIS	T							T3 =
									S1 =
									S2 =
									S3 =
									H1 =
									H2 =
									H3 =
									H4 =
									N =
									V =
									E =

Cover Class Scale:
 T = >0-1%
 P = >1-5%
 1 = >5-15%
 2 = >15-25%
 3 = >25-35%
 4 = >35-45%
 5 = >45-55%
 6 = >55-65%
 7 = >65-75%
 8 = >75-85%
 9 = >85-95%
 10 = >95%

Strata:
 T1 = Emergent
 T2 = Canopy
 T3 = Subcanopy
 S1 = Tall Shrub
 S2 = Short Shrub
 S3 = Dwarf Shrub
 H1 = Graminoid
 H2 = Forb
 H3 = Fern
 H4 = Tree seedling
 N = Nonvascular
 V = Vine/liana
 E = Epiphyte

B.3. Example of an Observation Point Data Form

NATIONAL PARK VEGETATION MAPPING PROGRAM: OBSERVATION POINT FORM

IDENTIFIERS/LOCATORS

Plot Code (Please Circle One): GOSP PISP TICA P6 9104

Provisional Community Name: ARSDRI(TPJ)/BRODEC

State: UT Park Name (Please Circle One): Golden Spike Pipe Spring, Timpanogos Park Site Name: West Gordo Auto Tour

Quad Name: _____ Quad Code: _____

GPS File Name: P6 Field UTM X: 367920 mE Field UTM Y: 4605075 mN
Please do not complete the following information when in the field: _____ +1.4 m

Corrected UTM X: _____ mE Corrected UTM Y: _____ mN Zone: _____

Observers: Williams Date: 6-30-07 Photos: PWS Fr. 7 → SW

ENVIRONMENTAL DESCRIPTION

Elevation: _____ Slope: 2 deg. Aspect: 130 deg.

Topographic Position: toeslope

Landform: valley floor Geology: residuum

<p>Cowardin Wetland Classification System</p> <p><input checked="" type="checkbox"/> Upland</p> <p><input type="checkbox"/> Estuarine</p> <p><input type="checkbox"/> Riverine</p> <p><input type="checkbox"/> Palustrine</p> <p><input type="checkbox"/> Lacustrine</p>	<p>Hydrologic Regime - Non Tidal</p> <p><input type="checkbox"/> Permanently Flooded</p> <p><input type="checkbox"/> Semi-permanently Flooded</p> <p><input type="checkbox"/> Seasonally/Temporarily Flooded</p> <p><input type="checkbox"/> Saturated</p> <p><input type="checkbox"/> Seasonally Flooded/Saturated</p> <p><input type="checkbox"/> Intermittently Flooded</p>
--	--

<p>Environmental Comments:</p> <p>High rock content of surface reduces the ARSDRI cover a bit from some sections of this very long, skinny polygon. Occasional patches of SISACT also occur, but polygon is pretty homogeneous in this section.</p>	<p>Unvegetated Surface (please use cover scale below)</p> <p><input checked="" type="checkbox"/> Bedrock</p> <p><input checked="" type="checkbox"/> Rocks > 10 cm</p> <p><input checked="" type="checkbox"/> Rocks 0.2-10 cm</p> <p><input checked="" type="checkbox"/> Sand</p> <p><input checked="" type="checkbox"/> Other (describe) <u>WCS</u></p> <p><input checked="" type="checkbox"/> Bare Soil</p> <p><input checked="" type="checkbox"/> Litter/Duff</p> <p><input checked="" type="checkbox"/> Wood</p>
---	--

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic Class	Cover Scale for Strata and Unvegetated Surface
<p>Trees and Shrubs</p> <p><input checked="" type="checkbox"/> Evergreen</p> <p><input type="checkbox"/> Cold-deciduous</p> <p><input type="checkbox"/> Drought-deciduous</p> <p><input type="checkbox"/> Mixed evergreen/cold-deciduous</p> <p>Herbs</p> <p><input type="checkbox"/> Annual</p> <p><input type="checkbox"/> Perennial</p>	<p><input checked="" type="checkbox"/> Broad-leaved</p> <p><input type="checkbox"/> Needle-leaved</p> <p><input type="checkbox"/> Microphyllous</p> <p><input type="checkbox"/> Graminoid</p> <p><input type="checkbox"/> Forb</p> <p><input type="checkbox"/> Pteridophyte</p> <p><input type="checkbox"/> Mixed (describe)</p>	<p><input type="checkbox"/> Forest</p> <p><input type="checkbox"/> Woodland</p> <p><input checked="" type="checkbox"/> Shrubland</p> <p><input type="checkbox"/> Dwarf shrubland</p> <p><input type="checkbox"/> Shrub Herbaceous</p> <p><input type="checkbox"/> Herbaceous</p> <p><input type="checkbox"/> Nonvascular</p> <p><input type="checkbox"/> Sparsely vegetated</p>	<p>01 = 0 - 10%</p> <p>02 = 10 - 25%</p> <p>03 = 25 - 60%</p> <p>04 = 60 - 100%</p>

NATIONAL PARK VEGETATION MAPPING PROGRAM: OBSERVATION POINT FORM

Stratum	Height	Cover Class	Dominant species (mark diagnostic spp with a *)	% cover
T1: Emergent	---	---	_____	---
			_____	---
			_____	---
T2: Canopy	---	---	_____	---
			_____	---
			_____	---
T3: Sub-canopy	---	---	_____	---
			_____	---
			_____	---
S1: Tall shrub	---	---	_____	---
			_____	---
			_____	---
S2: Short shrub	02	03	<i>Artemisia tridentata</i> <i>tridentata</i> or (<i>tridentata</i>)	30
			_____	---
			_____	---
H: Herbaceous	01	02	<i>Bromus tectorum</i> <i>Sisymbrium officinalis</i>	12 T
			_____	---
			_____	---
N: Non-vascular	---	---	_____	---
			_____	---
V: Vine/liana	---	---	_____	---
			_____	---
E: Epiphyte	---	---	_____	---
Height Scale for strata:			Cover scale for strata and Unvegetated Surface:	
01 = <0.5 m	06 = 10-15m			
02 = 0.5-1m	07 = 15-20m	01 = 0 - 10%		
03 = 1-2m	08 = 20-35m	02 = 10 - 25%		
04 = 2-5m	09 = 35-50m	03 = 25 - 60%		
05 = 5-10m	10 = >50m	04 = 60 - 100%		

Appendix C. Database Documentation

C.1. Plots Database Documentation

Background

This database, designed for data resulting from fieldwork related to vegetation mapping projects, was developed by the Northern Colorado Plateau Network (NCPN). The Plots Database System, developed by The Nature Conservancy, was the starting point for this database. From this starting point, NCPN normalized the data structure, added fields and lookup tables, and developed an extensive user interface. Similar versions of this database, subsequently referred to as the GOSP VegMapDB, have been used for all vegetation mapping projects conducted by NCPN. GOSP VegMapDB contains plot, observation point, and accuracy assessment data collected during project field work.

Two database files are required to use GOSP VegMapDB:

- *GOSP_PlotsAA_XP.mdb*. This “frontend” file contains all queries, forms, reports, associated modules and Visual Basic code.
- *GOSP_PlotsAA_XP_be.mdb*. This “backend” file contains the database tables.

The frontend/backend file structure allows multiple users to enter data in a network environment, and allows for easy backup and transfer of the data tables. Users typically launch the frontend file, and a utility will prompt them to establish a link to the back-end file. The contents of the backend file, however, can be used independently of the frontend.

Entity Relationship Diagram

The primary tables and relationships from the backend file (*GOSP_PlotsAA_XP_be.mdb*) are illustrated below. The database follows the design structure of the National Park Service Natural Resource Database Template, which is based on a location record, one or more related event records, and observation data elements linked to each event.

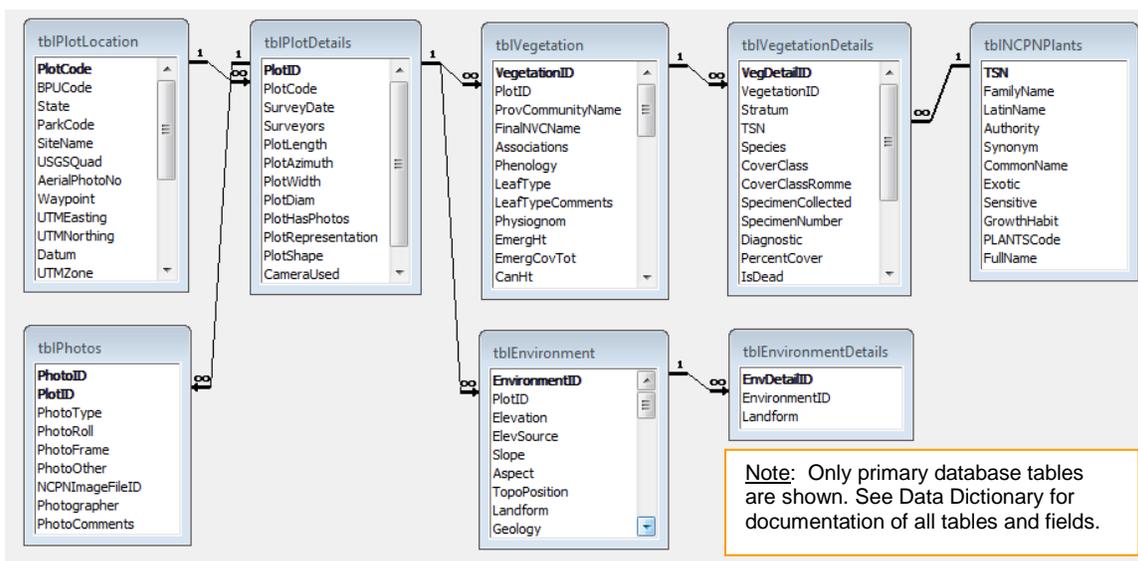


Figure 1. Entity Relationship Diagram for GOSP VegMapDB

Data Dictionary

The database consists of two types of tables: plot data tables and lookup tables that provide a standardized list of values to be used for certain data fields. Tables appear in alphabetical order within each of these two categories.

Plot-related tables

Table Name: tblDataMgmtLog

Description: Table containing a log of data set manipulations or database object alterations.

Field Name	Field Description	Field Type	Field Width
ActionDate	The date on which the data set was massaged or manipulated.	dbDate	8
ActionMonth	If ActionDate known to month only, use this field and the ActionYear field.	dbText	50
ActionYear	If ActionDate known to year only, use this field.	dbText	50
Action	What was done with the data set. How was it altered, massaged, manipulated, etc. Include changes to data and changes to database objects or structures.	dbMemo	0
Who	The name of the person who performed the action with the data set.	dbText	50

Table Name: tblEnvironment

Description: Table containing values on environmental features and conditions of plot or observation point

Field Name	Field Description	Field Type	Field Width
EnvironmentID	Unique record identifier	dbLong	4
PlotID	Foreign key; links record to tblPlotDetails	dbLong	4
Elevation	Elevation of plot in meters as estimated from either map or GPS unit	dbLong	4
ElevSource	How elevation was derived in the field (GPS or Quad Map)	dbText	50
Slope	Slope of plot measured in degrees	dbLong	4
Aspect	Aspect of plot	dbText	50
TopoPosition	Topographic position of plot; value selected from tkpTopography	dbText	50
Landform	Landform on which plot is located; value selected from tkpLandform	dbText	50
Geology	Geologic substrate influencing the plant community; value selected from tkpGeology	dbText	75
CowardinSystem	If the plot is in a wetland system, select term that best describes its hydrology; value selected from tkpCowardin	dbText	12
Hydrology	Select value that best describes hydrology of plot from tkpHydrology	dbText	50
EnvironmentalComments	Comments on environmental setting and its effect on the vegetation; also comments on any disturbance or reproduction factors	dbMemo	0
BareSoil	Estimate to the nearest percentage of bare soil ground cover	dbText	3
Bedrock	Estimate to the nearest percentage of bedrock ground cover	dbText	3
Sand	Estimate to the nearest percentage of sand (particle size 0.1-2mm) ground cover	dbText	3

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Field Name	Field Description	Field Type	Field Width
Moss	Estimate to the nearest percentage of moss ground cover	dbText	3
Other	Estimate to the nearest percentage of other type of ground cover	dbText	3
Litter	Estimate to the nearest percentage of litter ground cover	dbText	3
Rocks	Estimate to the nearest percentage of rocks >10cm wide ground cover	dbText	3
Lichen	Estimate to the nearest percentage of lichen ground cover	dbText	3
Wood	Estimate to the nearest percentage of wood >1cm ground cover	dbText	3
Gravel	Estimate to the nearest percentage of rocks <10cm wide ground cover	dbText	3
Water	Estimate to the nearest percentage of water ground cover	dbText	3
Cryptogam	Estimate to the nearest percentage of cryptogam ground cover	dbText	3
SoilTexture	Assessment of average soil texture from sample taken a few inches below the surface; values selected from tlkpSoilTexture	dbText	50
SoilDrainage	Soil drainage class based on actual moisture content and extent period; values selected from tlkpSoilDrainage	dbText	30
AnimalUseComments	Comments on evidence of use by non-domestic animals in plot area	dbMemo	0
DisturbanceComments	Comments on evidence of natural or anthropogenic disturbance in plot area, severity and effects on vegetation	dbMemo	0
OtherComments	Other general comments	dbMemo	0
LandscapeComments	Description of landscape context of plot, including any important landscape features influencing the community	dbMemo	0
SoilTaxonDesc	Field used for either identifying soils keyed, or to describe if large rocks or outcrops are present on the surface	dbText	255
LiveVegLitter	Estimate to the nearest percentage of live veg litter ground cover	dbText	3
LiveVegWood	Estimate to the nearest percentage of live veg wood ground cover	dbText	3
LiveBasalArea	[not used for GOSP]	dbText	4
LichenRocks	Estimate to the nearest percentage of lichen covering rocks	dbText	3
LichenGround	Estimate to the nearest percentage of lichen ground cover (on the soil, associated with cryptogams)	dbText	3
MossPct	Estimate to the nearest percentage of moss ground cover	dbText	3
DarkCyanobacteria	Estimate to the nearest percentage of dark cyanobacteria ground cover	dbText	3
TotalPct	Calculated total percent of ground cover.	dbInteger	2

Table Name: tblEnvironmentDetails

Description: Table containing values on environmental features and conditions of plot or observation point

Field Name	Field Description	Field Type	Field Width
EnvDetailID	Unique record identifier	dbLong	4
EnvironmentID	Foreign key; links to tblEnvironment	dbLong	4
Landform	Landform value corresponding to plot location; values chosen from tlkpLandform	dbText	50

Table Name: tblFinalAssociationNamesPlots

Description: Table containing final Association Names assigned by NatureServe.

Field Name	Field Description	Field Type	Field Width
PlotCode	Identifier assigned to plot by survey crew	dbText	255
Association_Name	Association Name assigned by NatureServe	dbText	255
ELC_Code	Unique ID assigned by NatureServe	dbText	255

Table Name: tblFuels

Description: Table containing details on fuels characteristics of plot [not used for GOSP]

Field Name	Field Description	Field Type	Field Width
FuelsID	[not used for GOSP]	dbLong	4
PlotID	[not used for GOSP]	dbLong	4
PPDFPhotoGuide	[not used for GOSP]	dbText	3
PJPhotoGuide	[not used for GOSP]	dbText	3
SBPhotoGuide	[not used for GOSP]	dbText	3
PJAgeClass	[not used for GOSP]	dbText	15
LitterOrigin	[not used for GOSP]	dbText	3
LitterNorth	[not used for GOSP]	dbText	3
LitterEast	[not used for GOSP]	dbText	3
LitterSouth	[not used for GOSP]	dbText	3
LitterWest	[not used for GOSP]	dbText	3
DuffOrigin	[not used for GOSP]	dbText	3
DuffNorth	[not used for GOSP]	dbText	3
DuffEast	[not used for GOSP]	dbText	3
DuffSouth	[not used for GOSP]	dbText	3
DuffWest	[not used for GOSP]	dbText	3
IsSubplot	[not used for GOSP]	dbBoolean	1

Table Name: tblFuelsDetails

Description: Table containing details on stems, height, crown width, and other attributes of trees within plot [not used for GOSP]

Field Name	Field Description	Field Type	Field Width
FuelsDetailID	[not used for GOSP]	dbLong	4
FuelsID	[not used for GOSP]	dbLong	4
StemCount	[not used for GOSP]	dbInteger	2
StemDiameter	[not used for GOSP]	dbDouble	8
TSN	[not used for GOSP]	dbDouble	8
WoodlandCrownWidth	[not used for GOSP]	dbDouble	8
WoodlandCrownHeight	[not used for GOSP]	dbDouble	8
ForestCrownBaseHeight	[not used for GOSP]	dbDouble	8
ForestCrownHeight	[not used for GOSP]	dbDouble	8
CrownRatio	[not used for GOSP]	dbText	12

Field Name	Field Description	Field Type	Field Width
StructureStage	[not used for GOSP]	dbText	12
Comments	[not used for GOSP]	dbText	255

Table Name: tblGeneralPhotos

Description: Table containing information pertaining to photos not associated with plots [not used for GOSP]

Field Name	Field Description	Field Type	Field Width
GenPhotoID	[not used for GOSP]	dbLong	4
GenPhotoDate	[not used for GOSP]	dbText	50
GenPhotographer	[not used for GOSP]	dbText	75
GenPhotoParkCode	[not used for GOSP]	dbText	4
GenPhotoDesc	[not used for GOSP]	dbText	250
GenPhotoAssocName	[not used for GOSP]	dbText	50
GenPhotoUTME	[not used for GOSP]	dbLong	4
GenPhotoUTMN	[not used for GOSP]	dbLong	4
GenUTMZone	[not used for GOSP]	dbLong	4
GenPhotoRoll10	[not used for GOSP]	dbText	50
GenPhotoFrame	[not used for GOSP]	dbText	10
GenPhotoDigFile	[not used for GOSP]	dbText	50
ImageFileID	[not used for GOSP]	dbText	50
GenPhotoComments	[not used for GOSP]	dbText	250

Table Name: tblGeneralSpecimens

Description: Table used to enter data on specimens collected outside of plots or observation points but within the park

Field Name	Field Description	Field Type	Field Width
GenSpecimenID	Unique record ID	dbLong	4
GenSpecFamily	Family name of species collected	dbText	50
GenSpecLatinName	Latin name of species collected	dbText	120
GenSpecCollector	Name of person collecting specimen	dbText	50
GenSpecCollectNum	Reference of specimen assigned by collector	dbText	50
GenSpecAccNumber	NPS Accession Number of specimen	dbText	15
GenSpecCatNumber	NPS Catalog Number of specimen	dbText	15
GenSpecDate	Date collection made	dbDate	8
GenSpecUTMN	Northing of collection location	dbLong	4
GenSpecUTME	Easting of collection location	dbLong	4
GenSpecCounty	County of collection location	dbText	50
GenSpecElev	Elevation (ft) of collection location	dbLong	4
GenSpecLocality	Description of locality where specimen was collected	dbText	250
GenSpecHabitat	Description of habitat where specimen was collected	dbText	250
GenSpecAssocSpec	Associated species where specimen was collected	dbText	250
GenSpecComments	Comments about specimen	dbText	250

Table Name: tblPhotos

Description: Details on individual photos taken of plot or observation point.

Field Name	Field Description	Field Type	Field Width
PhotoID	Unique record identifier	dbLong	4
PlotID	Foreign key, links to tblPlotDetails	dbLong	4
PhotoType	Type of photo being referenced.	dbText	16
PhotoRoll	Reference number for film roll of photo.	dbText	12

Field Name	Field Description	Field Type	Field Width
PhotoFrame	Frame number of photo within roll.	dbText	50
PhotoOther	Other unique identifier or reference number for digital photo or name of movie file.	dbText	25
NCPNImageFileID	NCPN Photo Database digital image file name.	dbText	50
Photographer	Name of photographer.	dbText	50
PhotoComments	Brief description of photo.	dbText	255

Table Name: tblPlotDetails

Description: Information on a plot that is specific to a visit

Field Name	Field Description	Field Type	Field Width
PlotID	Unique identifier for record	dbLong	4
PlotCode	Foreign key, links to tblPlotLocation	dbText	10
SurveyDate	Date plot was visited and data collected	dbDate	8
Surveyors	Names of persons collecting data at plot (last names)	dbText	75
PlotLength	Length of plot, in meters	dbText	5
PlotAzimuth	Azimuth of plot; synonymous with aspect. One or the other, or both, can be used	dbText	5
PlotWidth	Width of plot, in meters	dbText	5
PlotDiam	Diameter of plot, in meters, if plot is circular	dbText	5
PlotHasPhotos	Yes if photos are taken of plot	dbBoolean	1
PlotRepresentation	Description or discussion of representativeness of plot in stand, and in comparison to associations outside the park (if known)	dbMemo	0
PlotShape	Shape of plot	dbText	15
CameraUsed	Make and model of camera used to photograph plot	dbText	50
ObsPointArea	Estimated size of observation point	dbText	50

Table Name: tblPlotLocation

Description: Basic and unchanging information on plot or observation point location

Field Name	Field Description	Field Type	Field Width
PlotCode	Identifier assigned to plot by survey crew	dbText	10
BPUCode	Biophysical unit code where plot is located. Numbers before the slash refer to the BPU number, while numbers after the slash are unique identifiers for the plot. N/a means the plot was not in a BPU.	dbText	25
State	State where plot is located	dbText	2
ParkCode	Park unit where plot is located	dbText	4
SiteName	Short, descriptive name of site where plot is located	dbText	100
USGSQuad	USGS quadrangle (1:24K) where plot is located	dbText	50
AerialPhotoNo	Aerial photo number corresponding to plot location	dbText	10
Waypoint	Garmin plot code	dbText	7
UTMEasting	UTM easting of plot	dbText	50
UTMNorthing	UTM northing of plot	dbText	7
Datum	Datum of UTM coordinates	dbText	10
UTMZone	UTM zone of coordinates	dbText	4
UTM Error	error, in meters, of location data (based on reading from Garmin GPS unit)	dbText	5
PDOP	satellite Precision Dilution of Position (based on reading from Trimble GPS unit)	dbText	50

Field Name	Field Description	Field Type	Field Width
DiffCorrected	Indicate if coordinates have been differentially corrected	dbText	3
DirectionsToPlot	Precise directions to plot	dbMemo	0
County	County where plot is located.	dbText	50
GPSUnit	Manufacturer and model of GPS unit (e.g., Trimble GeoExplorer 3)	dbText	25
GPSComments	Any brief comments on GPS data collection at plot.	dbText	255
InPark	Select Yes if plot is within park boundaries.	dbBoolean	1
IsObservationPt	Yes if observation point.	dbBoolean	1

Table Name: tblVegetation

Description: Overall vegetation characteristics of a plot or observation point

Field Name	Field Description	Field Type	Field Width
VegetationID	Unique record ID	dbLong	4
PlotID	Foreign key, links to tblPlotDetails	dbLong	4
ProvCommunityName	Community name (provisional) assigned by field crews by following naming protocols as described in field manual and training 04/04.	dbText	120
FinalINVCName	Final name assigned to association by NatureServe	dbText	100
Associations	Association corresponding to provisional community name	dbText	100
Phenology	Leaf phenology of the dominant stratum. Field is blank for non-vascular plots	dbText	35
LeafType	Leaf form of the dominant stratum.	dbText	20
LeafTypeComments	If Leaf Type is "mixed," this field describes the multiple leaf types found in the dominant stratum.	dbText	255
Physiognom	Physiognomic class of plot (from tlkpPhysiogClass)	dbText	20
EmergHt	Height class of emergent stratum (tlkpHeightClass)	dbText	2
EmergCovTot	Cover class of emergent stratum (tlkpCover)	dbText	4
CanHt	Height class of canopy stratum	dbText	2
CanCovTot	Cover class of canopy stratum	dbText	50
SubHt	Height class of subcanopy stratum	dbText	2
SubCovTot	Cover class of subcanopy stratum	dbText	4
TallShHt	Height class of tall shrub stratum	dbText	2
TallShCovTot	Cover class of tall shrub stratum	dbText	4
ShrubHt	Height class of short shrub stratum	dbText	2
ShrubCovTot	Cover class of short shrub stratum	dbText	4
DwarfHt	Height class of dwarf shrub stratum	dbText	2
DwarfCovTot	Cover class of dwarf shrub stratum	dbText	4
HerbHt	Height class of herbaceous stratum (all H layers)	dbText	2
HerbCovTot	Cover class of herbaceous stratum (all H layers)	dbText	4
GramHt	Height class of graminoid stratum	dbText	2
GramCovTot	Cover class of graminoid stratum	dbText	4
ForbHt	Height class of forb stratum	dbText	2
ForbCovTot	Cover class of forb stratum	dbText	4
FernHt	Height class of fern and fern ally stratum	dbText	2
FernCovTot	Cover class of fern and fern ally stratum	dbText	4
SeedlHt	Height class of seedling stratum	dbText	2
SeedlCovTot	Cover class of seedling stratum	dbText	4
NonvasHt	Height class of nonvascular stratum	dbText	2
NonvasCovTot	Cover class of nonvascular stratum	dbText	4

Field Name	Field Description	Field Type	Field Width
VineHt	Height class of vine stratum	dbText	2
VineTotCov	Cover class of vine stratum	dbText	4
EpiHt	Height class of epiphyte stratum	dbText	2
EpiTotCov	Cover class of epiphyte stratum	dbText	4
OutsidePlotHt	Height class of species occurring outside plot	dbText	50
OutsidePlotTotCov	Cover class of species occurring outside plot	dbText	50
Alliance	Alliance corresponding to provisional community name	dbText	100

Table Name: tblVegetationDetails

Description: Species and strata-specific data related to a plot or observation point

Field Name	Field Description	Field Type	Field Width
VegDetailID	Unique record ID	dbLong	4
VegetationID	Foreign key, links to tblVegetation	dbLong	4
Stratum	Strata class from tlkpStrata	dbText	2
TSN	Taxonomic Serial Number - unique taxon identifier assigned by ITIS	dbDouble	8
Species	Latin names of species, from tblNCPNPlants	dbText	100
CoverClass	Cover class to describe species and strata (from tlkpCover)	dbText	4
CoverClassRomme	[not used for GOSP]	dbText	50
SpecimenCollected	Check yes if a specimen of the species was collected.	dbBoolean	1
SpecimenNumber	Enter the collector's reference number for the specimen collected.	dbText	50
Diagnostic	Check yes if the species is known to be diagnostic of the vegetation type.	dbBoolean	1
PercentCover	Percent (0-100) cover of each species	dbLong	4
IsDead	Check yes if the species being documented was dead	dbBoolean	1
CollectedBy	Name of person making collection	dbText	50
NPSAccessionNumber	Accession number of specimen	dbText	50
NPSCatalogNumber	Unique reference number for individual specimen assigned by park curator	dbText	50
SpecimenLocality	Brief description of where collection was made	dbText	250
SpecimenHabitat	Description of habitat where collection was made	dbText	250
SpecimenAssocSpecies	Description of associated species where collection was made	dbText	250

Lookup tables

Table Name: tblINCPNPlants

Description: Master look-up table for plant species names and taxonomic information. Derived from ITIS (Integrated Taxonomic Information System)

Field Name	Field Description	Field Type	Field Width
TSN	Taxonomic Serial Number - unique taxon identifier assigned by ITIS	dbDouble	8
FamilyName	Family name of taxon	dbText	255
LatinName	Latin name of taxon	dbText	255
Authority	Authority of Latin name	dbText	255
Synonym	Accepted synonyms of taxon	dbText	255
CommonName	Locally accepted common name for taxon	dbText	255
Exotic	Check yes if species is exotic	dbBoolean	1
Sensitive	check yes if species is threatened, endangered, or sensitive	dbBoolean	1
GrowthHabit	Select GrowthHabit for species -- habit can vary based on region; edit as needed to reflect habit in park	dbText	255
PLANTSCode	Code for taxonomic unit assigned by USDA PLANTS	dbText	255
FullName	temporary field; concatenation of Latin name and authority	dbText	255

Table Name: tlkpAlliances

Description: Look-up of provisional community names

Field Name	Field Description	Field Type	Field Width
Alliance	Alliance name from NatureServe classification	dbText	100

Table Name: tlkpAssociations

Description: Look-up of association names

Field Name	Field Description	Field Type	Field Width
Associations	Association names from NatureServe classification	dbText	100

Table Name: tlkpCamera

Description: Lookup of Camera make/models used for plot photos.

Field Name	Field Description	Field Type	Field Width
CameraType	Model and make of camera used for photographs of plot	dbText	50
CameraComments	Additional comments on camera, including default focal length	dbText	50

Table Name: tlkpCover

Description: Look-up of cover classes assigned to species and strata in tblVegetationDetails.

Field Name	Field Description	Field Type	Field Width
CoverClass	Cover class code: T, P, 01, 02, 03, 04, 05, 06, 07, 08, 09, 10	dbText	50
CoverClassDef	Cover class code definition. Plots: T = 0-1%, P = 1-5%, 01 = 5-15%, 02 = 15-25%, 03 = 25-35%, 04 = 35-45%, 05 = 45-55%, 06 = 55-65%, 07 = 65-75%, 08 = 75-85%, 09 = 85-95%, 10 = >95%; Observation points: 01 = 0-10%, 02 = 10-25%, 03 = 25-60%, 04 = 60-100%	dbText	50

Table Name: tlkpCowardin

Description: Look-up table of Cowardin system categories for Environment descriptions.

Field Name	Field Description	Field Type	Field Width
CowardinSystem	Cowardin system descriptors for environmental description of plot.	dbText	50

Table Name: tlkpElevSource

Description: Lookup table of options for source of elevation data.

Field Name	Field Description	Field Type	Field Width
ElevSource	Source of elevation data entered on field forms	dbText	50

Table Name: tlkpGeology

Description: Look-up of geology types to describe substrate of plot.

Field Name	Field Description	Field Type	Field Width
Geology	Geology types used to describe substrate of plot or observation point	dbText	75

Table Name: tlkpHeightClass

Description: Look-up of height classes assigned to strata in tblVegetationDetails.

Field Name	Field Description	Field Type	Field Width
HeightClass	Height class code: 01, 02, 03, 04, 05, 06, 07, 08, 09, 10	dbText	2
HeightClassDef	Height class code definition: 01<.5m 02=.5-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m	dbText	50

Table Name: tlkpHydrology

Description: Look-up of hydrology types from Cowardin et al. 1979

Field Name	Field Description	Field Type	Field Width
Hydrology	Hydrology descriptors for plots that are in a wetland or upland with intermittent flooding (dry wash).	dbText	50

Table Name: tlkpLandform

Description: Lookup of landforms in Veg Mapping Manual (from <http://soils.usda.gov/technical/handbook/contents/part629.html#00>)

Field Name	Field Description	Field Type	Field Width
Landform	Landforms from appendix 1 of field manual	dbText	50

Table Name: tlkpLeafPhen

Description: Look-up of phenology types to describe dominant stratum (from VegMapping Manual 04/04.)

Field Name	Field Description	Field Type	Field Width
Phenology	Leaf phenology descriptors to describe dominant stratum	dbText	40

Table Name: tlkpLeafType

Description: Look-up of leaf form of dominant stratum (from VegMapping Manual 04/04)

Field Name	Field Description	Field Type	Field Width
LeafType	Leaf form description of the dominant stratum	dbText	35

Table Name: tlkpParks

Description: Look-up table of parks in the Northern Colorado Plateau Network

Field Name	Field Description	Field Type	Field Width
ParkCode	Four-letter abbreviation for park code	dbText	4
ParkName	Full name of park where data were collected	dbText	50

Table Name: tlkpPhotoComments

Description: Lookup table of photo comments

Field Name	Field Description	Field Type	Field Width
PhotoComments	Photograph comments.	dbText	50

Table Name: tlkpPhotographer

Description: Lookup table of photographer names

Field Name	Field Description	Field Type	Field Width
Photographer	Photographer name.	dbText	50

Table Name: tlkpPhotoTypes

Description: Look-up of types of photos taken during data collection.

Field Name	Field Description	Field Type	Field Width
PhotoType	Type of photo taken, associated with plot	dbText	50

Table Name: tlkpPhysiogClass

Description: Look-up of physiognomic types to describe each plot or observation point.

Field Name	Field Description	Field Type	Field Width
Physiognom	Physiognomic class used to describe plot	dbText	50

Table Name: tlkpPJAge

Description: Look-up of Pinyon-Juniper age classes

Field Name	Field Description	Field Type	Field Width
PJAgeClass	Pinyon- Juniper age class, if plot contains either of these two species.	dbText	15

Table Name: tlkpPlotShapes

Description: Look-up of shapes of plots.

Field Name	Field Description	Field Type	Field Width
PlotShape	shapes of plots	dbText	15

Table Name: tlkpSoilDrainage

Description: Look-up of soil drainage classes to describe plot or observation point.

Field Name	Field Description	Field Type	Field Width
SoilDrainage	Soil drainage classes used to describe soil where plot is located	dbText	30

Table Name: tlkpSoilTexture

Description: Look-up of soil textures based on Bowker 2003 field key for CANY, ARCH, and NABR.

Field Name	Field Description	Field Type	Field Width
SoilTexture	Look-up of soil textures based on Bowker 2003 field key for CANY, ARCH, and NABR.	dbText	15

Table Name: tlkpStates

Description: Look-up of all states in the USA

Field Name	Field Description	Field Type	Field Width
StateCode	Two-letter abbreviation for each state	dbText	2
StateName	Full name of each state in the USA	dbText	50

Table Name: tlkpStrata

Description: Look-up of strata classes in tblVegetationDetails (from VegMapping Manual 04/04).

Field Name	Field Description	Field Type	Field Width
Stratum	T1=Emergent T2=Canopy T3=Subcanopy S1=Tall Shrub S2=Short Shrub S3=Dwarf Shrub H1=Graminoid H2=Forb H3=Fern H4=Tree Seedl N=Nonvasc V=Vine E=Epiphyte	dbText	3

Table Name: tlkpStructureStages

Description: Lookup table for fuels structure stages [not used for GOSP]

Field Name	Field Description	Field Type	Field Width
StructureStage	[not used for GOSP]	dbText	12

Table Name: tlkpSurveyors

Description: Look-up of data collection teams.

Field Name	Field Description	Field Type	Field Width
SurveyorName	Last names of crew members on data collection team.	dbText	75

Table Name: tlkpTopography

Description: Look-up of topographic positions to describe where plot or observation point is located on its related landform.

Field Name	Field Description	Field Type	Field Width
TopoPosition	Topographic positions used to describe where plot or observation point is located on its related landform.	dbText	50

Table Name: tlkpUSGS_Quad

Description: Look-up of all 7.5 minute USGS quads for GOSP.

Field Name	Field Description	Field Type	Field Width
USGSQuad	Names of all 7.5 minute USGS quads for GOSP	dbText	50
USGSQuadCode	[not used for GOSP]	dbText	7

Table Name: tlkpUTMZone

Description: Look-up for UTM zones of GOSP

Field Name	Field Description	Field Type	Field Width
UTMZone	UTM zone where GOSP plots were collected	dbText	5

Table Name: fcl_Veg_Points

Description: The feature class containing all point data associated with the vegetation project (Plots and Observations).

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
SHAPE	ESRI generated	dbLongBinary	0
PLOT_CODE	Unique Plot code, used for relating tables and feature class (TBL_LOCATION_INFO)	dbText	20
Pnts_Type	Type of point (plot, observation, misc)	dbLong	4
Edit_Date	Date of any edits to the point or data	dbText	10
Edit_Notes	Notes regarding any edits	dbText	255

Table Name: fcl_Veg_Polys

Description: The feature class displaying the vegetation mapping units for the park.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
SHAPE	ESRI generated	dbLongBinary	0
Polygon_ID	Unique polygon code, used for relating tables (TBL_VEGMAP_INFO)	dbText	128
Map_Unit_ID	The map unit identifier, used by the mappers (aka: grid_code or map class code)	dbText	10
Map_Unit_Common_Name	The name of the map unit (or map class)	dbText	250
Edit_Date	Date of any edits to the polygon or its attributes	dbDate	8
Edit_Notes	Notes regarding any edits to the polygon or its attributes	dbText	250
Acres	Acres per polygon, generated using ArcMap	dbDouble	8
Hectares	Hectares per polygon, generated using ArcMap	dbDouble	8
SHAPE_Length	ESRI generated	dbDouble	8
SHAPE_Area	ESRI generated	dbDouble	8

Non-spatial tables

Table Name: TBL_ALLIANCE

Description: Contains the alliances for the vegetation polygons by map unit ID.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
MapUnit	The map unit identifier, used by the mappers (aka: grid_code or map class code, usually a number)	dbText	12
NVC_ALLIANCE_CODE	The NVC alliance code	dbText	20
ALLIANCE_COMMON_NAME	NVC alliance common name	dbText	250
ALLIANCE_NAME	NVC alliance Latin name	dbText	250

Table Name: TBL_ANDERSON_LANDUSE

Description: Contains the Anderson Landuse classes for the vegetation polygons.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
Polygon_ID	Unique polygon code, used for relating tables (TBL_VEGMAP_INFO)	dbText	20

Field Name	Field Description	Field Type	Field Width
LANDUSE	The Anderson landuse classes of the polygon (version 1.5, January 2002)	dbDouble	8
Level_1	Anderson landuse code for level one	dbText	255
L1_Name	Anderson landuse name for level one	dbText	255
Level_2	Anderson landuse code for level two	dbText	50
L2_Name	Anderson landuse name for level two	dbText	255
Level_3	Anderson landuse code for level three	dbText	255
L3_Name	Anderson landuse name for level three	dbText	255
Level_4	Anderson landuse code for level four	dbText	255
L4_Name	Anderson landuse name for level four	dbText	255
Level_5	Anderson landuse code for level five	dbText	255
L5_Name	Anderson landuse name for level five	dbText	255
Level_6	Anderson landuse code for level six	dbText	255
L6_Name	Anderson landuse name for level six	dbText	255

Table Name: TBL_ENVIRONMENT_COVER

Description: Contains ground cover data for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
COVER_TYPE	Ground cover type	dbText	30
COVER_CODE	Cover code from field sheet - observation points only	dbText	5
COVER_PERCENT	Field estimate to the nearest percentage of ground cover type (plots only).	dbDouble	8
COVER_CODE_RANGE	Cover code range - for plots with non-integer percentages.	dbText	50
COVER_PERCENT_DESC	Description of cover, if "other"	dbText	255
PLOT_CODE	Unique Plot code, used for relating tables	dbText	20

Table Name: TBL_ENVIRONMENT_LANDFORM

Description: Contains landform data for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
LANDFORM	Landform on which plot is located, any landform could be entered by crew.	dbText	100
PLOT_CODE	Unique Plot code, used for relating tables (TBL_LOCATION_INFO)	dbText	20

Table Name: TBL_FORMATION

Description: Contains NVC formation level data for the vegetation polygons.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
MAP_UNIT_ID	The map unit identifier, used by the mappers (aka: grid_code or map class code)	dbText	10
Formation_Code	NVC formation level code	dbText	30
Formation_Name	NVC formation level name	dbText	255

Table Name: TBL_GPS_INFO

Description: Contains information about the GPS unit and accuracies of data collected for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
PLOT_ID	Unique Plot code, used for relating tables (TBL_LOCATION_INFO)	dbText	20
GPS_TYPE	Manufacturer / model of GPS unit (e.g., Garmin Etrex or Trimble XM)	dbText	30
UTM_EASTING	UTM easting of plot	dbDouble	8
UTM_NORTHING	UTM northing of plot	dbDouble	8
UTM_ZONE	UTM zone of coordinates	dbText	3
DATUM	Datum of UTM coordinates (NAD83)	dbText	10
GPS_ERROR	Error, in meters, of location data (based on reading from Garmin GPS unit)	dbText	5
DIFF_CORRECTED	Indicates if coordinates have been differentially corrected (from Garmin screen)	dbText	3
GPS_COMMENTS	Any brief comments on GPS data collection at plot.	dbText	255
GPS_QUALITY	Indicates the quality of the GPS unit used (recreational, mapping grade)	dbText	35
PDOP	Positional Dilution Of Precision reading (from Garmin screen)	dbText	30
ERROR_RANGE	General error range, in meters, of the type of GPS unit used.	dbText	20

Table Name: TBL_LOCATION_INFO

Description: Contains data about the location of the point and general observations about the area for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
PLOT_CODE	Unique Plot code, used for relating tables and feature class (fcl_Veg_Points)	dbText	20
VISIT_DATE	Date the location was visited	dbText	10
SITE_NAME	General Site name given by field crew	dbText	180
PLOT_SHAPE	The shape of the area observed as a point	dbText	20
PLOT_WIDTH	The width of the point (plot and obs only)	dbText	3
PLOT_LENGTH	The length of the point (plot and obs only)	dbText	3
PLOT_DIAMETER	The diameter of the point (plot and obs only)	dbText	5
PLOT_AZIMUTH	The azimuth of the point (plot and obs only)	dbText	5
ASPECT	Aspect of plot	dbText	10
ELEVATION	Elevation of plot in meters, generated by GPS unit	dbDouble	8
SLOPE	Slope of plot measured in degrees	dbText	15
TOPO_POSITION	Topographic position of plot	dbText	50
DIRECTIONS_PLOT	Directions to the location of the plot (plot and obs only)	dbText	255
REPRESENTATIVENESS	The representativeness of the vegetation (at plots and obs only)	dbText	255
OBSERVER	The names of the field crew member(s) observing the site.	dbText	50
IN_PARK	Indicates if the point was inside or outside the	dbBoolean	1

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Field Name	Field Description	Field Type	Field Width
	park boundary ("1" = In Park, "0" = Not in park)		
UNIT_CODE	4 letter park code (GOSP)	dbText	10
AERIAL_PHOTO_NO	9X9 photo name on which the point most directly falls (2006 flight, plots & obs only)	dbText	30
STATE_CODE	State (UT)	dbText	2
USGS_NAME	USGS 1:24k Topo Name	dbText	75
COUNTY_NAME	County where plot is located (Box Elder County)	dbText	80
PHENOLOGY	Leaf phenology of the dominant stratum. Field is blank for non-vascular plots	dbText	50
PHYSIOGNOMIC_NAME	Physiognomic class of plot	dbText	80
LEAF_TYPE	Leaf form of the dominant stratum.	dbText	80
LEAF_TYPE_COMMENTS	If Leaf Type is "mixed," this field describes the multiple leaf types found in the dominant stratum.	dbText	250
PROVISIONAL_COMM_NAME	Community name (provisional) assigned by field crews by following naming protocols as described in field manual and training (plot and obs only).	dbText	220
ALLIANCE	Alliance corresponding to provisional community name (plots and obs only)	dbText	150
PLANT_SPECIES_COMMENTS	Comments about the plant species observed.	dbText	200
COWARDIN_SYSTEM	If the plot is in a wetland system, select term that best describes its hydrology (Upland, Palustrine, Riverine, Lacustrine). plot and obs only	dbText	40
HYDROLOGY	Describes hydrology of plot (plot and obs only)	dbText	40
GEOLOGY	Geologic substrate influencing the plant community (plot and obs only)	dbText	60
ENV_COMMENTS	Comments on environmental setting and its effect on the vegetation; also comments on any disturbance or reproduction factors	dbText	255
LANDSCAPE_COMMENTS	Description of landscape context of plot, including any important landscape features influencing the community (plot and obs only)	dbText	255
ANIMAL_USE_COMMENTS	Comments on evidence of use by non-domestic animals in plot area (plot and obs only)	dbText	255
DISTURBANCE_COMMENTS	Comments on evidence of natural or anthropogenic disturbance in plot area, severity and effects on vegetation (plot and obs only)	dbText	255
OTHER_COMMENTS	Other general comments (plot and obs only)	dbText	255
SOIL_TEXTURE	Assessment of average soil texture from sample taken a few inches below the surface (plot and obs only)	dbText	50
SOIL_DRAINAGE	Soil drainage class based on actual moisture content and extent period (plot and obs only)	dbText	30
SOIL_TAXON_DESC	Field used for either identifying soils keyed, or to describe if large rocks or outcrops are present on the surface (plot and obs only)	dbText	255

Table Name: TBL_MAPUNIT_ASSOC

Description: Contains association data for the vegetation polygons by map unit ID.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
MapUnitID	The map unit identifier, used by the mappers (aka: grid_code or map class code)	dbText	20
CEGL_Code	NVC association code	dbText	18
AssociationName	The NVC Association name (scientific)	dbText	250
AssociationCommonName	The NVC Association Common name	dbText	250

Table Name: TBL_MAPUNIT_ECOSYS

Description: Contains ecological system data for the vegetation polygons by map unit ID.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
MAP_UNIT_ID	The map unit identifier, used by the mappers (aka: grid_code or map class code)	dbText	10
ES_Code	Ecological System code	dbText	30
EcologicalSystemName	Ecological system name (mid-scale classification, larger than associations or alliances, smaller than ecoregions).	dbText	255

Table Name: TBL_PHOTOS

Description: Details on individual photos taken of a point.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
PLOT_CODE	Unique Plot code, used for relating tables (TBL_LOCATION_INFO)	dbText	50
PhotoType	Type of photo being referenced.	dbText	16
Photographer	Name of photographer.	dbText	50
PhotoComments	Brief description of photo.	dbText	255
IMAGE_ID	NCPN Photo Database (unique) file name.	dbText	50
PHOTO_PATH	Hard-coded path name to photos (update this field)	dbText	200

Table Name: TBL_STRATUM_SPECIES

Description: Contains species level data by stratum.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
TSN	Taxonomic Serial Number - unique taxon identifier assigned by ITIS	dbDouble	8
SPECIES	Latin names of species	dbText	255
PERCENT_COVER	n/a for GOSP	dbText	4
COVER_CODE	Cover class code to describe species and strata	dbText	5
COVER_CLASS	Cover class to describe species and strata	dbText	50
DIAGNOSTIC	Check yes if the species is known to be diagnostic of the vegetation type.	dbInteger	2
SPECIMEN_COLLECTED	"yes" (-1) if a specimen of the species was collected.	dbInteger	2
SPECIMEN_NO	The collector's reference number for the specimen collected.	dbText	10
DEAD	Percent cover of dead species seen at plot. Not completed of every species, but always done if	dbInteger	2

Field Name	Field Description	Field Type	Field Width
	diagnostic species.		
STRATUM_ID	Unique ID, relates to TBL_VEG_STRATA	dbLong	4

Table Name: TBL_VEG_STRATA

Description: Contains stratum data for the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
STRATUM_ID	Links to strata	dbLong	4
STRATUM	Stratum name/type	dbText	20
STRATUM_COVER_CODE	stratum cover code	dbText	5
STRATUM_COVER_CLASS	stratum percentage cover class	dbText	50
STRATUM_HEIGHT_CODE	stratum height code	dbText	5
STRATUM_HEIGHT_CLASS	stratum height class in meters	dbText	50
PLOT_CODE	Unique Plot code, used for relating tables (TBL_STRATUM_SPECIES)	dbText	15

Table Name: TBL_VEGASSOC_INFO

Description: Contains association data for all points (plots and obs. points) in the veg points feature class.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
PLOT_CODE	Unique Plot code, used for relating tables	dbText	35
CEGL_CODE	CEGL (association) code	dbText	10
ASSOCIATION	Association corresponding to provisional community name	dbText	180
FIELD_KEY_NAME	Yes if association name was chosen from field key	dbText	10
CREATED_NAME	Yes if no name really fits from the field key, the surveyor will create a new name.	dbText	10
POST_AA_FIELD_NAME	n/a for GOSP	dbText	10
ASSOC_RANK	Rank of vegetation association (primary, secondary, tertiary)	dbText	50
OTHER_ASSOC_50M	Other associations noted in a 50 meter area beyond plot	dbText	200

Table Name: TBL_VEGMAP_INFO

Description: Contains map unit level data for each vegetation map unit polygon.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
Polygon_ID	Unique polygon code, used for relating tables and feature classes (fcl_Veg_polys)	dbText	30
Map_Unit_ID	The map unit identifier, used by the mappers (aka: grid_code or map class code)	dbText	10
Map_Unit_Code	NCPN code (e.g., S-BSCG)	dbText	10
Map_Unit_Common_Name	The name of the map unit (or map class)	dbText	250
Cover_Code	n/a for GOSP	dbText	1
COVER_PATTERN	n/a for GOSP	dbText	100
Density_Code	Density value code	dbText	1
DENSITY_CLASS	Density of Forest/Woodland vegetation, and density for	dbText	100

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Field Name	Field Description	Field Type	Field Width
	sagebrush communities per polygon.		
Height_Code	n/a for GOSP	dbText	1
HEIGHT_CLASS	n/a for GOSP	dbText	100
USER_ACCURACY	n/a for GOSP	dbText	3
FUELS_TYPE	n/a for GOSP	dbText	50
FUELS_VERIFICATION	n/a for GOSP	dbText	255
VEGMAP_COMMENTS	Any comments about the particular polygon or map class.	dbText	255
MAP_UNIT_PDF	File name of pdf describing map unit (class)	dbText	50
MAP_UNIT_PDF_PATH	Hard-coded link to Map Unit description PDF document - path name (e.g. C:/GOSP/Vegetation/MapClassDescriptions/S-BSCG_mu22.pdf)	dbText	250

Table Name: TBL_VEGMAP_MODIFIERS

Description: Contains modifiers for the vegetation map unit polygons.

Field Name	Field Description	Field Type	Field Width
OBJECTID	ESRI generated autonumber	dbLong	4
Polygon_ID	Unique polygon code, used for relating tables (TBL_VEGMAP_INFO)	dbText	20
MODIFIER	Modifier code (one lower case letter)	dbText	12
MODIFIER_NAME	Name/type of modifier	dbText	50
MODIFIER_DESCRIPTION	Description of modifier	dbText	255

Appendix D. Plant Species List and Crosswalk

Fifty-five vascular plant species representing 12 families were noted during field work at GOSP. The Northern Colorado Plateau Network uses three taxonomic authorities for vascular plants: Welsh et al. 2003 as the nomenclatural authority for Utah parks, Weber and Wittmann 2001 for Colorado parks, and Dorn and Lichvar 1984 for the single park in Wyoming; the GOSP vegetation mapping project database reflects scientific names as assigned by Welsh. These names are crosswalked to Kartesz 1999, which is the nomenclatural authority used by NatureServe for the National Vegetation Classification. Scientific and common names used by NatureServe are presented in this crosswalk; these names are used throughout the GOSP vegetation mapping report and in the individual association descriptions in Appendix F. The taxonomic serial number (TSN) assigned by the Integrated Taxonomic Information System (ITIS) is provided for the Welsh name of each species.

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
Asteraceae	<i>Artemisia dracunculus</i> L.	<i>Artemisia dracunculus</i>	tarragon	35462
	<i>Artemisia nova</i> A. Nels.	<i>Artemisia nova</i>	black sagebrush	500971
	<i>Artemisia tridentata</i> ssp. <i>tridentata</i> Nutt.	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>	basin big sagebrush	35499
	<i>Brickellia microphylla</i> (Nutt.) Gray	<i>Brickellia microphylla</i>	littleleaf brickellbush	36886
	<i>Chrysopsis villosa</i> (Pursh) Nutt. ex DC.	<i>Heterotheca villosa</i>	hairy false goldenaster	37689
	<i>Chrysothamnus nauseosus</i> (Pallas ex Pursh) Britt.	<i>Ericameria nauseosa</i>	rubber rabbitbrush	507594
	<i>Chrysothamnus nauseosus</i> ssp. <i>graveolens</i> (Nutt.) Piper	<i>Ericameria nauseosa</i> ssp. <i>nauseosa</i> var. <i>glabrata</i>	rubber rabbitbrush	566639
	<i>Chrysothamnus vaseyi</i> (Gray) Greene	<i>Chrysothamnus vaseyi</i>	Vasey's rabbitbrush	37089
	<i>Chrysothamnus viscidiflorus</i> (Hook.) Nutt.	<i>Chrysothamnus viscidiflorus</i>	yellow rabbitbrush	37090
	<i>Cirsium undulatum</i> (Nutt.) Spreng.	<i>Cirsium undulatum</i>	wavyleaf thistle	36423
	<i>Gutierrezia sarothrae</i> (Pursh) Britt. & Rusby	<i>Gutierrezia sarothrae</i>	broom snakeweed	37483
	<i>Haplopappus acaulis</i> (Nutt.) Gray	<i>Stenotus acaulis</i>	stemless mock goldenweed	37499
	<i>Helianthus annuus</i> L.	<i>Helianthus annuus</i>	common sunflower	36616
	<i>Tetradymia canescens</i> DC.	<i>Tetradymia canescens</i>	spineless horsebrush	38494
Boraginaceae	<i>Cryptantha humilis</i> (Gray) Payson	<i>Cryptantha humilis</i>	roundspike cryptantha	31820
Brassicaceae	<i>Alyssum desertorum</i> Stapf	<i>Alyssum desertorum</i>	desert madwort	23032
	<i>Descurainia pinnata</i> (Walt.) Britt.	<i>Descurainia pinnata</i>	western tansymustard	22826
	<i>Descurainia sophia</i> (L.) Webb ex Prantl	<i>Descurainia sophia</i>	herb sophia	22843
	<i>Sisymbrium altissimum</i> L.	<i>Sisymbrium altissimum</i>	tall tumbledustard	23312
Chenopodiaceae	<i>Atriplex canescens</i> (Pursh) Nutt.	<i>Atriplex canescens</i>	fourwing saltbush	20518
	<i>Atriplex confertifolia</i> (Torr. & Frém.) S. Wats.	<i>Atriplex confertifolia</i>	shadscale saltbush	20519
	<i>Krascheninnikovia lanata</i> (Pursh) A.D.J. Meeuse & Smit	<i>Krascheninnikovia lanata</i>	winterfat	503290
	<i>Sarcobatus vermiculatus</i> (Hook.) Torr.	<i>Sarcobatus vermiculatus</i>	greasewood	20707
	<i>Suaeda torreyana</i> S. Wats.	<i>Suaeda moquinii</i>	Mojave seablite	505404
Fabaceae	<i>Astragalus</i> L.	<i>Astragalus</i>	milkvetch	25392
	<i>Astragalus tenellus</i> Pursh	<i>Astragalus tenellus</i>	looseflower milkvetch	25696
	<i>Psoraleidum lanceolatum</i> (Pursh) Rydb.	<i>Psoraleidum lanceolatum</i>	lemon scurfpea	504645
Loasaceae	<i>Mentzelia laevicaulis</i> (Dougl. ex Hook.) Torr. & Gray	<i>Mentzelia laevicaulis</i>	smoothstem blazingstar	503779

Family	Scientific Name (Welsh et al. 2003)	Scientific Name (Kartesz 1999)	Common Name (NatureServe)	TSN
Malvaceae	<i>Sphaeralcea munroana</i> (Dougl. ex Lindl.) Spach ex Gray	<i>Sphaeralcea munroana</i>	Munro's globemallow	21949
	<i>Sphaeralcea parvifolia</i> A. Nels.	<i>Sphaeralcea parvifolia</i>	smallflower globemallow	21953
Poaceae	<i>Aegilops cylindrica</i> Host	<i>Aegilops cylindrica</i>	jointed goatgrass	182537
	<i>Agropyron cristatum</i> (L.) Gaertn.	<i>Agropyron cristatum</i>	crested wheatgrass	182478
	<i>Agropyron smithii</i> Rydb.	<i>Pascopyrum smithii</i>	western wheatgrass	504124
	<i>Aristida purpurea</i> Nutt.	<i>Aristida purpurea</i>	purple threeawn	41429
	<i>Bromus briziformis</i> Fisch. & C.A. Mey.	<i>Bromus briziformis</i>	rattlesnake brome	40495
	<i>Bromus japonicus</i> Thunb. ex Murr.	<i>Bromus japonicus</i>	Japanese brome	40479
	<i>Bromus tectorum</i> L.	<i>Bromus tectorum</i>	cheatgrass	40524
	<i>Elymus cinereus</i> Scribn. & Merr.	<i>Leymus cinereus</i>	basin wildrye	503433
	<i>Elymus elongatus</i> (Host) Runemark	<i>Thinopyrum ponticum</i>	rush wheatgrass	522542
	<i>Elymus elymoides</i> (Raf.) Swezey	<i>Elymus elymoides</i>	squirreltail	502264
	<i>Elymus hispidus</i> (Opiz) Melderis	<i>Thinopyrum intermedium</i>	intermediate wheatgrass	512825
	<i>Elymus spicatus</i> (Pursh) Gould	<i>Pseudoroegneria spicata</i>	bluebunch wheatgrass	504637
	<i>Hordeum jubatum</i> L.	<i>Hordeum jubatum</i>	foxtail barley	40871
	<i>Poa bulbosa</i> L.	<i>Poa bulbosa</i>	bulbous bluegrass	41116
	<i>Poa secunda</i> J. Presl	<i>Poa secunda</i>	Sandberg bluegrass	41103
	<i>Sporobolus cryptandrus</i> (Torr.) Gray	<i>Sporobolus cryptandrus</i>	sand dropseed	42132
	<i>Stipa comata</i> Trin. & Rupr.	<i>Hesperostipa comata</i> ssp. <i>comata</i>	needle and thread	42172
<i>Stipa hymenoides</i> Roemer & Schultes	<i>Achnatherum hymenoides</i>	Indian ricegrass	507943	
Polemoniaceae	<i>Leptodactylon pungens</i> (Torr.) ex Nutt.	<i>Leptodactylon pungens</i>	granite prickly phlox	31233
	<i>Leptodactylon watsonii</i> (Gray) Rydb.	<i>Leptodactylon watsonii</i>	Watson's prickly phlox	503390
	<i>Phlox hoodii</i> Richards.	<i>Phlox hoodii</i>	spiny phlox	30948
Ranunculaceae	<i>Ranunculus testiculatus</i> Crantz	<i>Ceratocephala testiculata</i>	curveseed butterwort	501365
Rosaceae	<i>Petrophytum caespitosum</i> (Nutt.) Rydb.	<i>Petrophyton caespitosum</i>	rockspiraea	25272
	<i>Purshia tridentata</i> (Pursh) D.C.	<i>Purshia tridentata</i>	antelope bitterbrush	25290
Solanaceae	<i>Lycium barbarum</i> L.	<i>Lycium barbarum</i>	matrimony vine	503599

Appendix E. Field Plot Crosswalk to NVC Associations

Plots and observation points from GOSP are assigned to National Vegetation Classification associations based on their composition and structure as they were recorded in the field. Element codes are used by NatureServe and state Natural Heritage Programs to track nomenclature and status of rare plants, rare animals, and communities (“elements”). Nomenclature used by the NVC follows Kartesz (1999). Vegetation types that could not be classified by NVC criteria were retained as “Park Specials”. Several associations not sampled but were observed in field and became the basis for some of the rarer map classes (e.g., Great Basin Wildrye Grassland, Juniper / Cheatgrass Woodland). These types appear with the notation “Field notes only”.

Plant Association Scientific Name	Element Code	Count	Plots and Observation Points
<i>Agropyron cristatum</i> - (<i>Pascopyrum smithii</i> , <i>Hesperostipa comata</i>) Semi-natural Herbaceous Vegetation	CEGL005266	2	GOSP.9107, GOSP.9219
<i>Agropyron cristatum</i> - <i>Bromus tectorum</i> Semi-natural Herbaceous Vegetation	Park Special	3	GOSP.9004, GOSP.9109, GOSP.9220
<i>Aristida purpurea</i> Herbaceous Vegetation	CEGL005800	1	GOSP.9230
<i>Artemisia tridentata</i> - (<i>Ericameria nauseosa</i>) / <i>Bromus tectorum</i> Semi-natural Shrubland	CEGL002699	9	GOSP.9002, GOSP.9005, GOSP.9106, GOSP.9124, GOSP.9210, GOSP.9214, GOSP.9216, GOSP.9217, GOSP.9218,
<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Agropyron cristatum</i> Semi-natural Shrubland	Park Special	2	GOSP.9003, GOSP.9221
<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Leymus cinereus</i> Shrubland	CEGL001016	0	Field notes only
<i>Artemisia tridentata</i> ssp. <i>tridentata</i> / <i>Poa secunda</i> Shrubland	CEGL001008	5	GOSP.0123, GOSP.9122, GOSP.9125, GOSP.9227, GOSP.9229
<i>Bromus tectorum</i> Semi-natural Herbaceous Vegetation	CEGL003019	11	GOSP.9008, GOSP.9110, GOSP.9111, GOSP.9113, GOSP.9116, GOSP.9119, GOSP.9211, GOSP.9212, GOSP.9213, GOSP.9225, GOSP.9226,
<i>Chrysothamnus viscidiflorus</i> Shrub Herbaceous Vegetation	CEGL002530	1	GOSP.0120
<i>Distichlis spicata</i> Herbaceous Vegetation	CEGL001770	0	Field notes only
<i>Ericameria nauseosa</i> / <i>Bromus tectorum</i> Semi-natural Shrubland	CEGL002937	2	GOSP.9215, GOSP.9224
<i>Hesperostipa comata</i> Great Basin Herbaceous Vegetation	CEGL001705	1	GOSP.9223
<i>Juniperus osteosperma</i> / <i>Bromus tectorum</i> Semi-natural Woodland	CEGL002817	0	Field notes only
<i>Leymus cinereus</i> Herbaceous Vegetation	CEGL001479	0	Field notes only

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Plant Association Scientific Name	Element Code	Count	Plots and Observation Points
<i>Lycium barbarum</i> / <i>Bromus tectorum</i> Semi-natural Shrubland	Park Special	1	GOSP.9001
<i>Poa secunda</i> Herbaceous Vegetation	CEGL001657	2	GOSP.9010, GOSP.9126
<i>Prunus virginiana</i> - (<i>Prunus americana</i>) Shrubland	CEGL001108	0	Field notes only
<i>Pseudoroegneria spicata</i> - <i>Hesperostipa comata</i> Herbaceous Vegetation	CEGL001679	1	GOSP.9115
<i>Pseudoroegneria spicata</i> - <i>Poa secunda</i> Herbaceous Vegetation	CEGL001677	1	GOSP.0210
<i>Pseudoroegneria spicata</i> Herbaceous Vegetation	CEGL001660	4	GOSP.9007, GOSP.9009, GOSP.9108, GOSP.9228
<i>Sarcobatus vermiculatus</i> Disturbed Shrubland	CEGL001357	2	GOSP.9222, GOSP.9231
<i>Tamarix</i> spp. Temporarily Flooded Semi-natural Shrubland	CEGL003114	0	Field notes only
<i>Thinopyrum ponticum</i> Semi-natural Herbaceous Vegetation	Park Special	1	GOSP.9006

Appendix F. Plant Association Descriptions for Golden Spike National Historic Site

The Golden Spike National Historic Site (GOSP) vegetation mapping project identified 14 National Vegetation Classification (NVC) plant associations and four park special vegetation types representing 11 vegetation alliances. Detailed vegetation descriptions are essential for recognizing floristic vegetation types (association and alliance levels of the NVC) in the field. Local and global descriptions “*provide specific information on the geographical distribution, level of acceptable physiognomic and compositional variation, and the key ecological process and environmental / abiotic factors that are associated with a type*” (Grossman et al. 1998). The two levels of vegetation descriptions are valuable for comparing each association as it appears in the park with the global range of variation for that association.

The following report was prepared by NatureServe to provide local and global descriptions for each plant association found at GOSP. These descriptions reflect NatureServe’s accumulated data and analysis. Global descriptions of NVC associations are available on NatureServe’s Explorer Web site (<http://www.natureserve.org/explorer>); local descriptions are not.

In this appendix, NVC plant associations are arranged by physiognomic class (e.g., Forest, Woodland). Within each physiognomic class, associations are sorted into formations (e.g., Conical-crowned temperate), and alliances (e.g., *Juniperus osteosperma* Woodland Alliance).

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***Juniperus osteosperma* / *Bromus tectorum* Semi-natural Woodland**
Utah Juniper / Cheatgrass Semi-natural Woodland

CODE	CEGL002817
PHYSIOGNOMIC CLASS	Woodland (I)
PHYSIOGNOMIC SUBCLASS	Evergreen woodland (I.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar needle-leaved evergreen woodland (II.A.4.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.)
FORMATION	Rounded-crowned temperate or subpolar needle-leaved evergreen woodland (II.A.4.N.a.)
ALLIANCE	<i>JUNIPERUS OSTEOSPERMA</i> WOODLAND ALLIANCE (A.536) Utah Juniper Shrubland Alliance

ECOLOGICAL SYSTEM(S): Great Basin Pinyon-Juniper Woodland (CES304.773)
Colorado Plateau Pinyon-Juniper Woodland (CES304.767)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This semi-natural woodland association is usually a degraded form of other *Juniperus osteosperma* associations with native grass understories. It occurs on ridges and benches in western Colorado and eastern Utah. In these stands, significant ground disturbance, such as ground fire or sheep grazing, allows *Bromus tectorum* to establish and out-compete native grasses. Elevations range from below 1600 to 1745 m (5250-5725 feet), and slopes vary from gentle to moderately steep. Soils are sandy and well-drained. The substrate is often rocky, and rocks, downed wood and cryptobiotic crusts may cover most of the unvegetated surface. The canopy of *Juniperus osteosperma* is usually open, with between 20 and 55% cover. Shrubs are sparse and low in diversity but may include scattered individuals of *Artemisia tridentata*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The exotic annual grass *Bromus tectorum* dominates the understory, although cover will vary from year to year depending on soil moisture levels in the early spring. Sometimes traces of the original native grasses will persist, including *Achnatherum hymenoides*, *Poa fendleriana*, *Pleuraphis jamesii*, and *Hesperostipa comata*. If forbs are present, they also tend to indicate disturbance.

DISTRIBUTION

Golden Spike National Historic Site

This association is only known from scattered stands on the north rim of the “Grand Canyon” within the NHS.

Globally

This association has been described from western Colorado and eastern Utah. It is likely to occur throughout the Intermountain West.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

The only sampled stand is located on gentle to moderate, south-facing slopes on the north rim of the “Grand Canyon”, a deep gully that cuts through the southern part of the NHS’s largest parcel. The ground surface is composed mostly of bedrock (limestone) exposures and shattered limestone fragments, with patches of soil. Soil texture is unknown.

Globally

This woodland association occurs on ridges and benches in western Colorado and eastern Utah. Elevations range from below 1600 to 1745 m (5250-5725 feet), and slopes vary from gentle to moderately steep. Soils are sandy and well-drained. The substrate is often rocky, and rocks, downed wood and cryptobiotic crusts may cover most of the unvegetated surface.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This association has a sparse canopy of *Juniperus osteosperma* providing up to 10% cover. The understory consists of scattered forbs and grasses typical of limestone outcrops in the NHS and large, continuous patches of *Bromus tectorum*. Shrubs are scattered throughout the community but are not dense enough to comprise a layer; *Sarcobatus*

vermiculatus and *Atriplex confertifolia* are the most conspicuous. Relict native herbaceous species include *Poa secunda*, *Leptodactylon watsonii*, and *Brickellia microphylla*.

Globally

This semi-natural woodland association is usually a degraded form of other *Juniperus osteosperma* associations with native grass understories. The canopy of *Juniperus osteosperma* is usually open, with between 20 and 55% cover. Shrubs are sparse and low in diversity but may include scattered individuals of *Artemisia tridentata*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*. The exotic annual grass *Bromus tectorum* dominates the understory, although cover will vary from year to year depending on soil moisture levels in the early spring. Sometimes traces of the original native grasses will persist, including *Achnatherum hymenoides*, *Poa fendleriana*, *Pleuraphis jamesii*, and *Hesperostipa comata*. If forbs are present, they also tend to indicate disturbance.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Herb (field)	<i>Bromus tectorum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Juniperus osteosperma</i>
Herb (field)	<i>Bromus tectorum</i>

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (12-Jul-2005).

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association occurs on the rocky rim of the deep gully that cuts across the southern part of the largest section of the NHS.

Golden Spike National Historic Site Plots: This description is based on 2007 field notes written directly on copies of the aerial imagery. No plot or observation point data were collected.

Local Description Authors: J. Coles

Global Description Authors: J. Coles

REFERENCES: Western Ecology Working Group n.d.

***Artemisia tridentata ssp. tridentata* / *Poa secunda* Shrubland
Basin Big Sagebrush / Curly Bluegrass Shrubland**

CODE	CEGL001008
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4)

PHYSIOGNOMIC SUBGROUP FORMATION ALLIANCE Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N)
Lowland microphyllous evergreen shrubland (III.A.4.N.a)
ARTEMISIA TRIDENTATA (*ssp. TRIDENTATA*, *ssp. XERICENSIS*) SHRUBLAND ALLIANCE (A.830)
(Basin Big Sagebrush, Foothill Big Sagebrush) Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This basin big sagebrush shrubland is known from the Great Basin, southern Columbia Plateau, Colorado Plateau, and Wyoming Basins. Stands occur on valley floors, drainages, and lower leeward slopes of ridges. Sites are flat to moderate sloping (1-8 degrees) and are found on all aspects. Elevation ranges between 241 m in eastern Washington up to 2095 m in southwestern Wyoming. The unvegetated surface has high exposure of bare soil, low cover of litter, and sparse cover of small rocks and downed wood. Soils are moderately well-drained to rapidly drained and vary texturally from sandy and silty loams to silty clay loam and clay. Parent materials include sandstones and shale. The vegetation is characterized by open to moderate cover of the tall shrub *Artemisia tridentata ssp. tridentata* (10-35% cover) and sparse to moderate cover of the perennial bunchgrass *Poa secunda* (1-50% cover). The shrub layer includes other short and dwarf-shrubs with sparse to low cover, such as *Artemisia arbuscula ssp. longiloba*, *Artemisia tridentata ssp. vaseyana*, *Atriplex gardneri*, *Chrysothamnus viscidiflorus*, and *Eriogonum* spp. The herbaceous layer has low diversity. Other grasses present may include low cover of *Aristida purpurea*, *Elymus elymoides*, *Elymus lanceolatus*, *Hesperostipa comata*, *Poa glauca*, and the non-native bunchgrass *Agropyron cristatum*. *Pseudoroegneria spicata* is usually absent or sparse. Forbs have very low cover and species diversity.

DISTRIBUTION

Golden Spike National Historic Site

This association is only known from the central part of the national historic site.

Globally

This basin big sagebrush shrubland is reported from the Great Basin, southern Columbia Plateau, Colorado Plateau, and Wyoming Basins of Nevada, Utah and Wyoming.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

The only sampled stand is located on a Pleistocene wavecut bench at 1461 m elevation. The ground surface is rocky with some cover by leaf litter and bare soil. The soil texture is silty clay.

Globally

This basin big sagebrush shrubland is known from the Great Basin, southern Columbia Plateau, Colorado Plateau, and Wyoming Basins. Stands occur on valley floors, drainages, and lower leeward slopes of ridges. Sites are flat to moderate sloping (1-8 degrees) and are found on all aspects. Elevation ranges between 241 m in eastern Washington up to 2095 m in southwestern Wyoming (Daubenmire 1970). The unvegetated surface has high exposure of bare soil, low cover of litter, and sparse cover of small rocks and downed wood. Soils are moderately well-drained to rapidly drained and vary texturally from sandy and silty loams to silty clay loam and clay. Parent materials include sandstones and shale that have eroded and deposited as secondary stream alluvium.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This association has an open canopy of *Artemisia tridentata ssp. tridentata* providing 10% cover and a sparse understory of *Poa secunda*. *Pseudoroegneria spicata*, and *Bromus tectorum* may also occur in the herbaceous layer.

Globally

This association is characterized by open to moderate cover of the tall shrub *Artemisia tridentata ssp. tridentata* (10-35% cover) and sparse to moderate cover of the perennial bunchgrass *Poa secunda* (1-50% cover). The shrub layer includes other short and dwarf-shrubs with sparse to low cover, such as *Artemisia arbuscula ssp. longiloba*, *Artemisia tridentata ssp. vaseyana*, *Atriplex gardneri*, *Chrysothamnus viscidiflorus*, and *Eriogonum* spp. The

herbaceous layer has low diversity. Other grasses present may include low cover of *Aristida purpurea*, *Elymus elymoides*, *Elymus lanceolatus*, *Hesperostipa comata*, *Poa glauca*, and the non-native bunchgrass *Agropyron cristatum*. *Pseudoroegneria spicata* is usually absent or sparse. Forbs have very low cover and species diversity and may include *Alyssum desertorum*, *Antennaria dimorpha*, *Descurainia* sp., *Lappula occidentalis*, *Lepidium virginicum*, and *Ceratocephala testiculata* (Daubenmire 1970).

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>
Herb (field)	<i>Poa secunda</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Bromus tectorum

Globally

Agropyron cristatum, *Alyssum desertorum*, *Ceratocephala testiculata*, *Lepidium virginicum*

CONSERVATION STATUS RANK

Global Rank & Reasons: G3G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association occurs on an ancient lake bench that was disturbed by fiber optic line installation. The type is small, with a distinct photosignature, but does not occur elsewhere within the national historic site.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (1 observation point: GOSP.9229).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Daubenmire 1970, Driscoll et al. 1984, Moretti 1979, Moretti and Brotherson 1982, Robertson 1971, Western Ecology Working Group n.d.

***Artemisia tridentata* - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland Basin Big Sagebrush - (Rubber Rabbitbrush) / Cheatgrass Semi-natural Shrubland**

CODE	CEGL002699
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N)
FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a)
ALLIANCE	ARTEMISIA TRIDENTATA SHRUBLAND ALLIANCE (A.829)

Basin Big Sagebrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)
Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association is common throughout the Colorado Plateau and likely occurs on disturbed sites throughout the range of basin big sagebrush in the western U.S. Stands occur in small to moderate-sized patches on alluvial terraces, floodplains, and point bars, mostly below 2000 m (6560 feet) elevation. *Artemisia tridentata ssp. tridentata* shrubs are always present, often with a lesser component of *Ericameria nauseosa*, *Atriplex canescens*, or *Chrysothamnus viscidiflorus*. *Bromus tectorum* dominates the occasionally sparse herbaceous layer, frequently accompanied by other weedy exotic or annual grasses and forbs. Individuals or small patches of native grasses and forbs may occur, including *Leymus cinereus*, *Achnatherum hymenoides*, and *Sporobolus cryptandrus*.

DISTRIBUTION

Golden Spike National Historic Site

This is one of the most abundant and widespread associations within the national historic site. It is dominant along the West Auto Tour route as well as the area around the East Auto Tour route.

Globally

This association is widespread in southern Utah and western Colorado and likely occurs on disturbed sites throughout the range of basin big sagebrush in the western U.S.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

Stands occur on nearly level sites to moderately steep slopes with varying exposures between 1363 and 1514 m elevation. Bare soil, gravel, and leaf litter cover most of the ground surface, sometimes with low cover of moss or scattered dead wood. Soils are typically shallow and gravelly, based on the underlying limestone bedrock.

Globally

This association occurs on alluvial terraces, flats and fans or valley floors throughout the Colorado Plateau and extends into the Great Basin. Most stands occur on level to gently sloping sites below 2000 m (6560 feet) elevation. Soils are variable and include sandy loams, silt loams, and clay loams, depending on the size of the stream and the geology of the area. Parent materials is frequently alluvium but includes sandstones, shale, limestone, eolian deposits and Precambrian gneiss. The unvegetated surface often has high cover of litter and bare soil with low cover of rocks. Cryptobiotic soil crusts are often extensive (up to 15% in some stands).

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This association is characterized by the tall shrub *Artemisia tridentata ssp. tridentata* providing 4 to 30% cover, typically with an understory dominated by *Bromus tectorum* with between 10 and 50% cover. Other shrubs present with low cover may include *Artemisia nova*, *Brickellia microphylla*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, and *Gutierrezia sarothrae*. The remaining herbaceous layer includes a diversity of native and exotic grasses, among which *Agropyron cristatum*, *Aristida purpurea*, *Bromus briziformis*, *Pseudoroegneria spicata*, and *Sporobolus cryptandrus* are the most consistent. Forbs are a sparse but consistent element of the herbaceous layer and include *Descurainia pinnata*, *Stenotus acaulis*, *Heterotheca villosa*, *Leptodactylon watsonii*, *Ceratocephala testiculata*, and *Sisymbrium altissimum*.

Globally

This big sagebrush association is widespread on floodplains and terraces within the Colorado Plateau that have been subject to grazing. *Artemisia tridentata ssp. tridentata* is always present in the sparse to dense shrub canopy (10-70% cover) with cover of sagebrush between 5 and 70% and up to 2 m in height. *Ericameria nauseosa* is not always present but is likely to be present in the vicinity. *Artemisia tridentata ssp. wyomingensis* may be present in some stands. Other shrubs that occur in this community consistently include *Atriplex canescens*, *Chrysothamnus viscidiflorus*, and *Sarcobatus vermiculatus*. Less common shrubs are *Artemisia nova*, *Brickellia microphylla*,

Ephedra viridis, *Gutierrezia sarothrae*, *Opuntia* spp., or *Tetradymia canescens*. In some stands there may be scattered trees of *Pinus edulis*, *Juniperus osteosperma*, *Juniperus scopulorum*, and *Populus angustifolia*. The herbaceous layer reflects a long history of disturbance and is dominated by exotic annual *Bromus* species, especially *Bromus tectorum*. Other common exotic herbaceous species include *Bromus rigidus*, *Ceratocephala testiculata*, *Erodium cicutarium*, *Lappula occidentalis*, *Lactuca serriola*, and *Sisymbrium altissimum*. Because it is dominated by annual species, the total herbaceous cover varies depending on seasonal precipitation. Remnant native herbaceous vegetation may include scattered individuals or patches of *Achnatherum hymenoides*, *Descurainia pinnata*, *Elymus elymoides*, *Hesperostipa comata*, *Heterotheca villosa*, *Leptodactylon watsonii*, *Oenothera caespitosa*, *Senecio spartioides*, *Stenotus acaulis*, and others. Exotic perennial species such as *Acroptilon repens*, *Agropyron cristatum*, *Bromus inermis*, *Cardaria draba*, and *Carduus nutans ssp. macrolepis* may also be present because of the disturbed nature of this community.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ericameria nauseosa</i> , <i>Artemisia tridentata ssp. tridentata</i>
Herb (field)	<i>Ceratocephala testiculata</i>
Herb (field)	<i>Agropyron cristatum</i> , <i>Bromus briziformis</i> , <i>Bromus tectorum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Tall shrub/sapling	<i>Artemisia tridentata ssp. tridentata</i>
Herb (field)	<i>Bromus tectorum</i>

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Agropyron cristatum, *Bromus briziformis*, *Bromus tectorum*, *Sisymbrium altissimum*

Globally

Acroptilon repens, *Agropyron cristatum*, *Bromus inermis*, *Bromus rigidus*, *Bromus tectorum*, *Cardaria draba*, *Carduus nutans ssp. macrolepis*, *Ceratocephala testiculata*, *Erodium cicutarium*, *Lactuca serriola*, *Salsola tragus*, *Sisymbrium altissimum*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (14-Aug-2001).

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

This semi-natural association is likely much more widespread across the western U.S. but is not often sampled.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: Several stands have numerous small outcrops of dark gray limestone and dry, rocky slopes. Black sagebrush is limited to thin soils and bedrock fractures. There is evidence of recent cattle grazing on one site.

Golden Spike National Historic Site Field Data: This description is based on 2007 field data (9 observation points: GOSP.9002, GOSP.9005, GOSP.9106, GOSP.9124, GOSP.9210, GOSP.9214, GOSP.9216, GOSP.9217, GOSP.9218).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Cogan et al. 2004, Western Ecology Working Group n.d.

***Ericameria nauseosa* / *Bromus tectorum* Semi-natural Shrubland
Rubber Rabbitbrush / Cheatgrass Semi-natural Shrubland**

CODE	CEGL002937
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Evergreen shrubland (III.A)
PHYSIOGNOMIC GROUP	Microphyllous evergreen shrubland (III.A.4)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural microphyllous evergreen shrubland (III.A.4.N)
FORMATION	Lowland microphyllous evergreen shrubland (III.A.4.N.a)
ALLIANCE	<i>ERICAMERIA NAUSEOSA</i> SHRUBLAND ALLIANCE (A.835) Rubber Rabbitbrush Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)
Inter-Mountain Basins Wash (CES304.781)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This shrubland occurs in disturbed situations at moderate altitudes in the Colorado Plateau; it extends into the Great Basin and is likely widespread in disturbed areas across the western U.S. Most stands are the result of fires in sagebrush or other types of shrublands, but some derive from other forms of disturbance, including overgrazing. Elevations range from 1220 to 2085 m (4000-6840 feet), and sites occur on gentle to steep slopes. Sites include intermittently flooded drainages, stream terraces and broad floodplains, basins and upland slopes. Soils are variable; most stands occur on well-drained sandy loams that are often rocky, but others occur on loam or gravelly clay or clay loam soils. Total vegetation cover is relatively sparse to dense, depending primarily on the density of cheatgrass in any given year. The shrub canopy is open to moderately dense, consisting of *Ericameria nauseosa* with 10-60% cover. Scattered individuals of other shrub species such as *Artemisia tridentata*, *Rhus trilobata*, *Atriplex canescens*, and *Atriplex confertifolia* may be present. The herbaceous layer contains many species but is overwhelmingly dominated by *Bromus tectorum*. Relict native herbaceous grasses include *Aristida purpurea*, *Elymus elymoides*, *Achnatherum hymenoides*, *Poa fendleriana*, and *Sporobolus cryptandrus*. Native herbaceous species are common but contribute only sparse cover and may include *Cleome lutea*, *Eriogonum inflatum*, and *Heterotheca villosa*. Weedy forbs are abundant in most stands, including *Descurainia pinnata*, *Lappula occidentalis*, and *Salsola tragus*.

DISTRIBUTION

Golden Spike National Historic Site

This association is known from the central and western sections of the national historic site.

Globally

This association has currently only been described from northeastern Arizona, northwestern Colorado and southern, eastern and northern Utah but is likely more widespread throughout the western U.S. in disturbed areas.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

Stands occur on a broad range of sites between 1388 and 1416 m elevation. As is typical of stands characterized by cheatgrass, leaf litter covers most of the ground surface. Soils are gravelly clays and gravelly clay loams based on the local limestone bedrock and Pleistocene lake deposits.

Globally

This shrubland occurs in disturbed situations at moderate altitudes in the Colorado Plateau; it extends into the Great Basin and is likely widespread in disturbed areas across the western U.S. It has been documented from sites in northeastern Arizona, northwestern Colorado and southern, eastern and northern Utah. Sites include intermittently flooded drainages, stream terraces and broad floodplains, basins and moderate to steep upland slopes. Elevations range from 1220 to 2085 m (4000-6840 feet), and sites occur on gentle to steep slopes that may be oriented to any aspect. Soils are variable; most sampled stands occur on sandy loams that are well-drained and often rocky, but other stands occur on loam or gravelly clay or clay loam soils. Litter and bare soil cover most of the ground surface. Parent materials are variable and include sandstones and shale that have eroded and deposited as alluvium, limestone, and Pleistocene lake deposits.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This association is characterized by a sparse to open canopy of *Ericameria nauseosa* (10-20% cover). Associated canopy shrubs include *Artemisia tridentata* ssp. *tridentata* and *Gutierrezia sarothrae*. *Bromus tectorum* dominates the herbaceous layer, providing up to 90% cover. Native bunch grasses such as *Aristida purpurea* and *Sporobolus cryptandrus* may be present with low cover.

Globally

Total vegetation cover is relatively sparse to dense, depending primarily on the density of cheatgrass in any given year. The shrub canopy is open to moderately dense, consisting of *Ericameria nauseosa* with 10-60% cover. Scattered individuals of other shrub species such as *Artemisia tridentata*, *Rhus trilobata*, *Gutierrezia sarothrae*, *Atriplex canescens*, and *Atriplex confertifolia* may be present. Cover of *Yucca elata* var. *utahensis* and *Opuntia* spp. may be more abundant. Occasional *Elaeagnus angustifolia* or *Juniperus* spp. trees are present in some stands. The herbaceous layer contains many species but is overwhelmingly dominated by *Bromus tectorum* providing up to 90% cover. Relict native herbaceous grasses include *Aristida purpurea*, *Achnatherum hymenoides*, *Elymus elymoides*, *Poa fendleriana*, and *Sporobolus cryptandrus*. Native herbaceous species are also common but contribute only sparse cover and may include *Cleome lutea*, *Eriogonum inflatum*, and *Heterotheca villosa*. Weedy forbs are more abundant in most stands, including *Descurainia pinnata*, *Lappula occidentalis*, and exotics *Salsola tragus*, *Rumex crispus*, *Sonchus asper*, *Tamarix chinensis*, and *Tragopogon dubius*.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ericameria nauseosa</i>
Herb (field)	<i>Bromus tectorum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Ericameria nauseosa</i>
Herb (field)	<i>Bromus tectorum</i>

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Bromus tectorum

Globally

Bromus tectorum, *Descurainia pinnata*, *Elaeagnus angustifolia*, *Lepidium latifolium*, *Rumex crispus*, *Salsola tragus*, *Sonchus asper*, *Tamarix chinensis*, *Tragopogon dubius*, *Yucca elata* var. *utahensis*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (ruderal) (14-Aug-2001).

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association occurs on gentle slopes amid large stands of cheatgrass representing recent burns. The shrubs on one site are mostly young.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (2 observation points: GOSP.9215, GOSP.9224).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Cogan et al. 2004, Western Ecology Working Group n.d.

***Sarcobatus vermiculatus* Disturbed Shrubland Greasewood Disturbed Shrubland**

CODE	CEGL001357
PHYSIOGNOMIC CLASS	Shrubland (III)
PHYSIOGNOMIC SUBCLASS	Deciduous shrubland (III.B)
PHYSIOGNOMIC GROUP	Extremely xeromorphic deciduous shrubland (III.B.3)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural extremely xeromorphic deciduous shrubland (III.B.3.N)
FORMATION	Intermittently flooded extremely xeromorphic deciduous subdesert shrubland (III.B.3.N.b)
ALLIANCE	<i>SARCOBATUS VERMICULATUS</i> INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1046) Greasewood Intermittently Flooded Shrubland Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Greasewood Flat (CES304.780)
Inter-Mountain Basins Wash (CES304.781)
Inter-Mountain Basins Playa (CES304.786)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This greasewood shrubland occurs on saline soils of terraces, swales, alluvial fans and flats, valley floors, playas, toeslopes and ridges throughout the Colorado Plateau and Great Basin and extends to mountain valleys in the southern Rocky Mountains. It is distinguished from other *Sarcobatus vermiculatus* associations in that disturbance has removed most or all of the native herbaceous understory. Black greasewood will increase in density at the expense of grasses such as *Sporobolus airoides* under conditions of heavy grazing, since the shrub is only moderately palatable and is somewhat poisonous to livestock. Soil textures in these communities range from sandy loam to silty clay and may have a white salt crust on the soil surface. *Sarcobatus vermiculatus* dominates the sparse to moderately dense shrub layer, usually with a minor component of *Ericameria nauseosa*, *Suaeda moquinii*, *Opuntia polyacantha*, *Atriplex canescens*, or *Atriplex confertifolia*. If *Artemisia tridentata* is present, it is with very low cover. The understory ranges from sparse to dense in cover, but native species typically have very low cover. The dominant herbaceous species tend to be weedy and/or exotic; *Vulpia octoflora*, *Bromus tectorum*, *Descurainia pinnata*, *Salsola tragus*, *Alyssum desertorum*, and *Halogeton glomeratus* are typical understory species.

DISTRIBUTION

Golden Spike National Historic Site

This association is known from the central part of the national historic site.

Globally

This association is likely to be widespread on floodplains and valley floors throughout the interior western United States. It is currently documented from the Colorado Plateau, Great Basin, Uinta Basin and San Luis Valley from northwestern New Mexico, southern and western Colorado, Utah, Nevada, and eastern California.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

The sampled stand occurs on moderately to steep gullies and slopes with east- to southeast-facing exposures between 1351 and 1379 m elevation. Bare ground and leaf litter cover most of the ground surface, although wood and gravel are often present. Soils are gravelly clays and gravelly clay loams.

Globally

This widespread but patchy shrubland occurs throughout the Colorado Plateau and Great Basin and extends to mountain valleys in the southern Rocky Mountains. Stands are found on terraces, swales, coppice dunes, playas, alluvial fans and flats, valley floors, toeslopes and ridges. Elevation ranges between 1200 and 2308 m (3940-7570 feet), and slopes tend to be gentle. Soils are typically derived from mixed alluvium (shale, sandstone and gneiss), from shale that erodes into moderate to steep gullies and slopes (badlands), or from eolian deposits. Soil textures range from sand to silty clay and tend to be alkaline and saline, often with a white salt crust on the soil surface.

Sabkha substrates (carbonate cemented sand) occur on subirrigated areas near dunes in southern Colorado. Biological soil crusts are typically absent or provide low cover, but occasionally have higher (up to 25%) cover. Bare ground values tend to be high, up to 80%, unless *Bromus tectorum* is a major component of the system, in which case litter cover values are high.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This association is characterized by an open canopy of *Sarcobatus vermiculatus* shrubs. Other shrubs present with lower cover include *Chrysothamnus vaseyi*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, and *Gutierrezia sarothrae*. *Bromus tectorum* usually dominates the understory. Native bunch grasses, including *Achnatherum hymenoides*, *Leymus cinereus*, *Poa secunda*, and *Pseudoroegneria spicata*, may be present with low cover. The forbs *Artemisia dracunculus* and *Leptodactylon watsonii* are scattered within some stands.

Globally

This shrubland occurs where conditions support *Sarcobatus vermiculatus*, but disturbance has removed most or all of the native herbaceous understory. *Sarcobatus vermiculatus* dominates the sparse to moderately dense shrub layer with a cover of 10-60%. Other shrubs commonly present may include *Atriplex canescens*, *Atriplex confertifolia*, *Atriplex gardneri*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Grayia spinosa*, *Opuntia polyacantha*, *Picrothamnus desertorum*, *Suaeda moquinii* (= *Suaeda torreyana*), and *Tetradymia canescens*. If *Artemisia tridentata* is present, it is with very low cover. The understory ranges from sparse to dense in cover, but native species typically have very low cover. The dominant herbaceous species tend to be weedy and/or exotic; *Vulpia octoflora*, *Bromus tectorum*, *Descurainia pinnata*, *Erodium cicutarium*, *Salsola tragus*, *Alyssum desertorum*, and *Halogeton glomeratus* are typical understory dominants.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i> , <i>Sarcobatus vermiculatus</i>
Herb (field)	<i>Bromus tectorum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Sarcobatus vermiculatus</i>

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Bromus tectorum

Globally

Alyssum desertorum, *Bromus tectorum*, *Descurainia pinnata*, *Erodium cicutarium*, *Halogeton glomeratus*, *Salsola tragus*

CONSERVATION STATUS RANK

Global Rank & Reasons: G5 (23-Feb-1994).

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

Stands included in this association are often affected by livestock grazing, and either lack an understory or possess an understory dominated by weedy or exotic herbaceous species.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association occurs on variable terrain with multiple slope exposures. Black greasewood occupies more exposed sites, while green rabbitbrush occurs in protected sites.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (2 observation points: GOSP.9222, GOSP.9231).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Brotherson et al. 1986, Dastrup 1963, Donovan et al. 1996, Driscoll et al. 1984, Francis 1986, Ganskopp 1986, Graham 1937, Groeneveld and Crowley 1988, Shantz and Piemeisel 1940, Western Ecology Working Group n.d., Young et al. 1986

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

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

CODE	CEGL005266
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC 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	<i>AGROPYRON CRISTATUM</i> SEMI-NATURAL HERBACEOUS ALLIANCE (A.3563) Crested Wheatgrass Semi-natural Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Northwestern Great Plains Mixedgrass Prairie (CES303.674)
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This crested wheatgrass association occurs most commonly in the northern Great Plains of the United States and Canada. Sites are also reported from the southern Rocky Mountains and Colorado Plateau, and it likely occurs throughout much of the semi-arid interior West. Stands occur in a variety of human-disturbed habitats, including highway rights-of-way, jeep trails, etc. It is also widely planted to revegetate pastures and western rangelands. The vegetation is characterized by a sparse to dense, medium-tall graminoid layer dominated by *Agropyron cristatum*, an introduced forage species from Russia and Siberia that has been planted extensively in the western United States. 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. In the Intermountain West, native grasses *Poa secunda* and *Pseudoroegneria spicata* may be present at low cover.

DISTRIBUTION

Golden Spike National Historic Site

This association occupies planted areas along the railroad right-of-way throughout most of the national historic site. It also dominates some of the old fields surrounding the Visitor Center.

Globally

This community occurs most commonly in the northern Great Plains of the United States and Canada. Sites are also reported from the southern Rocky Mountains and Colorado Plateau, and it likely occurs throughout much of the semi-arid interior West.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

This common association occupies level to gently sloping sites in the western half of the national historic site. Exposed soil, gravel, and leaf litter provide most of the ground cover. Soils are deep and formed in alluvial deposits.

Globally

This grassland occurs in the northern Great Plains, southern Rocky Mountains, Colorado Plateau and likely occurs throughout much of the semi-arid interior West. This type can occur in a wide variety of human-disturbed habitats,

including railroad and highway rights-of-way, jeep trails, etc. It is also widely planted to revegetate pastures and western rangelands. Substrates are variable but tend to be loamy or finer-textured soils such as silt or clay loams.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This association is characterized by the overwhelming dominance of the non-native bunchgrass *Agropyron cristatum*. Vegetation is relatively dense for an herbaceous community; most stands provide 40 to 60% cover. Some stands are nearly pure crested wheatgrass; others include scattered clumps of native grasses such as *Pseudoroegneria spicata*. *Bromus tectorum* may be present but is not abundant. Exotic and native forbs such as *Helianthus annuus* and *Sisymbrium altissimum* are often present.

Globally

The vegetation is characterized by an open to dense, medium-tall (0.5-1 m) graminoid layer dominated by *Agropyron cristatum*, an introduced forage species from Russia and Siberia that has been planted extensively in the northwestern Great Plains and to a lesser extent in the interior western U.S. such as on the Colorado Plateau. It has also been used to revegetate disturbed areas and has expanded into natural vegetation communities. Other species present are often introduced or weedy and include annuals *Bromus japonicus*, *Bromus tectorum*, *Helianthus annuus*, and *Sisymbrium altissimum*, and perennials *Bromus inermis*, *Convolvulus arvensis*, *Descurainia sophia*, *Linaria vulgaris*, *Melilotus officinalis*, *Poa pratensis*, *Psathyrostachys juncea* (= *Elymus junceus*), and *Verbascum thapsus*. Remnant native species generally have less than 10% cover and include *Bouteloua gracilis*, *Nassella viridula*, *Pascopyrum smithii*, and *Hesperostipa comata* in mixed-grass prairie, and *Poa secunda*, *Pseudoroegneria spicata*, and *Leptodactylon pungens* in intermountain regions. Short and dwarf-shrubs may provide sparse cover in some stands and include *Atriplex canescens*, *Ericameria nauseosa*, and *Gutierrezia sarothrae*.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Agropyron cristatum</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Agropyron cristatum</i>

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Agropyron cristatum, *Bromus tectorum*, *Sisymbrium altissimum*

Globally

Agropyron cristatum, *Bromus inermis*, *Bromus japonicus*, *Bromus tectorum*, *Convolvulus arvensis*, *Descurainia sophia*, *Helianthus annuus*, *Linaria vulgaris*, *Melilotus officinalis*, *Poa pratensis*, *Psathyrostachys juncea*, *Sisymbrium altissimum*, *Verbascum thapsus*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (17-Jun-1999). This is a naturalized type from Europe, widely planted to revegetate roadsides and pastures.

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

Where native species are conspicuous enough to identify the native plant association that could occupy the site, the stand should be typed as such.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association was seeded in disturbed sites such as railroad rights-of-way and old fields. Once established it forms a near monoculture with only scattered native grasses.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (2 observation points: GOSP.9107, GOSP.9219).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: D. Faber-Langendoen, mod. K.A. Schulz

REFERENCES: Butler et al. 2002, Hansen et al. 1984, MTNHP 2002b, Midwestern Ecology Working Group n.d., NDNHI n.d., Von Loh et al. 2000

***Aristida purpurea* Herbaceous Vegetation Purple Three-awn Herbaceous Vegetation**

CODE	CEGL005800
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC 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	<i>ARISTIDA PURPUREA</i> HERBACEOUS ALLIANCE (A.2570) Purple Three-awn Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
Western Great Plains Shortgrass Prairie (CES303.672)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This purple three-awn grassland association occurs widely in the interior western U.S. and the western Great Plains. This semi-arid grassland is found on a variety of sites, such as western shortgrass prairie, intermountain basins, alluvial flats, and a Pleistocene lake bench. Substrates are often sandy or gravelly soils. The vegetation is characterized by *Aristida purpurea* dominating a sparse to open grass layer. Associates vary depending on the pre-disturbance community, but frequently include other dry, grazing-tolerant grasses such as scattered *Bouteloua gracilis*, *Poa secunda*, or *Sporobolus cryptandrus*; occasional shrubs may include *Ericameria nauseosa* or *Gutierrezia sarothrae* that are common in disturbed areas, or remnants of late-seral communities such as *Artemisia tridentata* ssp. *tridentata*. Introduced species may be common, such as *Bromus tectorum* in disturbed stands.

DISTRIBUTION

Golden Spike National Historic Site

This association was sampled in the central section of the national historic site on Promontory Summit.

Globally

This grassland association is reported from the Colorado Plateau, Great Basin and shortgrass prairie, but likely occurs widely in the semi-arid interior western U.S. and the western Great Plains.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

The one sampled site for this association is on a Pleistocene lake bench at an elevation of 1465 m. Leaf litter covers most of the ground surface, with sparse cover of gravel and bare soil. Soils are gravelly in texture.

Globally

This semi-arid grassland association occurs widely the interior western U.S. and the western Great Plains, but is infrequently sampled because it is associated with disturbance. Stands are reported from a Pleistocene lake bench in northern Utah and alluvial flats in northern Arizona; however, it is found on a variety of sites, including western prairie and intermountain basins. Elevation ranges from 1465-1970 m. Substrates are often sandy or gravelly soils.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This sparse grassland is dominated by *Aristida purpurea* with around 10% cover. *Poa secunda* and *Bromus tectorum* are also usually present with lesser cover. Other species present include scattered individuals of *Sisymbrium altissimum* and *Artemisia tridentata* ssp. *tridentata*.

Globally

This generally sparse or open grassland is characterized by the dominance of *Aristida purpurea*. Associates are variable depending on what community existed before disturbance, but frequently include low cover of other dry, grazing-tolerant grasses. *Bouteloua gracilis*, *Poa secunda*, or *Sporobolus cryptandrus* may be present but do not codominate. Occasional shrubs may include *Ericameria nauseosa* or *Gutierrezia sarothrae* that are common in disturbed areas, or remnants of late-seral communities such as *Artemisia tridentata*. *Yucca* spp. are common on sites with coarse-textured soils. Introduced species may be common, such as *Bromus tectorum*, *Sisymbrium altissimum*, and *Verbascum thapsus*.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Aristida purpurea</i> , <i>Bromus tectorum</i> , <i>Poa secunda</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Aristida purpurea</i>

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Bromus tectorum, *Sisymbrium altissimum*

Globally

Bromus tectorum, *Sisymbrium altissimum*, *Verbascum thapsus*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (29-Aug-2002).

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

Stands of this association are strongly dominated by *Aristida purpurea* and are frequently anthropogenically or naturally disturbed. Some stands result from heavy livestock grazing of other perennial grassland types. This type is likely to occur throughout much of the Colorado Plateau and western Great Plains. Further documentation is needed.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association is uncommon within the national historic site and was sampled on a site disturbed by fiber optic line installation. The stand occurs as an inclusion within a basin big sagebrush shrubland.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (1 observation point: GOSP.9230).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: K.A. Schulz

REFERENCES: Hansen et al. 2004a, Howard 1997, Shaw et al. 1989, USFS 1937, Western Ecol. Working Gp n.d.

***Hesperostipa comata* Great Basin Herbaceous Vegetation**
Needle-and-Thread Great Basin Herbaceous Vegetation

CODE	CEGL001705
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC 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	<i>HESPEROSTIPA COMATA</i> BUNCH HERBACEOUS ALLIANCE (A.1270) Needle-and-Thread Bunch Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This semi-arid grassland occurs on the Great Basin and Colorado Plateau east into the western slope of the southern Rocky Mountains. Stands are found on a variety of sites, such as on point bars, stream terraces, in sand-filled potholes in slickrock washes, on plains, valleys, canyon floors, gentle hillslopes, knolls and bluffs, mesatops, and plateau parks. Sites are generally flat to gently sloping, but occasionally are steep (to 53% slope). Soils are variable and range from sand to silty clay. The unvegetated surface has moderate to high cover of bare soil with sparse to moderate cover of litter. Biological soil crusts are often present with low cover. The vegetation is characterized by a relatively sparse to moderate herbaceous layer (10-40% cover) that is strongly dominated by the medium-tall, cool-season bunchgrass *Hesperostipa comata*, but it may also include stands with less than 10% total vegetation cover. Low cover of other grasses, such as *Achnatherum hymenoides*, *Achnatherum lettermanii*, *Aristida purpurea*, *Elymus elymoides*, *Koeleria macrantha*, *Leymus salinus*, *Pleuraphis jamesii*, *Poa fendleriana*, or *Sporobolus cryptandrus*, may be present. However, *Bouteloua eriopoda* is not present. Forb cover ranges from sparse to moderate and may be diverse. Associated forbs include *Balsamorhiza sagittata*, *Hymenopappus filifolius*, *Machaeranthera canescens*, *Sphaeralcea coccinea*, *Vicia americana*, and species of *Antennaria*, *Astragalus*, *Cryptantha*, *Eriogonum*, *Gilia*, and *Lappula*. Scattered shrubs and dwarf-shrubs may present with less than 5% total cover. Common species include *Artemisia tridentata*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Opuntia polyacantha*, and *Symphoricarpos oreophilus*. The widespread introduced annual grass *Bromus tectorum* often contributes significant cover in disturbed stands. Some stands have high cover of biological soil crusts.

DISTRIBUTION

Golden Spike National Historic Site

This association is known only from the central area of the national historic site.

Globally

This grassland is found on the west slope of the Colorado Rocky Mountains, Colorado Plateau and Great Basin in Colorado and Utah, and probably occurs in adjacent states.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

This association occupies gentle to moderate slopes and is uncommon at the historic site. The sampled site is at 1435 m elevation. Stands occur as bands or patches within matrix-forming shrublands. In most sites, fires have cleared the area of woody vegetation. Bare soil and leaf litter cover most of the ground surface. Soils are typically deep.

Globally

This grassland occurs on the Great Basin and Colorado Plateau east into the western slope of the southern Rocky Mountains. Stands are found a variety of sites, such as on point bars, stream terraces, in sand-filled potholes in slickrock washes, on plains, valleys, canyon floors, gentle hillslopes, knolls and bluffs, mesatops, and plateau parks. Sites are generally flat to gently sloping, but occasionally are steep (to 53% slope). Elevation ranges from 1250-2320 m. The unvegetated surface has moderate to high cover of bare soil with sparse to moderate cover of litter. Biological soil crusts are often present with low cover. Soils are variable and include sand, cobbles, sandy, silt and clay loams and silty clay. Common parent materials are sandstones and shale that have been eroded and

redistributed in alluvial and eolian deposits, but include Tertiary volcanic rocks. Fires may be important in maintaining these grasslands by reducing woody cover, but burning during the growing season could also damage *Hesperostipa comata* plants.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This herbaceous association is overwhelmingly dominated by the native bunchgrass *Hesperostipa comata*. Stands are relatively open, seldom exceeding 35% cover. *Poa secunda* and *Bromus tectorum* are common components of the community, although with relatively low cover. *Chrysothamnus viscidiflorus* provides up to 5% cover, and *Ericameria nauseosa* shrubs are widely scattered. The shrubs become denser on north-facing slopes.

Globally

This association is characterized by a relatively sparse to moderate herbaceous layer (10-40% cover) that is strongly dominated by the medium-tall, cool-season bunchgrass *Hesperostipa comata*, but it may also include stands with less than 10% total vegetation cover. Low cover of other grasses, such as *Achnatherum hymenoides*, *Achnatherum lettermanii*, *Aristida purpurea*, *Elymus elymoides*, *Koeleria macrantha*, *Leymus salinus*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, or *Sporobolus cryptandrus*, may be present. However, *Bouteloua eriopoda* is not present. Forb cover ranges from sparse to moderate and may be diverse. Associated species include *Artemisia campestris*, *Artemisia dracunculoides*, *Artemisia ludoviciana*, *Balsamorhiza sagittata*, *Cirsium arizonicum*, *Machaeranthera canescens*, *Cryptantha crassisepala*, *Hymenopappus filifolius*, *Sphaeralcea coccinea*, *Vicia americana*, and species of *Antennaria*, *Astragalus*, *Eriogonum*, *Gilia*, and *Lappula*. Scattered shrubs and dwarf-shrubs may present with less than 5% total cover. *Artemisia tridentata* ssp. *tridentata*, *Artemisia tridentata* ssp. *vaseyana*, *Ericameria nauseosa*, *Chrysothamnus depressus*, *Chrysothamnus viscidiflorus*, *Krascheninnikovia lanata*, *Ribes cereum*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Purshia tridentata*, , and *Symphoricarpos oreophilus* have been reported from this grassland. The widespread introduced annual grass *Bromus tectorum* often contributes significant cover in disturbed stands. Several other exotic species may be present to abundant and include *Salsola tragus*, *Bassia scoparia*, *Poa pratensis*, *Sisymbrium altissimum*, and *Tragopogon dubius*. Some stands have high cover of soil cryptogams *Collema tenax*, *Tortula ruralis*, *Buellia papillata*, and *Fulgensia bracteata* (Kleiner and Harper 1977).

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i>
Herb (field)	<i>Hesperostipa comata</i> , <i>Poa secunda</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Hesperostipa comata</i>

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Bromus tectorum

Globally

Arabis crandallii, *Astragalus anisus*, *Bassia scoparia*, *Bromus tectorum*, *Cirsium arizonicum*, *Poa pratensis*, *Salsola tragus*, *Sisymbrium altissimum*, *Tragopogon dubius*

CONSERVATION STATUS RANK

Global Rank & Reasons: G2G4 (23-Feb-1994).

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

This association is composed of relatively pure *Hesperostipa comata* grasslands in the Intermountain West. The similar associations are distinguished by the codominance by other grass species or a shrub layer.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association is limited to higher, better drained ground on valley floors and is uncommon at the historic site.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (1 observation point: GOSP.9223).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: K.A. Schulz, mod. J. Coles

REFERENCES: Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Cogan et al. 2004, Coles pers. comm., Daubenmire 1970, Driscoll et al. 1984, FEIS 1998, Kleiner 1968, Kleiner 1983, Kleiner and Harper 1977, Thilenius et al. 1995, Western Ecology Working Group n.d.

***Pseudoroegneria spicata* - *Hesperostipa comata* Herbaceous Vegetation
Bluebunch Wheatgrass - Needle-and-Thread Herbaceous Vegetation**

CODE	CEGL001679
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC 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	<i>PSEUDOROEGNERIA SPICATA</i> HERBACEOUS ALLIANCE (A.1265) Bluebunch Wheatgrass Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Columbia Basin Palouse Prairie (CES304.792)
Western Great Plains Foothill and Piedmont Grassland (CES303.817)
Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)
Western Great Plains Sand Prairie (CES303.670)
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This grassland association occurs in the Columbia Basin and Great Basin across north-central Wyoming east to the Big Horn Mountains into the northwestern Great Plains. Stands occur on a variety of sites that include windswept slopes and ridges. Sites range from gentle to steep slopes on all aspects. Bare soil, leaf litter, and gravel cover most of the ground surface. The vegetation is characterized by an open to moderately dense bunchgrass layer codominated by *Pseudoroegneria spicata* and *Hesperostipa comata*. The dwarf-shrubs *Artemisia frigida* and *Gutierrezia sarothrae* occur with sparse cover. Other graminoids include *Bouteloua gracilis*, *Carex* spp., *Koeleria macrantha*, *Leymus cinereus*, *Poa fendleriana*, and *Poa secunda*. Associated forbs include *Astragalus* spp., *Comandra umbellata*, *Phlox hoodii*, and *Sphaeralcea munroana*. The exotic annual grass *Bromus tectorum* is present to abundant on some sites.

DISTRIBUTION

Golden Spike National Historic Site

This association is known from the Big Fill area of the national historic sites and is uncommon there.

Globally

This grassland association occurs in the Columbia Basin and Great Basin extending east to the Big Horn Mountains to the northwestern Great Plains.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

This association was sampled on a moderately steep north-facing slope near the Big Fill. Bare soil, leaf litter, and gravel cover most of the ground surface. Soils are deep and rocky.

Globally

This grassland association occurs in the Columbia Basin and Great Basin across north-central Wyoming east to the Big Horn Mountains into the northwestern Great Plains. Elevation can range from approximately 915 to 2440 m (3000-8000 feet). Stands occur on a variety of sites that include windswept slopes and ridges. Sites range from gentle to steep slopes on all aspects. Bare soil, leaf litter, and gravel cover most of the ground surface. Soils are often deep and rocky and derived from limestones and volcanics.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This association is characterized by the codominance of *Pseudoroegneria spicata* and *Hesperostipa comata*. *Poa secunda* and *Bromus tectorum* each provide lower cover. Total vegetation cover is around 30%. The dwarf-shrub *Gutierrezia sarothrae* occurs with sparse cover. Other associated herbaceous species include *Leymus cinereus* and *Sphaeralcea munroana*.

Globally

This grassland is characterized by an open to moderately dense bunchgrass layer codominated by *Pseudoroegneria spicata* and *Hesperostipa comata*. The dwarf-shrubs *Artemisia frigida* and *Gutierrezia sarothrae* occur with sparse cover. Occasional shrubs, such as *Artemisia tridentata* ssp. *wyomingensis*, *Chrysothamnus viscidiflorus*, and *Ericameria nauseosa*, are sometimes present. Other graminoids include *Bouteloua gracilis*, *Carex* spp., *Koeleria macrantha*, *Leymus cinereus*, *Poa fendleriana*, and *Poa secunda*. Associated forbs include *Astragalus* spp., *Comandra umbellata*, *Phlox hoodii*, and *Sphaeralcea munroana*. The exotic annual grass *Bromus tectorum* may be present to abundant.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Hesperostipa comata</i> , <i>Poa secunda</i> , <i>Pseudoroegneria spicata</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Hesperostipa comata</i> , <i>Poa secunda</i> , <i>Pseudoroegneria spicata</i>

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Bromus tectorum

Globally

Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G4 (1-Feb-1996).

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association is only documented from a north-facing slope.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (1 observation point: GOSP.9115).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: K.A. Schulz

REFERENCES: Anderson 1956, Bighorn Coal Mine n.d., Bourgeron and Engelking 1994, Daubenmire 1970, Driscoll et al. 1984, Hyde 1964, Johnston 1987, Jones and Ogle 2000, Kagan et al. 2000, MTNHP 2002b, MTNHP unpubl. data, Mueggler and Stewart 1980, Poulton 1955, Tweit and Houston 1980, Williams 1961

***Pseudoroegneria spicata* - *Poa secunda* Herbaceous Vegetation**
Bluebunch Wheatgrass - Curly Bluegrass Herbaceous Vegetation

CODE	CEGL001677
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC 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	<i>PSEUDOROEGNERIA SPICATA</i> HERBACEOUS ALLIANCE (A.1265) Bluebunch Wheatgrass Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Columbia Basin Palouse Prairie (CES304.792)
Western Great Plains Foothill and Piedmont Grassland (CES303.817)
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This association has been described from lower montane to subalpine elevations in British Columbia, Washington, Oregon, Idaho, Utah, Colorado, Wyoming, and Montana. Stands of this association occupy loamy, rocky, often shallow soils on slopes and ridges, generally around the edges of basins and in the foothills of the mountains. 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 Northwest. Throughout its geographic range 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. The common shrubs are *Ericameria nauseosa*, *Chrysothamnus viscidiflorus*, and *Artemisia tridentata* (subspecies unknown). Associated forbs are highly variable, given the broad geographic and elevational range. This association was at one time common throughout its wide geographic range, but much of it in Washington and Oregon has been converted to agricultural fields. In many of the remaining stands, the cover of *Pseudoroegneria spicata* has decreased and the cover of *Hesperostipa comata* and shrubs have increased, and exotics (especially *Bromus tectorum*, *Tragopogon* spp., and *Alyssum* spp.) have become common members of the vegetation; these changes are attributed in large part to livestock grazing.

DISTRIBUTION

Golden Spike National Historic Site

This association is known only from the southwestern corner of the large central block of the national historic site.

Globally

This grassland association occurs in the intermountain northwestern U.S. and adjacent Canada, and extends east into the Rocky Mountains from northern Colorado to northern Montana and east on to the northwestern Great Plains.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

The sampled stand of this association occupies a moderate to steep northeast-facing slope at an elevation of 1450 m. It is on the edge of the lowest lake bench within the national historic site. Leaf litter and gravel cover most of the ground surface. Soils are gravelly throughout the stand.

Globally

This association occurs at lower montane to subalpine elevations throughout much of the Rocky Mountains and intermountain northwestern United State and adjacent Canada, and east on to the northwestern Great Plains. 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 part (British Columbia,

Washington, Idaho) and northern part (Montana) 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 elevational 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. Stands grow on well-drained, often shallow, and frequently gravelly or rocky soils generally of loam, clay loam, silt loam, or sandy loam textural classes.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This association is dominated by *Pseudoroegneria spicata* and *Poa secunda*. *Bromus briziformis* and *Bromus tectorum* are present with low cover.

Globally

Because this association has a geographic range with a broad range of climates and 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* 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 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* 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*, and a number of other forbs as well as the fern *Cryptogramma acrostichoides*; *Hesperostipa comata* or *Hesperostipa 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. 1979a), 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*.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Poa secunda</i> , <i>Pseudoroegneria spicata</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Koeleria macrantha</i> , <i>Poa secunda</i> , <i>Pseudoroegneria spicata</i>

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Bromus briziformis, *Bromus tectorum*

Globally

Bromus tectorum, *Draba verna*, *Taraxacum officinale*

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (1-Feb-1996).

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

Relationships between this association and several others are unclear. *Pseudoroegneria spicata* - *Balsamorhiza sagittata* - *Poa secunda* Herbaceous Vegetation (CEGL001662) from Idaho and Oregon, apparently taken from Tisdale's (1986) *Agropyron spicatum* / *Poa secunda* / *Balsamorhiza sagittata* habitat type of western Idaho, is included here. *Pseudoroegneria spicata* - *Poa secunda* Lithosolic Herbaceous Vegetation (CEGL001678) of Idaho, Oregon, and Washington may be based on the lithosolic phase of Daubenmire's (1988) habitat type; this association presently includes that vegetation. If these types are to be considered separate associations, clear distinctions must be made between them.

In *Pseudoroegneria spicata* - *Pascopyrum smithii* Herbaceous Vegetation (CEGL001675), rhizomatous wheatgrasses (*Pascopyrum smithii* or *Elymus lanceolatus*) are subdominant or codominant and clearly contribute more cover than does *Poa secunda*. Similarly, in *Pseudoroegneria spicata* - *Hesperostipa comata* Herbaceous Vegetation (CEGL001679), *Hesperostipa comata* is subdominant or codominant and clearly contributes more cover than does *Poa secunda*. *Pseudoroegneria spicata* - Cushion Plants Herbaceous Vegetation (CEGL001666) contains a substantial amount of *Pseudoroegneria spicata* and often contains *Poa secunda*, but forbs generally provide more cover than do the grasses. The relationship between this association and the *Pseudoroegneria spicata* - *Poa fendleriana* Herbaceous Vegetation (CEGL001676) is unclear.

The examples of this type as found within the Waterton-Glacier International Peace Park (IPP) extend the known environmental range of the association. The fact that *Poa secunda* was not recorded for IPP plots does not contravene the concept of the type as described and defined by Mueggler and Stewart (1980). However, with further sampling in northwestern Montana, and the IPP in particular, it may prove that these stands in Glacier National Park represent a different association. All the plots initially identified by Achuff et al. (1997, 2002a) as the H42: *Agropyron spicatum* Vegetation Type in Waterton Lakes National Park were placed into other associations.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association is limited to the edge of an ancient lake bench at the national historic site and has evidence of a stand-replacing fire. *Bromus tectorum* is more abundant on the flats below and above this site.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (1 plot: GOSP.0210).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Achuff et al. 1993, Achuff et al. 1997, Achuff et al. 2002a, Anderson 1956, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Christensen 1963, Christensen and Welsh 1963, Cooper 2003, Cooper et al. 1995, Daubenmire 1970, Daubenmire 1988, DeVelice et al. 1995, Driscoll et al. 1984, Fisser 1964, Fisser et al. 1965, Hall 1973, Hess and Wasser 1982, Johnson and Simon 1985, Johnson and Simon 1987, Johnston 1987, Jones and Ogle 2000, Kagan et al. 2000, Kleiner 1968, MTNHP 2002b, Mueggler and Stewart 1980, Poulton 1955, Price and Brotherson 1987, Stoddart 1941, Terwilliger et al. 1979a, Tisdale 1947, Tisdale 1986, Tweit and Houston 1980, WNHP unpubl. data, Western Ecology Working Group n.d., Williams 1961

Pseudoroegneria spicata Herbaceous Vegetation Bluebunch Wheatgrass Herbaceous Vegetation

CODE	CEGL001660
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)

PHYSIOGNOMIC 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 (A.1265)
Bluebunch Wheatgrass Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Western Great Plains Foothill and Piedmont Grassland (CES303.817)
Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)
Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This grassland association occurs on rock outcrops, talus, mesas, plateaus, windswept bluffs, ridgetops and mountains in northern Colorado, northeastern and northern Utah and western and southwestern Wyoming. It frequently occurs on moderately to steep, mid- to high-slope landforms, although gentle slopes are not uncommon. Sites are relatively xeric and are often found on southerly aspects at lower elevations or on harsh or on windswept areas at higher elevation sites. Substrates are typically shallow, often calcareous, rocky soils. Ground surface often has significant cover of bare ground, gravel and/or rock (10-90% cover). Stands are also reported east of the Continental Divide in Rocky Mountain National Park on a windward knoll and at Grand Teton National Park from a very steep northeast-facing high slope. The vegetation is characterized by an open herbaceous layer that is typically dominated by the cool-season, perennial bunchgrass *Pseudoroegneria spicata* with low to moderate cover (5-30%) and low-growing forbs. *Koeleria macrantha* is repeatedly present in low abundance. Other dry grasses may be present with low cover (less than half the cover of *Pseudoroegneria spicata*). A sparse dwarf-shrub layer (<10% cover) occurs with a variety of woody species of *Artemisia*, *Atriplex confertifolia*, *Cercocarpus*, *Eriogonum*, *Gutierrezia*, *Krascheninnikovia* or *Tetradymia* depending on elevation and substrate. There are several to many low-growing forbs (cushion plants) present with low cover, such as *Arenaria* spp., *Arenaria hookeri*, *Astragalus* spp., *Paronychia sessiliflora*, *Phlox* spp., *Stenotus acaulis*, *Tetraneuris acaulis*, and *Townsendia incana*. There are no clear dominants in this list, and the percent cover of each species present will vary from site to site. A diverse and abundant forb layer probably indicates a degraded occurrence.

DISTRIBUTION

Golden Spike National Historic Site

This association is known from sites scattered throughout the central third of the national historic site and is relatively uncommon there.

Globally

This association occurs in Piceance Basin and Dinosaur National Park in western Colorado and the Cache Valley of northeastern Utah. Stands are reported from Fossil Butte National Monument and Grand Teton National Park in Wyoming and Rocky Mountain National Park in Colorado.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

This association occupies nearly level to moderately steep slopes between 1406 and 1588 m. Gravel, rocks, and leaf litter cover most of the ground surface. Soils are gravelly to rocky in texture.

Globally

This herbaceous association occurs in northern Colorado, northeastern and northern Utah, and western and southwestern Wyoming (Hull and Hull 1974, Baker 1982b, Baker and Kennedy 1985). Stands occur on rock outcrops, talus, mesas, plateaus, windswept bluffs, ridgetops and mountains. It frequently occurs on moderate to steep, mid- to high-slope landforms, although gentle slopes are not uncommon. Elevation ranges between 1680 and 2840 m (5500-9310 feet) in Colorado and down to 1340-1590 m (4400-5200 feet) in Utah. Stands reported from Fossil Butte National Monument and Grand Teton National Park occur between 2234 and 2382 m (7328-7810 feet) elevation on well-drained clay soils that are very prone to erosion. Sites are relatively xeric and are often found on southerly aspects at lower elevations or on harsh, steep or windswept areas at higher elevations. Substrates are typically shallow, often calcareous, rocky soils and include sandstone and marlstone of the Uinta and Green River formations, Madison limestone, Mancos shale, Wasatch Formation shale and Morgan/Round Valley and Lodore

formations and granite. Ground surface often has significant cover of bare ground, gravel and/or rock (10-90% cover). Evidence of erosion is often present.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This herbaceous association is clearly dominated by *Pseudoroegneria spicata*, with between 15 and 20% cover. Associated grasses with lower cover include *Agropyron cristatum*, *Bromus briziformis*, *Bromus tectorum*, and *Poa secunda*. Scattered shrubs of *Artemisia tridentata* ssp. *tridentata*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Tetradymia canescens* may be present.

Globally

This association is characterized by an open vegetation layer that is typically dominated by the cool-season, perennial bunchgrass *Pseudoroegneria spicata* with low to moderate cover (7-30%) and low-growing forbs. *Koeleria macrantha* is repeatedly present in low abundance. Other grasses may include *Achnatherum hymenoides*, *Hesperostipa comata*, *Poa fendleriana*, and *Poa secunda*; if present, they have low cover (less than half the cover of *Pseudoroegneria spicata*). A sparse dwarf-shrub layer (<10% cover) may be present and includes a variety of woody species, such as *Artemisia arbuscula* ssp. *longiloba*, *Artemisia frigida*, *Artemisia nova*, *Artemisia tridentata*, *Atriplex confertifolia*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Chrysothamnus greenii*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Eriogonum microthecum*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Rosa woodsii*, *Ribes cereum*, *Symphoricarpos oreophilus*, or *Tetradymia canescens*, depending on elevation and substrate. Several to many low-growing forbs (often cushion plants) are present with low cover but not codominant. Species may include *Arenaria fendleri*, *Arenaria hookeri*, *Astragalus jejunus*, *Astragalus spatulatus*, *Astragalus tenellus*, *Chaetopappa ericoides*, *Draba oligosperma*, *Eriogonum lonchophyllum*, *Heterotheca villosa*, *Leptodactylon pungens*, *Lesquerella alpina*, *Linum lewisii*, *Machaeranthera grindelioides*, *Mertensia oblongifolia*, *Paronychia sessiliflora*, *Penstemon paysoniorum*, *Phlox austromontana*, *Phlox hoodii*, *Sphaeralcea coccinea*, *Stenotus acaulis*, *Tetraneuris acaulis*, *Townsendia incana*, and *Trifolium gymnocarpon*. There are no clear dominants in this list, and the percent cover of each species present will vary from site to site. A diverse and abundant forb layer probably indicates a degraded occurrence (R. Rondeau pers. comm. 1998). Introduced species such as *Agropyron cristatum*, *Bromus briziformis*, or *Bromus tectorum* are present in some stands.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Agropyron cristatum</i> , <i>Bromus briziformis</i> , <i>Bromus tectorum</i> , <i>Pseudoroegneria spicata</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Heterotheca villosa</i>
Herb (field)	<i>Pseudoroegneria spicata</i>

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Agropyron cristatum, *Bromus briziformis*, *Bromus tectorum*

Globally

Agropyron cristatum, *Astragalus jejunus*, *Bromus briziformis*, *Bromus tectorum*, *Penstemon paysoniorum*

CONSERVATION STATUS RANK

Global Rank & Reasons: G2 (30-Nov-1998). This association is known only from northern Colorado and northwestern Wyoming but is expected to occur in Utah. Grazing has a negative effect on this association, and it is believed that it now occupies a very small portion of the original range. Baker (1982b) reports that *Pseudoroegneria spicata* does not tolerate grazing and will eventually convert to *Koeleria macrantha* or *Poa secunda* grassland if grazing pressures continue. Baker (1982b) also estimates that at least two-thirds of the original *Pseudoroegneria spicata* grassland community in the Piceance Basin has been replaced by *Koeleria macrantha* grasslands. The size of most occurrences is very small, five under 15 acres and two under 60 acres.

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

This association needs to be compared with *Pseudoroegneria spicata* - Cushion Plants Herbaceous Vegetation (CEGL001666) of Pryor Mountains and Bighorn Canyon in south-central Montana, the Tendoy Mountains in southwest Montana and as described in Dinosaur National Monument in northwestern Colorado. It is distinguished by its lack of significant cover by cushion plants. Both associations occur on windswept ridgelines on calcareous substrates, have relatively sparse vegetation cover and contain cushion plants. The range of this association needs further review, especially disjunct stands, because the diagnostic grass in this association can be readily confused with awned *Elymus lanceolatus* (note if rhizomes are present, whereas *Pseudoroegneria spicata* has no rhizomes). Also *Pseudoroegneria spicata* ssp. *inermis* is often confused with *Pascopyrum smithii* or other wheatgrasses.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association occurs on rocky slopes, has been burned at two sites, appears to be seeded on two sites, and occurs on the side of an ancient lake bench on one site.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (4 observation points: GOSP.9007, GOSP.9009, GOSP.9108, GOSP.9228).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: D. Zoellner, mod. K.A. Schulz and J. Coles

REFERENCES: Baker 1982b, Baker and Kennedy 1985, Bourgeron and Engelking 1994, CONHP unpubl. data 2003, Driscoll et al. 1984, Hull and Hull 1974, Jones and Ogle 2000, Rondeau pers. comm.

Poa secunda Herbaceous Vegetation Curly Bluegrass Herbaceous Vegetation

CODE	CEGL001657
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland (V.A.5)
PHYSIOGNOMIC 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	<i>POA SECUNDA</i> SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1410) Curly Bluegrass Seasonally Flooded Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)
Southern Rocky Mountain Montane-Subalpine Grassland (CES306.824)

USFWS WETLAND SYSTEM: Palustrine

CONCEPT SUMMARY

Globally

This widespread grassland association occurs across the intermountain western U.S. Elevation ranges from 1440 to 2722 m (4720-8925 feet). Stands occur on uplands in swales, gentle slopes and drainage bottoms, often with easterly facing aspects. Substrates are deep, well-drained loam and clay loam soils. The vegetation is characterized by a somewhat open to dense graminoid canopy dominated by the short bunchgrass *Poa secunda* (up to 50% cover). The herbaceous layer is diverse, with additional graminoids such as *Carex microptera*, *Eleocharis quinqueflora*, *Hordeum brachyantherum* ssp. *californicum*, *Leymus simplex*, *Juncus* spp., and *Pascopyrum smithii* providing low to moderate cover. Forbs provide moderate cover and include *Achillea millefolium*, *Agoseris glauca*, *Iris missouriensis*, *Iva axillaris*, *Potentilla gracilis*, *Senecio* sp., and *Trifolium* spp. The short shrub *Artemisia tridentata* ssp. *wyomingensis* may be present with sparse cover. Introduced species may also be common in some stands.

DISTRIBUTION

Golden Spike National Historic Site

This association is known from the East Auto Tour route and Big Fill Trail areas of the national historic site and is relatively uncommon there.

Globally

This grassland association occurs across the intermountain western U.S. from western Colorado to California, north to Idaho and Oregon.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

This association occupies gentle southeast-facing slopes at 1440 m elevation. Bare soil and leaf litter cover most of the ground surface.

Globally

This widespread grassland association occurs across the intermountain western U.S. Elevation ranges from 1440 to 2722 m (4720-8925 feet). Stands occur on uplands in swales, gentle slopes and drainage bottoms and valley floors, often with easterly facing aspects. Substrates are deep, well-drained loam, clay loam and silty clay soils derived from alluvium. Litter cover is variable but often relatively high.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This herbaceous association is clearly dominated by *Poa secunda* with between 20 and 37% cover. *Bromus tectorum* is generally present with lower cover. The forbs *Alyssum desertorum* and *Sphaeralcea munroana* contribute low cover. Scattered short and dwarf-shrubs include *Artemisia tridentata* ssp. *tridentata*, *Ericameria nauseosa*, and *Gutierrezia sarothrae*.

Globally

This herbaceous vegetation association forms a somewhat open to dense graminoid canopy strongly dominated by the short bunchgrass *Poa secunda* (up to 50% cover). The herbaceous layer may be diverse, with graminoids such as *Carex microptera*, *Eleocharis quinqueflora*, *Elymus trachycaulus*, *Hordeum brachyantherum* ssp. *californicum*, *Leymus simplex*, *Koeleria macrantha*, *Juncus balticus*, *Juncus confusus*, *Juncus ensifolius*, and *Pascopyrum smithii* providing low to moderate cover. Forbs provide moderate cover and include *Achillea millefolium*, *Agoseris glauca*, *Elymus trachycaulus*, *Iris missouriensis*, *Potentilla gracilis*, *Machaeranthera canescens*, *Senecio* sp., *Trifolium cyathiferum*, *Trifolium dubium*, and *Trifolium gymnocarpon*. The short shrubs *Artemisia tridentata* ssp. *wyomingensis*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Krascheninnikovia lanata* may be present with sparse cover. Introduced species may also be common, including *Descurainia sophia*, *Iva axillaris*, *Lepidium perfoliatum*, *Poa pratensis*, *Taraxacum officinale*, and *Tragopogon dubius*.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Bromus tectorum</i> , <i>Poa secunda</i>

Globally

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Poa secunda</i>

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Alyssum desertorum, *Bromus tectorum*

Globally

Descurainia sophia, *Lepidium perfoliatum*, *Poa pratensis*, *Taraxacum officinale*, *Tragopogon dubius*, *Trifolium dubium*

CONSERVATION STATUS RANK

Global Rank & Reasons: G4? (1-Feb-1996).

CLASSIFICATION COMMENTS

Golden Spike National Historic Site
Data are not available.

Globally

The dominant grass in this association, *Poa secunda*, was originally identified as *Poa nevadensis*, a taxon which Kartesz (1999) has subsumed into *Poa secunda*.

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association is limited to patches within a matrix of *Bromus tectorum* annual grasslands.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (2 observation points: GOSP.9010, GOSP.9126).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: K.A. Schulz

REFERENCES: Blackburn et al. 1969a, Bourgeron and Engelking 1994, Driscoll et al. 1984, IDCDC 2005, Kagan et al. 2000, Kagan et al. 2004, Manning 1988, Manning and Padgett 1995, Western Ecology Working Group n.d.

***Artemisia tridentata* (ssp. *tridentata*, ssp. *xericensis*) / *Pseudoroegneria spicata* Shrub Herbaceous Vegetation (Basin Big Sagebrush, Foothill Big Sagebrush) / Bluebunch Wheatgrass Shrub Herbaceous Vegetation**

CODE	CEGL001018
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland with a sparse shrub layer (V.A.7)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland with a sparse shrub layer (V.A.7.N)
FORMATION	Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub layer (V.A.7.N.e)
ALLIANCE	ARTEMISIA TRIDENTATA (SSP. TRIDENTATA, SSP. XERICENSIS) SHRUB HERBACEOUS ALLIANCE (A.1522) (Basin Big Sagebrush, Foothill Big Sagebrush) Shrub Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Big Sagebrush Steppe (CES304.778)
Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This type occurs in deep soils in basins and foothills of the Idaho, Montana and Wyoming Rocky Mountains west to eastern Washington, eastern Oregon, and northeastern California. Stands of this type grow in deep, generally alluvial soils of fans, swales, and draws in intermountain basins and in the foothills of the surrounding mountains. *Artemisia tridentata* ssp. *tridentata* dominates the shrub layer, which may contain *Chrysothamnus* spp. and *Artemisia tridentata* ssp. *wyomingensis*. Shrub cover generally ranges from 10-25%, but may exceed 25% in some stands.

Pseudoroegneria spicata dominates the understory in good condition stands, which may also contain a variety of other graminoids and forbs. *Bromus tectorum* is common in degraded stands. The species composition of this type is very similar to *Artemisia tridentata* ssp. *wyomingensis* / *Pseudoroegneria spicata* Shrubland (CEGL001009) (which grows on shallower, drier soils), but *Artemisia tridentata* ssp. *tridentata* dominates the overstory in this association. Stands of this type occupy deeper soils than do stands of the shorter *Artemisia tridentata* ssp. *wyomingensis* / *Pseudoroegneria spicata* Shrubland (CEGL001009), which may form the surrounding matrix vegetation.

DISTRIBUTION

Golden Spike National Historic Site

This association is known from the central third of the national historic site as well as the East Auto Tour route. It is relatively uncommon in the national historic site.

Globally

This association at one time extended from the northeastern corner of California, eastern Oregon, and eastern Washington on the west to northwestern Wyoming on the east, and as far south as northeastern Nevada. It has been reported from southwestern Montana. It may also occur in northern Utah and perhaps in northwestern Colorado, although it apparently has not been found in vegetation surveys of northwestern Colorado.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

The sampled stand occurs on a moderate to steep northeast-facing slope at 1380 m elevation. The site is characterized by thin, rocky soils with some limestone bedrock outcrops. The ground surface cover consists of bare ground, gravel, rocks, and leaf litter.

Globally

This tall-shrub big sagebrush association is found on deep soils in basins and foothills of the Idaho, Montana and Wyoming Rocky Mountains west to eastern Washington, eastern Oregon, and northeastern California. Stands of this type grow in deep, generally alluvial soils of fans, swales, and draws in intermountain basins and in the foothills of the surrounding mountains. Occasional stands in mountains occur on shallow, rocky soils.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This association is characterized by an open canopy of *Artemisia tridentata* ssp. *tridentata* shrubs with up to 22% cover. *Pseudoroegneria spicata* dominates the understory with 5 to 22% cover. Other shrubs in the canopy may include *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, *Sarcobatus vermiculatus*, and *Tetradymia canescens*. *Poa secunda*, *Bromus briziformis*, *Bromus tectorum*, *Leptodactylon watsonii*, and *Phlox hoodii* may occur in the herbaceous layer. The plot taken in this association is the only recorded occurrence of developed biological soil crusts within the national historic site.

Globally

Artemisia tridentata ssp. *tridentata* forms a shrub layer commonly up to 1.5-2 m tall, with canopy cover of 10% to over 25%. Other shrub species present in smaller amounts are *Artemisia tridentata* ssp. *wyomingensis*, *Ericameria nauseosa*, and *Chrysothamnus viscidiflorus*. *Atriplex confertifolia*, *Sarcobatus vermiculatus*, and *Tetradymia canescens* occur less frequently. Two subshrubs, *Artemisia frigida* and *Gutierrezia sarothrae*, usually are present in the understory. *Pseudoroegneria spicata* contributes substantial cover and dominates or codominates in stands in good condition. Other grass species that usually are present but contribute less cover are *Bouteloua gracilis*, *Hesperostipa comata*, *Koeleria macrantha*, *Poa secunda*, and *Pascopyrum smithii*. In degraded stands, *Bromus briziformis* or *Bromus tectorum* contribute substantial cover. A number of forbs may be present in small amounts, especially *Erigeron* spp., *Leptodactylon watsonii*, *Phlox hoodii*, *Opuntia polyacantha*, and *Allium cernuum*.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i>
Short shrub/sapling	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>
Herb (field)	<i>Gutierrezia sarothrae</i> , <i>Leptodactylon watsonii</i> , <i>Phlox hoodii</i>
Herb (field)	<i>Pseudoroegneria spicata</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Bromus briziformis, *Bromus tectorum*

Globally

Bromus briziformis, Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: G1 (31-Jan-2007). The number of viable occurrences and area of occupancy of the association have declined severely since the time of European settlement. Remaining occurrences are mostly in relatively poor condition due to the combined and cumulative effects of livestock grazing, exotic species introductions, and altered fire disturbance regimes. As early as 1983, Hironaka et al. (1983) noted that the habitat type supporting this association in Idaho "has been drastically reduced" by cultivation of the floodplains where it used to occur, and that only a few stands remain. In Oregon and Washington, this association was probably much more common before settlement than it is now, and most stands have been destroyed by conversion to agriculture, prolonged heavy grazing, and inundation. This association is also assumed to have declined in area in California. In northwestern Wyoming, the area occupied by this association may have declined little, but stands there are restricted to specialized sites and apparently are small, so that geographic area probably has always contained only a small proportion of the original extent of the association.

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 1 - Strong

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association occurs on thin, rocky soils of north-facing slopes between wavecut benches. Cryptobiotic crusts were apparent in this type but not elsewhere on the national historic site.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (4 observation points: GOSP.9122, GOSP.9123, GOSP.9125, GOSP.9227).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: G.P. Jones, mod. K.A. Schulz

REFERENCES: Bourgeron and Engelking 1994, Caicco and Wellner 1983k, Cooper et al. 1999, Daubenmire 1970, Daubenmire 1988, Driscoll et al. 1984, Hansen et al. 1984, Hironaka et al. 1983, Jensen et al. 1988a, Johnston 1987, Jones and Ogle 2000, MTNHP 2002b, Mooney 1985, Mueggler and Stewart 1980, Tweit and Houston 1980

***Chrysothamnus viscidiflorus* Shrub Herbaceous Vegetation [Provisional]
Green Rabbitbrush Shrub Herbaceous Vegetation**

CODE	CEGL002530
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial graminoid vegetation (V.A)
PHYSIOGNOMIC GROUP	Temperate or subpolar grassland with a sparse shrub layer (V.A.7)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar grassland with a sparse shrub layer (V.A.7.N)
FORMATION	Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub layer (V.A.7.N.e)
ALLIANCE	CHRYSOTHAMNUS VISCIDIFLORUS SHRUB HERBACEOUS ALLIANCE (A.1524) Green Rabbitbrush Shrub Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This steppe or open shrubland is known from the southern San Luis Valley of Colorado, the lower slopes of Grand Teton National Park, Wyoming, and northern Utah. The vegetation is characterized by an open to moderate shrub layer dominated by *Chrysothamnus viscidiflorus* with 3-20% cover. Other shrub species may be present with low cover, such as *Artemisia tridentata ssp. tridentata*, *Atriplex canescens*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Tetradymia canescens*. The herbaceous layer is mainly a mixture of grasses, including *Hesperostipa comata*, *Koeleria macrantha*, *Poa secunda*, *Pseudoroegneria spicata*, and introduced annuals *Bromus briziformis* and *Bromus tectorum*. *Leymus cinereus* may be present in mesic gully bottoms in Utah. Scattered forbs are present, such as *Antennaria* spp., *Astragalus bisulcatus*, *Castilleja* spp., *Cirsium undulatum*, *Cryptantha humilis*, *Leptodactylon pungens*, and *Leptodactylon watsonii*. Colorado stand information will be added at a later date.

DISTRIBUTION

Golden Spike National Historic Site

This association was sampled in drainages southeast of the Big Fill area of the national historic site.

Globally

This association occurs in Wyoming and Colorado and Utah, and is likely more widespread in the western U.S.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

This community tends to occupy the banks of deeply eroded gullies cut into fine-textured soils. The sampled stand of this association is located within a gully system. Most of the ground surface consists of exposed soil with some leaf litter and moss. The soils are deep and based on alluvium.

Globally

This steppe community has been sampled on lower slopes of the Grand Tetons between 2012 and 2326 m elevation and in northern Utah on the banks of a gully near 1400 m elevation and is reported in a large southern Colorado valley. Sites range from gentle to moderately steep (4 and 55%) with variable aspects. Some sites are highly disturbed by gully erosion. Soils include deep well-drained, fine-textured alluvium soils such as silty clay loams. Ground surface is variable and has low to high cover of gravel, bare soil, litter and duff.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This sparsely vegetated association is characterized by a sparse to open canopy of *Chrysothamnus viscidiflorus* shrubs. Additional shrubs with lower cover include *Artemisia tridentata ssp. tridentata*, *Atriplex canescens*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Tetradymia canescens*. The understory consists of a mix of grasses. *Pseudoroegneria spicata*, *Poa secunda*, *Bromus briziformis*, and *Bromus tectorum* occur in the drier parts of this community, with *Leymus cinereus* in the gully bottoms. Forbs present may include *Astragalus* sp., *Cirsium undulatum*, *Cryptantha humilis*, *Leptodactylon pungens*, and *Leptodactylon watsonii*.

Globally

This association is characterized by an open to moderately dense shrub layer ranging from 3-20% shrub cover of *Chrysothamnus viscidiflorus*. Other shrubs may be present with low cover, such as *Artemisia tridentata ssp. tridentata*, *Atriplex canescens*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, and *Tetradymia canescens*. The herbaceous layer is mainly a mixture of grasses, including *Hesperostipa comata*, *Koeleria macrantha*, *Poa secunda*, *Pseudoroegneria spicata*, and introduced annuals *Bromus briziformis* and *Bromus tectorum*. *Leymus cinereus* is present in mesic gully bottoms in Utah. Forb species are present with low cover and include *Antennaria lanata*, *Astragalus kentrophyta*, *Antennaria microphylla*, *Astragalus bisulcatus*, *Castilleja applegatei*, *Castilleja flava*, *Castilleja sulphurea*, *Cirsium undulatum*, *Cryptantha humilis*, *Leptodactylon pungens*, and *Leptodactylon watsonii*.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Chrysothamnus viscidiflorus</i>
Herb (field)	<i>Bromus tectorum</i> , <i>Leymus cinereus</i> , <i>Pseudoroegneria spicata</i>

Globally

Stratum

Short shrub/sapling

Species

Chrysothamnus viscidiflorus

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Bromus briziformis

Globally

Bromus briziformis, *Bromus tectorum*

CONSERVATION STATUS RANK

Global Rank & Reasons: GNR (30-Mar-2005).

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

This type is described from Element Occurrences from the Colorado Natural Heritage Program and plot data from Grand Teton National Park and Golden Spike National Historic Site.

CLASSIFICATION CONFIDENCE:

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association occurs in a gully and slope system southeast of the Big Fill. Grass species are distributed by aspect, but shrubs are more generally distributed in the type. Erosion is active onsite but affects a relatively small area.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (1 plot: GOSP.0120).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: G. Kittel, mod. K.A. Schulz

REFERENCES: Western Ecology Working Group n.d.

***Bromus tectorum* Semi-natural Herbaceous Vegetation**

Cheatgrass Semi-natural Herbaceous Vegetation

CODE	CEGL003019
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Annual graminoid or forb vegetation (V.D)
PHYSIOGNOMIC GROUP	Temperate or subpolar annual grasslands or forb vegetation (V.D.2)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate / subpolar annual grasslands or forb vegetation (V.D.2.N)
FORMATION	Short temperate annual grassland (V.D.2.N.d)
ALLIANCE	BROMUS TECTORUM SEMI-NATURAL HERBACEOUS ALLIANCE (A.1814) Cheatgrass Semi-natural Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

This herbaceous vegetation type is found throughout much of western North America from the western Great Plains to the Intermountain West. It occurs most often after disturbance of a natural shrub- or grass-dominated community that results in the replacement of the natural vegetation by non-native, annual grass species of *Bromus*. *Bromus tectorum* typically dominates the community with over 80-90% of the total vegetation cover, making it difficult to determine what natural community was formerly present. This vegetation also includes grasslands dominated or codominated by other Eurasian introduced annual *Bromus* species such as *Bromus hordeaceus*, *Bromus madritensis*, *Bromus japonicus*, *Bromus rigidus*, or *Bromus rubens*. It is distinct from the annual *Bromus* communities found along the Pacific Coast typical of the Mediterranean or maritime climates.

DISTRIBUTION

Golden Spike National Historic Site

This association is widespread throughout the national historic site, especially around and east of the Visitor Center.

Globally

This alliance-level herbaceous vegetation type is found throughout much of western North America from the western Great Plains to intermountain and southwestern U.S.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

This common association occupies gentle to steep slopes between 1365 and 1427 m elevation. Leaf litter, bare ground, and limestone bedrock are the most common elements of the ground cover. Mosses and lichens can provide sparse cover. Soils are based on limestone bedrock and are gravelly in texture.

Globally

This herbaceous vegetation type is found throughout much of western North America from the western Great Plains to the Intermountain and southwestern U.S. Elevation ranges from sea level to 2200 m. Stands occur after disturbance of a natural shrub- or grass-dominated community, resulting in the replacement of the natural vegetation by non-native, annual grass species of *Bromus*, although invasion of undisturbed sites has also been reported (e.g., Evans et al. 2001). At Wind Cave National Park in South Dakota, weedy non-native graminoid vegetation occurs on recently disturbed areas, most commonly along roads. Small stands also occur in prairie dog towns (H. Marriott pers. comm. 1999). In the Great Basin, *Bromus tectorum* grasslands have invaded large areas of burned-over sagebrush steppe. *Bromus tectorum* increases the fire frequency of steppe communities, which eventually eliminates sagebrush (FEIS 2001).

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This association is clearly dominated by the non-native annual grass *Bromus tectorum*. Cover varies depending on the timing and amount of precipitation but may range between 15 and 50% cover. Many stands contain a few relict clumps of native grasses, including *Achnatherum hymenoides*, *Aristida purpurea*, *Thinopyrum ponticum* (= *Elymus elongatus*), *Elymus elymoides*, *Hesperostipa comata*, *Leymus cinereus*, *Poa secunda*, *Pseudoroegneria spicata*, and *Sporobolus cryptandrus*. The forbs *Cirsium undulatum*, *Helianthus annuus*, *Leptodactylon watsonii*, *Mentzelia laevicaulis*, *Sphaeralcea munroana*, and *Sphaeralcea parvifolia* may provide low cover. Scattered shrubs may be present, usually *Gutierrezia sarothrae*; *Artemisia dracuncululus*, *Artemisia tridentata* ssp. *tridentata*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, and *Suaeda moquinii* (= *Suaeda torreyana*) are less common.

Globally

This vegetation type is characterized by a sparse to dense, short, annual graminoid layer that is typically dominated by *Bromus tectorum* with over 80-90% of the total vegetation cover. Other Eurasian introduced annual species of *Bromus* which may alternatively dominate or codominate are *Bromus carinatus*, *Bromus hordeaceus*, *Bromus madritensis*, *Bromus japonicus*, *Bromus rigidus*, or *Bromus rubens*. Although there may be remnant species of the former native vegetation, the high cover of annual bromes makes it difficult to determine what natural community was formerly present. Weedy and exotic annual forbs may also have significant cover in some stands. Scattered shrubs and dwarf-shrubs, especially *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Ephedra viridis*, *Gutierrezia sarothrae*, and *Opuntia polyacantha*, may be present with low cover. At Wind Cave National Park in South Dakota, this weedy non-native graminoid vegetation is usually dominated by several perennial and annual brome grasses, including *Bromus inermis*, *Bromus japonicus*, and *Bromus tectorum*. Cover is variable (H. Marriott pers. comm. 1999), and in drought years, *Bromus tectorum* may be sparse or absent.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

Stratum

Herb (field)

Herb (field)

Species

Gutierrezia sarothrae

Aristida purpurea, *Bromus tectorum*, *Poa secunda*

Globally

Stratum

Species

Herb (field) *Bromus hordeaceus, Bromus japonicus, Bromus madritensis, Bromus rigidus, Bromus rubens, Bromus tectorum*

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site
Agropyron cristatum, Bromus tectorum, Thinopyrum ponticum

Globally
Bromus carinatus, Bromus hordeaceus, Bromus japonicus, Bromus madritensis, Bromus rigidus, Bromus rubens, Bromus tectorum

CONSERVATION STATUS RANK

Global Rank & Reasons: GNA (invasive) (1-Dec-1997).

CLASSIFICATION COMMENTS

Golden Spike National Historic Site
Data are not available.

Globally
This alliance also includes grasslands dominated or codominated by other Eurasian introduced annual *Bromus* species. It is distinct from the annual *Bromus* communities found along the Pacific Coast with Mediterranean or maritime climates because it does not have the introduced annual oatgrass (*Avena barbata* and *Avena fatua*), or other species typical of the California annual grassland (Sawyer and Keeler-Wolf 1995).

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association typically occurs on gravelly slopes.
Golden Spike National Historic Site Plots: This description is based on 2007 field data (11 observation points: GOSP.9008, GOSP.9110, GOSP.9111, GOSP.9113, GOSP.9116, GOSP.9119, GOSP.9211, GOSP.9212, GOSP.9213, GOSP.9225, GOSP.9226).
Local Description Authors: J. Von Loh, mod. J. Coles
Global Description Authors: D. Faber-Langendoen, mod. K. Schulz and J. Coles

REFERENCES: Beatley 1976, Cogan et al. 2004, Daubenmire 1975, Englund 2004, Evans et al. 2001, FEIS 2001, Karl et al. 1999, Marriott pers. comm., Naumann pers. comm., Redente et al. 1992, Sawyer and Keeler-Wolf 1995, Western Ecology Working Group n.d., Young and Evans 1973, Young and Evans 1978

***Agropyron cristatum* – *Bromus tectorum* Semi-natural Herbaceous Vegetation [Park Special]
Crested Wheatgrass - Cheatgrass Semi-natural Herbaceous Vegetation [Park Special]**

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally
Data are not available.

DISTRIBUTION

Golden Spike National Historic Site

This association is known from the old fields surrounding the Visitor Center along the railroad and county road rights-of-way throughout the central part of the national historic site.

Globally

Data are not available.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

This common association occupies gentle slopes throughout the western half of the national historic site. Sampled sites occur between 1474 and 1492 m elevation. Leaf litter covers most of the ground; mosses provide sparse cover.

Globally

Data are not available.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This association is dominated by the non-native bunchgrass *Agropyron cristatum* in stands in which the non-native annual grass *Bromus tectorum* is abundant to codominant. Total vegetation cover ranges from 20 to 80%. Native grasses such as *Leymus cinereus*, *Pseudoroegneria spicata*, and *Poa secunda* provide sparse cover. The exotic grass *Poa bulbosa* may be present, as well as *Descurainia sophia*. Stands lining the railroad grade in the western part of the national historic site contain scattered individual short shrubs of *Artemisia tridentata ssp. tridentata*.

Globally

Data are not available.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

Stratum

Species

Graminoid

Agropyron cristatum, Bromus tectorum

Globally

Data are not available

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Descurainia sophia, Poa bulbosa

Globally

Data are not available

CONSERVATION STATUS RANK

Global Rank & Reasons: Not applicable

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association occurs along the railroad and county road rights-of-way disturbed during construction and revegetated for erosion control. There are signs of recent livestock grazing.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (3 observation points: GOSP.9004, GOSP.9109, GOSP.9109).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: Data are not available

REFERENCES: Western Ecology Working Group n.d.

***Artemisia tridentata ssp. tridentata* / *Agropyron cristatum* Semi-natural Shrubland [Park Special]**

Basin Big Sagebrush / Crested Wheatgrass Semi-natural Shrubland [Park Special]

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Big Sagebrush Shrubland (CES304.777)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

Data are not available.

DISTRIBUTION

Golden Spike National Historic Site

This association is widespread from near the Visitor Center to the western end of the national historic site. Scattered stands also occur near the eastern end of the mapping area.

Globally

Data are not available.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

Stands occur on nearly level sites between 1474 and 1487 m elevation. Bare soil and leaf litter cover most of the ground surface. The soil texture is clay derived from Pleistocene lake deposits and exhibits geometric cracking patterns upon drying.

Globally

Data are not available.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

Artemisia tridentata ssp. tridentata forms a canopy with between 10 and 20% cover in most stands of this association. *Chrysothamnus viscidiflorus* may be present in the canopies of some stands, although never with high cover. The understory is dominated by *Agropyron cristatum* with up to 40% cover. Other grasses present with lower cover may include *Pascopyrum smithii*, *Poa bulbosa*, and *Bromus tectorum*. Weedy forbs are also usually present, including *Alyssum desertorum* and *Sisymbrium altissimum*.

Globally

Data are not available.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Artemisia tridentata ssp. tridentata</i>
Herb (field)	<i>Agropyron cristatum</i> , <i>Bromus tectorum</i> , <i>Sisymbrium altissimum</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Alyssum desertorum, Poa bulbosa

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: Not Applicable

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association occurs on disturbed soils within the railroad right-of-way. In one stand, many of the shrubs are dead, presumably from drought. Ant hills are a common feature in another stand.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (2 observation points: GOSP.9003, GOSP.9221).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: Data are not available

REFERENCES: Western Ecology Working Group n.d.

***Lycium barbarum* / *Bromus tectorum* Semi-natural Shrubland [Park Special]**

Common Matrimony Vine / Cheatgrass Shrubland [Park Special]

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Shrub-Steppe (CES304.788)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

Data are not available.

DISTRIBUTION

Golden Spike National Historic Site

This association is known from the vicinity of the Visitor Center.

Globally

Data are not available.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

The one sampled stand occupies a nearly level site adjacent to the Visitor Center at 1500 m elevation. The ground surface is characterized by low exposure of bare soil and high cover of leaf litter.

Globally

Data are not available.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This exotic shrubland is characterized by *Lycium barbarum* shrubs up to 1.5 m tall providing 20% cover. The exotic annual grass *Bromus tectorum* provides 75% cover in the herbaceous layer. The non-native annual forb *Descurainia sophia* is scattered throughout the stand.

Globally

Data are not available.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Short shrub/sapling	<i>Lycium barbarum</i>
Herb (field)	<i>Bromus tectorum</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Descurainia sophia

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: Not Applicable

CLASSIFICATION COMMENTS

Golden Spike National Historic Site

Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association occurs on an ancient lake bench that was disturbed by fiber optic line installation. The type occupies a small area, with a distinct photosignature, but does not occur elsewhere within the national historic site.

Golden Spike National Historic Site Plots: This description is based on 2007 field data (1 observation point: GOSP.9001).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: Data are not available

***Thinopyrum ponticum* Semi-natural Herbaceous Vegetation [Park Special]
Eurasian Quack Grass Semi-natural Herbaceous Vegetation [Park Special]**

CODE	Park Special
PHYSIOGNOMIC CLASS	Not Applicable
PHYSIOGNOMIC SUBCLASS	Not Applicable
PHYSIOGNOMIC GROUP	Not Applicable
PHYSIOGNOMIC SUBGROUP	Not Applicable
FORMATION	Not Applicable
ALLIANCE	Not Applicable

ECOLOGICAL SYSTEM(S): Inter-Mountain Basins Semi-Desert Grassland (CES304.787)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY

Globally

Data are not available.

DISTRIBUTION

Golden Spike National Historic Site

This association was introduced in the central and eastern parts of the national historic site.

Globally

Data are not available.

ENVIRONMENTAL DESCRIPTION

Golden Spike National Historic Site

The one sampled stand of this association occupies a nearly level site at an elevation of 1362 m. The ground surface consists mostly of bare soil. Soils are a light gray silt.

Globally

Data are not available.

VEGETATION DESCRIPTION

Golden Spike National Historic Site

This association is dominated by the exotic tall grass *Thinopyrum ponticum* with up to 20% cover. *Bromus japonicus*, *Bromus tectorum*, and *Aristida purpurea* occupy open ground between bunches of the taller grass. *Suaeda moquinii* (= *Suaeda torreyana*) is scattered throughout the sampled stand

Globally

Data are not available.

MOST ABUNDANT SPECIES

Golden Spike National Historic Site

<u>Stratum</u>	<u>Species</u>
Herb (field)	<i>Thinopyrum ponticum</i> , <i>Bromus japonicus</i> , <i>Bromus tectorum</i>

Globally

Data are not available.

OTHER NOTEWORTHY SPECIES

Golden Spike National Historic Site

Bromus inermis, *Bromus tectorum*, *Dactylis glomerata*

Globally

Data are not available.

CONSERVATION STATUS RANK

Global Rank & Reasons: Not Applicable

CLASSIFICATION COMMENTS

Golden Spike National Historic Site
Data are not available.

Globally

Data are not available.

CLASSIFICATION CONFIDENCE: 3 - Weak

ELEMENT SOURCES

Golden Spike National Historic Site Inventory Notes: This association is restricted to a revegetation planting within the national historic site. The bunch grasses are large and "woffy."

Golden Spike National Historic Site Plots: This description is based on 2007 field data (1 observation point: GOSP.9006).

Local Description Authors: J. Von Loh, mod. J. Coles

Global Description Authors: Data are not available

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Appendix G. Illustrated Key to the Plant Associations of Golden Spike National Historic Site

Introduction

The vegetation of Golden Spike National Historic Site was sampled during the summer of 2007 under the USGS-NPS Vegetation Mapping Program. This dichotomous key, illustrated with images taken during the plot sampling, was prepared to assist in the field identification of association, alliance and park special vegetation units described for GOSP. The key is designed to work using one or more dominant species with environmental characteristics. In ecotones (areas where plant associations mix), it may be difficult to determine a definitive association name. This illustrated key also allows the user to crosswalk plant associations directly to the GOSP vegetation map.

Six vegetation associations occurring within the NHS are not included in this key. These were not sampled, generally because they occurred in stands too small for a standard plot. Nevertheless, they support a number of map classes and thus deserve mention. These non-sampled types are

- *Artemisia tridentata* ssp. *tridentata* / *Leymus cinereus* Shrubland
- *Distichlis spicata* Herbaceous Vegetation
- *Juniperus osteosperma* / *Bromus tectorum* Semi-natural Woodland
- *Leymus cinereus* Herbaceous Vegetation
- *Prunus virginiana* - (*Prunus americana*) Shrubland
- *Tamarix* spp. Temporarily Flooded Semi-natural Shrubland

How to use the key

The key approaches plant association identification based on the physiognomy of the community (e.g., shrubland, grassland), followed by a combination of species composition and habitat characteristics. Photographs demonstrating variation within vegetation types are shown below the association names.

It is possible that in using this key, you will have difficulty arriving at an association that describes your community. There are several possible reasons for this, and each has a solution:

1. You are observing vegetation that you think is an herbaceous community, but it has some shrub cover. In this case, try keying the vegetation as though it were a shrubland **and** as though it were a grassland. In general with any layer, if it does not contribute at least 5% absolute cover, it is ignored. The exception is in very sparse communities where the total vegetation cover is less than 10% (see #3).

2. You can follow a key to a certain point, but you clearly have something not described in the key. This is to be expected – very likely you have an association that was not found during the sampling phase of the project. Be sure to note the dominant species and their cover.

3. Communities that are sparsely vegetated (i.e., < 10% total vascular plant cover) should be run through multiple keys. Even though they contain trees or shrubs, they may not fall cleanly into a physiognomic category such as “shrubland”.

Key to the Vegetation of Golden Spike National Historic Site

- 1a** Vegetation types in which shrubs appear to contribute at least 1/3 of the total vegetation cover. The spaces between shrub crowns may be filled with herbaceous vegetation, or may be nearly bare. Communities in which the shrub and herbaceous layers have roughly equal cover are referred to as “shrub-herbaceous” vegetation. Characteristic species include *Artemisia tridentata* ssp. *tridentata*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, or *Lycium barbarum* (2)
- 1b** Vegetation types in which herbaceous species, usually grasses, are clearly dominant. Shrubs may be scattered through the community, but in general do not contribute more than 1/4 of the total vegetation cover. Dominant species are in the genera *Agropyron*, *Bromus*, *Leymus*, *Hesperostipa*, *Poa*, *Pseudoroegneria*, or *Thinopyrum* (9)
- 2a** (1) Shrublands or shrub-herbaceous communities in which *Artemisia tridentata* ssp. *tridentata* is dominant. *Ericameria nauseosa* may have significant cover in disturbed (usually burned) stands (3)
- 2b** Shrublands dominated by species other than *Artemisia* (6)
- 3a** (2) Shrublands characterized by *Artemisia tridentata* ssp. *tridentata* (sometimes with *Ericameria nauseosa* as a co-dominant) with an understory dominated by exotic grass species such as *Bromus tectorum*, *B. japonicus*, *B. briziformis*, or *Agropyron cristatum* (4)
- 3b** Shrublands characterized by *Artemisia tridentata* ssp. *tridentata* with an understory dominated by native bunchgrass species such as *Poa secunda*, *Leymus cinereus*, or *Pseudoroegneria spicata*. Exotic grasses are generally present (5)
- 4a** (3) *Artemisia tridentata* ssp. *tridentata* shrublands or shrub-herbaceous communities (shrub cover at least 10%) with an understory dominated by one or several non-native species of *Bromus* (*B. tectorum*, *B. japonicus*, *B. briziformis*). *Chrysothamnus nauseosus* may be present to co-dominant. Stands tend to be concentrated in and near areas disturbed by construction of the railroad grades – ***Artemisia tridentata* - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland (Basin Big Sagebrush (Rubber Rabbitbrush) / Cheatgrass Semi-natural Shrubland) [Map Class # 20, Map Class #22]**



- 4b) *Artemisia tridentata* ssp. *tridentata* shrublands or shrub herbaceous communities (shrub cover at least 10%) with an understory dominated by the introduced bunchgrass *Agropyron cristatum*. *Bromus tectorum* may be present in the understory. Stands tend to be concentrated along the railroad grade west of the Visitor Center - ***Artemisia tridentata* ssp. *tridentata* / *Agropyron cristatum* Semi-natural Shrubland (Basin Big Sagebrush / Crested Wheatgrass Semi-natural Shrubland)** [Map Class #20, Map Class 21]



- 5a** (4) Open *Artemisia tridentata* ssp. *tridentata* shrublands with a sparse understory dominated or co-dominated by *Poa secunda* - ***Artemisia tridentata* ssp. *tridentata* / *Poa secunda* Shrubland (Basin Big Sagebrush / Curly Bluegrass Shrubland)** [Map Class #28]



- 5b** *Artemisia tridentata* ssp. *tridentata* shrublands with a sparse to dense understory dominated by the native bunchgrass *Pseudoroegneria spicata*. Other grasses present may include *Poa secunda* and *Bromus tectorum* with low cover - ***Artemisia tridentata* (ssp. *tridentata*, ssp. *xericensis*) / *Pseudoroegneria spicata* Shrub Herbaceous Vegetation (Basin Big Sagebrush / Bluebunch Wheatgrass Shrub Herbaceous Vegetation)** [Map Class #29]



- 6a** (2) Shrub and shrub-herbaceous communities with a canopy dominated by either *Ericameria nauseosa* or *Chrysothamnus viscidiflorus*. Stands tend to be in sagebrush shrublands that have burned (7)
- 6b** Shrublands or shrub-herbaceous communities with a canopy dominated by *Sarcobatus vermiculatus* or *Lycium barbarum* (8)
- 7a** (6) Shrublands or shrub-herbaceous communities (shrub cover at least 10%) in burned sagebrush stands, with a canopy dominated by *Chrysothamnus viscidiflorus*. Other shrubs present may include scattered *Artemisia tridentata* ssp. *tridentata* and *Atriplex canescens*. The understory is dominated by native grasses, including *Pseudoroegneria spicata*, *Leymus cinereus*, and *Poa secunda*. *Bromus tectorum* and *Bromus briziformis* are usually present but not dominant - ***Chrysothamnus viscidiflorus* Shrub Herbaceous Vegetation (Green Rabbitbrush Shrubland)** [Map Class # 56]



- 7b** Open shrublands in burned sagebrush stands with a canopy dominated by *Ericameria nauseosa*. Depending on how old the burn is, scattered *Artemisia tridentata* ssp. *tridentata* may be present. The understory is mixed grasses in which *Bromus tectorum* is dominant – ***Ericameria nauseosa* / *Bromus tectorum* Semi-natural Shrubland (Rubber Rabbitbrush / Cheatgrass Shrubland)** [Map Class # 52]



- 8a** (6) Shrublands with an open canopy of scattered *Sarcobatus vermiculatus*, usually with *Chrysothamnus viscidiflorus* present to co-dominant. The herbaceous understory is dominated by *Bromus tectorum*, although native grasses such as *Aristida purpurea*, *Leymus cinereus*, *Pseudoroegneria spicata*, and *Poa secunda* are usually scattered throughout the community - ***Sarcobatus vermiculatus* Disturbed Shrubland (Black Greasewood Disturbed Shrubland)** [Map Class # 25]



- 8b** Tall shrublands near the Visitor Center with a canopy of *Lycium barbarum*. The understory consists primarily of exotic herbaceous grasses and forbs - *Lycium barbarum* / *Bromus tectorum* Semi-natural Shrubland (Matrimony Vine / Cheatgrass Semi-natural Shrubland)) [Map Class # 26]



- 9a** (1) Grasslands dominated by non-native species, including *Agropyron cristatum*, *Bromus tectorum*, *B. briziformis*, *B. japonicus*, or *Thinopyrum ponticum*. Scattered native grasses may be present, but comprise less than ¼ of the total cover in all but the driest years (10)
- 9b** Grasslands dominated by native species, including *Aristida purpurea*, *Hesperostipa comata*, *Pseudoroegneria spicata* and *Poa secunda*. Non-native grasses may provide up to 1/3 the total cover, and scattered shrubs may be present (13)
- 10a** (9) Grasslands visually dominated by mid- to tall non-native bunchgrasses, either *Thinopyrum ponticum* or *Agropyron cristatum*. Annual exotic grasses such as *Bromus tectorum* and *Bromus japonicus* may form a dense understory (11)
- 10b)** Grasslands dominated by annual species in the genus *Bromus*, usually *B. tectorum*, but sometime *B. briziformis* or *B. japonicus* will be abundant. Scattered native grasses such as *Aristida purpurea*, *Poa secunda*, *Hesperostipa comata*, or *Pseudoroegneria spicata* may be present, but comprise less than ¼ of the total cover in all but the driest years. Scattered shrubs may also be present, including *Artemisia tridentata* ssp. *tridentata* or *Ericameria nauseosa*, and annual forbs may be abundant - ***Bromus tectorum* Semi-natural Herbaceous Vegetation (Cheatgrass Semi-natural Herbaceous Vegetation) [Map Class # 12. With native bunchgrasses = Map Class #14, with Russian thistle = Map Class #41, with snakeweed = Map Class #42]**



- 11a (10)** Grasslands dominated by *Agropyron cristatum*, either in a near monoculture or associated with native bunchgrasses or non-native annual grasses. Most stands are west of or adjacent to the visitor center and represent old fields (12)
- 11b)** Grasslands visually dominated by very tall bunches of *Thinopyrum ponticum*. Most stands are along the railroad right-of-way between the Big Fill and Blue Creek. *Bromus tectorum* dominates the understory - ***Thinopyrum ponticum* Semi-natural Herbaceous Vegetation (Tall Wheatgrass Semi-natural Herbaceous Vegetation)** [Map Class # 13]



- 12a (11)** Grasslands dominated by *Agropyron cristatum* but with significant presence (at least $\frac{1}{4}$ of total grass cover) of native bunchgrasses, especially *Pascopyrum smithii*, *Leymus cinereus*, and *Hesperostipa comata*. Non-native species of *Bromus* have much less cover than the perennial grasses - *Agropyron cristatum* - (*Pascopyrum smithii*, *Hesperostipa comata*) **Semi-natural Herbaceous Vegetation (Crested Wheatgrass – (Western Wheatgrass, Needle-and-Thread) Semi-natural Herbaceous Vegetation)** [Map Class # 11]



- 12b** Grasslands dominated by the exotic bunchgrass *Agropyron cristatum* and non-native, annual species of *Bromus*: *B. tectorum*, *B. japonicus*, or *B. briziformis*. Either *Agropyron* or *Bromus* may be dominant, but both are always present. Native grasses are absent or very scattered, comprising less than $\frac{1}{4}$ of the total grass cover - *Agropyron cristatum* - *Bromus tectorum* **Semi-natural Herbaceous Vegetation (Crested Wheatgrass – Cheatgrass Semi-natural Herbaceous Vegetation)** [Map Class # 11]



- 13a** (9) Grasslands dominated or co-dominated by native grasses; *Pseudoroegneria spicata* is dominant to co-dominant with other native bunchgrasses; non-native annual grasses are present to abundant but comprise less than 1/2 of the total grass cover (14)
- 13b** Grasslands dominated by native bunchgrasses other than *Pseudoroegneria spicata*, although this species may be present with very low cover (16)
- 14a** (13) Grasslands dominated by *Pseudoroegneria spicata*; other native grasses have only a few percent cover, although exotic species of *Bromus* may be abundant to co-dominant. Stands occupy north-facing, rocky, often steep slopes - ***Pseudoroegneria spicata* Herbaceous Vegetation (Bluebunch Wheatgrass Herbaceous Vegetation)** [Map Class # 19]



- 14b)** Grasslands dominated or co-dominated by *Pseudoroegneria spicata* with other native bunchgrass species, especially *Poa secunda* and *Hesperostipa*. Exotic species of grass are absent or have low cover **(15)**
- 15a** **(14)** Grasslands in which *Pseudoroegneria spicata* and *Hesperostipa comata* are both present to co-dominant. Exotic species of *Bromus* are present with low cover - *Pseudoroegneria spicata* - *Hesperostipa comata* **Herbaceous Vegetation (Bluebunch Wheatgrass – Needle-and-Thread Herbaceous Vegetation)** [Map Class # 19]



- 15b)** Grasslands in which *Pseudoroegneria spicata* and *Poa secunda* are dominant to co-dominant. *Poa secunda* and exotic species of *Bromus* are present with low cover - *Pseudoroegneria spicata* - *Poa secunda* Herbaceous Vegetation (Bluebunch Wheatgrass – Curly Bluegrass Herbaceous Vegetation)) [Map Class # 19]



- 16a** (13) Mid-height bunchgrass grasslands dominated by *Hesperostipa comata*. *Poa secunda* is present to co-dominant; exotic species such as *Bromus tectorum* are rare. These grasslands may contained scattered shrubs or clumps of *Chrysothamnus viscidiflorus* or *Ericameria nauseosa* - *Hesperostipa comata* Great Basin Herbaceous Vegetation (Needle-and-Thread Great Basin Herbaceous Vegetation)) [Map Class # 15]



16b Short grasslands dominated by either *Aristida purpurea* or *Poa secunda*. *Bromus tectorum* is usually present to co-dominant, but is clearly not dominant (**17**)

17a (16) Short, sparse grasslands dominated by *Aristida purpurea*, often with *Poa secunda* and *Bromus tectorum* present with low cover - ***Aristida purpurea* Herbaceous Vegetation (Purple Threeawn Herbaceous Vegetation)** [Map Class # 16; with high cheatgrass cover = Map Class 14]



- 17b** Short grasslands dominated by *Poa secunda*, although *Bromus tectorum* is usually present to co-dominant - ***Poa secunda* Herbaceous Vegetation (Curly Bluegrass Herbaceous Vegetation)**
[Map Class # 18]



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Appendix H. Modified Anderson Land Use-Land Cover Classification

This classification was used to attribute polygons in the environs mapped around Golden Spike National Historic Site.

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	
1.0 Water	1.1 Open Water	1.11 Stream/river				
		1.12 Canal/ditch	1.121 Lined canal/ditch			
			1.122 Unlined canal/ditch			
		1.13 Lake/pond				
		1.14 Reservoir				
		1.15 Bay/estuary				
	1.16 Sea/ocean					
	1.2 Perennial Ice/Snow	1.21 Snowfield				
		1.22 Glacier				
2.0 Developed	2.1 Residential	2.11 Single-family residential				
		2.12 Multi-family residential				
	2.2 Non-residential Developed	2.21 Commercial/Light Industry		2.211 Major Retail		
				2.212 Mixed/Minor Retail and Services		
				2.213 Office		
				2.214 Light industry		
			2.22 Heavy Industry	2.221 Petro-chemical Refinery		
			2.23 Communications and Utilities			
		2.24 Institutional	2.241 Schools			
			2.242 Cemeteries			
		2.25 Agricultural Business	2.251 Aquiculture			
			2.252 Confined feeding			
	2.26 Transportation	2.261 Airport				
	2.27 Entertainment/Recreation	2.271 Golf Course				
		2.272 Urban Parks				
	2.3 Mixed Urban					
3.0 Bare	3.1 Transitional					
	3.2 Quarries/Strip mines/Gravel pits					
	3.3 Bare Rock/Sand					

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
	3.4 Flats				
	3.5 Disposal				
4.0 Vegetated	4.1 Woody	4.11 Forested	4.111 Deciduous		
			4.112 Evergreen		
			4.113 Mixed		
		4.12 Shrub land	4.121 Deciduous		
			4.122 Evergreen		
			4.123 Mixed		
			4.124 Desert scrub		
		4.13 Orchards/vineyards/groves	4.131 Irrigated Orchard/vineyards/groves		
			4.132 Citrus		
			4.133 Non-managed Citrus		
	4.14 Mixed Forest/Shrub				
	4.2 Herbaceous	4.21 Natural Herbaceous	4.211 Natural Grassland		
			4.22 Planted/cultivated	4.221 Fallow/Bare Fields	
			4.222 Small Grains	4.2221 Irrigated small grains	
			4.223 Row Crops	4.2231 Irrigated row crops	
				4.2232 Sugar Cane	
			4.224 Planted grasses	4.2241 Pasture/hay	4.22411 Irrigated Pasture/hay
				4.2242 Other grass	4.22421 Irrigated Other grass
			4.225 Irrigated Planted/cultivated		
	4.3 Wetlands	4.31 Woody wetlands			
4.32 Emergent wetlands					

Classification Definitions

1.0 WATER - area covered by water, snow, or ice with less than 25% vegetated or developed cover, unless specifically included in another category

1.1 Open Water - all areas of open water with less than 25% vegetative or developed cover

1.11 Stream/river - a natural body of flowing water. Includes streams and rivers that have been channelized in order to control flooding or erosion or to maintain flow for navigation.

1.12 Canal/ditch - a man-made open waterway constructed to transport water, to irrigate or drain land, to connect two or more bodies of water, or to serve as a waterway for watercraft. Collection should include the right of ways and associated dikes and levees.

1.121 Lined canal/ditch - a canal or ditch lined with concrete or other impervious material preventing passage of water into underlying strata

1.122 Unlined canal/ditch - a canal or ditch constructed with dirt or other porous material allowing water to drain

1.13 Lake/pond - a non-flowing, naturally-existing, body of water. Includes water impounded by natural occurrences and artificially regulated natural lakes. The delineation of a lake is based on the areal extent of water at the time the imagery was acquired.

1.14 Reservoir - any artificial body of water, unless specifically included in another category. It can lie in a natural basin or a man-constructed basin. The delineation of a reservoir is based on the areal extent of water at the time the imagery was acquired. (The water control structures are classified as Communications/Utilities)

2.0 DEVELOPED - Areas of the earth that have been improved by man. Includes all “built-up” and urban areas of the landscape. Does NOT include mining lands, croplands, or waste-disposal areas (dumps). This land use category takes precedence over a land cover category when the criteria for more than one category are met.

2.1 Residential - lands containing structures used for human habitation

2.11 Single-family Residential - Lands used for housing residents in single-family dwelling units. Includes trailer parks, mobile home parks, and entire “farmsteads” when there is a home in the complex. (If no home is present, it should be classified as Agricultural Business.) Single-family residential buildings located within another category should be placed in this category.

2.12 Multi-family Residential - All lands devoted to housing more than one family on a permanent or semi-permanent basis, group living situations, and their associated grounds. Includes apartments, apartment complexes, duplexes, triplexes, condominiums, attached row houses, retirement homes, nursing homes, and residential hotels. Residential buildings located within another category, such as barracks and dormitories, should be identified in this category when possible.

2.2 Non-residential Developed - Any developed area that is used for a purpose other than housing.

2.21 Commercial/Light Industry - structures and associated grounds used for the sale of products and services, for business, or for light industrial activities. Includes all retail and wholesale operations. Include “industrial parks” and other features that cannot be clearly classified as either a retail service or light industry, such as heavy equipment yards, machinery repair, and junkyards.

2.211 Major Retail - This category includes shopping malls, retail “outlet centers,” and “superstores” that draw clientele from a regional area. Major retail centers consist of extremely large single buildings or a complex of large buildings and their parking lots. Malls usually house one or two major department stores and numerous small retail stores. Includes outlet centers, “superstores”, multi-plex movie theaters, and huge warehouse-type stores. The structures themselves are often several acres and have extensive parking lots.

2.212 Mixed/Minor Retail and Services - Includes individual stores and services of various sizes and associated grounds and parking. Includes neighborhood strip malls and shopping centers, veterinarian services, small movie theaters, gas stations and auto repair shops, garden centers, motels, small auto dealerships, public parking lots, lumber yards, art galleries, farm supply stores, flea-markets, bars and restaurants, grocery stores, and

commercial “truck stops”. Many small office buildings will have no features to distinguish them from retail stores and will fall in this category.

2.213 Office - structures and their associated grounds and parking, that provide financial, professional, administrative, and informational type services. Includes administrative government offices (e.g., IRS and State Motor Vehicles offices) trade schools, professional medical office complexes, research facilities/centers, and banks. Usually only office buildings in office complexes or in downtown areas will be distinguishable as offices. Small, single-story office buildings may blend in with minor retail.

2.214 Light industry - structures and their associated grounds and facilities that are used primarily to produce or process some finished product; or as a wholesale distribution center. Activities include design, assembly, finishing, packaging, warehousing or shipping of products rather than processing raw materials. The materials used in light industry have generally been processed at least once. They are generally “clean” industries that do not produce lots of waste materials. Use this category as a default for those facilities with semi-truck and trailer activity around loading docks, but that cannot be classified as either retail services or heavy industry. Includes electronic firms, clothing and furniture manufacture, grain elevators, printing plants, commercial bakeries, shipping and distribution centers, sand/gravel sorting facilities, secondary buildings associated with a mining or quarrying site, and generic warehouses.

2.22 Heavy Industry - structures and their associated grounds used for heavy fabrication, manufacturing and assembling parts that are, in themselves, large and heavy; or for processing raw materials such as iron ore, timber, and animal products. Accumulated raw materials are subject to treatment by mechanical, chemical, or heat processing to render them suitable for further processing, or to produce materials from that finished products are created. Heavy industries generally require large amounts of energy and raw materials and produce a significant amount of waste products. Indicators of heavy industry may be stockpiles of raw materials, energy producing sources and fuels, waste disposal areas and ponds, transportation facilities capable of handling heavy materials, smokestacks, furnaces, tanks, and extremely large buildings that are complex in outline and roof structure. Include associated waste piles and waste ponds. Heavy industry is usually located away from residential areas. Includes steel mills, paper mills, lumber mills, cotton gins, chemical plants, cement and brick plants, smelters, rock crushing machinery, and ore-processing facilities associated with mining.

2.23 Communications and Utilities - structures or facilities and associated grounds used for the generation of power and communications, the treatment or storage of drinking water, waste management, flood control, or the distribution and storage of gas and oil. Includes pumping stations, tank farms, power plants, electric substations, sewage treatment facilities and ponds, garbage collection facilities (not the final dumping ground - these are included in Bare), dams, levees, and spillways of appropriate dimensions, filtration plants, and heavy concentrations of antennas or satellite dishes; along with the related operational buildings.

2.24 Institutional - specialized government or private features that meet the educational, religious, medical, governmental, protective, and correctional needs of the public. Parking lots and associated grounds are included with these features. Includes public and private schools (not day care), state capitols, city halls, courthouses, libraries, churches, convents, monasteries, hospitals and training hospitals, post offices, police and fire departments, prisons, and military bases. Only the military-business areas of a military base are classified here; residential, airport, athletic fields, and vegetated areas are classified in the appropriate category.

2.241 Schools/Universities - public and private schools, seminaries, university campuses, and associated lands. Include the entire “core campus” area, along with athletic fields and vegetated areas. This category does not include day care centers or commercial trade schools, both of that are commercial uses.

2.242 Cemeteries - structures and lands devoted to burial of the dead. Includes mausoleums, service areas, and parking lots.

2.25 Agricultural Business - structures and all associated grounds used for raising plants or animals for food or fiber. Includes fish farms and hatcheries, feedlots, poultry farms, dairy farms, temporary shipping and holding pens, animal breeding or training facilities, and greenhouses. (Farmsteads including a dwelling are classified as residential.)

2.251 Aquiculture site - a set of pools of water and related structures used for producing fish, shellfish, or aquatic plants

2.252 Confined feeding operation - structures and associated pens, storage facilities, waste areas, and ponds that are used for raising meat and dairy cattle, hogs, poultry, or other animals. These features must have a relatively permanent and high animal population density. Temporary holding pens and thoroughbred horse farms usually do not qualify.

2.26 Transportation - Roads, railroads, airports, port facilities, and their associated lands. Roads and railroads include the right-of-way, interchanges, and median strips. Category includes railroad stations, railroad yards, bus stations, highway maintenance yards, school bus parking and service yards, and park-and-ride lots. Port facilities include loading and unloading facilities, docks, locks and, temporary storage areas. Associated warehousing and transfer stations for truck or rail are included only if they appear to be an integral part of the airport or port facility. Nearby but separate warehouses will be classified as light industry.

2.27 Entertainment and Recreational - areas and structures used predominantly for athletic or artistic events, or for leisure activities, and all associated lands and developed parking areas. Includes outdoor amphitheaters, drive-in theaters, campgrounds, zoos, sports arenas (including indoor arenas), developed parks and playgrounds, community recreation centers, museums, amusement parks, public swimming pools, fairgrounds, and ski complexes (not the ski slopes). Marinas with over 25% of water surface covered by docks and boats are included here.

2.271 Golf Course - structures, associated grounds, driving ranges, and interspersed natural areas used for the game of golf.

2.272 Urban Parks - designated open space in urban settings used for outdoor recreation. Include grass fields and associated structures, parking lots, and facilities. Includes city parks, "green-belt" urban parks, and athletic fields not associated with a school. Does not include undeveloped "open space" on the periphery of urban areas or undeveloped regional, state, or national park areas.

2.3 Mixed Urban - developed areas that have such a mixture of residential and non-residential features where no single feature meets the minimum mapping unit specification. This category is used when more than one-third of the features in an area do not fit into a single category. Often applicable in the central, urban-core area of cities.

3.0 BARE - undeveloped areas of the earth not covered by water that exhibit less than 25% vegetative cover or less than 5% vegetative cover if in an arid area. The earth's surface may be composed of bare soil, rock, sand, gravel, salt deposits, or mud.

3.1 Transitional Bare - areas dynamically changing from one land cover/land use to another, often because of land use activities. Includes all construction areas, areas transitioning between forest and agricultural land, and urban renewal areas that are in a state of transition.

3.2 Quarries/Strip Mines/Gravel Pits - areas of extractive mining activities with significant surface disturbance. Vegetative cover and overburden are removed for the extraction of deposits such as coal, iron ore, limestone, copper, sand and gravel, or building and decorative stone. Current mining activity does not need to be identifiable. Inactive or unreclaimed mines and pits are included in this category until another land cover or land use has been established. Includes strip mines, open-pit mines, quarries, borrow pits, oil and gas drilling sites, and gravel pits with their associated structures, waste dumps, and stockpiles.

3.3 Bare Rock/Sand - includes bare bedrock, natural sand beaches, sand bars, deserts, desert pavement, scarps, talus, slides, lava, and glacial debris.

3.4 Flats - A level landform composed of unconsolidated sediments of mud, sand, gravel, or salt deposits. Includes coastal tidal flats and interior desert basin flats and playas.

3.5 Disposal - designated areas where refuse is dumped or exists, such as landfills, trash dumps, or hazardous-waste disposal sites, but not reclaimed disposal areas or those covered with vegetation.

4.0 VEGETATED - areas having generally 25% or more of the land or water with vegetation. Arid or semi-arid areas may have as little as 5% vegetation cover.

4.1 Woody Vegetation - land with at least 25% tree and (or) shrub canopy cover

4.11 Forested - land where trees form at least 25% of the canopy cover

4.111 Deciduous Forest - area dominated by trees where 75% or more of the canopy cover can be determined to be trees that lose all their leaves for a specific season of the year.

4.112 Evergreen Forest - area dominated by trees where 75% or more of the canopy cover can be determined to be trees that maintain their leaves all year.

4.113 Mixed Forest - areas dominated by trees where neither deciduous nor evergreen species represent more than 75% of the canopy cover.

4.12 Shrub land - areas where trees have less than 25% canopy cover and the existing vegetation is dominated by plants that have persistent woody stems, a relatively low growth habit, and that generally produce several basal shoots instead of a single shoot. Includes true shrubs, trees that are small or stunted because of environmental conditions, desert scrub, and chaparral. In the eastern US, include former cropland or pasture lands that are now covered by brush to the extent that they are no longer identifiable or usable as cropland or pasture. Clear-cut areas will exhibit a stage of shrub cover during the regrowth cycle. Some common species that would be classified as shrub land are mountain mahogany, sagebrush, and scrub oaks.

4.121 Deciduous Shrub land - areas where 75% or more of the land cover can be determined to be shrubs that lose all their leaves for a specific season of the year

4.122 Evergreen Shrub land - areas where 75% or more of the land cover can be determined to be shrubs that keep their leaves year round.

4.123 Mixed Shrub land - areas dominated by shrubs where neither deciduous nor evergreen species represent more than 75% of the land cover

4.124 Desert Scrub - land areas predominantly in arid and semi-arid portions of the southwestern U.S. Existing vegetation is sparse and often covers only 5-25% of the land.

Example species include sagebrush, creosote, saltbush, black greasewood, and cactus.

4.13 Planted/Cultivated Woody (Orchards/Vineyards/Groves) - areas containing plantings of evenly spaced trees, shrubs, bushes, or other cultivated climbing plants usually supported and arranged evenly in rows. Includes orchards, groves, vineyards, cranberry bogs, berry vines, and hops. Includes tree plantations planted for the production of fruit, nuts, Christmas tree farms, and commercial tree nurseries. Exclude pine plantations and other lumber or pulp wood plantings that will be classified as Forest.

4.131 Irrigated Planted/Cultivated Woody - orchards, groves, or vineyards where a visible irrigation system is in place to supply water

4.14 Mixed Forest/Shrub - areas dominated by forest and shrub where neither species represent more than 75 % of the canopy cover.

4.2 Herbaceous Vegetation - areas dominated by non-woody plants such as grasses, forbs, ferns and weeds, either native, naturalized, or planted. Trees must account for less than 25% canopy cover while herbaceous plants dominate all existing vegetation.

4.21 Natural Herbaceous - areas dominated by native or naturalized grasses, forbs, ferns and weeds. It can be managed, maintained, or improved for ecological purposes such as weed/brush control or soil erosion. Includes vegetated vacant lots and areas where it cannot be determined

whether the vegetation was planted or cultivated such as in areas of dispersed grazing by feral or domesticated animals. Includes landscapes dominated by grass-like plants such as bunch grasses, Palouse grass, palmetto prairie areas, and tundra vegetation, as well as prairie grasses.

4.211 Natural Grasslands - natural areas dominated by true grasses. Includes undisturbed tall-grass and short-grass prairie in the Great Plains of the U.S.

4.22 Planted/Cultivated Herbaceous - areas of herbaceous vegetation planted and/or cultivated by humans for agronomic purposes in developed settings. The majority of vegetation in these areas is planted and/or maintained for the production of food, feed, fiber, pasture, or seed. Temporarily flooded are included in this category. Do not include harvested areas of naturally occurring plants such as wild rice and cattails.

4.221 Fallow/Bare Fields - areas within planted or cultivated regions that have been tilled or plowed and do not exhibit any visible vegetation cover

4.222 Small Grains - areas used for the production of grain crops such as wheat, oats, barley, graham, and rice. Category is difficult to distinguish from cultivated grasses grown for hay and pasture. Indicators of small grains may be a less than 10% slope, annual plowing and seeding, distinctive field patterns and sizes, different timing of green-up and harvest, different harvesting practices, a very “even” texture and tone, or regional variations discovered during field checks.

4.223 Row Crops - areas used for the production of crops or plants such as corn, soybeans, vegetables, tobacco, flowers and cotton. Fields that exhibit characteristics similar to row crops, but that do not have any other distinguishing features for a more specific category may be included.

4.2231 Irrigated Row Crops - areas used for the production of row crops where a visible irrigation system is in place to supply water

4.224 Cultivated grasses - areas of herbaceous vegetation, including perennial grasses, legumes, or grass-legume mixtures that are planted by humans and used for erosion control, for seed or hay crops, for grazing animals, or for landscaping purposes

4.2241 Pasture/Hay - areas of cultivated perennial grasses and/or legumes (e.g., alfalfa) used for grazing livestock or for seed or hay crops. Pasturelands can have a wide range of cultivation levels. It can be managed by seeding, fertilizing, application of herbicides, plowing, mowing, or baling. Pastureland has often been cleared of trees and shrubs, is generally on steeper slopes than cropland, is intended to graze animals at a higher density than open rangeland, and is often fenced and divided into smaller parcels than rangeland or cropland. Hay fields may be more mottled than small grain fields as they are not plowed annually and may be harvested and baled two or three times a year in some locations.

4.22411 Irrigated Pasture/Hay - areas used as pasture or hay fields where a visible irrigation system is in place to supply water

4.2242 Other planted grasses - areas of other cultivated grass such as turf and sod farms.

4.22421 Irrigated other grasses - areas of other cultivated grasses where a visible irrigation system is in place to supply water

4.225 Irrigated Planted Herbaceous - land that is growing some indistinguishable crop or grass, but is obviously irrigated

4.3 Vegetated Wetland - areas where the water table is at, near, or above the land surface for a significant part of most years and vegetation indicative of this covers more than 25% of the land surface. Wetlands can include marshes, swamps situated on the shallow margins of bays, lakes, ponds, streams, or reservoirs; wet meadows or perched bogs in high mountain valleys, or seasonally wet or flooded low spots or basins. Do not include agricultural land that is flooded for cultivation.

4.31 Woody Wetland - areas dominated by woody vegetation. Includes seasonally flooded bottomland, mangrove swamps, shrub swamps, and wooded swamps around bogs.

4.32 Emergent Herbaceous Wetlands - areas dominated by wetland herbaceous vegetation that is present for most of the growing season. Includes fresh-water, brackish-water, and salt-water marshes, tidal marshes, mountain meadows, wet prairies, and open bogs.

Appendix J. Map Class Descriptions for Golden Spike National Historic Site

Introduction

This document provides a visual guide and description of the map classes created for the Golden Spike National Historic Site Vegetation Mapping Project. Twenty-nine vegetation and one sparsely vegetated geologic map classes are described in this guide. Ten land cover / land use map classes are not described. Each of the map classes is documented by:

- photographs of the map class from ground level (if available)
- a list of component NVC associations and ecological systems
- common or characteristic plant species
- examples of each map class signature clipped from the ortho imagery with delineated polygons, and narrative descriptions of the photo signature
- a description of the ecology and distribution of the map class within the NHS
- polygon statistics report (polygon number, area and proportion)

This key does not attempt to show all variations within each vegetation map class; only the most common or significant representations are included. These descriptions and examples should be sufficient to provide the user with guidance for the imagery and an understanding of the relationships between the vegetation classification and mapping.

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Woodlands

Map Class 31

Juniper / Cheatgrass Open Woodland (W-UJCG)

NO GROUND PHOTO AVAILABLE

Associations

Juniperus osteosperma / *Bromus tectorum* Semi-natural Woodland

Ecological Systems

Great Basin Pinyon-Juniper Woodland

Characteristic species

Juniperus osteosperma
Sarcobatus vermiculatus
Bromus tectorum

Map Class Statistics

Frequency: 1 project polygons
Area: 1 hectares / 2 acres
Avg. Size: 0.8 hectares / 2 acres
Proportion: 0.1 % of mapping area

Distribution/Ecology/Composition

This map class is represented by a single polygon occurring on the north rim of the “Grand Canyon” of GOSP. It consists of scattered, large Utah juniper with an open understory dominated by cheatgrass. Shrubs contribute low cover and include black greasewood and shadscale. Bare ground and limestone chips cover much of the ground surface. The polygon and vegetation type was documented by field notes only.

Interpretation

The Utah juniper trees appear as large, dark green dots in a matrix with the smooth texture and bright green color characteristic of cheatgrass on this imagery.



Example of photo signature for map class W-UJCG (#31).

Shrublands

Map Class 20
Big Sagebrush / Floodplain Shrubland (S-BSFL)

NO GROUND PHOTO AVAILABLE

Associations

Artemisia tridentata - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland
Artemisia tridentata ssp. *tridentata* / *Agropyron cristatum* Semi-natural Shrubland

Ecological Systems

Inter-Mountain Basins Big Sagebrush Shrubland

Map Class Statistics

Frequency: 3 project polygons
Area: 4 hectares / 11 acres
Avg. Size: 1.5 hectares / 3.7 acres
Proportion: 0.4 % of mapping area

Characteristic species

Artemisia tridentata ssp. *tridentata*
Ericameria nauseosa
Agropyron cristatum
Bromus tectorum
Leymus cinereus

Distribution/Ecology/Composition

This short shrub community occurs in narrow strips on gully bottoms as well as in swales scattered throughout the NHS. Stands are characterized by large big sagebrush shrubs; rubber rabbitbrush is sometimes present. The understory is inconsistent and varies by location, ranging from native basin wildrye clumps to non-native crested wheatgrass, the annual cheatgrass, and the biennial forb yellow sweetclover.

Interpretation

The signature is a stippled, dark gray-green which is characteristic of sagebrush-dominated stands within GOSP. Most polygons are delimited by a light tan area around the polygon margins that represents sparsely vegetated gully sides.



Example of photo signature for map class S-BSFL (#20).

Map Class 21
Big Sagebrush / Crested Wheatgrass Shrubland (S-BSCW)



Photo credit: NPS

Associations

Artemisia tridentata ssp. *tridentata* / *Agropyron cristatum* Semi-natural Shrubland

Ecological Systems

Inter-Mountain Basins Big Sagebrush Shrubland

Characteristic species

Artemisia tridentata ssp. *tridentata*

Agropyron cristatum

Bromus tectorum

Map Class Statistics

Frequency: 40 project polygons
Area: 29 hectares / 73 acres
Avg. Size: 0.7 hectares / 1.8 acres
Proportion: 2.6 % of mapping area

Distribution/Ecology/Composition

This short shrub community occurs on plowed and seeded sites where crested wheatgrass was introduced and big sagebrush has become re-established, and sometimes occurs as shrub herbaceous shrub-herbaceous stands (primarily along the railroad grades and adjacent to the Visitor Center). Polygons often occur as islands in larger areas of crested wheatgrass. Basin big sagebrush provides 10 to 60 percent cover in association with the non-native bunchgrass, crested wheatgrass. Higher shrub cover may indicate a longer time has passed since the last disturbance, or that site conditions are more conducive for shrub establishment (e.g. deeper soil, moisture availability, etc.). Crested wheatgrass provides as much or more cover than basin big sagebrush in most stands.

Interpretation

The signature is a stippled, dark gray-green, common to stands of sagebrush throughout GOSP. The crested wheatgrass signature is medium gray in color with a slightly rough, even texture resulting from the regularly spaced grass clumps.



Example of photo signature for map class S-BCSW (#21).

Map Class 22
Big Sagebrush / Cheatgrass Shrubland (S-BSCG)



Photo credit: NPS

Associations

Artemisia tridentata - (*Ericameria nauseosa*) / *Bromus tectorum* Semi-natural Shrubland

Ecological Systems

Inter-Mountain Basins Big Sagebrush Shrubland

Characteristic species

Artemisia tridentata ssp. *tridentata*
Bromus tectorum

Map Class Statistics

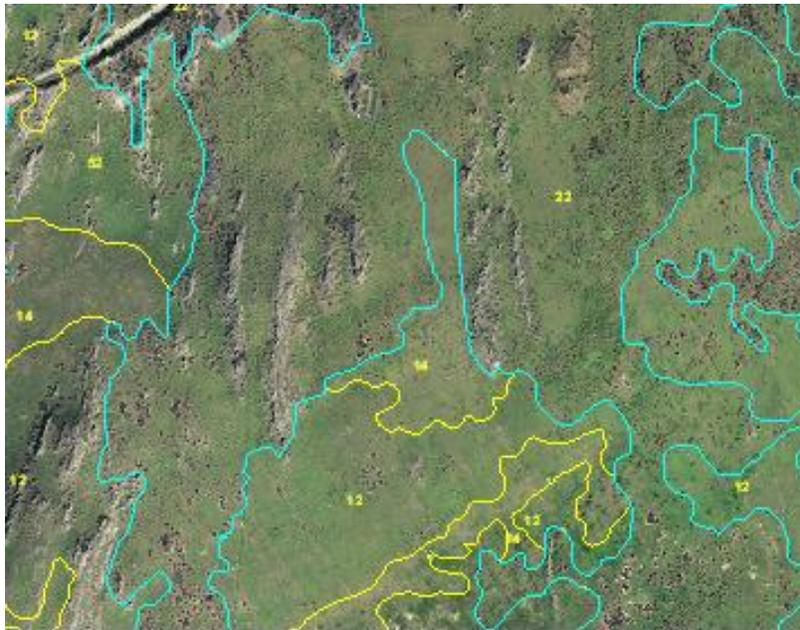
Frequency: 141 project polygons
Area: 318 hectares / 785 acres
Avg. Size: 2.3 hectares / 5.6 acres
Proportion: 27.8 % of mapping area

Distribution/Ecology/Composition

This short shrub community occurs in historic burn areas where sufficient time has passed for basin big sagebrush to become re-established in shrubland or shrub-herbaceous stands. Polygons occur throughout GOSP. Basin big sagebrush provides 10 to 50 percent cover, within a non-native annual cheatgrass matrix understory. Higher shrub cover may suggest a longer time has passed since the last disturbance, or that conditions are more conducive to shrub establishment. Other exotic herbaceous species may be present but vary from stand to stand; native grasses are absent or represent less than 5% cover. Cheatgrass provides equal or more cover than basin big sagebrush in most stands.

Interpretation

The signature is a stippled, dark gray-green common to stands of sagebrush throughout GOSP. The cheatgrass signature is bright green and has a smooth texture.



Example of photo signature for map class S-BSCG (#22).

Map Class 23
Big Sagebrush / Tall Wheatgrass Shrubland (S-BSTW)



Photo credit: NPS

Associations

None assigned

Ecological Systems

Inter-Mountain Basins Big Sagebrush Shrubland

Characteristic species

Artemisia tridentata ssp. *tridentata*

Ericameria nauseosa

Thinopyrum ponticum

Bromus tectorum

Map Class Statistics

Frequency: 2 project polygons

Area: 1 hectare / 2 acres

Avg. Size: 0.4 hectares / 0.9 acres

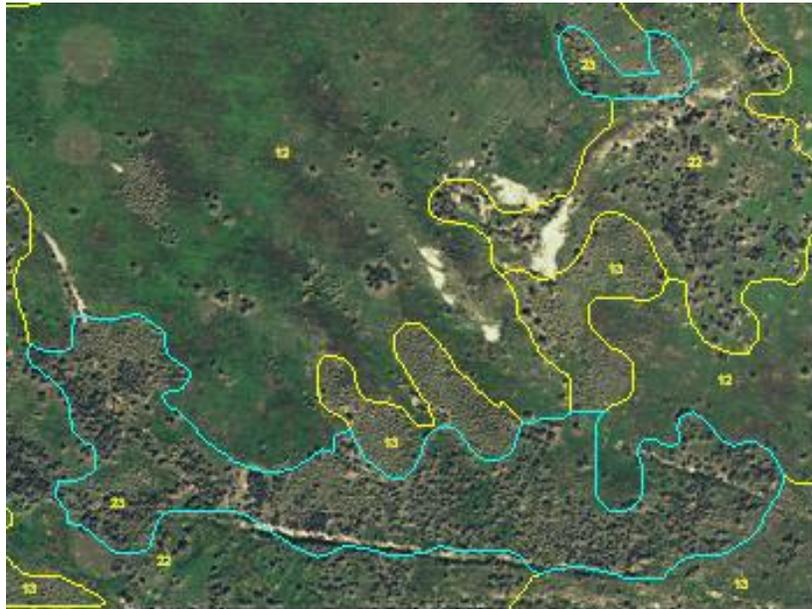
Proportion: 0.1 % of mapping area

Distribution/Ecology/Composition

This short shrub community was described from field observations. It occurs on sites historically seeded with tall wheatgrass, a non-native bunchgrass. Either aerial application of seeds occurred that did not disturb existing basin big sagebrush shrubs, or sites have been free of disturbance sufficiently long that big sagebrush has become re-established. Cheatgrass, a non-native annual, is the primary associated herbaceous species.

Interpretation

The signature is a stippled, dark gray-green common to stands of sagebrush throughout GOSP. The tall wheatgrass - cheatgrass signature is medium gray-green with a rough, even texture resulting from the large, regularly spaced tall wheatgrass bunches, which may be nearly as large as crowns of individual basin big sagebrush, creating a stippled pattern.



Example of photo signature for map class S-BSTW (#23).

Map Class 24
Chokecherry Shrubland (S-PRVI)

NO GROUND PHOTO AVAILABLE

Associations

Prunus virginiana - (*Prunus americana*) Shrubland

Ecological Systems

Rocky Mountain Lower Montane-Foothill Shrubland

Characteristic species

Prunus virginiana

Map Class Statistics

Frequency: 3 project polygons
Area: 0.4 hectares / 1 acres
Avg. Size: 0.1 hectares / 0.4 acres
Proportion: 0.04 % of mapping area

Distribution/Ecology/Composition

This map class occurs as three narrow elongated polygons. These small, but dense stands of tall chokecherry shrubs occupy protected sites on the lee side of slopes where snow collects and roadway runoff occurs.

Interpretation

Polygons are long and narrow, paralleling the road. The signature is dark green and clumpy within drainages.



Example of photo signature for map class S-PRVI (#24).

Map Class 25
Greasewood Disturbed Shrubland (S-SAVE)



Photo credit: NPS

Associations

Sarcobatus vermiculatus Disturbed Shrubland

Ecological Systems

Inter-mountain Basins Wash

Characteristic species

Sarcobatus vermiculatus
Chrysothamnus viscidiflorus
Bromus tectorum

Map Class Statistics

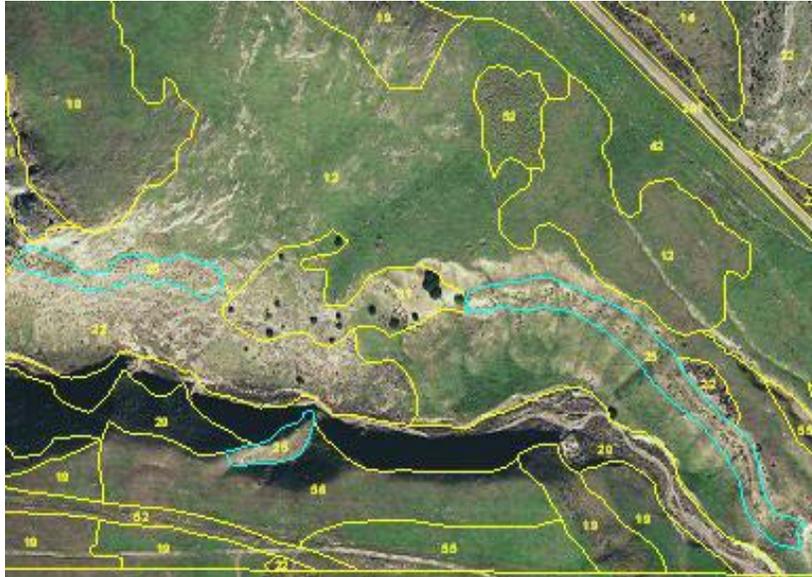
Frequency: 3 project polygons
Area: 1 hectares / 3 acres
Avg. Size: 0.4 hectares / 0.9 acres
Proportion: 0.1 % of mapping area

Distribution/Ecology/Composition

This short shrub community occurs on the “Grand Canyon” rim and on the banks of Blue Creek. Typical of upland greasewood stands, individual shrubs are relatively small (<1m tall) and widely but regularly distributed. Greasewood shrubs root in cracks in limestone bedrock, which collect runoff and soil and are likely alkaline. The information provided herein is derived from field notes.

Interpretation

The signature matrix color is light gray (Oquirrh limestone outcrops and exposures), interrupted by darker gray specks representing greasewood shrubs. Close inspection reveals smaller speckles that represent smaller shrubs such as shadscale and yellow rabbitbrush.



Example of photo signature for map class S-SAVE (#25).

Map Class 26
Matrimony Vine Shrubland (S-LYBA)



Photo credit: NPS

Associations

Lycium barbarum / *Bromus tectorum* Semi-natural Shrubland

Ecological Systems

Inter-Mountain Basins Semi-Desert Shrub-Steppe

Characteristic species

Lycium barbarum

Bromus tectorum

Map Class Statistics

Frequency: 6 project polygons

Area: 1 hectares / 3 acres

Avg. Size: 0.2 hectares / 0.5 acres

Proportion: 0.1 % of mapping area

Distribution/Ecology/Composition

Matrimony vine was introduced as an ornamental planting by homesteading families in the area. Extant stands occur near the visitor center, and may spread to other habitats within GOSP.

Interpretation

The signature of short shrub community is dull medium green with a rough texture created by matrimony vine and minor shadowing.



Example of photo signature for map class S-LYBA (#26).

Map Class 27
Big Sagebrush / Great Basin Wildrye Shrubland (S-BSBW)

NO GROUND PHOTO AVAILABLE

Associations

Artemisia tridentata ssp. *tridentata* / *Leymus cinereus* Shrubland

Ecological Systems

Inter-Mountain Basins Big Sagebrush Shrubland

Characteristic species

Artemisia tridentata ssp. *tridentata*

Leymus cinereus

Bromus tectorum

Map Class Statistics

Frequency: 1 project polygon
Area: 0.1 hectares / 0.3 acres
Avg. Size: 0.1 hectares / 0.3 acres
Proportion: 0.01 % of mapping area

Distribution/Ecology/Composition

This short shrub, large bunchgrass association occurs as a small stand on one site within GOSP. A more extensive distribution may have occurred historically and included lowlands, swales, and drainages. The stand occupies a gully where the non-native annual cheatgrass is an understory associate with scattered individuals of basin wildrye and basin big sagebrush.

Interpretation

This community was mapped from ground observations. The characteristic signature, a stippled, dark gray-green, is also characteristic environmental setting are similar to that of S-BSFL, the Big Sagebrush / Floodplain Shrubland map class.



Example of photo signature for map class S-BSBW (#27).

Map Class 28
Big Sagebrush / Curly Bluegrass Shrubland (S-BSCB)



Photo credit: NPS

Associations

Artemisia tridentata ssp. *tridentata* / *Poa secunda* Shrubland

Ecological Systems

Inter-Mountain Basins Big Sagebrush Shrubland

Characteristic species

Artemisia tridentata ssp. *tridentata*

Poa secunda

Map Class Statistics

Frequency: 1 project polygon
Area: 0.1 hectares / 0.3 acres
Avg. Size: 0.1 hectares / 0.3 acres
Proportion: 0.01 % of mapping area

Distribution/Ecology/Composition

This short shrub or shrub herbaceous community of dry upland sites is characterized by an open canopy of basin big sagebrush with scattered clumps of curly bluegrass; there is sparse cover of non-native cheatgrass and crested wheatgrass.

Interpretation

This community was mapped from ground observations. The characteristic signature, a stippled, dark gray-green, and environmental setting are similar to, and may be confused with that of S-BSCG, the Big Sagebrush / Cheatgrass Shrubland map class.



Example of photo signature for map class S-BSCB (#28).

Map Class 29
Big Sagebrush / Bluebunch Wheatgrass Shrubland (S-BSBB)



Photo credit: NPS

Associations

Artemisia tridentata (ssp. *tridentata*, ssp. *xericensis*) / *Pseudoroegneria spicata* Shrub Herbaceous Vegetation

Ecological Systems

Inter-Mountain Basins Big Sagebrush Shrubland

Characteristic species

Artemisia tridentata ssp. *tridentata*

Tetradymia canescens

Bromus tectorum

Poa secunda

Pseudoroegneria spicata

Map Class Statistics

Frequency: 5 project polygons

Area: 15 hectares / 38 acres

Avg. Size: 3.1 hectares / 7.5 acres

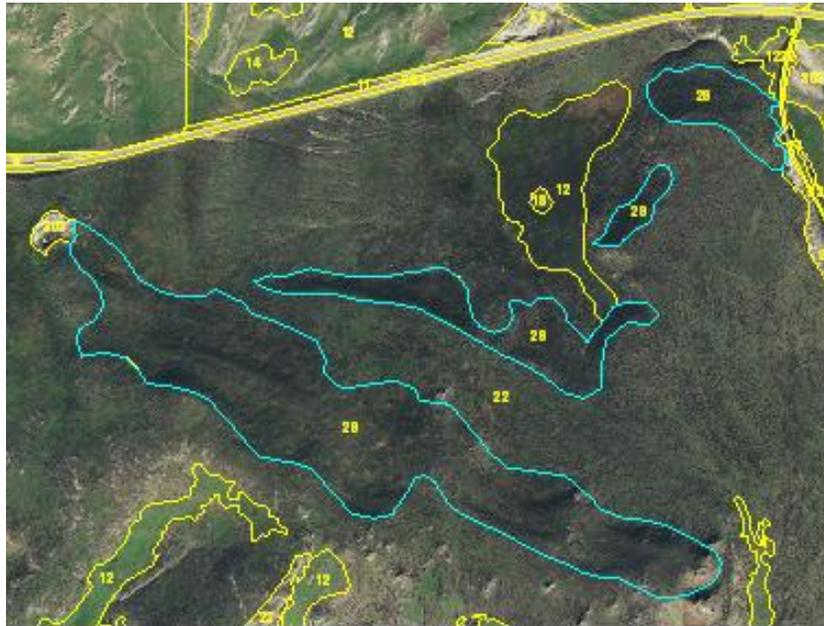
Proportion: 1.3 % of mapping area

Distribution/Ecology/Composition

Polygons of this short shrub community occur on sheltered, north-facing slopes near the East Auto Tour route. GOSP stands represent presettlement remnants of what was likely once the dominant upland vegetation type within the region. These stands represent some of the southernmost occurrences of a community that is common in the northern Great Basin and the Columbia Plateau.

Interpretation

The signature is a stippled, dark gray-green characteristic of sagebrush-dominated stands within GOSP. The bluebunch wheatgrass signature is darker than that of most other basin big sagebrush map classes, due to its occurrence on mesic, north-facing slopes that have more shadowing and higher cover of darker green native bunchgrasses.



Example of photo signature for map class S-BSBB (#29).

Map Class 51
Rubber Rabbitbrush / Crested Wheatgrass Shrubland (S-RRCW)

NO GROUND PHOTO AVAILABLE

Associations

None assigned

Ecological Systems

Inter-Mountain Basins Semi-Desert Shrub-Steppe

Characteristic species

Ericameria nauseosa

Agropyron cristatum

Map Class Statistics

Frequency: 2 project polygons
Area: 1 hectares / 2 acres
Avg. Size: 0.3 hectares / 0.9 acres
Proportion: 0.1 % of mapping area

Distribution/Ecology/Composition

This short shrub to shrub herbaceous community has become established following recent burns (past few decades) within Big Sagebrush / Crested Wheatgrass Shrubland stands. Stands occur along the railroad rights-of-way, and were described from field notes. The shrub layer is generally open, and in older stands, a few basin big sagebrush are becoming established. In the absence of new disturbance, stands should return to Big Sagebrush / Crested Wheatgrass type within a few decades.

Interpretation

The signature is scattered, bright yellowish green speckles (rubber rabbitbrush shrubs) formed in series where deeper soils have deposited. The matrix color is a brownish-gray representing grass litter with a rough texture provided by bunches of crested wheatgrass. Both polygons occur as inclusions within larger areas dominated by the non-native crested wheatgrass.



Example of photo signature for map class S-RRCW (#51).

Map Class 52
Rubber Rabbitbrush / Cheatgrass Shrubland (S-RRCG)



Photo credit: NPS

Associations

Ericameria nauseosa / *Bromus tectorum* Semi-natural Shrubland

Ecological Systems

Inter-Mountain Basins Semi-Desert Shrub-Steppe

Characteristic species

Ericameria nauseosa

Chrysothamnus viscidiflorus

Aristida purpurea

Bromus tectorum

Map Class Statistics

Frequency: 37 project polygons
Area: 38 hectares / 94 acres
Avg. Size: 1 hectares / 2.5 acres
Proportion: 3.3 % of mapping area

Distribution/Ecology/Composition

This common short shrub to shrub herbaceous community represents stands of Big Sagebrush / Cheatgrass Shrubland that have burned within the past few decades. The shrub layer is generally open, and in older stands, a few basin big sagebrush are becoming established. In the absence of new disturbance, rubber rabbitbrush stands may succeed to the Big Sagebrush / Cheatgrass type within a few decades.

Interpretation

The signature is a series of scattered, bright yellowish-green speckles (rubber rabbitbrush shrubs). The matrix color is the bright green of cheatgrass cover, and most polygons occur as inclusions within larger areas dominated by cheatgrass.



Example of photo signature for map class S-RRCG (#52).

Map Class 55
Yellow Rabbitbrush / Cheatgrass Shrubland (S-YRCG)

NO GROUND PHOTO AVAILABLE

Associations

None assigned

Ecological Systems

Inter-Mountain Basins Semi-Desert Shrub-Steppe

Characteristic species

Chrysothamnus viscidiflorus

Bromus tectorum

Aristida purpurea

Map Class Statistics

Frequency: 8 project polygons
Area: 6 hectares / 14 acres
Avg. Size: 0.7 hectares / 1.8 acres
Proportion: 0.5 % of mapping area

Distribution/Ecology/Composition

This short shrubland or shrub herbaceous community occurs on the sides of gullies within burned areas. This map class was described from field notes.

Interpretation

The matrix signature is a smooth gray, tinged with bright green (cheatgrass cover). Yellow rabbitbrush is a small shrub and is not generally visible in one-foot resolution orthoimagery; scattered larger shrubs provide a sparsely-speckled texture to the map class signature.



Example of photo signature for map class S-YRCG (#55).

Map Class 56
Yellow Rabbitbrush / Native Bunchgrass Shrubland (S-YRNB)



Photo credit: NPS

Associations

Chrysothamnus viscidiflorus Shrub Herbaceous Vegetation

Ecological Systems

Inter-Mountain Basins Semi-Desert Shrub-Steppe

Characteristic species

Artemisia tridentata ssp. *tridentata*

Chrysothamnus nauseosus

Chrysothamnus viscidiflorus

Gutierrezia sarothrae

Pseudoroegneria spicata

Bromus tectorum

Leymus cinereus

Map Class Statistics

Frequency: 7 project polygons

Area: 6 hectares / 15 acres

Avg. Size: 0.8 hectares / 2.1 acres

Proportion: 0.5 % of mapping area

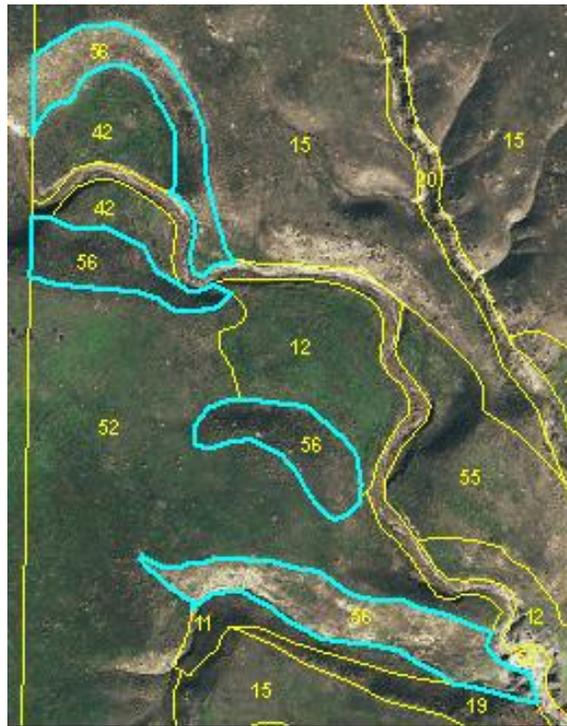
Distribution/Ecology/Composition

This short shrub to shrub herbaceous community occurs on sheltered slopes and gully sides in areas that have burned. Most stands are on mesic north-facing slopes; presumably, the lower moisture stress created

by the sheltered locations enables native bunchgrasses to dominate while inhibiting establishment of non-native annual plant species.

Interpretation

The signature is a dark gray matrix color with a smooth to slightly rough texture (visible under magnification), and is similar to that of S-YRCG, except that the green tinge of cheatgrass is lacking,



Example of photo signature for map class S-YRNB (#56).

Map Class 53
Tamarisk - Greasewood Floodplain Shrubland (S-TCSV)

NO GROUND PHOTO AVAILABLE

Associations

Tamarix spp. Temporarily Flooded Semi-natural Shrubland

Ecological Systems

Inter-mountain Basins Wash

Characteristic species

Tamarix chinensis

Sarcobatus vermiculatus

Distichlis spicata

Hordeum jubatum

Juncus balticus

Map Class Statistics

Frequency: 3 project polygons

Area: 1 hectares / 3 acres

Avg. Size: 0.4 hectares / 0.9 acres

Proportion: 0.1 % of mapping area

Distribution/Ecology/Composition

This tall shrub community is restricted to the lower alluvial terraces of Blue Creek at the extreme eastern end of the NHS.

Greasewood occurs on the drier, upper sides of the incised gully eroded by Blue Creek, but is inseparable as a map class.

The tamarisk component of this community within GOSP was removed in 2007.

Interpretation

This community was interpreted and mapped using field notes.



Example of photo signature for map class S-TCSV (#53).

Herbaceous Vegetation

Map Class 11

Crested Wheatgrass - Cheatgrass Grassland (H-CWCG)



Photo credit: NPS

Associations

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

Agropyron cristatum - *Bromus tectorum* Semi-natural Herbaceous Vegetation

Ecological Systems

Inter-Mountain Basins Semi-Desert Grassland

Characteristic species

Agropyron cristatum

Bromus tectorum

Map Class Statistics

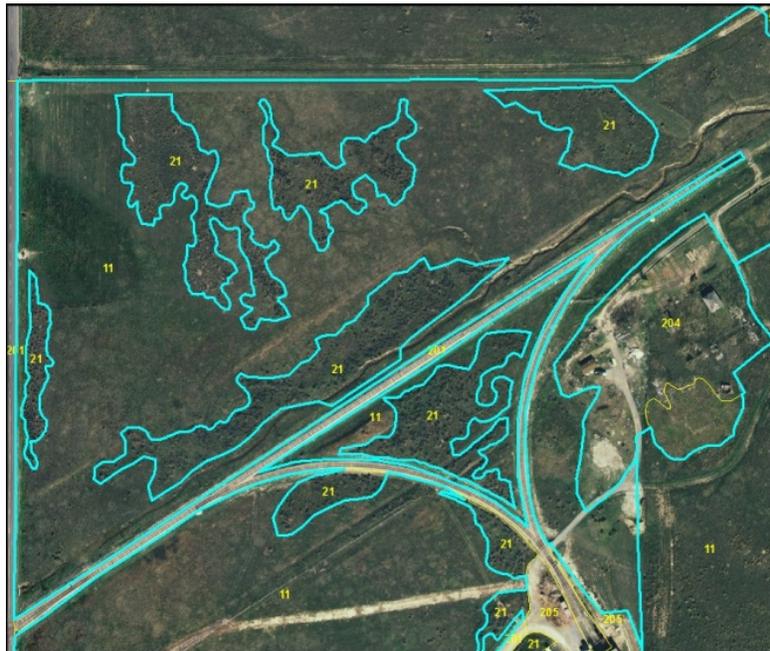
Frequency: 43 project polygons
Area: 160 hectares / 396 acres
Avg. Size: 3.7 hectares / 9.2 acres
Proportion: 14 % of mapping area

Distribution/Ecology/Composition

Crested wheatgrass is a non-native bunchgrass that was planted or seeded aurally for forage, reclamation, and soil stabilization throughout GOSP; it persists on soils developed in Lake Bonneville sediments. Crested wheatgrass is absent from the rocky, hilly parts of the NHS, as it is generally not an invasive species. The non-native annual cheatgrass is the most common associated species; native grasses when present generally provide less than 5% cover and always have less cover than cheatgrass.

Interpretation

The color signature is a distinctive bright-to-dull green, mottled with grayish-brown patches. The texture is smooth with fine stippling created by the distinct grass bunches evident. In areas that were planted recently, the parallel furrows made by a range seed drill are visible under magnification. Many polygons contain inclusions of Big Sagebrush / Crested Wheatgrass Shrubland.



Example of photo signature for map class H-CWCG (#11).

Map Class 12
Cheatgrass Grassland (H-BRTE)



Photo credit: NPS

Associations

Bromus tectorum Semi-natural Herbaceous Vegetation

Ecological Systems

Inter-Mountain Basins Semi-Desert Grassland

Characteristic species

Gutierrezia sarothrae

Bromus tectorum

Map Class Statistics

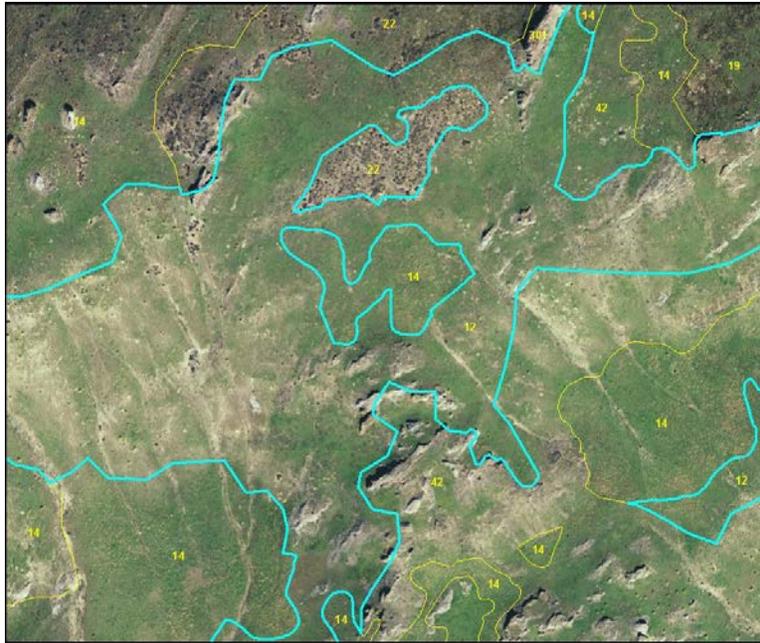
Frequency: 95 project polygons
Area: 251 hectares / 619 acres
Avg. Size: 2.6 hectares / 6.5 acres
Proportion: 21.9 % of mapping area

Distribution/Ecology/Composition

Cheatgrass, an invasive non-native annual, dominates large areas throughout GOSP; most sites likely were basin big sagebrush stands in which the native bunchgrass component was replaced by cheatgrass, then burned. Some stands have high cover by forbs, including annual sunflower, blazing star, and globemallow.

Interpretation

The signature is distinctive with smooth texture and bright green colors. Scattered speckles representing shrubs may be visible under magnification. Polygons are often large and irregularly shaped. Adjacent polygons are also generally dominated by cheatgrass, but with enough of a shrub element to be placed in other map classes.



Example of photo signature for map class H-BRTE (#12).

Map Class 13
Tall Wheatgrass Grassland (H-THPO)

NO GROUND PHOTO AVAILABLE

Associations

Thinopyrum ponticum Semi-natural Herbaceous Vegetation

Ecological Systems

Inter-Mountain Basins Semi-Desert Grassland

Characteristic species

Thinopyrum ponticum

Bromus tectorum

Bromus japonicus

Map Class Statistics

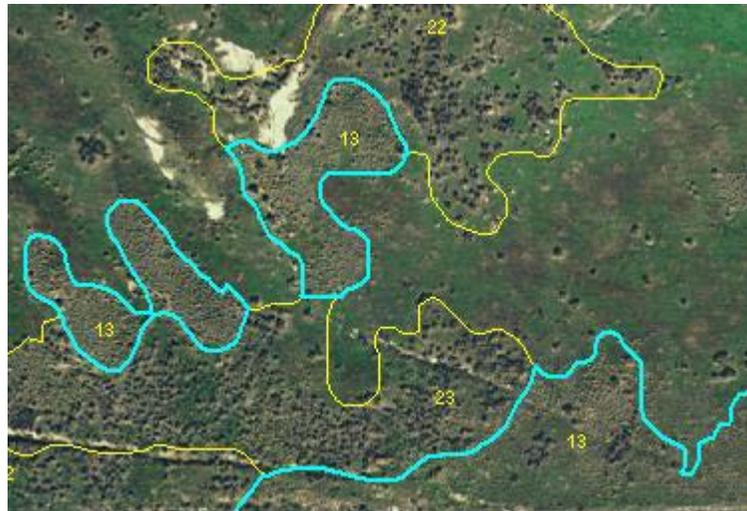
Frequency: 15 project polygons
Area: 4 hectares / 10 acres
Avg. Size: 0.3 hectares / 0.7 acres
Proportion: 0.4 % of mapping area

Distribution/Ecology/Composition

Tall wheatgrass was introduced to provide forage, reclamation, and soil stabilization. Although it generally does not native grasses rarely re-establish in this community. The understory is dominated by non-native and invasive annual brome grasses, including cheatgrass and Japanese brome.

Interpretation

The matrix signature class is a dull gray-green with even stippling created by the large, distinct bunches of tall wheatgrass (visible without magnification). Polygons tend to be small, with distinct edges.



Example of photo signature for map class H-THPO (#13).

Map Class 14
Cheatgrass - Native Bunchgrass Grassland (H-CGNB)



Photo credit: NPS

Associations

Bromus tectorum Semi-natural Herbaceous Vegetation

Ecological Systems

Inter-Mountain Basins Semi-Desert Grassland

Characteristic species

Bromus tectorum

Aristida purpurea

Achnatherum hymenoides

Hesperostipa comata

Leymus cinereus

Poa secunda

Pseudoroegneria spicata

Map Class Statistics

Frequency: 28 project polygons
Area: 75 hectares / 186 acres
Avg. Size: 2.7 hectares / 6.6 acres
Proportion: 6.6 % of mapping area

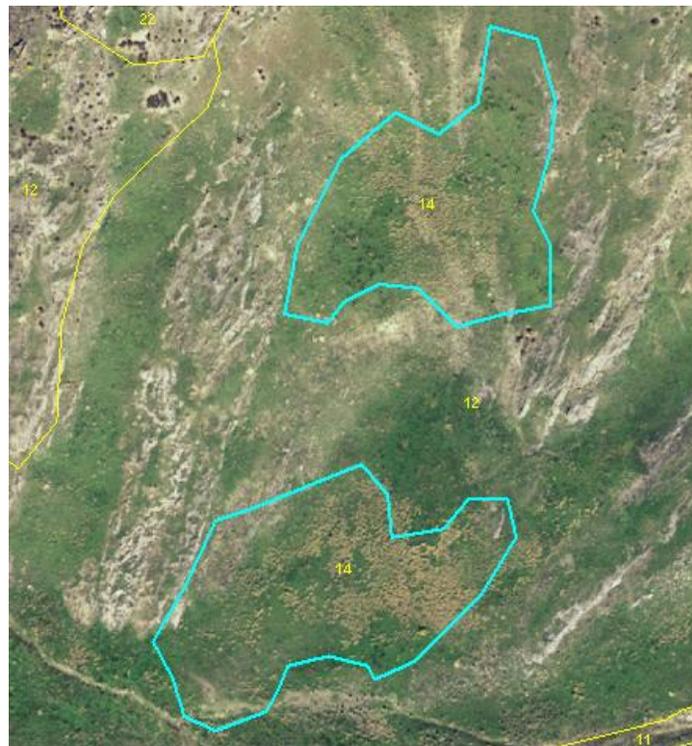
Distribution/Ecology/Composition

This non-native annual cheatgrass community supports 5% or greater canopy cover of native bunchgrasses. Such stands and sites have the best potential for successful restoration to a native perennial bunchgrass community because a source of native seed and extensive root systems exist. Most stands

formed following burns in basin big sagebrush / mixed perennial bunchgrass shrubland stands, and many polygons support scattered basin big sagebrush and rubber rabbitbrush shrubs.

Interpretation

The signature varies depending on the native grass species and cover within the stand. The most common native bunchgrass is purple threeawn; its presence modifies the bright green cheatgrass color, providing a yellowish, stippled texture. Indian ricegrass, needle-and-thread, and bluebunch wheatgrass result in a grayish cast to the bright green matrix signature. Great Basin wildrye creates a coarse stippling texture that may be confused with tall wheatgrass cover. Representative signatures and interpretation were completed using field notes.



Example of photo signature for map class H-CGNB (#14).

Map Class 15
Needle-and-Thread Grassland (H-HECO)



Photo credit: NPS

Associations

Hesperostipa comata Great Basin Herbaceous Vegetation

Ecological Systems

Inter-Mountain Basins Semi-Desert Grassland

Characteristic species

Chrysothamnus viscidiflorus

Hesperostipa comata

Poa secunda

Map Class Statistics

Frequency: 2 project polygons
Area: 12 hectares / 30 acres
Avg. Size: 6 hectares / 14.8 acres
Proportion: 1 % of mapping area

Distribution/Ecology/Composition

This medium-tall to tall bunchgrass community occurs at the head of the “Grand Canyon” at the west end of the East Auto Tour. Soils are thin and rocky, formed from and deposited over limestone bedrock, and bunchgrass stands have burned. Yellow rabbitbrush is a consistently present member of the community, although with low cover.

Interpretation

The matrix signature a dark , mottled gray with smooth texture; scattered, faint to white stipples represent the cleared area around anthills.



Example of photo signature for map class H-HECO (#15).

Map Class 16
Mixed Native Bunchgrass Grassland (H-NABU)



Photo credit: NPS

Associations

Aristida purpurea Herbaceous Vegetation

Ecological Systems

Inter-Mountain Basins Semi-Desert Grassland

Characteristic species

Aristida purpurea

Poa secunda

Bromus tectorum

Map Class Statistics

Frequency: 1 project polygon
Area: 0.1 hectares / 0.3 acres
Avg. Size: 0.1 hectares / 0.3 acres
Proportion: 0.01 % of mapping area

Distribution/Ecology/Composition

This bunchgrass community occurs as patches throughout GOSP that are too small to map. The single interpreted and mapped polygon occurs on a gravelly Lake Bonneville wave-cut bench. Purple three-awn and curly bluegrass are co-dominant native bunchgrasses, with low to sparse cover by the non-native annual cheatgrass and the native dwarf-shrub snakeweed.

Interpretation

This short bunchgrass community was interpreted based on from field notes and delineation. The signature is the bright green cheatgrass color with a yellowish, stippled texture that is similar to that of the Cheatgrass-Native Bunchgrass Grassland map class.



Example of photo signature for map class H-NABU (#16).

Map Class 17
Great Basin Wildrye Grassland (H-LECI)



Photo credit: NPS

Associations

Leymus cinereus Herbaceous Vegetation

Ecological Systems

Inter-Mountain Basins Greasewood Flat

Characteristic species

Leymus cinereus
Bromus tectorum

Map Class Statistics

Frequency: 3 project polygons
Area: 1 hectares / 1 acres
Avg. Size: 0.2 hectares / 0.4 acres
Proportion: 0.05 % of mapping area

Distribution/Ecology/Composition

This rare, relict tall bunchgrass community occurs within non-gullied swales where runoff and possibly shallow groundwater provide a more mesic habitat. The interpreted and mapped polygons occur in burned areas which may have supported the basin big sagebrush / Great Basin wildrye shrubland association historically.

Interpretation

The signature is medium brown in color, modified by the bright green color of non-native annual cheatgrass. Great Basin wildrye bunches create a coarse yellowish-colored stippling. The interpretation and mapping were prepared from field notes and delineation; confusion may occur with that of Tall Wheatgrass Grassland.



Example of photo signature for map class H-LECI (#17).

Map Class 18
Curly Bluegrass Grassland (H-POSE)



Photo credit: NPS

Associations

Poa secunda Herbaceous Vegetation

Ecological Systems

Inter-Mountain Basins Semi-Desert Grassland

Characteristic species

Poa secunda

Bromus tectorum

Map Class Statistics

Frequency: 2 project polygons
Area: 1 hectares / 2 acres
Avg. Size: 0.4 hectares / 1.1 acres
Proportion: 0.1 % of mapping area

Distribution/Ecology/Composition

This rare short bunchgrass community occurs on dry, rocky, shallow soils. Curly bluegrass is dominant with at least 20% cover; the non-native annual cheatgrass may be co-dominant or present in higher cover.

Interpretation

The signature is the bright green color of cheatgrass modified by a gray cast resulting from curly bluegrass litter. The texture is smooth with very faint dark gray stippling visible under high magnification. Polygons were interpreted and mapped from field notes.



Example of photo signature for map class H-POSE (#18).

Map Class 19
Bluebunch Wheatgrass Grassland (H-PSSP)



Photo credit: NPS

Associations

Pseudoroegneria spicata - *Hesperostipa comata* Herbaceous Vegetation
Pseudoroegneria spicata - *Poa secunda* Herbaceous Vegetation
Pseudoroegneria spicata Herbaceous Vegetation

Ecological Systems

Inter-Mountain Basins Semi-Desert Grassland

Characteristic species

Pseudoroegneria spicata
Bromus briziformis
Bromus tectorum
Poa secunda

Map Class Statistics

Frequency: 13 project polygons
Area: 24 hectares / 59 acres
Avg. Size: 1.8 hectares / 4.5 acres
Proportion: 2.1 % of mapping area

Distribution/Ecology/Composition

This bunchgrass community is the most common of the native grasslands at GOSP. Stands are small- to medium-sized and located primarily on mesic north-facing, somewhat rocky slopes. Bluebunch wheatgrass is the dominant bunchgrass and curly bluegrass can be co-dominant. Cheatgrass and rattlesnake brome (non-native annual grasses), when present, provide low cover.

Interpretation

The signature is a medium grayish-brown color with a smooth texture. In some polygons, cheatgrass contributes a greenish cast to the color matrix. This community may be confused with Needle-and-thread Grassland but can be differentiated by the north-facing slope aspect.



Example of photo signature for map class H-PSSP (#19).

Map Class 40
Annual Forbs Disturbed Vegetation (H-ANNF)



Photo credit: NPS

Associations

None assigned

Ecological Systems

Inter-Mountain Basins Semi-Desert Grassland

Characteristic species

Sisymbrium altissimum

Helianthus annuus

Bromus tectorum

Map Class Statistics

Frequency: 2 project polygons

Area: 1 hectares / 2 acres

Avg. Size: 0.3 hectares / 0.8 acres

Proportion: 0.1 % of mapping area

Distribution/Ecology/Composition

This is an uncommon non-native annual herbaceous community that occurs on highly disturbed areas in the railroad rights-of-way. The map class is dominated by weedy annual forbs and grasses such as tumbled mustard, annual sunflower, and cheatgrass.

Interpretation

The signature is mottled brownish and green colors (typical of mixed herbaceous vegetation) with smooth texture, indicating a lack of shrubs or native bunchgrasses within the stand.



Example of photo signature for map class H-ANNF (#40).

Map Class 41
Cheatgrass - Russian Thistle Disturbed Vegetation (H-CGRT)

NO GROUND PHOTO AVAILABLE

Associations

Bromus tectorum Semi-natural Herbaceous Vegetation

Ecological Systems

Inter-Mountain Basins Semi-Desert Grassland

Characteristic species

Bromus tectorum
Salsola spp.

Map Class Statistics

Frequency: 4 project polygons
Area: 1 hectares / 2 acres
Avg. Size: 0.2 hectares / 0.6 acres
Proportion: 0.1 % of mapping area

Distribution/Ecology/Composition

This non-native annual herbaceous vegetation community is established on soils derived from Lake Bonneville sediments that are disturbed and used either for ranch access or for trailing livestock. The chronic disturbance including soil compaction and mechanical plant injury prevents all but annual plant species from becoming established.

Interpretation

The signature is light to medium gray in color due to exposure of and reflectance by bare ground. Light-colored linear features in the matrix signature represent truck tracks and livestock trails.



Example of photo signature for map class H-CGRT (#41).

Map Class 42
Cheatgrass - Snakeweed Disturbed Vegetation (H-CGSW)



Photo credit: NPS

Associations

Bromus tectorum Semi-natural Herbaceous Vegetation

Ecological Systems

Inter-Mountain Basins Semi-Desert Grassland

Characteristic species

Gutierrezia sarothrae

Bromus tectorum

Aristida purpurea

Map Class Statistics

Frequency: 29 project polygons
Area: 152 hectares / 376 acres
Avg. Size: 5.2 hectares / 12.9 acres
Proportion: 13.3 % of mapping area

Distribution/Ecology/Composition

This non-native annual cheatgrass and snakeweed dwarf-shrub community occurs primarily within burned, hilly, and dry areas of GOSP. The shallow, gravelly soils support the establishment and growth of snakeweed.

Interpretation

The signature matrix color is the bright green of cheatgrass and snakeweed provides texture in the form of tiny dark speckles visible only under magnification. Thin soils appear as pale gray patches of reflected light within the bright green matrix.



Example of photo signature for map class H-CGSW (#42).

Map Class 61
Saltgrass - Squirreltail Floodplain Grassland (H-FLPN)



Photo credit: NPS

Associations

Distichlis spicata Herbaceous Vegetation

Ecological Systems

Inter-mountain Basins Wash

Characteristic species

Distichlis spicata

Hordeum jubatum

Map Class Statistics

Frequency: 1 project polygon
Area: 0.5 hectares / 1.1 acres
Avg. Size: 0.5 hectares / 1.1 acres
Proportion: 0.04 % of mapping area

Distribution/Ecology/Composition

This community of deep alkaline soils is restricted to the active channel and lowest terraces of Blue Creek at the extreme eastern end of GOSP. The dominant species are grasses that tolerate alternating wet and dry conditions, inundation, and alkaline soils.

Interpretation

The signature is a smooth texture with medium brown color, but is often under shadow from the high banks of Blue Creek. Interpreted and mapped polygons include the stream channel and first terraces of Blue Creek. The interpretation and mapping were prepared from field notes and delineation.



Example of photo signature for map class H-FLPN (#61).

Sparsely Vegetated Geological Sites

Map Class 301

Sparsely Vegetated Limestone Outcrop (G-LIME)



Photo credit: NPS

Associations

None assigned

Ecological Systems

Inter-mountain Basins Cliff and Canyon

Characteristic species

Brickellia microphylla

Petrophytum caespitosum

Artemisia ludoviciana

Heterotheca villosa

Aristida purpurea

Phlox longifolia

Map Class Statistics

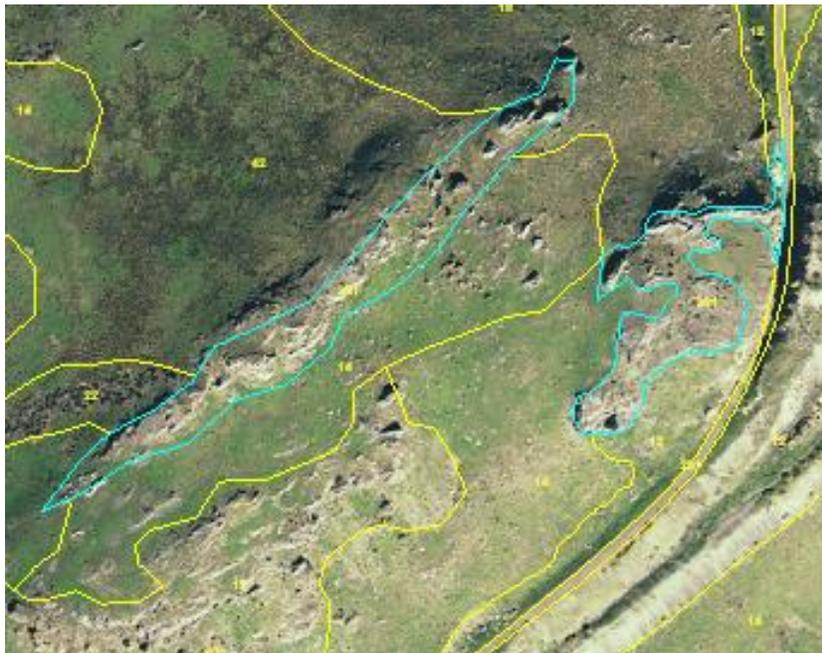
Frequency: 12 project polygons
Area: 4 hectares / 10 acres
Avg. Size: 0.3 hectares / 0.8 acres
Proportion: 0.3 % of mapping area

Distribution/Ecology/Composition

Only the largest polygons of this type were mapped; stands too small to map effectively are abundant throughout the hilly parts of the NHS. This map class is intended to represent the unique vegetation that grows on outcrops of Oquirrh Limestone. Most outcrops support elements of the surrounding vegetation, such as cheatgrass, yellow rabbitbrush, and snakeweed. However, several species grow only on the rocks, including rockspiraea, hairy goldenaster, and littleleaf brickellbush.

Interpretation

This map class is distinguished by the rough, gray texture of the outcrops. Vegetation is usually not apparent, except when cheatgrass is present (bright green signature). Small dots representing larger shrubs may be visible under magnification.



Example of photo signature for map class G-LIME (#301)

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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National Park Service
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