USDA Natural Resources
Conservation Service

Ecological site DX034A02X124
Loamy Argillic Pinedale Plateau (LyA PP)

Last updated: 9/28/2023
Accessed: 05/18/2024

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.

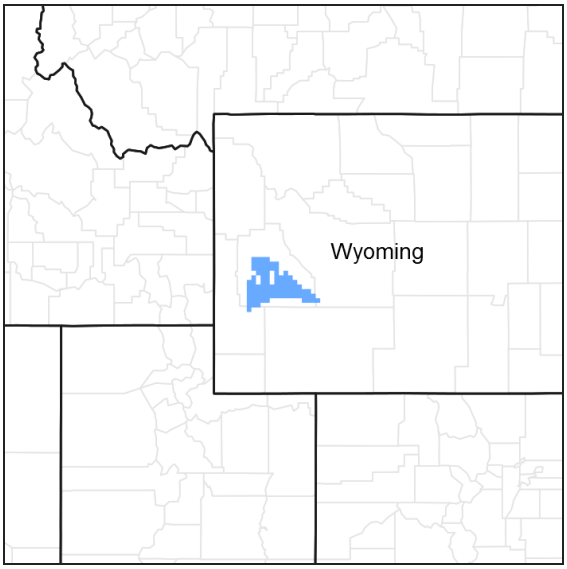


Figure 1. Mapped extent

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): 034A–Cool Central Desertic Basins and Plateaus

Major Land Resource Area (MLRA): 34A-Cool Central Desertic Basins and Plateaus
For further information regarding MLRAs, refer to:
http://soils.usda.gov/survey/geography/mlra/index.html

Land Resource Unit (LRU) 34A-C: Pinedale Plateau
Moisture Regime: aridic ustic
Temperature Regime: frigid, cool
Dominant Cover: rangeland
Representative Value (RV) Effective Precipitation: 9-12 inches
RV Frost-Free Days: 30-60 days

Classification relationships

Site Type: Rangeland

Site ID: R034C124WY

Site Name: Loamy, Argillic

Precipitation or Climate Zone: 9-12” P.Z.

Relationship to Other Established Classification Systems
National Vegetation Classification System (NVC):
3 Semi-Desert
3.B.1 Cool Semi-Desert Scrub & Grassland
D040 Western North American Cool Semi-Desert Scrub & Grassland
M169 Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe Group
CEGL001011 Artemisia tridentata/*Achnatherum lettermanii* Shrubland

Ecoregions (EPA):
Level I: 10 North American Deserts
Level II: 10.1 Cold Deserts
Level II: 10.1.4 Wyoming Basin

Ecological site concept

Site does not receive any additional water.
Soils are:
not saline or saline-sodic.
moderately deep or deep with < 3% stone and boulder cover.
not skeletal within 20” of soil surface.
not strongly or violently effervescent in surface mineral 6”.
textures usually range from clay loam to silty clay in surface mineral 6”.
Slope is < 20%.
Clay content is > 32% in surface mineral 6”.
Site does have an argillic horizon with > 35% clay below 10”.

Associated sites

DX034A02X122	**Loamy Pinedale Plateau (Ly PP)**
DX034A02X150	**Sandy Pinedale Plateau (Sy PP)**
R034AY204WY	**Clayey Foothills and Basins West (Cy)**
R034AY262WY	**Shallow Loamy Foothills and Basins West (SwLy)**

Similar sites

DX034A02X122	**Loamy Pinedale Plateau (Ly PP)** PP has big sage instead of early sage
R034AY262WY	**Shallow Loamy Foothills and Basins West (SwLy)**
R034AY204WY	**Clayey Foothills and Basins West (Cy)**

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia arbuscula subsp. longiloba*
Herbaceous	(1) *Poa fendleriana* (2) *Achnatherum lettermanii*

Legacy ID

R034AC124WY

Physiographic features

The Loamy, Argillic Pinedale Plateau(Ly,A) ecological site (R034AC124WY) is located within LRU “C” in MLRA “34A.” This ecological site occurs in intermontane basin landscapes on hill, stream terrace, draw, pediment, and fan remnant landforms (see definitions below). The slope ranges from level to 20%. This site occurs on all exposures.

fan remnant – A general term for landforms that are the remaining parts of older fan-landforms, such as alluvial fans, fan aprons, inset fans, and fan skirts, that either have been dissected (erosional fan-remnants) or partially buried (nonburied fan-remnants). An erosional fan remnant must have a relatively flat summit that is a relict fan-surface.
intermontane basin – A generic term for wide structural depressions between mountain ranges that are partly filled with alluvium and called "valleys" in the vernacular.
hills – A landscape dominated by hills and associated valleys. The landform term is singular (hill).

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Fan remnant
Flooding frequency	None
Ponding frequency	None
Elevation	1,981–2,286 m
Slope	0–20%
Water table depth	152 cm
Aspect	Aspect is not a significant factor

Climatic features

Annual precipitation ranges from 9-12 inches per year. Wide fluctuations may occur in yearly precipitation and result in more dry years than those with more than normal precipitation. Temperatures show a wide range between summer and winter and between daily maximums and minimums. This is predominantly due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks in winter move rapidly from northwest to southeast and account for extreme minimum temperatures.

Much of the precipitation accumulation (45%) comes in the winter in the form of snow (Oct to April). The wettest month is May (1.69 inches). The growing season is short (<60 day) and cool (growing degree days?): primary growth typically occurs between May and June. The dominant plants (sagebrush and cool season grasses) are well adapted to these conditions.
Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 mph.

Growth of native cool season plants begins about mid-April and continues to approximately early-July. Some green up of cool season plants usually occurs in September with adequate fall moisture.

The following information is from the “Pinedale” climate station:

Table 3. Representative climatic features

Frost-free period (average)	31 days
Freeze-free period (average)	62 days
Precipitation total (average)	305 mm

Climate stations used

- (1) PINEDALE [USC00487260], Pinedale, WY

Influencing water features

None

Soil features

The soils of this site are deep to moderately deep with a root restricting argillic layer at 10-20 inches, well-drained soils formed in alluvium, residuum or colluvium with 35-50 percent clay. They soils may have the soil texture modifier of channery.

Major soil series correlated to this site includes: Hogblack, Billiesdraw, Yoda, Mantlemine and Golphco series.

Other soil series in MLRA 34A correlated to this site include: Waybe, Roxal and some phases of the Rallod and Blazon series.

Table 4. Representative soil features

Parent material	(1) Alluvium–sandstone and shale
Surface texture	(1) Gravelly loam (2) Clay loam (3) Clay
Family particle size	(1) Clayey
Drainage class	Moderately well drained to well drained
Permeability class	Very slow to slow
Soil depth	25–51 cm
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0–10%
Available water capacity (0-101.6cm)	6.35–15.24 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0–8 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–5
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–20%
Subsurface fragment volume >3" (Depth not specified)	0–15%

Ecological dynamics

This ecological site is an early sagebrush-dominated community in which forbs and grasses are a minor component. The site consists of four stable states: the Reference State (1), Grazing Resistant State (2), and Eroded State (3).

The Reference Plant Community (Early Sagebrush/Bunchgrass) of this site is dominated by Early Sagebrush and cool-season perennial bunchgrass species, primarily Muttongrass (*Poa fendleriana*) Indian Ricegrass (*Achnatherum hymenoides*), Needleandthread (*Hesperostipa comata*) and Letterman's needlegrass (*Achnatherum lettermanii*). Sites have a minor component of bluegrasses and rhizomatous grasses like thickspike wheatgrass (*Elymus lanceolatus*, lanceolatus), and perennial forbs.

The majority of precipitation comes in spring and early summer. The wettest months are April to June with almost half of the yearly precipitation occurring during these three months. The growing season is short and cool: primary growth typically occurs between May and August. The dominant plants have adapted to these conditions.

The Reference Community is found on sites where good management practices have been consistently applied for a long period of time. The site is resilient to grazing, but under heavy continuous grazing without growing-season deferment, bunch grasses will decrease. If further degradation takes place, these species will decrease while bluegrasses and rhizomatous grasses will increase in species composition.

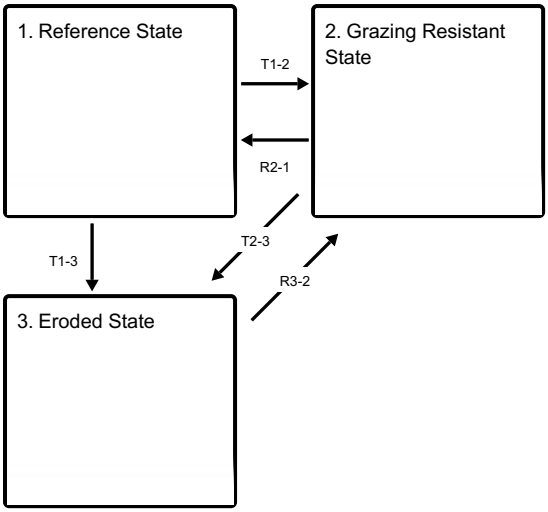
Mid stature bunchgrasses act as a decreaser species in the Reference Community. Mid stature bunchgrasses and rhizomatous grasses tolerate higher grazing pressure and grow on less fertile soils (USDA/NRCS 2007) than tall stature bunchgrasses. They often fill in the vegetation gaps created when tall stature bunchgrasses decline.

Prior to the introduction of livestock (cattle and sheep) during the late 1800s, elk, mule deer, and pronghorn grazed this ecological site, primarily as winter and transitional range (early spring, late fall). Significant livestock grazing has occurred on most of this ecological site for more than 100 years. The Trans-Continental Railroad in the 1860s brought the first herds, and homesteaders began settling the area through the turn of the century. Livestock grazing in this region has historically been cattle. In fact, early grazers established a “Deadline” from Fontenelle Creek across the desert to the Big Sandy River and sheep grazing was not allowed north of this line. Sheep crossing the line often died of plant poisoning from plants that were left lying along the boundary line by cattlemen. (Sommers, 1994)

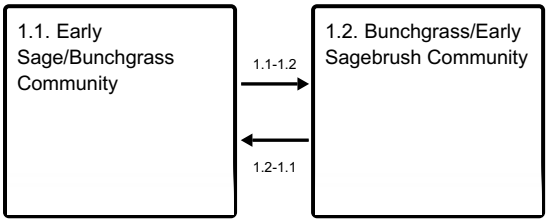
Without ground disturbing activities, this site is relatively free of invasive weeds, but once mechanically or physically disturbed it is prone to weed invasion, primarily by annuals such as lambsquarter (*Chenopodium album*), Russian thistle (*Salsola kali*), flixweed (*Descurainia sophia*), and kochia (*Bassia scoparia*). The most common noxious species affecting this site after soil disturbance is whitetop (Cardraria draba) and Canada thistle (*Cirsium arvense*) at the upper end of its precipitation range. Soil disturbance can be caused by vehicles, equipment, severe over-utilization of the herbaceous vegetation, or large amounts of bare ground created by extended drought conditions combined with over-utilization. Cheatgrass, an invasive annual grass introduced and on south aspects, has been found on sites with higher gravel content that have been severely disturbed (roads, gravel pits, etc.).
The most prevalent noxious weed in the Pinedale Plateau LRU is Canada thistle (*Cirsium arvense*). It can be found in all ecological sites but is mostly associated with riparian areas and disturbances. Canada thistle invades Federal, State and private lands. Developments and disturbance of the soil usually will result in a new infestation of Canada thistle. Canada thistle is from Eurasia, it was introduced via Canada as a seed contaminate in the 18th Century. It is prevalent though out the United States as seeds are transported via wind and its aggressive rhizomatous root system sustains very dense patches.
The second most prevalent noxious weed in riparian areas is perennial pepperweed (*Lepidium latifolium*). This mustard is usually found in riparian areas but we are now locating it invading other plant communities too. The Green River and many of its tributaries have significant perennial pepperweed infestations. It is said to be introduced to the Sublette County Area as a hay contaminant, when ranches had to bring in hay from Utah, Idaho and other areas in the state during a drought in the 70's.
Another noxious mustard of concern is whitetop or hoary cress (*Cardaria draba*). This species is also found in all habitat types within the Green River Basin. It is found in irrigated hay meadows, roadsides, rangelands, but most significantly invades rangelands or fields that have had a disturbance event. This disturbance can be from over utilization of forage or native plant thinning due to drought. This deep rooted perennial mustard completes its life cycle in early summer. There are several varieties of *Cardaria draba* in the area, which are difficult to distinguish but all seem to have the same effect but bloom at different times of the summer.

State and transition model

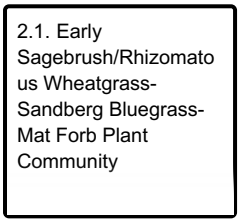
Ecosystem states



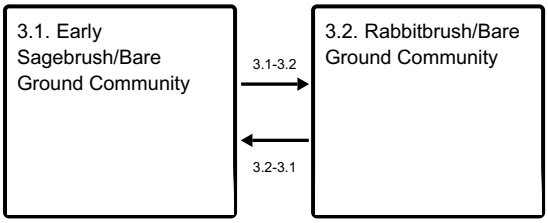
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference State

The Reference State consists of two communities: the Early Sagebrush/Bunchgrass Community (1.1), and the Bunchgrass/Early Sagebrush Community (1.2). Each community differs in percent composition of bunchgrasses and percent woody canopy cover. Forbs are a minor component on this site. Woody canopy cover is typically less than 30 percent. Dominant shrub species is Early Sagebrush in the Reference State (1), with some instances of rabbitbrush, Wyoming big sagebrush, and salt desert shrubs. Two important processes occurring in this state drive plant communities away from the Early Sagebrush/Bunchgrass Community (1.1): improper grazing management both wildlife and domestic. Improper grazing management without adequate growing-season deferment decreases the vigor of plants that are heavily grazed and not highly grazing tolerant. Muttongrass, indian ricegrass and letterman’s needlegrass decreases in vigor and species composition. Through natural succession and proper management this plant community will increase in bunchgrass composition and drive the Early Sagebrush/Bunchgrass Community (1.1) to the Bunchgrass/Early Sagebrush Community (1.2). If improperly managed the species composition of muttongrass, inidan ricegrass and letterman’s needlegrass will decline and sagebrush canopy will begin to increase. Once the amount and vigor of bunchgrasses declines to the point where there is limited seed source to repopulate the stand and is replaced by higher sagebrush canopy cover, the site

transitions to the Grazing Resistant State (2). The increase in woody canopy cover can occur with or without degradation of the understory. Therefore, the transition to the Grazing Resistant State (2) can occur from the Bunchgrass/Early Sagebrush (1.2) Community within the Reference State (1). The shift from the Early Sagebrush/Bunchgrass Community (1.1) to the Bunchgrass/Early Sagebrush Community (1.2) is dependent on an increase of herbaceous canopy cover, and on the decrease of woody canopy cover. The shift from the Early Sagebrush/Bunchgrass Community (1.1) or the Bunchgrass/Early Sagebrush Community (1.2) is dependent on an increase of herbaceous cover. Without proper grazing management both wild and domestic, shrubs will increase on this ecological site

Community 1.1
Early Sage/Bunchgrass Community

Figure 6. 1.1

The Early Sage/Bunchgrass Community (1.1) is dominated by early sagebrush and mid-stature cool-season bunchgrasses (muttongrass: dominant; indian ricegrass and letterman's needlegrass: subdominant). Many common forb species, such as common yarrow (*Achillea millefolium* L.) and sulfur-flowered buckwheat (*Eriogonum umbellatum* Torr), occur on this site as a small portion of species composition. Minor grass species include shortgrasses (squirreltail (Elymus elymodies) and rhizomatous grasses (thickspike wheatgrass (Elymus lanceolatous, lanceolatous)). Shrub species, including early sagebrush, are present as a much of the community. The Early Sagebrush/Bunchgrass Community (1.1) generally occurs on the Loamy, Argillic site in areas where proper grazing management practices have been implemented over a long period, in combination with favorable climate conditions. Historically, these were most often areas with limited livestock access due to topography or long distances to water. The Early Sagebrush/Bunchgrass Community can be maintained through the implementation of properly managed grazing that provides adequate growing-season deferment to allow for the establishment of midgrass propagules and/or the recovery of stressed plants. The plant community is well adapted to Cool Central Desertic Basins and Plateaus climatic conditions. The diversity in plant species allows for drought tolerance, and natural plant mortality is very low. These plants have strong, healthy root systems that allow production to increase significantly with favorable moisture conditions. This plant community provides for soil stability and a properly functioning hydrologic cycle. The soils associated with this site are fertile and hold moderately large amounts of soil moisture, providing a very favorable soil-water-plant relationship

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	135	303	471
Grass/Grasslike	67	151	235
Forb	22	50	78
Total	**224**	**504**	**784**

Figure 8. Plant community growth curve (percent production by month).
WY0301, 34AC, Upland Sites. All Upland Sites.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			5	40	50			5			

Community 1.2
Bunchgrass/Early Sagebrush Community

Figure 9. 1.2

The Bunchgrass/Big Sagebrush Community (1.2) can occur across the entire ecological site on a given landscape but more likely occurs in a mosaic pattern associated with the disturbance cycle at any given location. Bunchgrasses and early sagebrush share dominance in the Bunchgrass/Early Sagebrush Community (1.2). Bluegrasses and rhizomatous grasses will increase. Palatable and nutritious forbs will begin to be replaced by less desirable and more aggressive species. In the Bunchgrass/Early Sagebrush Community (1.2), canopy gaps are generally larger than basal gaps, and most basal gaps are short (less than 3 feet). Rock cover on the soil surface is essentially nonexistent. Many plant interspaces have canopy or litter cover. With reduced production and litter, evaporation begins to increase, moisture retention decreases, and soil surface temperatures increase as the taller grasses are replaced by shorter-statured plants. Production of grasses is slightly higher than in the Early Sagebrush/Bunchgrass Community (1.1). Infiltration is still high due to high ground cover.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	112	252	392
Shrub/Vine	90	202	314
Forb	22	50	78
Total	**224**	**504**	**784**

Figure 11. Plant community growth curve (percent production by month). WY0301, 34AC, Upland Sites. All Upland Sites.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			5	40	50			5			

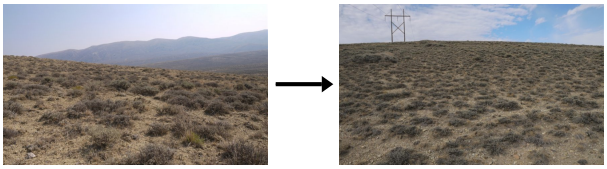
Pathway 1.1-1.2
Community 1.1 to 1.2

Early Sage/Bunchgrass Community

Bunchgrass/Early Sagebrush Community

The driver for community shift 1.1-1.2 is natural succession. The trigger for this shift is an increase in herbaceous canopy cover and decline in overall shrubs. The transition to the Bunchgrass/Early Sagebrush Community (1.2) can be the result of sagebrush naturally decreasing its canopy cover along with yearly climatic differences. This transition can also occur due to a combination of proper stocking rates, proper grazing management, and favorable climate. Bunchgrasses lose vigor under moderate to heavy grazing without adequate growing-season deferment. These plants become smaller or die, and some natural ecological processes will be altered. It is typical for shrubs to decrease as the community shifts from the Early Sagebrush/Bunchgrass Community (1.1) to the Bunchgrass/Early Sagebrush Community (1.2).

Pathway 1.2-1.1
Community 1.2 to 1.1



Bunchgrass/Early Sagebrush Community

Early Sage/Bunchgrass Community

The driver for community shift 1.2-1.1 is the increase in vigor of muttongrass, indian ricegrass and letterman's needlegrass to the point that it dominates species composition. The trigger for this is typically natural succession with proper management. The Bunchgrass/Early Sagebrush Community (1.2) will return to the Early Sagebrush/Bunchgrass Community (1.1) with proper grazing management that provides sufficient critical growing season deferment in combination with a sagebrush treatment. This transition is indicated when production of muttongrass, inidan ricegrass and letterman's needlegrass share dominance with early sagebrush. Favorable moisture conditions will facilitate or accelerate this transition.

State 2
Grazing Resistant State

The Grazing Resistant State (2) is characterized by an herbaceous layer dominated by bluegrasses, rhizomatous grasses, and a varying shrub component. Muttongrass, indian ricegrass and letterman's needlegrass have become scarce or absent. This state has one plant community, Early Sagebrush/Rhizomatous Wheatgrass-Sandberg Bluegrass-Mat Forb Plant Community (2.1). The site crosses the threshold to the Grazing Resistant State (2) from the Reference State (1) when desirable mid-stature grasses lose dominance. Once the key species become scarce, it is unlikely that they have sufficient reproductive capability (seed source, tillering, or resprouting) to recover dominance in a reasonable time frame without extra energy being added to the system. The Plant Community in the Grazing Resistant State (2) is very resilient and therefore common on Loamy, Argillic sites in this MLRA. In many cases, the transition to the Grazing Resistant State (2) may have occurred many decades ago during the era of high stocking rates and continuous grazing. While dominance by rhizomatous grasses makes the return to the Reference State (1) plant community difficult, it also makes the site resistant to further degradation. The main factor creating high resiliency of the Early Sagebrush/Rhizomatous Wheatgrass-Sandberg Bluegrass-Mat Forb Plant Community (2.1) is that the bluegrass and rhizomatous grasses are highly grazing tolerant. The bluegrass and rhizomatous grasses are low to the ground, so, even under heavy grazing, enough biomass remains for the grasses to maintain plant vigor. The rhizomatous grasses can form mats that provide soil protection by protecting the soil from raindrop impact, decreasing the risk of soil erosion. However, overall soil health is lower than the reference state, primarily due to a reduction in soil organic matter. Reduced soil organic matter is due to a reduction in litter. The decreased infiltration is due to shallower rooting depths and increased runoff. Under continuous high intensity early season grazing, especially by horses, does ground cover decrease to a point that the site will transition to the Eroded State (3).

Community 2.1
Early Sagebrush/Rhizomatous Wheatgrass-Sandberg Bluegrass-Mat Forb Plant Community

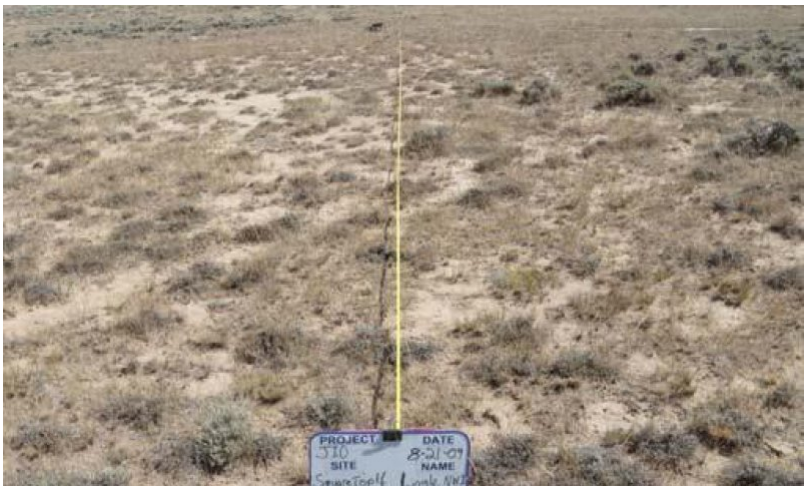


Figure 12. 2.1

The Early Sagebrush/Rhizomatous Wheatgrass-Sandberg Bluegrass-Mat Forb Plant Community (2.1) is characterized by an herbaceous component dominated by bluegrass, rhizomatous wheatgrass and/or mat forbs, with limited mid stature bunchgrasses. Once these key species becomes scarce, it is unlikely to have sufficient reproductive capability (seed source, tillering, or resprouting) to recover dominance in a reasonable time frame without extra energy being added to the system. The plant community is highly resilient to changes in composition, due to the dominance and competition of established bluegrass, rhizomatous wheatgrass, and/or mat forbs. However, the community can shift back to the Bunchgrass/Early Sagebrush Community (1.2) over time with seeding and/or rest and deferment. This community is shrub dominated. Sagebrush canopy may be as high as 25 percent. The dominant shrub is early sagebrush. The Early Sagebrush/Rhizomatous Wheatgrass-Sandberg Bluegrass-Mat Forb Plant Community occurs if the herbaceous component has been degraded. Areas that catch and retain snow are more likely to have higher shrub cover. Production is considerably lower than in Reference State (1), leading to lower soil organic matter content and therefore lower soil stability than in the Reference State. Ground cover is still high. Infiltration is lower than in the Reference State and the water cycle has reduced function due to decreased soil organic matter.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	112	168	224
Grass/Grasslike	90	135	179
Forb	22	34	45
Total	**224**	**337**	**448**

Figure 14. Plant community growth curve (percent production by month). WY0301, 34AC, Upland Sites. All Upland Sites.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			5	40	50			5			

State 3
Eroded State

Community 3.1
Early Sagebrush/Bare Ground Community

Community 3.2
Rabbitbrush/Bare Ground Community

Pathway 3.1-3.2

Community 3.1 to 3.2

Pathway 3.2-3.1
Community 3.2 to 3.1

Transition T1-2
State 1 to 2

The driver for Transition T1-2 is continuous spring grazing and/or long-term drought. Continuous spring grazing (wild and domestic) and/or drought can lead to a decline in palatable bunchgrasses. As bunchgrasses diminish or die during periods of stress, bluegrasses and rhizomatous grasses gain a competitive advantage, creating a shift in species composition towards less productive, shorter species. Once mid-stature bunchgrass species become scarce, it is unlikely that they have sufficient reproductive capability (seed source, tillering, or resprouting) to recover dominance in a reasonable time frame without extra energy being added to the system. When the understory plant community has been degraded to this point, the transition to the Grazing Resistant State (2) can occur from either the Bunchgrass/Early Sagebrush Community (1.2). The transition is not dependent on the increase of woody canopy cover, but rather on the decrease of bunchgrasses becoming scarce in species composition. Management should focus on grazing management strategies that will prevent further degradation. This can be achieved through a grazing management scheme that varies the season of use to provide periodic deferment during the critical growth period (roughly May-June). Forage quantity and/or quality in the Grazing Resistant State (2) may be substantially reduced compared to the Reference State. Rangeland Health Implications/Indicators: The Biotic Integrity is impaired through the shift in relative dominance of functional/structural groups as well as a decrease in the number of species within a functional/structural group as well as reduced site productivity. The changes in bare ground patterns affect both Soil Site Stability and Hydrologic Function.

Transition T1-3
State 1 to 3

The driver for Transition T1-3 is continuous high intensity early season grazing and/or long-term drought. The Reference State (1) transitions to the Eroded State (3) if plant canopy cover declines significantly or total annual aboveground biomass production falls. The trigger for this transition is the loss of bunchgrasses, which creates open spots with bare soil. Soil erosion is accompanied by decreased soil fertility driving the transitions to the Eroded State. Several other key factors signal the approach of transition T1B: an increase in soil physical crusting, a decrease in soil surface aggregate stability, and/or evidence of erosion, including water flow patterns, development of plant pedestals, and litter movement.

Restoration pathway R2-1
State 2 to 1

The drivers for this restoration pathway are removal of woody species and restoration of native herbaceous species by mechanical or chemical treatment of sagebrush, and grazing rest or deferment. If some mid- stature bunchgrasses remain under the sage canopy, proper grazing management can move the site back to the Reference State (1) combined with a mechanical or chemical sagebrush treatment. This could take multiple generations of management or could be accelerated with rest or deferment combined with successive wet springs conducive to seed germination and seedling establishment. (Derner, Schuman, Follett, & Vance, 2014)

Transition T2-3
State 2 to 3

The driver for this transition is continuous high intensity early season grazing. Removal of shrubs without proper grazing management can lead to an increase in bare ground and erosion of the upper soil horizon, and the site can degrade to the Eroded State (3). Consequences of this transition are decreased soil fertility or even soil erosion, soil crusting, and decrease of soil surface aggregate stability.

Restoration pathway R3-2
State 3 to 2

The drivers for this restoration pathway are reclamation efforts and proper grazing management.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Mid-Size Cool Season Bunchgrasses**			46–101	
	muttongrass	POFE	*Poa fendleriana*	26–76	5–15
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	26–76	5–15
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	26–50	5–10
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–26	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–26	0–5
	needle and thread	HECO26	*Hesperostipa comata*	0–26	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–26	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	0–26	0–5
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–26	0–5
2	**Rhizomatous Grasses**			26–50	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	26–50	5–10
	western wheatgrass	PASM	*Pascopyrum smithii*	26–50	5–10
3	**Miscellaneous Grasses/Grass-likes**			26–50	
	plains reedgrass	CAMO	*Calamagrostis montanensis*	0–26	0–5
	needleleaf sedge	CADU6	*Carex duriuscula*	0–26	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	6–26	1–5
	Grass, perennial	2GP	*Grass, perennial*	0–26	0–5
Forb					
4	**Perennial Forbs**			20–46	
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–26	0–5
	textile onion	ALTE	*Allium textile*	0–26	0–5
	rosy pussytoes	ANRO2	*Antennaria rosea*	0–26	0–5
	milkvetch	ASTRA	*Astragalus*	0–26	0–5
	fleabane	ERIGE2	*Erigeron*	0–26	0–5
	buckwheat	ERIOG	*Eriogonum*	0–26	0–5
	desertparsley	LOMAT	*Lomatium*	0–26	0–5
	tansyaster	MACHA	*Machaeranthera*	0–26	0–5
	tufted evening primrose	OECA10	*Oenothera caespitosa*	0–26	0–5
	phlox	PHLOX	*Phlox*	6–26	1–5
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–26	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–26	0–5
5	**Annual Forbs**			0–6	
	rockjasmine	ANDRO3	*Androsace*	0–6	0–1
	bushy bird's beak	CORA5	*Cordylanthus ramosus*	0–6	0–1
	Forb, annual	2FA	*Forb, annual*	0–6	0–1

Shrub/Vine					
6	**Dominant Shrubs**			111–228	
	little sagebrush	ARARL	*Artemisia arbuscula ssp. longiloba*	111–228	22–45
7	**Miscellaneous Shrubs**			10–26	
	little sagebrush	ARARA	*Artemisia arbuscula ssp. arbuscula*	0–26	0–5
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–26	0–5
	Gardner's saltbush	ATGA	*Atriplex gardneri*	0–26	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–26	0–5
	green molly	BAAM4	*Bassia americana*	0–26	0–5
	winterfat	KRLA2	*Krascheninnikovia lanata*	6–26	1–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–26	0–5

Table 9. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Mid-Size Cool Season Bunchgrasses**			76–151	
	muttongrass	POFE	*Poa fendleriana*	50–101	10–20
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	26–101	5–20
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	26–50	5–10
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–26	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–26	0–5
	needle and thread	HECO26	*Hesperostipa comata*	0–26	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–26	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	0–26	0–5
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–26	0–5
2	**Rhizomatous Grasses**			26–50	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	26–50	5–10
	western wheatgrass	PASM	*Pascopyrum smithii*	26–50	5–10
3	**Miscellaneous Grasses/Grasslikes**			26–50	
	plains reedgrass	CAMO	*Calamagrostis montanensis*	0–26	0–5
	needleleaf sedge	CADU6	*Carex duriuscula*	0–26	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	6–26	1–5
	Grass, perennial	2GP	*Grass, perennial*	0–26	0–5
Forb					
4	**Perennial Forbs**			20–46	
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–26	0–5
	textile onion	ALTE	*Allium textile*	0–26	0–5
	pussytoes	ANTEN	*Antennaria*	0–26	0–5
	milkvetch	ASTRA	*Astragalus*	0–26	0–5
	fleabane	ERIGE2	*Erigeron*	0–26	0–5
	buckwheat	ERIOG	*Eriogonum*	0–26	0–5
	desertparsley	LOMAT	*Lomatium*	0–26	0–5

	tansyaster	MACHA	*Machaeranthera*	0–26	0–5
	tufted evening primrose	OECA10	*Oenothera caespitosa*	0–26	0–5
	phlox	PHLOX	*Phlox*	6–26	1–5
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–26	0–5
	Forb, perennial	2FP	*Forb, perennial*	0–26	0–5
5	**Annual Forbs**			0–6	
	rockjasmine	ANDRO3	*Androsace*	0–6	0–1
	bushy bird's beak	CORA5	*Cordylanthus ramosus*	0–6	0–1
	Forb, annual	2FA	*Forb, annual*	0–6	0–1
Shrub/Vine					
6	**Dominant Shrubs**			76–151	
	little sagebrush	ARARL	*Artemisia arbuscula ssp. longiloba*	76–151	15–30
7	**Miscellaneous Shrubs**			26–50	
	winterfat	KRLA2	*Krascheninnikovia lanata*	26–50	5–10
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–26	0–5
	little sagebrush	ARARA	*Artemisia arbuscula ssp. arbuscula*	0–26	0–5
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–26	0–5
	Gardner's saltbush	ATGA	*Atriplex gardneri*	0–26	0–5
	green molly	BAAM4	*Bassia americana*	0–26	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–26	0–5

Table 10. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Mid-Size Cool Season Bunchgrasses**			7–17	
	squirreltail	ELEL5	*Elymus elymoides*	0–17	0–5
	needle and thread	HECO26	*Hesperostipa comata*	0–17	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–17	0–5
	Sandberg bluegrass	POSE	*Poa secunda*	0–17	0–5
	muttongrass	POFE	*Poa fendleriana*	3–17	1–5
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–17	0–5
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	3–17	1–5
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	17	5
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–17	0–5
2	**Rhizomatous Grasses**			37–84	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	50–101	15–30
	western wheatgrass	PASM	*Pascopyrum smithii*	50–101	15–30
3	**Miscellaneous Grasses/Grasslikes**			13–34	
	Sandberg bluegrass	POSE	*Poa secunda*	3–34	1–10
	Grass, perennial	2GP	*Grass, perennial*	0–17	0–5
	plains reedgrass	CAMO	*Calamagrostis montanensis*	0–17	0–5

	needleleaf sedge	CADU6	*Carex duriuscula*	0–17	0–5
Forb					
4	**Perennial Forbs**			7–13	
	rosy pussytoes	ANRO2	*Antennaria rosea*	0–13	0–4
	buckwheat	ERIOG	*Eriogonum*	0–13	0–4
	phlox	PHLOX	*Phlox*	3–13	1–4
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–3	0–1
	Forb, perennial	2FP	*Forb, perennial*	0–3	0–1
	desertparsley	LOMAT	*Lomatium*	0–3	0–1
	tansyaster	MACHA	*Machaeranthera*	0–3	0–1
	tufted evening primrose	OECA10	*Oenothera caespitosa*	0–3	0–1
	milkvetch	ASTRA	*Astragalus*	0–3	0–1
	fleabane	ERIGE2	*Erigeron*	0–3	0–1
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–3	0–1
5	**Annual Forbs**			0–3	
	rockjasmine	ANDRO3	*Androsace*	0–3	0–1
	bushy bird's beak	CORA5	*Cordylanthus ramosus*	0–3	0–1
	Forb, annual	2FA	*Forb, annual*	0–3	0–1
Shrub/Vine					
6	**Dominant Shrubs**			74–168	
	little sagebrush	ARARL	*Artemisia arbuscula ssp. longiloba*	74–168	22–50
7	**Miscellaneous Shrubs**			7–17	
	little sagebrush	ARARA	*Artemisia arbuscula ssp. arbuscula*	0–17	0–5
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–17	0–5
	Gardner's saltbush	ATGA	*Atriplex gardneri*	0–17	0–5
	green molly	BAAM4	*Bassia americana*	0–17	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–17	0–5
	winterfat	KRLA2	*Krascheninnikovia lanata*	3–17	1–5
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–17	0–5

Animal community

The following table lists suggested stocking rates for cattle under continuous season-long grazing under normal growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies can result in an increased carrying capacity. If distribution problems occur, stocking rates must be reduced to maintain plant health and vigor.

Plant Community Production Carrying Capacity*
(lb./ac) (AUM/ac)
Early Sagebrush/Bunchgrass 200-450-700 .05
Bunchgrass/Early Sagebrush 200-450-700 .10
Early Sage/Rhizomatous Wheatgrass 200-300-400 .05

Early Sage/*Bare Ground* 100-200-300 .01
Rabbitbrush/*Bare Ground* 100-200-300 .01

* - Continuous, season-long grazing by cattle under average growing conditions.

**Calculation for stocking rates are as follows: using RV values for production, take forage palatable to grazing cattle multiply by 0.25 harvest efficiency and divide by 912.5 (air dried weight) to arrive at carrying capacity.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage for cattle, sheep, or horses. During the dormant period, the forage for livestock use needs to be supplemented with protein because the quality does not meet minimum livestock requirements.

Distance to water, shrub density, and slope can affect grazing capacity within a management unit. Adjustments should be made for the area that is considered necessary for reduction of animal numbers. For example, 30% of a management unit may have 25% slopes and distances of greater than 1 mile from water; therefore the adjustment is only calculated for 30% of the unit (i.e. 50% reduction on 30% of the management unit). Fencing, slope length, management, access, terrain, kind and class of livestock, and breeds are all factors that can increase or decrease the percent of graze-able acres within a management unit. Adjustments should be made that incorporate these factors when calculating stocking rates.

Wildlife:
The Loamy, Argillic (Ly,A) ecological site in the Pinedale Plateau, LRU C, in MLRA 34A, Cool Central Desertic Basins and Plateaus provides suitable and valuable habitat to an array of wildlife species. including, but not limited to, suitable food for mule deer, elk, and pronghorn antelope. Sagebrush, which can approach 15% protein and 40-60% digestibility, provides important winter forage for the greater sage-grouse, mule deer, and antelope. Year-round habitat is provided for sage grouse and many other sagebrush obligate species such as the sage sparrow, Brewer’s sparrow, sage thrasher, pygmy rabbit, sagebrush vole, horned lizard, and pronghorn antelope. Other birds that would frequent this plant community include horned larks and golden eagles. (Stiver, Rinkes, & Naugle, 2010)

Reference State:
1.1 Early Sagebrush/Bunchgrass: This plant community provides optimal winter habitat for sage-grouse, mule deer, and pronghorn antelope, as well as optimal sage-grouse early brood rearing habitat. (Carney, et al., 2010)

1.2 Bunchgrass/Early Sagebrush: This plant community provides marginal nesting habitat for sage-grouse, but excellent early brood-rearing habitat. Winter use by sage-grouse is significant. It is also provides suitable habitat and forage for other sagebrush obligate species. (Carney, et al., 2010)

Grazing Resistant State:
2.1 Early Sagebrush/Rhizomatous Wheatgrass-Sandberg Bluegrass-Mat Forb: This plant community is variable in its value to wildlife. In periods of high plant vigor it provides suitable nesting and brood-rearing habitat for sage-grouse, it is however, variable with climate conditions. In periods of less or low vigor and plant diversity such as during drought, production and plant diversity are less, lessening the value to wildlife. (Carney, et al., 2010)

Eroded State:
3.1 Early Sagebrush/*Bare Ground*: This plant community provides suitable winter habitat for foraging big game and sage-grouse, it is however, used little by non-game animal species. (Carney, et al., 2010)

3.2 Rabbitbrush/*Bare Ground*: This plant community consists of small, isolated patches where wildlife use is limited or unknown, it does however, produce a high number of insects which are important for pollination and sage-grouse early brood-rearing. (Carney, et al., 2010)

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group C, with localized areas in hydrologic group D. Permeability for this site is moderately slow to very slow due to a

heavy argillic horizon in a subsurface horizon. Runoff potential for this site varies from moderate to high, depending upon soil hydrologic group and ground cover. In many cases, lesser sloping areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. Greater sloping areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (refer to Part 630, NRCS National Engineering Handbook for detailed hydrologic information).

Rills and gullies should not typically be present. Water flow patterns should be barely distinguishable if at all present. Pedestals are only slightly present in association with bunchgrasses and shrubs. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are sometimes present on this site. Biological crusts are present, but only cover 1-2% of the soil surface.

Recreational uses

This site provides some limited recreational opportunities for hiking, horseback riding, bird watching, and upland game hunting. The forbs have a variety of colors and shapes that appeal to photographers. This site provides valuable open space when located in large, unfragmented landscapes.

Wood products

None

Other products

None

Inventory data references

Information presented was derived from 1988 Range Site Descriptions: (Shallow Clayey Green River and Great Divide Basins (7-9GR) and Shallow Clayey Foothills and Basins West (10-14W) Cool Desertic Basins and Plateaus,), NRCS clipping data, literature, field observations (based on two sampled sites and observations from numerous others), and personal contacts with range-trained personnel (i.e., agency specialists, landowners, land managers, and scientists).

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Approval

Kirt Walstad, 9/28/2023

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	09/30/2014
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rare to nonexistent. Where present, short and widely spaced

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2. **Presence of water flow patterns:** Barely observable

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3. **Number and height of erosional pedestals or terracettes:** Rare to nonexistent

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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 can range from 20-50%.

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5. **Number of gullies and erosion associated with gullies:** Active gullies should not be present

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Rare to nonexistent

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7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous litter expected to move only in small amounts (to leeward side of shrubs) due to wind. Large woody debris from sagebrush will show no movement.

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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):** Soil Stability Index ratings range from 1 (interspaces) to 5 (under plant canopy), but average values should be 3.0 or greater.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil data is limited for this site. Soil OM usually varies from .5 to 1.5%.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community consists of 30-50% grasses, 5-10% forbs, and 40-60% shrubs. Evenly distributed plant canopy (30-50%) and litter plus slow to moderate infiltration rates result in slight to minimal runoff. Basal cover is typically less than 5% for this site and does very little to effect runoff on this site.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None, but some soil crusting and cracking is expected during dry conditions.

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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: perennial shrubs>>Mid-size, cool season bunchgrasses

    Sub-dominant: short, cool season bunchgrasses>perennial forbs

    Other: cool season rhizomatous grasses

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal decadence, typically associated with shrub component

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14. **Average percent litter cover (%) and depth (in):** Litter ranges from 20-30% of total canopy measurement with total litter (including beneath the plant canopy) from 30-50% expected. Herbaceous litter depth typically ranges from 3-10mm. Woody litter can be up to a couple inches (4-6 cm).

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** English: 200-700 lb/ac (450 lb/ac average); Metric 224-784 kg/ha (504 kg/ha average).

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:** Bare ground greater than 75% is the most common indicator of a threshold being crossed. Annual weeds such as kochia, mustards, lambsquarter, and Russian thistle are common invasive species in disturbed sites.

17. **Perennial plant reproductive capability:** All species are capable of reproducing, except in drought years.