

## Ecological site R047XB309UT Upland Loam (black sagebrush)

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### General information

**Provisional.** A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

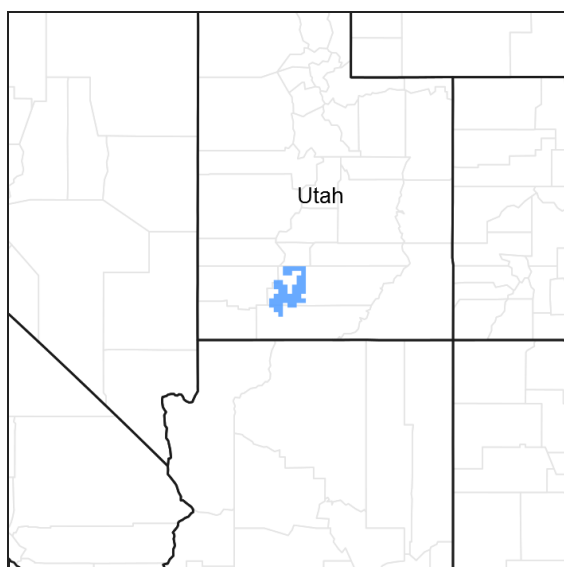


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

### MLRA notes

Major Land Resource Area (MLRA): 047X–Wasatch and Uinta Mountains

MLRA 47 occurs in Utah (86 percent), Wyoming (8 percent), Colorado (4 percent), and Idaho (2 percent). It encompasses approximately 23,825 square miles (61,740 square kilometers). The northern half of this area is in the Middle Rocky Mountains Province of the Rocky Mountain System. The southern half is in the High Plateaus of the Utah Section of the Colorado Plateaus Province of the Intermontane Plateaus. Parts of the western edge of this MLRA are in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. The MLRA includes the Wasatch Mountains, which trend north and south, and the Uinta Mountains, which trend east and west. The steeply sloping, precipitous Wasatch Mountains have narrow crests and deep valleys. Active faulting and erosion are a dominant force in controlling the geomorphology of the area. The Uinta Mountains have a broad, gently arching, elongated shape. Structurally, they consist of a broadly folded anticline that has an erosion-resistant quartzite core. The Wasatch and Uinta Mountains have an elevation of 4,900 to about 13,500 feet (1,495 to 4,115 meters).

The mountains in this area are primarily fault blocks that have been tilted up. Alluvial fans at the base of the mountains are recharge zones for the basin fill aquifers. An ancient shoreline of historic Bonneville Lake is evident on the footslopes along the western edge of the area. Rocks exposed in the mountains are mostly Mesozoic and Paleozoic sediments, but Precambrian rocks are exposed in the Uinta Mountains. The Uinta Mountains are one of the few ranges in the United States that are oriented west to east. The southern Wasatch Mountains consist of

Tertiary volcanic rocks occurring as extrusive lava and intrusive crystalline rocks.

The average precipitation is from 8 to 16 inches (203 to 406 mm) in the valleys and can range up to 73 inches (1854 mm) in the mountains. In the northern and western portions of the MLRA, peak precipitation occurs in the winter months. The southern and eastern portions have a greater incidence of high-intensity summer thunderstorms; hence, a significant amount of precipitation occurs during the summer months. The average annual temperature is 30 to 50 degrees Fahrenheit (-1 to 15 C). The freeze-free period averages 140 days and ranges from 60 to 220 days, generally decreasing in length with elevation.

The dominant soil orders in this MLRA are Aridisols, Entisols, Inceptisols, and Mollisols. The lower elevations are dominated by a frigid temperature regime, while the higher elevations experience cryic temperature regimes. Mesic temperature regimes come in on the lower elevations and south facing slopes in the southern portion of this MLRA. The soil moisture regime is typically xeric in the northern part of the MLRA, but grades to ustic in the extreme eastern and southern parts. The mineralogy is generally mixed and the soils are very shallow to very deep, generally well drained, and loamy or loamy-skeletal.

### LRU notes

E47B is the Wasatch Mountains South MLRA. It occurs in the Loa, Panguitch, New Harmony area. Most of Zion, Bryce Canyon National Parks and Cedar Breaks National Monument are in this area. This area is composed of mountain ranges that run north and south.

### Classification relationships

Modal Soil: Zinzer Loam 3-15% — fine-loamy, mixed Aridic Calciborolls

### Ecological site concept

The soils of this site formed mostly in alluvium and/or colluvium from igneous and sedimentary rock. Surface soils are loam to very fine sandy loam in texture. Rock fragments may be present on the soil surface and throughout the profile, but make up less than 35 percent of the soil volume. These soils are deep to very deep, well-drained, and have moderate to moderately rapid permeability. pH is slightly alkaline. Available water-holding capacity ranges from 5.9 to 6.7 inches of water in the upper 60 inches of soil. The soil moisture regime is mostly ustic and the soil temperature regime is frigid. Precipitation ranges from 12 to 16 inches annually.

### Associated sites

R047XB303UT	<b>Upland Clay (pinyon/Utah juniper)</b>
R047XB306UT	<b>Upland Gravelly Loam (black sagebrush)</b>
R047XB308UT	<b>Upland Loam (mountain big sagebrush/Indian ricegrass)</b>
R047XB312UT	<b>Upland Shallow Clay (pinyon/Utah juniper)</b>
R047XB316UT	<b>Upland Shallow Hardpan (black sagebrush)</b>
R047XB318UT	<b>Upland Shallow Hardpan (pinyon/Utah juniper)</b>
R047XB322UT	<b>Upland Shallow Loam (mountain big sagebrush)</b>
R047XB333UT	<b>Upland Stony Loam (pinyon/Utah juniper)</b>
R047XB336UT	<b>Upland Stony Loam (mountain big sagebrush)</b>

### Similar sites

R047XB306UT	<b>Upland Gravelly Loam (black sagebrush)</b>
R047XB308UT	<b>Upland Loam (mountain big sagebrush/Indian ricegrass)</b>

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Artemisia nova</i>
Herbaceous	(1) <i>Achnatherum hymenoides</i>

Physiographic features

Dissected alluvial fans and mountain slopes.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope (2) Alluvial fan
Runoff class	Low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	6,800–8,500 ft
Slope	1–20%
Aspect	Aspect is not a significant factor

Climatic features

The climate is characterized by cold, snowy winters and cool, moist summers. Approximately 50 percent of the moisture comes during the plant growth period from April 1 through September 30. On the average April, May, and June are the driest months and July, August, and September are the wettest months.

Table 3. Representative climatic features

Frost-free period (characteristic range)	
Freeze-free period (characteristic range)	70-100 days
Precipitation total (characteristic range)	12-16 in

Influencing water features

Due to its landscape position, this site is not influenced by streams or wetlands.

Wetland description

N/A

Soil features

The soils of this site formed mostly in alluvium and colluvium from igneous and sedimentary rock (sandstone and shale). Surface soils are loam to very fine sandy loam in texture. Rock fragments may be present on the soil surface and throughout the profile, but make up less than 35 percent of the soil volume. These soils are deep to very deep, well-drained, and have moderate to moderately rapid permeability. pH is slightly alkaline. Available water-holding capacity ranges from 5.9 to 6.7 inches of water in the upper 60 inches of soil. The soil moisture regime is mostly ustic and the soil temperature regime is frigid. Precipitation ranges from 12 to 16 inches annually.

Modal Soil: Zinzer Loam 3-15% — fine-loamy, mixed Aridic Calciborolls

Table 4. Representative soil features

Parent material	(1) Alluvium–igneous and sedimentary rock (2) Colluvium–igneous and sedimentary rock
Surface texture	(1) Loam (2) Very fine sandy loam
Family particle size	(1) Fine-loamy
Drainage class	Well drained
Permeability class	Moderate to moderately rapid
Depth to restrictive layer	60–100 in
Soil depth	60–100 in
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0–15%
Available water capacity (Depth not specified)	5.9–6.7 in
Calcium carbonate equivalent (Depth not specified)	0–25%
Electrical conductivity (Depth not specified)	0–4 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–15%
Subsurface fragment volume >3" (Depth not specified)	0–10%

## Ecological dynamics

It is impossible to determine in any quantitative detail the Historic Climax Plant Community (HCPC) for this ecological site because of the lack of direct historical documentation preceding all human influence. In some areas, the earliest reports of dominant plants include the cadastral survey conducted by the General Land Office, which began in the late 19th century for this area (Galatowitsch 1990). However, up to the 1870s the Shoshone Indians, prevalent in northern Utah and neighboring states, grazed horses and set fires to alter the vegetation for their needs (Parson 1996). In the 1860s, Europeans brought cattle and horses to the area grazing large numbers of them on unfenced parcels year-long (Parson 1996). Itinerant and local sheep flocks followed as the proportion of browse increased.

Below is a State and Transition Model diagram to illustrate the “phases” (common plant communities), and “states” (aggregations of those plant communities) that can occur on the site. Differences between phases and states depend primarily upon observations of a range of disturbance histories in areas where this ESD is represented. These situations include grazing gradients to water sources, fence-line contrasts, patches with differing dates of fire, herbicide treatment, tillage, etc. Reference State 1 illustrates the common plant communities that probably existed just prior to European settlement.

The major successional pathways within states, (“community pathways”) are indicated by arrows between phases. “Transitions” are indicated by arrows between states. The drivers of these changes are indicated in codes decipherable by referring to the legend at the bottom of the page and by reading the detailed narratives that follow the diagram. The transition between Reference State 1 and State 2 is considered irreversible because of the naturalization of exotic species of both flora and fauna, possible extinction of native species, and climate change. There may have also been accelerated soil erosion.

When available, monitoring data (of various types) were employed to validate more subjective inferences made in this diagram. See the complete files in the office of the State Range Conservationist for more details.

The plant communities shown in this State and Transition Model may not represent every possibility, but are probably the most prevalent and recurring plant communities. As more monitoring data are collected, some phases or states may be revised, removed, or new ones may be added. None of these plant communities should necessarily be thought of as “Desired Plant Communities.” According to the USDA NRCS National Range and Pasture Handbook (USDA-NRCS 2003), Desired Plant Communities (DPC’s) will be determined by the decision-makers and will meet minimum quality criteria established by the NRCS. The main purpose for including descriptions of a plant community is to capture the current knowledge at the time of this revision.

#### State 1: Reference State

The Reference State is a description of this ecological site just prior to Euro-American settlement but long after the arrival of Native Americans. The description of the Reference State was determined by NRCS Soil Survey Type Site Location information, and familiarity with rangeland relict areas where they exist.

The least modified plant community (1.1) within the Reference State would have been a black sagebrush-dominated (*Artemisia nova*) stand and associated bunch grasses such as Indian ricegrass (*Achnatherum hymenoides*), Needle and thread (*Hesperostipa comata*) and blue grama (*Bouteloua gracilis*). Forbs such as phlox (Phlox spp.), buckwheat (Eriogonum spp.), milkvetch (Astragalus spp.), and bird's beak (Cordylanthus spp.) would have been common. The generally shallow and stony soils would have accentuated the effects of drought and reduced the chances of fire altering this state.

The reference plant community (1.1) would have been relatively stable with occasional use by wildlife. However, heavy utilization by bison, elk, and Native American horses on these sites (1.1a) would have depleted the grasses creating a near monoculture of black sagebrush (1.2). Heavy browsing by deer during the dormant season of black sagebrush (1.1b) would have created an herbaceous variant (1.3). Occasional very wet years during El Nino-Southern Oscillation periods could have caused temporary soil anoxia (West 2000) (1.1c) killing the sagebrush and allowing the forbs and grasses to dominate for a short time (1.3). Infestation of some insects and pathogens on sagebrush (1.1c) could have led to a similar result where the herbaceous species become temporarily dominant (1.3).

The interaction of an unusually dry period and heavy utilization by all grazers (e.g. deer, bison, elk, and horses used by native American) (1.1d) would have removed the palatable species from the plant community while allowing unpalatable, shorter-lived species such as yellow rabbitbrush (*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*), milkvetch, and phlox to predominate (1.4). The depauperate black sagebrush (*Artemisia nova*) community (1.2) could have also shifted to the unpalatable short-lived shrub community phase (1.4) in areas that have sustained heavy browsing by deer (1.2b). Relatively rocky sites such as these typically would not have declined in overall cover or productivity. However, the portion that is palatable may have changed appreciably. Similarly, these soils would have been more resistant to erosion than other stone-free soils.

Each of the phases within State 1 could have returned to Community Phase 1.1 if climate conditions were within the normal range of variability and there was a release from heavy grazing and browsing pressure (1.2a, 1.3a, 1.4a). A small amount of Wyoming big sagebrush and an informally recognized variety of big sagebrush (*A. tridentata*), called “bonnevilleensis” (Shultz, 2009) would have also been present. A more complete list of species by lifeform for the Reference State is available in the accompanying tables in the “Plant Community Composition by Weight and Percentage” section of this document.

The least modified plant community within the Reference State would have been a black sagebrush-dominated and associated bunch grasses such as Indian ricegrass (*Achnatherum hymenoides*), needle and thread (*Hesperostipa comata*) and blue grama (*Bouteloua gracilis*). Forbs such as phlox (Phlox spp.), buckwheat (Eriogonum spp.), milkvetch (Astragalus spp.), and bird's beak (Cordylanthus spp.) would have been common.

#### Community Phase Pathway 1.1a

Heavy continuous season-long grazing by bison, elk, and Native American horses would have converted the Reference State to a depauperate black sagebrush community.

#### Community Phase Pathway 1.1b

Heavy browsing by deer would have converted the Reference State to a plant community dominated by bunchgrasses and perennial forbs. An extremely wet period such as an El Nino-Southern Oscillation event and

subsequent anoxic soil conditions would have converted the Reference State to a plant community dominated by bunchgrasses and perennial forbs. The same result would occur following a sudden insect (or other pathogen) outbreak on sagebrush.

#### Community Phase Pathway 1.1c

The interaction of exceptionally dry climatic influences compounded by heavy continuous season-long grazing by all grazers including deer, bison, elk, and Native American horses, would have converted the Reference State to an unpalatable short-lived shrub & perennial forb plant community.

#### Community Phase 1.2: Depauperate black sagebrush

This plant community would have developed under heavy continuous season-long grazing by bison, elk, and Native American horses. Heavy utilization of grasses would have created a near monoculture of black sagebrush.

#### Community Phase Pathway 1.2a

The absence of grazing would have allowed the native bunchgrasses and perennial forbs to return to the system converting it back to the Community Phase 1.1.

#### Community Phase Pathway 1.2b

Heavy browsing by deer would have converted the depauperate black sagebrush community to an unpalatable short-lived shrub community phase.

#### Community Phase 1.3: Bunch grasses & Perennial Forbs/Sparse black sagebrush

There are several environmental conditions that would have produced this plant community. Heavy browsing by deer would have resulted in an herbaceous-dominated variant because of the utilization of black sagebrush during the dormant season. Under the occasional very wet period associated with an El Nino-Southern Oscillation event, temporary soil anoxia could have developed (West 2000), killing the sagebrush and allowing the forbs and grasses to dominate for a short time. A similar plant community would have also developed following an outbreak of insects and pathogens where sagebrush was the dominant host.

#### Community Phase Pathway 1.3a

A return to normal climate conditions and the absence of heavy browsing would have allowed black sagebrush to re-establish and convert back to the Community Phase 1.1.

#### Community Phase 1.4: Short-lived Shrubs/Perennial Forbs

This plant community would have developed under the combined effect of unusual drought conditions and heavy grazing by all grazers including deer, bison, elk, and Native American horses. Focused utilization would have reduced the palatable species while allowing the noxious, unpalatable, and shorter-lived species such as yellow rabbitbrush, milkvetch, and phlox to predominate.

#### Community Phase Pathway 1.4a

A return to normal climate conditions followed by a prolonged reduction in grazing pressure would have allowed black sagebrush and native bunchgrasses to re-establish returning to the Reference Plant Community (1.1).

#### Transition 1a

The simultaneous introduction of exotic species, both plants and animals, and possible extinctions of native flora and fauna, along with climate change, will cause State 1 to transition to State 2. A return pathway back to State 1 would be impracticable because of these issues.

#### State 2: Black Sagebrush/ Introduced Non-natives State

State 2 is identical to State 1 in form and function, with the exception of the presence of non-native plants and animals, possible extinctions of native species, and a different climate. State 2 is a description of the ecological site shortly following Euro-American settlement, which can be regarded as the current potential.

The least modified plant community (2.1) within State 2 is a black sagebrush-dominated stand with scattered prickly pear and associated bunch grasses such as Indian ricegrass (*Achnatherum hymenoides*), needle and thread (*Hesperostipa comata*) and blue grama (*Bouteloua gracilis*). Forbs such as phlox (*Phlox* spp.), buckwheat (*Eriogonum* spp.), milkvetch (*Astragalus* spp.), and bird's beak (*Cordylanthus* spp.) would have been common. The generally shallow and stony soils accentuate the effect of drought and reduce the chances of fires altering this state.

This plant community is relatively stable under mixed use by wildlife and livestock. However, heavy utilization by bison, elk, horses, and domestic cattle on these sites during the growing season (2.1a) would deplete the grasses creating a near monoculture of black sagebrush (2.2). Heavy browsing by deer and sheep (2.1b) would create an herbaceous variant (2.3) because of year-round utilization of black sagebrush. Occasionally very wet years during El Nino-Southern Oscillation periods can cause temporary soil anoxia (West 2000) (2.1c) killing the sagebrush and allowing the forbs and grasses to dominate for a short time (2.3). Some insects and pathogens on sagebrush (2.1c) can lead to a similar result where the herbaceous species become temporarily dominant (2.3).

The interaction of an unusually dry period and heavy utilization of grasses by bison, elk, horses, and domestic cattle (2.1d) would remove the palatable species from the plant community while allowing unpalatable, shorter-lived species such as yellow rabbitbrush, milkvetch, and phlox to predominate. Species composition does not change, just their abundance (2.4). The depauperate black sagebrush community (2.2) may also shift to the unpalatable short-lived shrub community phase (2.4) with heavy utilization of browse by deer and sheep (2.2b). Relatively rocky sites such as these typically do not decline in overall cover or productivity, however, the portion that is palatable may change appreciably. Similarly, these soils are more resistant to erosion than associated stone-free soils.

Each of the phases within State 2 can return to Community Phase 2.1 when climate conditions are within the normal range of variability and grazing pressure is moderated (2.2a, 2.3a, 2.4a). A small amount of Wyoming big sagebrush and an informally recognized variety of big sagebrush, called “bonnevillensis” (Shultz, 2009) may also be present.

#### Community Phase 2.1: Black sagebrush/Sparse bunchgrasses and Perennial forbs

The least modified plant community within the Black Sagebrush/ Introduced Non-natives State is a black sagebrush-dominated stand with scattered prickly pear and associated bunch grasses such as Indian ricegrass (*Achnatherum hymenoides*), Needle and thread (*Hesperostipa comata*) and blue grama (*Bouteloua gracilis*). Forbs such as phlox (Phlox spp.), buckwheat (Eriogonum spp.), milkvetch (Astragalus spp.), and bird's beak (Cordylanthus spp.) would have been common.

#### Community Phase Pathway 2.1a

Heavy continuous season-long grazing by bison, elk, horses, and cattle would convert the Black sagebrush/ Sparse bunchgrasses & Perennial forbs phase to a depauperate black sagebrush community.

#### Community Phase Pathway 2.1b

Heavy browsing by deer and sheep would convert the Black sagebrush/ Sparse bunchgrasses and Perennial forbs phase to a plant community dominated by bunchgrasses and perennial forbs. An extremely wet period such as an El Nino-Southern Oscillation event and subsequent anoxic soil conditions would convert the Black sagebrush/ Sparse bunchgrasses and Perennial forbs phase to a plant community dominated by bunchgrasses and perennial forbs. The same result would be seen following a sudden insect (or other pathogen) outbreak on sagebrush.

#### Community Phase Pathway 2.1c

The interaction of exceptionally dry climatic influences and heavy continuous season-long grazing by all grazers would convert the Black sagebrush/ Sparse bunchgrasses and Perennial forbs phase to an unpalatable short-lived shrub and perennial forb plant community.

#### Community Phase 2.2: Depauperate Black sagebrush

This plant community is developed under heavy continuous season-long grazing by bison, elk, cattle, and horses. Heavy utilization of grasses creates a near monoculture of black sagebrush.

#### Community Phase Pathway 2.2a

This plant community can move back towards the Black sagebrush/ Sparse bunchgrasses and Perennial forbs phase when grazing management, particularly of sheep, and use by deer, take place only during the non-growing season of the herbaceous component, along with broadcast re-seeding with native perennial forbs and grasses.

#### Community Phase Pathway 2.2b

Heavy browsing by deer and sheep would convert the depauperate black sagebrush phase to the unpalatable short-lived shrub and perennial forb community

### Community Phase 2.3: Bunchgrasses and perennial forbs/ Sparse black sagebrush

There are several environmental conditions that would produce this plant community. Heavy year-round browsing by deer and sheep would result in an herbaceous-dominated variant because of the utilization of black sagebrush. Following the occasional very wet period associated with an El Nino-Southern Oscillation event, temporary soil anoxia could develop, (West 2000) killing the sagebrush and allowing the forbs and grasses to dominate for a short time. A similar plant community would also develop following an outbreak of insects and pathogens where sagebrush is the dominant host.

#### Community Phase Pathway 2.3a

This plant community can move back to the Black sagebrush/ Sparse bunchgrasses and Perennial forbs phase with a return to normal climate conditions and when grazing by both livestock and wildlife is concentrated during the spring to put pressure on the herbaceous component, allowing the native woody component to re-establish.

### Community Phase 2.4: Short-lived shrubs/perennial forbs

This plant community is developed under extreme drought conditions combined with heavy continuous season-long grazing. Such disturbances will reduce the palatable species and allow the unpalatable, shorter-lived species such as yellow rabbitbrush, milkvetch, and phlox to predominate. Because of the prevalence of historic unrestricted ungulate grazing, this is the most likely of the phases within State 2 to transition to States 3 or 4.

#### Community Phase Pathway 2.4a

A return to the Black sagebrush/ Sparse bunchgrasses and Perennial forbs phase is possible with a return to normal (or wetter) climate conditions and high intensity short duration grazing management to allow the native woody component to re-establish and decrease the competition by herbaceous species.

#### Transition 2a

The Black Sagebrush/ Introduced Non-natives State will transition to the Introduced Annuals/Biennials State following a sustained period of eutrophication caused by excessive year-long livestock grazing, trampling and bedding, especially by large flocks of domestic sheep. Sheep bedding, salting, watering, and handling locations involve intensive trampling, urination, defecation, and consequent eutrophication, which can be influential in this type of transition. It is also common to see accelerated soil erosion in such locations.

#### Transition 2b

The Black Sagebrush/ Introduced Non-natives State will transition to the Cushion Plant State under conditions marked by accelerated soil erosion and soil compaction caused by mechanical damage from trail and road development, excessive trail/foot traffic, or jeep/ATV impacts resulting in permanent reduction of plant cover.

### State 3: Introduced Annuals/Biennials State

Invasive annuals and biennial forbs such as cheatgrass (*Bromus tectorum*), Russian thistle (*Salsola tragus*), knapweeds (*Centaurea* spp.), and horehound (*Marrubium vulgare*) are favored by an increase in nutrient build-up in old, eutrophicated sheep bed-grounds. Where fire return intervals are frequent (3.2a) annuals such as cheatgrass and Russian thistle will predominate (3.1). Longer intervals between fire events (3.1a) will result in a plant community dominated by biennial forbs (3.2). The soil profiles of the plant communities within this state are mainly intact.

#### Community Phase 3.1: Annual grass/annual forb

This plant community will develop where fire return intervals are frequent and annual species such as cheatgrass and Russian thistle predominate.

#### Community Phase Pathway 3.1a

When intervals between fire events are prolonged, biennial forbs will dominate the plant community.

#### Community Phase 3.2: Annual forb/biennial forb

This plant community will develop when intervals between fires are longer, allowing biennial species such as knapweeds, tumble mustard (*Sisymbrium altissimum*), and Dyer's woad (*Isatis tinctoria*) to become established.

#### Community Phase Pathway 3.2a

When fire return intervals are frequent, annual forbs and grasses will dominate the plant community.



#### State 4: Cushion Plant State

Curlycup gumweed (*Grindelia squarrosa*) and other cushion plants such as spiny phlox (*Phlox hoodii*), prickly phlox (*Leptodactylon* spp.), etc. are found on highly eroded sites, where accelerated soil erosion and soil compaction caused by mechanical damage has removed the fine soil particles and compacted the soils leaving a rocky self-armored surface (4.1).

#### Community Phase 4.1: Cushion Plant/annual forb

This plant community will develop following prolonged mechanical damage caused by trail and road development, excessive trail/foot traffic, or jeep/ATV impacts resulting in permanent reduction of plant cover. The only plants remaining are those tolerant of drought, infertile soil, and mechanical disturbances.

### State and transition model

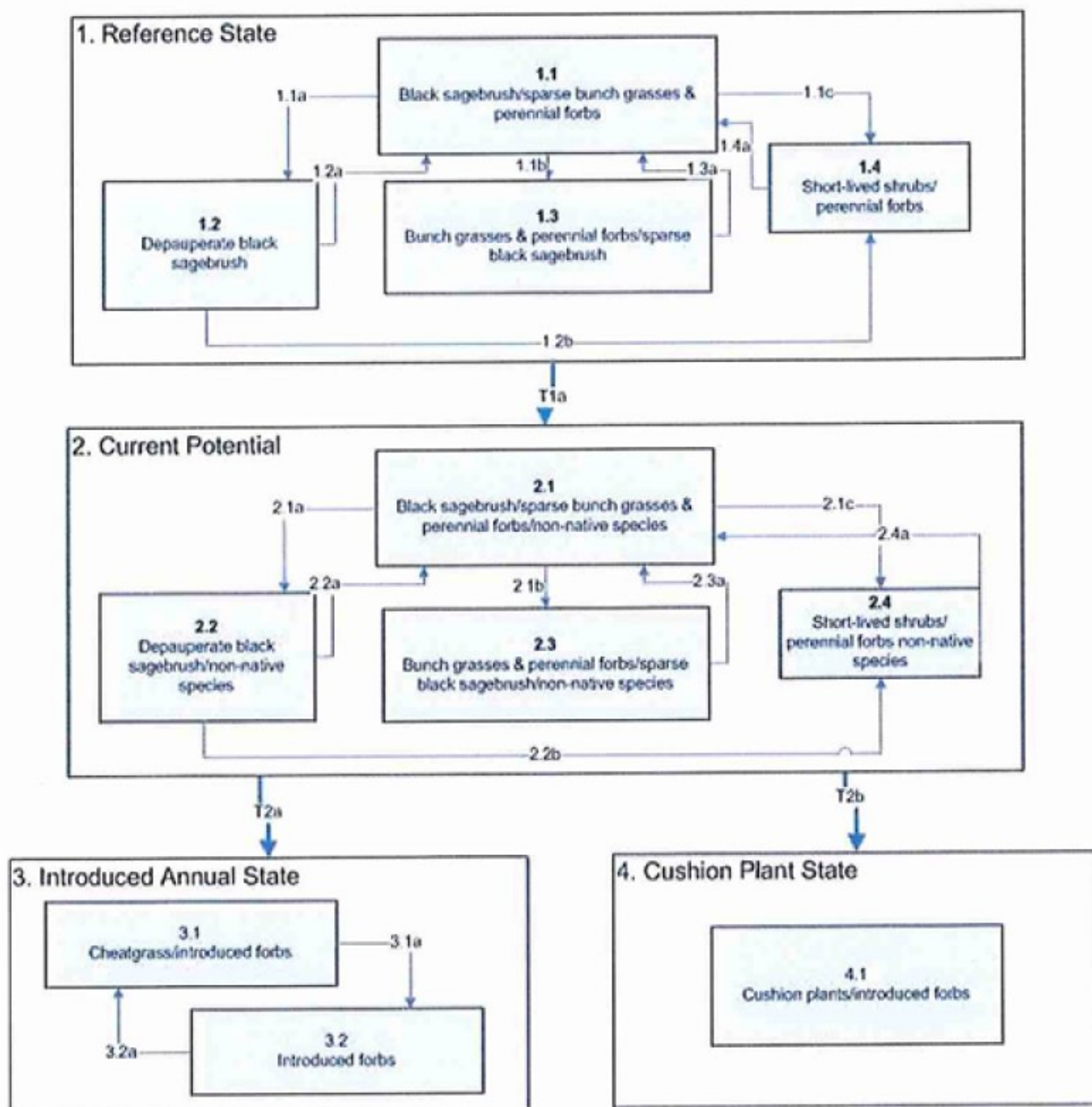


Figure 2. STM

#### Community Phase Pathway 1.1a

Heavy continuous season-long grazing by bison, elk, and Native American horses.

#### Community Phase Pathway 1.1b

Heavy browsing by deer.

#### Community Phase Pathway 1.1c

The interaction of exceptionally dry climatic influences compounded by heavy continuous season-long grazing.

#### Community Phase Pathway 1.2a

The absence of grazing .

#### Community Phase Pathway 1.2b

Heavy browsing by deer.

#### Community Phase Pathway 1.3a

A return to normal climate conditions and the absence of heavy browsing.

#### Community Phase Pathway 1.4a

A return to normal climate conditions followed by a prolonged reduction in grazing pressure.

#### Transition 1a

Introduction of exotic species.

#### Community Phase Pathway 2.1a

Heavy continuous season-long grazing by bison, elk, horses, and cattle.

#### Community Phase Pathway 2.1b

Heavy browsing by deer and sheep.

#### Community Phase Pathway 2.1c

The interaction of exceptionally dry climatic influences and heavy continuous season-long grazing.

#### Community Phase Pathway 2.2a

Grazing management.

#### Community Phase Pathway 2.2b

Heavy browsing by deer and sheep.

#### Community Phase Pathway 2.3a

Return to normal climatic conditions and grazing management.

#### Community Phase Pathway 2.4a

Return to normal climatic conditions and grazing management.

#### Transition 2a

Sustained period of eutrophication

#### Transition 2b

Accelerated soil erosion and soil compaction.

#### Community Phase Pathway 3.1a

When intervals between fire events are prolonged.

#### Community Phase Pathway 3.2a

When fire return intervals are frequent.

## State 1

### Reference State

## Community 1.1

### Reference Plant Community

The aspect of this site is a grass/shrub mixture. The grasses are dominated by Indian ricegrass. Blue grama and needle and thread are apparent. The shrub component is dominated by black sagebrush. Forbs make up a minor component of this plant community.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	330	495	660
Shrub/Vine	240	360	480
Forb	30	45	60
Total	600	900	1200

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	29-31%
Grass/grasslike foliar cover	19-21%
Forb foliar cover	4-6%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	—	—	—	—
>0.5 <= 1	—	—	—	4-6%
>1 <= 2	—	29-31%	19-21%	—
>2 <= 4.5	—	—	—	—
>4.5 <= 13	—	—	—	—
>13 <= 40	—	—	—	—
>40 <= 80	—	—	—	—
>80 <= 120	—	—	—	—
>120	—	—	—	—

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
<b>Shrub/Vine</b>					
0	<b>Dominant Shrubus</b>			200–300	
	black sagebrush	ARNO4	<i>Artemisia nova</i>	200–300	–
3	<b>Sub-Dominant Shrubs</b>			120–280	
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	30–50	–
	ballhead ipomopsis	IPCOC3	<i>Ipomopsis congesta ssp. congesta</i>	30–50	–
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	10–30	–
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	10–30	–
	rubber rabbitbrush	ERNA10	<i>Ericameria nauseosa</i>	10–30	–
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	10–30	–
	Shrub (>.5m)	2SHRUB	<i>Shrub (&gt;.5m)</i>	10–30	–
	big sagebrush	ARTR2	<i>Artemisia tridentata</i>	10–30	–
<b>Grass/Grasslike</b>					
0	<b>Dominant Grasses</b>			300–500	
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	200–300	–
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	50–100	–
	needle and thread	HECO26	<i>Hesperostipa comata</i>	50–100	–
1	<b>Sub-Dominant Grasses</b>			150–350	
	Grass, annual	2GA	<i>Grass, annual</i>	50–100	–
	Grass, perennial	2GP	<i>Grass, perennial</i>	50–100	–
	squirreltail	ELEL5	<i>Elymus elymoides</i>	10–30	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	10–30	–
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	10–30	–
	muttongrass	POFE	<i>Poa fendleriana</i>	10–30	–
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	10–30	–
<b>Forb</b>					
2	<b>Sub-Dominant Forbs</b>			110–190	
	gooseberryleaf globemallow	SPGR2	<i>Sphaeralcea grossulariifolia</i>	20–30	–
	King's bird's-beak	COKI	<i>Cordylanthus kingii</i>	20–30	–
	redroot buckwheat	ERRA3	<i>Eriogonum racemosum</i>	20–30	–
	longleaf phlox	PHLO2	<i>Phlox longifolia</i>	10–20	–
	Forb, annual	2FA	<i>Forb, annual</i>	10–20	–
	Forb, perennial	2FP	<i>Forb, perennial</i>	10–20	–
	freckled milkvetch	ASLE8	<i>Astragalus lentiginosus</i>	10–20	–
	Pacific aster	SYCHC	<i>Symphyotrichum chilense var. chilense</i>	10–20	–

## Animal community

Good summer grazing for cattle and sheep.

Good forage production – Poor cover.

Mule deer, antelope.

## Hydrological functions

The soils in this site are in the B hydrologic group

## Recreational uses

This site has good esthetic appearances and beauty

## Wood products

None

## Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range trained personnel were also used.

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## Contributors

Tom Simper

## Approval

Kendra Moseley, 2/06/2025

## Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be

known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

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Date	12/06/2012
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

- 1. Number and extent of rills:** None. Some very minor rill development may be evident following significant thunderstorm or snow melt events but should mostly heal during the following growing season. The presence of rills may also be apparent where run-on from adjacent upland sites or exposed bedrock concentrate flows. Any rill development present should be less than 1 inch deep, moderately short (< 6') and spaced a minimum of 10 to 12 feet apart.

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- 2. Presence of water flow patterns:** Rare. A very few stable overland flow patterns may be present and wind around plant bases. They should show no evidence of current erosion or deposition. Flow patterns present are normally 15 to 20 feet long, follow natural contours, and are typically spaced at least 10 to 15 feet apart. A slight increase in flow activity may be observed immediately following significant weather events such as thunderstorms or spring run-off events.

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- 3. Number and height of erosional pedestals or terracettes:** None. There should be no evidence of pedestals or terracettes caused by accelerated water erosion. One to 2 inches of elevational mounding under black sagebrush and other shrub canopies, and within biological soil crusts, is normal for this site and is not caused by water erosion. There are no exposed roots around perennial grasses and shrubs.

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- 4. Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground ranges from 30% - 40%. Soil surface may be covered by 5% to 45% coarse fragments. Bare ground openings should not be greater than 2 to 3 feet in diameter and should normally not be connected.

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- 5. Number of gullies and erosion associated with gullies:** None at site level. Scattered landscape level gully channels, however, are a normal component of basin/range environments. Where landscape gullies are present, they should be stable, partially vegetated on their sides and bottoms, with no evidence of head-cutting. Some slight increase in disturbance may be evident following significant weather events or when gullies convey considerable runoff from higher elevation rocky or naturally eroding areas.

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- 6. Extent of wind scoured, blowouts and/or depositional areas:** None to Rare. Some very minor evidence of wind generated soil movement may be present. Slight depositional mounding within perennial grass crowns, under black sagebrush and other shrub canopies, and within biological soil crusts is normal for this site.

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- 7. Amount of litter movement (describe size and distance expected to travel):** The majority of litter accumulates in

place at the base of plants canopies. Slight movement of the finest material (< 1/8 inch) may move 1 to 2 feet in the direction of prevailing winds or down slope if being transported by water. Little accumulation is observed behind obstructions.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** This site should have a soil stability rating of 5 or 6 under plant canopies, and a 4 to 5 in the interspaces. Average should be a 5. Surface textures are typically gravelly loams, gravelly sandy loams, and sandy clay loams containing up to 50% coarse fragments.
9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** (Andys) Soil surface is typically 0 to 8 inches deep. Surface texture is a loam and structure is weak fine granular. The A-horizon color is dark brown (10YR 5/3). Soils have a Mollic epipedon that extends 8 inches into the soil profile. The A horizon is normally deeper and better developed under plant canopies. Use the specific information for the soil you are assessing found in the published soil survey to supplement this description.
10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Healthy stands of perennial grasses and shrubs, as well as the presence of biological crusts, provide for good infiltration, help break raindrop impact, and reduce runoff from storm events. Bare spaces are expected to be fairly small (< 3 feet) should be irregular in shape and usually not connected. Vegetative structure is adequate to capture snow and allow snowmelt to occur in a controlled manner.
11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None, There may be various layers of rock fragments or other naturally occurring hard layers within the soil profile. These should not be interpreted as compaction layers.
12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

Dominant: Non-Sprouting shrubs (black sagebrush, Wyoming big sagebrush) >> Cool Season Perennial bunchgrasses (Indian ricegrass, needle-and-thread)

Sub-dominant: Sprouting shrubs (green rabbitbrush, rubber rabbitbrush) > = Warm Season Perennial grasses (blue grama).

Other: A wide variety of other grasses and both perennial and annual forbs can be expected to occur in the plant community.

Additional: Moss and lichen communities will normally be found under plant canopies while cyanobacteria may be found throughout the site. Functional/structural groups may appropriately contain non-native species if their ecological function is the same as the native species. Perennial and annual forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions.
13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** All age classes of perennial grasses should be present during years with average to above-average precipitation, there should be very little recent mortality or decadence apparent in either the shrubs or grasses. During

severe (multi-year) drought or insect infestations up to 20% of the winterfat may die. There may be partial mortality of individual bunchgrasses and other shrubs during severe drought.

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14. **Average percent litter cover (%) and depth ( in):** Litter cover ranges from 20 to 25%. Most litter will be herbaceous and depths of 1 to 2 leaf thickness in the interspaces and from 1 to 1 1/2 inches under perennial plant canopies would be considered normal. Perennial vegetation should be well distributed on the site.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Annual production in air-dry herbage should be approximately 800 to 1000 pounds per acre on an average year. Production could vary from 500 to 1300 pounds per acre during drought or above-average years.

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Russian thistle, annual bromes, alyssum and annual mustard species are most likely to invade this site.

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17. **Perennial plant reproductive capability:** All perennial plant species have the ability to reproduce in most years except drought years. There are no restrictions on either seed or vegetative reproduction. Some seedling recruitment of major species may be present during average or above average years.

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