

Ecological site R067AY112WY Gravelly (Gr)

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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.

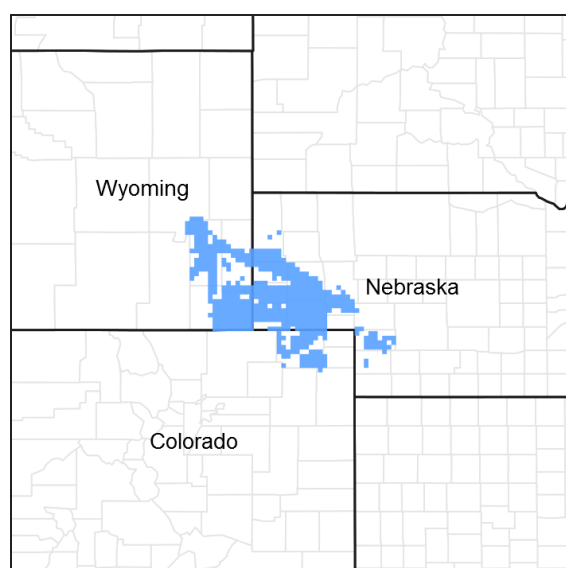


Figure 1. Mapped extent

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): 067A—Central High Plains, Northern Part

MLRA 67A-Central High Plains, Northern Part is located in southeastern Wyoming (58 percent), the southwestern portion of the Nebraska panhandle (38 percent), and extreme northeastern Colorado (4 percent). It is comprised of rolling plains, upland breaks, and river valleys. The major rivers are the North Platte and Laramie. The headwaters of these systems are in the Rocky Mountains. Other tributaries include Crow, Horse, and Lodgepole Creeks. This MLRA is traversed by Interstate 25 and Interstate 80, and by U.S. Highways 26, 30 and 85. Major land uses include rangeland (71 percent), cropland (21 percent), pasture and hayland (1 percent), urban (3 percent), and miscellaneous (4 percent). Cities in this area include Cheyenne, Torrington, and Wheatland, WY; and Kimball, Oshkosh, and Scottsbluff, NE. Land ownership is mostly private. Areas of interest include Scotts Bluff National Monument, Chimney Rock and Fort Laramie National Historic Sites; Hawk Springs, Lake Minatare, and Wildcat Hills State Recreation Areas; Ash Hollow and Guernsey State Parks.

The elevations in MLRA 67A range from approximately 3,300 to 6,200 feet. The average annual precipitation in this area ranges from 13 to 17 inches per year, but may increase up to 18 inches per year, in localized areas. Precipitation occurs mostly during the growing season from rapidly developing thunderstorms. Mean annual air temperature ranges from 47 degrees Fahrenheit in the western part to 52 degrees Fahrenheit in the eastern part. Summer temperatures may exceed 100 degrees Fahrenheit. Winter temperatures may drop to sub-zero, and snowfall varies from 20 to 50 inches per year.

Classification relationships

MLRA 67A is in the Western Great Plains Range and Irrigation Land Resource Region. It is in the High Plains Section, of the Great Plains Province, of the Interior Plains (USDA, 2006). MLRAs can be defined by climate, landscapes, geology, and annual precipitation zones (PZ). Other features such as landforms, soil properties, and key vegetation further refine these concepts, and are described at the Ecological Site Description (ESD) level.

Revision Notes:

The Gravelly (Gr) Ecological Site was developed using an earlier version of the Gravelly (Gr) 12-17" Precipitation Zone and Gravelly Loamy 12-17" Precipitation Zone Ecological Site Descriptions, respectively (2005, updated 2008). The earlier versions of the Gravelly and Gravelly Loamy ESD's were based on input from NRCS (formerly Soil Conservation Service) and historical information obtained from the Gravelly (Gr) and Gravelly Loamy Range Site Descriptions (1988). This ESD meets the Provisional requirements of the National Ecological Site Handbook (NESH). This ESD will continue refinement toward an Approved status according to the NESH.

Ecological site concept

The Gravelly Ecological Site is a run-off site with soil over 40 inches deep. The soil is not saline or alkaline, has a high volume of coarse fragments on the surface and throughout the profile, and gravelly surface soil textures.

Associated sites

R067AY122WY	Loamy (Ly) This ecological site is commonly adjacent.
R067AY150WY	Sandy (Sy) This ecological site is commonly adjacent.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Yucca glauca</i> (2) <i>Opuntia polyacantha</i>
Herbaceous	(1) <i>Schizachyrium scoparium</i> (2) <i>Hesperostipa comata</i>

Physiographic features

This site occurs on summits or shoulders of the hills, on knobs, and on crests or nose slopes of the ridges on the uplands.

Table 2. Representative physiographic features

Landforms	(1) Upland > Hill (2) Ridge (3) Knob
Runoff class	Very low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	1–2 m
Slope	1–50%
Water table depth	203–508 cm
Aspect	Aspect is not a significant factor

Climatic features

Wide fluctuations in precipitation may occur from year to year, as well as occasional periods of drought (longer than one year in duration). Two-thirds of the annual precipitation occurs during the growing season from April to September. The mean annual air temperature (MAAT) ranges from 47 degrees Fahrenheit in the western part to 52 degrees Fahrenheit in the eastern part. Cold air outbreaks from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may also occur in winter and bring rapid rises in temperature. Extreme storms may occur during the winter, but most severely affect ranch operations during the late winter and spring months. High-intensity afternoon thunderstorms may arise in summer. Wind speed averages about 8 miles per hour, ranging from 10 during the spring to 7 during late summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 75 mph. The average length of the freeze-free period (28 degrees Fahrenheit) is 150 days from May 4 to October 1. The average frost-free period (32 degrees Fahrenheit) is 128 days from May 16 to September 21. Growing season increases from west to east (Wyoming to Nebraska). Growth of native cool-season plants begins about April 1 and continues to mid-June. Native warm-season plants begin growth about May 15 and continue to about August 15. Regrowth of cool-season plants occur in September in most years, depending upon moisture.

Table 3. Representative climatic features

Frost-free period (characteristic range)	85-117 days
Freeze-free period (characteristic range)	119-135 days
Precipitation total (characteristic range)	406-432 mm
Frost-free period (actual range)	84-123 days
Freeze-free period (actual range)	116-137 days
Precipitation total (actual range)	356-457 mm
Frost-free period (average)	103 days
Freeze-free period (average)	128 days
Precipitation total (average)	406 mm

Climate stations used

- (1) CHEYENNE [USW00024018], Cheyenne, WY
- (2) CHUGWATER [USC00481730], Chugwater, WY
- (3) HARRISBURG 12WNW [USC00253605], Harrisburg, NE
- (4) KIMBALL 2NE [USC00254440], Kimball, NE
- (5) OLD FT LARAMIE [USC00486852], Yoder, WY
- (6) OSHKOSH [USC00256385], Oshkosh, NE
- (7) SCOTTSBLUFF HEILIG AP [USW00024028], Scottsbluff, NE
- (8) WHEATLAND 4 N [USC00489615], Wheatland, WY
- (9) PHILLIPS [USC00487200], LaGrange, WY
- (10) BRIDGEPORT [USC00251145], Bridgeport, NE

Influencing water features

There are no water features on the ecological site or adjacent wetland or riparian regimes that influence the vegetation or management of the site.

Soil features

The soils on this site are typically very deep, well to excessively drained soils that formed from old gravelly alluvium or outwash. They typically have a moderately rapid to very rapid permeability class, but ranges to moderate in some soils. The available water capacity is very low to low. The soil moisture regime is typically aridic ustic. The soil temperature regime is mesic.

The surface layer of the soils in this site are typically gravelly sandy loam, gravelly loam, or sandy loam, but may include gravelly fine sandy loam or very gravelly sandy loam. The surface layer ranges from a depth of 2 to 7 inches thick. The subsoil is typically very gravelly coarse sand, gravelly loamy coarse sand, gravelly coarse sand, or gravelly sand, but may include very gravelly sand, very gravelly loamy sand, gravelly sandy loam, or very gravelly sandy loam. Rock fragments are typically greater than 15 percent and can range as high as 60 percent. Soils in this site are typically leached of carbonates to depths of greater than 60 inches, but a few soils may have carbonates at the surface and throughout the soil profile. Exposed areas of gravel are inherent to this site. Areas with little or no surface gravel are susceptible to erosion by water and wind. The hazard of water erosion accelerates with increasing slope.

Surface soil structure is typically granular, and structure below the surface is typically single grain; massive or weak subangular blocky structure may be present in some horizons. Soil structure describes the manner in which soil particles are aggregated and defines the nature of the system of pores and channels in a soil.

Major soil series correlated to this ecological site: Aberone, Blueridge, Cascajo, Dix, Eckley, and Peetz.

Other soil series that have been correlated to this site: Nidix and Willowman.

The attributes listed below represent 0-40 inches in depth or to the first restrictive layer.

Note: Revisions to soil surveys are ongoing. For the most recent updates, visit the Web Soil Survey, the official site for soils information: <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>.



Figure 8. Soil Profile Image-Dix gravelly loam, Cheyenne County, NE. Depth is marked in feet.

Table 4. Representative soil features

Parent material	(1) Alluvium (2) Outwash
Surface texture	(1) Gravelly sandy loam (2) Gravelly loam (3) Sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained to excessively drained
Permeability class	Moderately rapid to very rapid
Soil depth	203 cm
Surface fragment cover <=3"	5–45%
Surface fragment cover >3"	0–5%
Available water capacity (Depth not specified)	2.03–9.14 cm

Calcium carbonate equivalent (Depth not specified)	0–15%
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Soil reaction (1:1 water) (Depth not specified)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	15–60%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

The information in this ESD, including the State-and-Transition Model (STM) diagram, was developed using archeological and historical data, professional experience, and scientific studies. The information is representative of a dynamic set of plant communities that represent the complex interaction of several ecological processes. The plant composition has been determined by study of rangeland relic areas, areas protected from excessive disturbance, seasonal use pastures, short duration/time-controlled grazing strategies, and historical accounts.

The Gravelly ecological site is characterized by three states: Reference, Sod-bound, and Increased *Bare Ground*. The Reference State is characterized by warm and cool-season bunchgrasses (little bluestem and needle and thread), and warm-season shortgrass (blue grama). Secondary grasses include cool-season rhizomatous midgrass (western wheatgrass), and a minor component of grass-like (threadleaf sedge): forbs including phlox, sandwort, and nailwort, and a minor component of shrubs. The Sod-bound State is characterized by blue grama and threadleaf sedge. The Increased *Bare Ground* State is characterized by remnant blue grama and threadleaf sedge, Fendler threeawn, phlox, increased broom snakeweed, and invasive annuals such as cheatgrass.

As this site begins to deteriorate from a combination of frequent and severe grazing during the growing season, grasses such as little bluestem, needle and thread, and sideoats grama, decrease in both frequency and production. Grasses such as blue grama and threadleaf sedge increase. Under continued frequent and severe defoliation with no rest periods, rhizomatous wheatgrasses such as western wheatgrass also begin to decrease. If continued, the plant community becomes sod-bound, and all mid- to tallgrasses may eventually be removed from the plant community. Over the long-term, this continuous use in combination with high stock densities results in a broken sod, with areas of bare ground developing, and species such as broom snakeweed and annual bromes (cheatgrass), invading. Once these events have occurred, it is difficult for native perennial plants to reestablish.

The degree of grazing has a significant impact on the ecological dynamics of the site. This region was historically occupied by large grazing animals, such as bison, elk, pronghorn, and mule deer. Grazing by these large herbivores, along with climatic and seasonal weather fluctuations, had a major influence on the ecological dynamics of the site. Deer and pronghorn are widely distributed throughout the MLRA. Secondary influences of herbivory by species such as prairie dogs and other small rodents, insects, and root-feeding organisms continues to impact the vegetation.

Historically, grazing patterns by herds of large ungulates were driven by water distribution, precipitation events, drought events, and fire. It is believed that grazing periods would have been shorter, followed by longer recovery periods. These large migrating herds impacted the ecological processes of nutrient and hydrologic cycles, by urination, trampling (incorporation of litter into the soil surface), and breaking of surface crust, (which increases water infiltration).

Today, livestock grazing, especially beef cattle has been a major influence on the ecological dynamics of the site. Grazing management, coupled with the effects of annual climatic variations, largely dictates the plant communities for the site.

Recurrent drought has historically impacted the vegetation of this region. Changes in species composition vary depending upon the duration and severity of the drought cycle and prior grazing management. Drought events since 2002 have significantly increased mortality of blue grama and buffalograss in some locales.

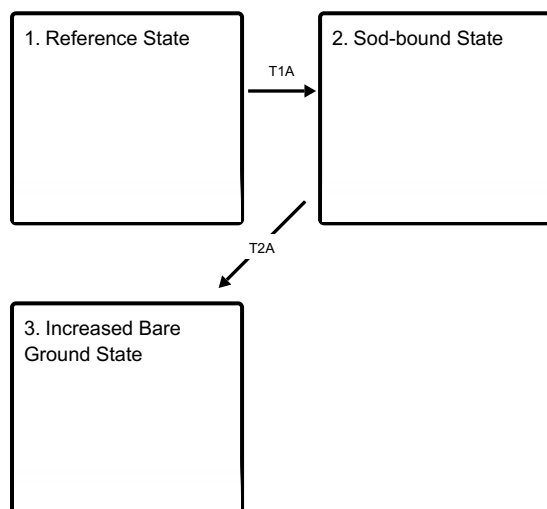
This site developed with occasional fire as part of the ecological processes. Historic fire frequency (pre-industrial) is estimated at 10 to 14 years (Guyette, 2012), randomly distributed, and started by lightning at various times throughout the growing season. Early human inhabitants also were likely to start fires for various reasons (deliberate or accidental). It is believed that fires were set as a management tool for attracting herds of large migratory herbivores (Stewart, 2002). The impact of fire over the past 100 years has been relatively insignificant due to the human control of wildfires and the lack of acceptance of prescribed fire as a management tool.

Mechanical treatment consisting of contour pitting, furrowing, terracing, chiseling, and disking has been practiced in the past. It was theorized that the use of this high-input technology would improve production and plant composition on rangeland. These high-cost practices have shown to have no significant long-term benefits on production or plant composition and have only resulted in a permanently rough ground surface. Prescribed grazing that mimics the historic grazing of herds of migratory herbivores, as described earlier, has been shown to result in desired improvements based on management goals for this ecological site.

Eastern Colorado was strongly affected by extended drought conditions in the “Dust Bowl” period of the 1930’s, with recurrent drought cycles in the 1950s and 1970s. Extreme to exceptional drought conditions have re-visited the area from 2002 to 2012, with brief interludes of near normal to normal precipitation years. Long-term effects of these latest drought events have yet to be determined. Growth of native cool-season plants begins about April 1 and continues to mid-June. Native warm-season plants begin growth about May 1 and continue to about August 15. Regrowth of cool-season plants occurs in September in most years, depending on the availability of moisture.

State and transition model

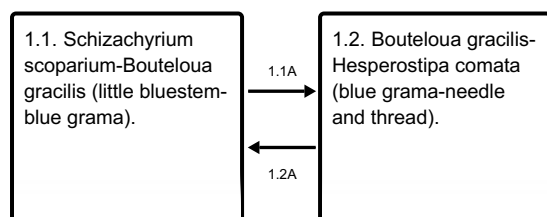
Ecosystem states



T1A - Excessive grazing. Lack of fire.

T2A - Excessive grazing. Lack of fire.

State 1 submodel, plant communities



1.1A - Excessive grazing. Lack of fire.

1.2A - Prescribed grazing. Prescribed fire.

State 2 submodel, plant communities

2.1. *Bouteloua gracilis*-*Carex filifolia* (blue grama-threadleaf sedge).

State 3 submodel, plant communities

3.1. *Aristida purpurea*-*Bromus tectorum* (Fendler threeawn-cheatgrass).

State 1 Reference State

The Reference State is characterized by two distinct plant community phases. These plant communities, and various successional stages between them, represent the natural range of variability within the Reference State.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- blue grama (*Bouteloua gracilis*), grass
- needle and thread (*Hesperostipa comata*), grass

Community 1.1 *Schizachyrium scoparium*-*Bouteloua gracilis* (little bluestem-blue grama).



Figure 9. Gravelly site, Kimball County, NE

This is the interpretive plant community for the Gravelly Ecological Site. This community developed with grazing by large herbivores and is suited to grazing by domestic livestock. Historically, fires likely occurred infrequently, and were randomly distributed. This plant community can be found on areas where grazed plants receive adequate periods of recovery during the growing season. The potential vegetation is about 75 to 85 percent grasses and grass-like, 15 to 20 percent forbs, and 0 to 5 percent woody plants. The major grasses include little bluestem, needle and thread, blue grama, and western wheatgrass. Secondary grasses include bluebunch wheatgrass, sideoats grama, and Indian ricegrass. Minor grasses include hairy grama, Fendler threeawn, plains muhly, and sand dropseed. Dominant forbs are dotted blazing star (also known as dotted gayfeather), hairy false goldenaster, and slimflower scurfpea. Other forbs include cuman ragweed (also known as western ragweed), and scarlet beeblossom. Legumes include spiny milkvetch, locoweeds, purple prairie clover, and slimflower scurfpea. Other

forbs include cushion plants such as pussytoes, spiny phlox, Hooker's sandwort, and sessile nailwort. A minor component of subshrubs and shrubs, such as prairie sagewort (also known as fringed sagewort) and field sagewort (also known as green sagewort), plains pricklypear, spreading buckwheat, and small soapweed are also present. The total annual production (air-dry weight) is about 800 pounds per acre during an average year, but it can range from about 550 pounds per acre in unfavorable years to about 1,100 pounds per acre in above-average years. Community dynamics (nutrient and water cycles and energy flow) are functioning properly. Infiltration rates are moderate and soil erosion is low. Litter is properly distributed where vegetative cover is continuous. Decadence and natural plant mortality are low. This community is resistant to many disturbances except heavy, continuous grazing, tillage, or development into urban or other uses.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- blue grama (*Bouteloua gracilis*), grass
- needle and thread (*Hesperostipa comata*), grass

Figure 11. Plant community growth curve (percent production by month). WY1107, 12-14 SP Upland sites, cool-season/warm-season co-dominant. 12-14" Precipitation Zone (PZ), Southern Plains (SP), with cool-season and warm-season (grass) species..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	20	28	21	10	5	3	0	0

Community 1.2

Bouteloua gracilis-Hesperostipa comata (blue grama-needle and thread).

Forbs and shrubs are still present in small amounts. This plant community is at risk of losing warm-season midgrasses and palatable forbs and shrubs. The dominant grasses are needle and thread and blue grama. Little bluestem is still present as a secondary grass in the community. Significant forbs include spiny phlox, Hooker's sandwort, hairy false goldenaster, cuman ragweed, slimflower scurfpea, and prairie (fringed) sagewort. Shrubs that have increased are yucca, broom snakeweed, and pricklypear cactus. The total annual production (air-dry weight) is about 600 pounds per acre during an average year, but it can range from about 400 pounds per acre in unfavorable years to about 800 pounds per acre in above-average years. Total aboveground biomass has been reduced. Reduction of warm-season midgrasses and cool-season rhizomatous wheatgrasses, nitrogen-fixing forbs, and increased sod-forming grasses and grass-like, have begun to alter the biotic integrity of this community. Water and nutrient cycles may be impaired. Nearly all plant species typically found in the Reference Plant Community are present and respond to changes in grazing management.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- blue grama (*Bouteloua gracilis*), grass
- needle and thread (*Hesperostipa comata*), grass

Figure 12. Plant community growth curve (percent production by month). WY1107, 12-14 SP Upland sites, cool-season/warm-season co-dominant. 12-14" Precipitation Zone (PZ), Southern Plains (SP), with cool-season and warm-season (grass) species..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	20	28	21	10	5	3	0	0

Pathway 1.1A

Community 1.1 to 1.2

Frequent and severe defoliation without adequate recovery between grazing events and lack of fire shifts this plant

community toward the 1.2 Community. Drought accelerates this process. Biotic integrity and the water and nutrient cycles may become impaired.

Pathway 1.2A
Community 1.2 to 1.1

Grazing that allows for adequate recovery between grazing events, proper stocking rates, and prescribed fire shift this community back to the Reference Plant Community.

Conservation practices

Prescribed Burning
Prescribed Grazing

State 2
Sod-bound State

This is a very stable state, resistant to change due to the high tolerance of blue grama and threadleaf sedge to grazing, the development of a shallow root system (root pan), and subsequent changes in hydrology and nutrient cycling. The loss of other functional/structural groups such as cool-season bunch and rhizomatous grasses, forbs, and shrubs reduces the biodiversity productivity of this site. An ecological threshold has been crossed and a significant amount of production and diversity has been lost when compared to the Reference State. Significant biotic and soil changes have negatively impacted energy flow and the nutrient and hydrologic cycles.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- blue grama (*Bouteloua gracilis*), grass
- threadleaf sedge (*Carex filifolia*), grass

Community 2.1
Bouteloua gracilis-Carex filifolia (blue grama-threadleaf sedge).

The mid-grasses and palatable forbs have been eliminated. The dominant species are blue grama and threadleaf sedge. These species have developed into a sod-bound condition occurring in localized colonies exhibiting a mosaic appearance. Needle and thread may persist, if seasonal grazing use occurs after awn development. Sideoats grama and little bluestem may still be present in small amounts on steeper slopes. There may also be remnants of rhizomatous wheatgrasses. Fendler threeawn has increased. Forbs that continue to increase are cuman ragweed (western ragweed), hairy false goldenaster, spiny phlox, Hooker’s sandwort, and spreading buckwheat. Prairie sagewort (also known as fringed sagebrush) and small soapweed also increase. Compared to the Reference Plant Community, nearly all the midgrasses are gone and weedy species have invaded the area. Undesirable grasses, forbs, and other plants have increased. Plant diversity is very low. The plant community lacks diversity and is resistant to change. Energy flow and the water and mineral cycles have been negatively affected. Litter levels are very low and unevenly distributed. The total annual production (air-dry weight) is about 400 pounds per acre during an average year, but it can range from about 350 pounds per acre in unfavorable years to about 500 pounds per acre in above-average years.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- blue grama (*Bouteloua gracilis*), grass
- threadleaf sedge (*Carex filifolia*), grass

Figure 13. Plant community growth curve (percent production by month).
WY1104, 12-14SP upland sites w/ warm. 12-14" Precipitation Zone, Southern
Plains (SP) with warm-season (grass) species.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	20	35	30	5	5	0	0	0

State 3
Increased Bare Ground State

An ecological threshold has been crossed. The Increased *Bare Ground* State denotes changes in infiltration, runoff, aggregate stability, and species composition. The changes in water movement and the plant community trigger changes in hydrologic functionality, biotic integrity, and soil and site stability. Infiltration, runoff, and soil erosion vary depending upon the vegetation present. Erosion and loss of organic matter and carbon reserves are concerns.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- Fendler threeawn (*Aristida purpurea* var. *longiseta*), grass
- cheatgrass (*Bromus tectorum*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

Community 3.1
Aristida purpurea-Bromus tectorum (Fendler threeawn-cheatgrass).

Bare ground, cushion plants, and cryptogamic crusts have significantly increased. Remnant grasses include blue and hairy grama and Fendler threeawn. Annual grasses such as cheatgrass and sixweeks fescue have increased or invaded. The dominant forbs include field sagewort, hairy false goldenaster, and annual weeds such as burningbush and Russian thistle. Cushion plants such as spiny phlox, Hooker’s sandwort, and spiny milkvetch (also known as mat loco), and shrubs such as pricklypear, broom snakeweed, and small soapweed persist. Forage palatability for livestock is low. The total annual production (air-dry weight) is about 300 pounds per acre during an average year, but it can range from about 100 pounds per acre in unfavorable years to about 400 pounds per acre in above-average years. NOTE: This plant community is highly variable in both species composition and production. Average annual production should be determined on site.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- Fendler threeawn (*Aristida purpurea* var. *longiseta*), grass
- cheatgrass (*Bromus tectorum*), grass

Figure 14. Plant community growth curve (percent production by month).
 WY1104, 12-14SP upland sites w/ warm. 12-14" Precipitation Zone, Southern
 Plains (SP) with warm-season (grass) species.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	20	35	30	5	5	0	0	0

Transition T1A
State 1 to 2

Frequent and severe defoliation and lack of fire shift this plant community across an ecological threshold toward the Sod-bound State. Biotic integrity and hydrologic function are impaired.

Transition T2A
State 2 to 3

Long-term frequent and severe defoliation without adequate recovery between grazing events and lack of fire cause a shift across an ecological threshold to the Increased *Bare Ground* State. The hazard of erosion and the loss of

organic matter, along with invasion of introduced plants and noxious weeds, are resource concerns.

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	12			185–278	
	little bluestem	SCSC	<i>Schizachyrium scoparium</i>	155–216	–
	sideoats grama	BOCU	<i>Bouteloua curtipendula</i>	31–62	–
2	12			62–185	
	needle and thread	HECO26	<i>Hesperostipa comata</i>	62–93	–
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	0–93	–
3	12			62–93	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	62–93	–
4	12			31–62	
	thickspike wheatgrass	ELLA3	<i>Elymus lanceolatus</i>	31–62	–
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	31–62	–
5	12			31–62	
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–31	–
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–31	–
	hairy grama	BOHI2	<i>Bouteloua hirsuta</i>	0–31	–
	prairie sandreed	CALO	<i>Calamovilfa longifolia</i>	0–31	–
	plains reedgrass	CAMO	<i>Calamagrostis montanensis</i>	0–31	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0–31	–
	plains muhly	MUCU3	<i>Muhlenbergia cuspidata</i>	0–31	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	0–31	–
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–31	–
	threeawn	ARIST	<i>Aristida</i>	0–12	–
6	12			31–62	
	threadleaf sedge	CAFI	<i>Carex filifolia</i>	31–62	–
	sedge	CAREX	<i>Carex</i>	0–31	–
9	15			202–303	
	little bluestem	SCSC	<i>Schizachyrium scoparium</i>	168–235	–
	sideoats grama	BOCU	<i>Bouteloua curtipendula</i>	34–67	–
10	15			67–202	
	needle and thread	HECO26	<i>Hesperostipa comata</i>	67–101	–
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	0–101	–
11	15			67–101	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	67–101	–
12	15			34–67	
	thickspike wheatgrass	ELLA3	<i>Elymus lanceolatus</i>	34–67	–
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	34–67	–
13	15			34–67	
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–34	–

	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	0–34	–
	threeawn	ARIST	<i>Aristida</i>	0–34	–
	hairy grama	BOHI2	<i>Bouteloua hirsuta</i>	0–34	–
	prairie sandreed	CALO	<i>Calamovilfa longifolia</i>	0–34	–
	plains reedgrass	CAMO	<i>Calamagrostis montanensis</i>	0–34	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0–34	–
	plains muhly	MUCU3	<i>Muhlenbergia cuspidata</i>	0–34	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	0–34	–
	sand dropseed	SPCR	<i>Sporobolus cryptandrus</i>	0–34	–
14	15			34–67	
	threadleaf sedge	CAFI	<i>Carex filifolia</i>	34–67	–
	sedge	CAREX	<i>Carex</i>	0–34	–
Forb					
7	12			93–123	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–31	–
	Cuman ragweed	AMPS	<i>Ambrosia psilostachya</i>	0–12	–
	pussytoes	ANTEN	<i>Antennaria</i>	0–12	–
	sandwort	ARENA	<i>Arenaria</i>	0–12	–
	prairie sagewort	ARFR4	<i>Artemisia frigida</i>	0–12	–
	prairie clover	DALEA	<i>Dalea</i>	0–12	–
	buckwheat	ERIOG	<i>Eriogonum</i>	0–12	–
	scarlet beeblossom	GACO5	<i>Gaura coccinea</i>	0–12	–
	hairy false goldenaster	HEVI4	<i>Heterotheca villosa</i>	0–12	–
	dotted blazing star	LIPU	<i>Liatris punctata</i>	0–12	–
	evening primrose	OENOT	<i>Oenothera</i>	0–12	–
	nailwort	PARON	<i>Paronychia</i>	0–12	–
	beardtongue	PENST	<i>Penstemon</i>	0–12	–
	phlox	PHLOX	<i>Phlox</i>	0–12	–
	lemon scurfpea	PSLA3	<i>Psoraleidium lanceolatum</i>	0–12	–
	ragwort	SENEC	<i>Senecio</i>	0–12	–
	scarlet globemallow	SPCO	<i>Sphaeralcea coccinea</i>	0–12	–
	greenthread	THELE	<i>Thelesperma</i>	0–12	–
15	15			101–135	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–34	–
	Cuman ragweed	AMPS	<i>Ambrosia psilostachya</i>	0–34	–
	pussytoes	ANTEN	<i>Antennaria</i>	0–34	–
	sandwort	ARENA	<i>Arenaria</i>	0–34	–
	prairie sagewort	ARFR4	<i>Artemisia frigida</i>	0–34	–
	prairie clover	DALEA	<i>Dalea</i>	0–34	–
	buckwheat	ERIOG	<i>Eriogonum</i>	0–34	–
	scarlet beeblossom	GACO5	<i>Gaura coccinea</i>	0–34	–
	hairy false goldenaster	HEVI4	<i>Heterotheca villosa</i>	0–34	–
	dotted blazing star	LIPU	<i>Liatris punctata</i>	0–34	–
	evening primrose	OENOT	<i>Oenothera</i>	0–34	–

	evening primrose	GENOT	<i>Genotricha</i>	0–34	–
	nailwort	PARON	<i>Paronychia</i>	0–34	–
	beardtongue	PENST	<i>Penstemon</i>	0–34	–
	phlox	PHLOX	<i>Phlox</i>	0–34	–
	lemon scurfpea	PSLA3	<i>Psoralea lanceolata</i>	0–34	–
	ragwort	SENEC	<i>Senecio</i>	0–34	–
	scarlet globemallow	SPCO	<i>Sphaeralcea coccinea</i>	0–34	–
	greenthread	THELE	<i>Thelesperma</i>	0–34	–
Shrub/Vine					
8				3–31	
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0–31	–
	soapweed yucca	YUGL	<i>Yucca glauca</i>	0–31	–
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–12	–
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–12	–
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–12	–
16				3–34	
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	0–34	–
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–34	–
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–34	–
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	0–34	–
	soapweed yucca	YUGL	<i>Yucca glauca</i>	0–34	–

Animal community

Animal Community – Wildlife Interpretations

Reference Plant Community—Little Bluestem, Needle and Thread, Blue Grama:

The predominance of grasses plus high forb diversity in this community favors large grazers such as pronghorn and elk. Suitable thermal and escape cover for mule deer is limited due to low shrub cover. White and black-tailed jackrabbit, badger, and coyote commonly use this community. This community also provides habitat for a wide array of smaller mammals, so diverse prey populations are available for raptors such as ferruginous and Swainson's hawks. Birds such as nighthawks utilize this community for nesting.

1.2 Community—Blue Grama, Needle and Thread, Decreased Little Bluestem:

The reduction in taller grasses in this community results in decreased use by lark buntings and western meadowlarks. Use by long-billed curlew increases, provided there is standing water within one-quarter mile. Killdeer, horned larks, and McCown's longspurs also make significant use of this community. Pronghorn may forage in this community.

2.1 Community—Blue Grama, Threadleaf Sedge:

This community provides limited foraging for antelope and other grazers. Ground-nesting birds favoring sparse vegetation may use this community. Long-billed curlews use this community if standing water is present within one-quarter mile. Generally, this is not a target vegetative community for wildlife habitat management.

3.1 Community—Cushion Plants, Threeawn, Cheatgrass, and Annuals:

This community has low habitat value for most wildlife species.

Animal Community – Grazing Interpretations

The following table is a guide to stocking rates for the plant communities described in the Gravelly site. These are conservative estimates for initial planning. On-site conditions vary, and stocking rates should be adjusted based on range inventories, animal kind and class, forage availability (adjusted for slope and distance to water), and the type of grazing system (number of pastures, planned moves, etc.), all of which is determined in the conservation planning process.

The following stocking rates are based on the total annual forage production in a normal year multiplied by 25 percent harvest efficiency of preferred and desirable forage species, divided by 912 pounds of ingested air-dry vegetation for an animal unit per month (Natl. Range and Pasture Handbook, 1997). An animal unit month (AUM) is defined as the amount of forage required by one mature cow for one month.

Plant Community (PC) Production (total lbs. /acre in a normal year) and Stocking Rate (AUMs/acre) are listed below:

Example: Reference PC – (800) (.22)

800 lbs. per acre X 25% Harvest Efficiency = 200 lbs. forage demand for one month. Then, 200 lbs. per acre/912 demand per AUM = .22

Plant Community (PC) Production (lbs.ac) and Stocking Rate (AUM/Acre)

Reference PC - (800) (0.22)

1.2 PC - (600) (0.16)

2.1 PC - (400) (0.11)

An on-site visit is required prior to developing a range plan.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangelands in this area provide year-long forage under prescribed grazing for cattle, sheep, horses, and other herbivores. During the dormant period, livestock may need supplementation based on reliable forage analysis.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic groups B and C. Infiltration ranges from moderate to rapid. Runoff potential for this site varies from moderate to high, depending upon soil hydrologic group and ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where shortgrasses form a strong sod. Areas where ground cover is less than 50 percent have the greatest potential for reduced infiltration and higher runoff (refer to NRCS Section 4, National Engineering Handbook (USDA–NRCS, 1972–2012) for runoff quantities and hydrologic curves).

Recreational uses

This site provides hunting, hiking, photography, bird watching, and other recreational opportunities. The wide varieties of plants that bloom from spring until fall have an aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are present on the site.

Other products

Site Development & Testing Plan

General Data (MLRA and Revision Notes, Hierarchical Classification, Ecological Site Concept, Physiographic, Climate, and Water Features, and Soils Data):

Updated. All “Required” items complete to Provisional level.

Community Phase Data (Ecological Dynamics, STM, Transition & Recovery Pathways, Reference Plant Community, Species Composition List, Annual Production Table):

Updated. All "Required" items complete to Provisional level.

Annual Production Table is from the "Previously Approved" ESD (2008).

Growth Curves are from the "Previously Approved" ESD (2008).

The Annual Production Table, Species Composition List, and Growth Curves will be reviewed for future updates at Approved level.

Each Alternative State/Community:

Complete to Provisional level.

Supporting Information (Site Interpretations, Assoc. & Similar Sites, Inventory Data References, Agency/State Correlation, References):

Updated. All "Required" items complete to Provisional level.

Wildlife Interpretations: Plant community names updated. Narrative is from "Previously Approved" ESD (2008). Wildlife species will need to be updated at the next Approved level.

Livestock Interpretations: Plant community names and stocking rates updated.

Hydrology, Recreational Uses, Wood Products, and Other Products carried over from previously "Approved" ESD (2008).

Plant Preferences table removed. Will be released as a technical guide notice by NRCS NE and WY state offices in the future.

Existing NRI or 417 Inventory Data References updated. More field data collection is needed to support this site concept.

Reference Sheet

Rangeland Health Reference Sheet carried over from previously "Approved" ESD (2008).

It will be updated at the next "Approved" level.

"Future work, as described in a project plan, to validate the information in this provisional ecological site description is needed. This will include field activities to collect low and medium intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document." (NI 430_306 ESI and ESD, April, 2015)

Inventory data references

Data Source: NRI

Number of Records: 5

(3 Gravelly and 2 Gravelly Loamy)

Sample Period: 2006-2013

States: NE, WY

Counties: Garden, Morrill (NE); Platte (WY)

Data Source: 417s

Number of Records: 6 (4 Gravelly and 2 Gravelly Loamy)

Sample Period: 1968-1980

States: NE, WY

Counties: Garden, Morrill (NE); Laramie, Platte (WY)

Data Source: Tier 1 Reconnaissance

Number of Records 3

States: NE

Counties Banner, Kimball, Sioux

NRI: references to Natural Resource Inventory data

Information presented here has been derived from data collection on private and federal lands using:

- Double Sampling (clipped 2 of 5 plots)*
- Rangeland Health (Pellant et al., 2005)
- Soil Stability (Pellant et al., 2005)
- Line Point Intercept : Foliar canopy, basal cover (Forb, Graminoid, Shrub, subshrub, Lichen, Moss, Rock fragments, bare ground, % Litter) (Herrick et al., 2005)
- Soil pedon descriptions collected on site (Schoeneberger et al., 2012)

*NRCS double-sampling method, CO NRCS Similarity Index Worksheet 528(1).

Additional reconnaissance data collection using numerous ocular estimates and other inventory data; NRCS clipping data for USDA program support; Field observations from experienced range trained personnel. Specific data information is contained in individual landowner/user case files and other files located in county NRCS field offices.

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Approval

Kirt Walstad, 9/07/2023

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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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Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None. Rills are not expected on this site.

2. **Presence of water flow patterns:** Water flow patterns are not expected on more level terrain. Water flow patterns are present on steeper slopes (greater than 30 percent) increasing with steeper slopes. Debris dams will be present in association with the waterflow patterns.

3. **Number and height of erosional pedestals or terracettes:** Pedestalled plants and terracettes are not expected until slopes exceed 30 percent, becoming more evident as slopes increase.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is typically 5 percent or less. This site can include a large amount of cobbles and gravel which are not considered to be bare ground.

5. **Number of gullies and erosion associated with gullies:** None. Gullies should not be present on this site.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None. Wind-scoured and depositional areas are not present on the site.

7. **Amount of litter movement (describe size and distance expected to travel):** On gentle slopes litter movement is not expected. As slopes increase fine litter may move short distances. When slopes exceed 30 percent, litter movement is expected and increases as slopes increase.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability ratings are typically 3 to 4.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface layer ranges from 2 to 7 inches (5-17.75 cm) thick. Exposed areas of gravel are inherent to the site.

Soil colors vary from gray, brown, grayish brown, to light brown (values of 5 to 6) when dry and very dark grayish brown, dark grayish brown, or dark brown (values of 3 to 4) when moist.

Soil surface structure is typically granular, and below the surface is typically single grain.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The functional/structural groups provide a combination of rooting depths and structure which positively influences infiltration. Combination of shallow and deep rooted species (mid & tall rhizomatous and tufted perennial cool season grasses) with fine and coarse roots positively influences infiltration.

The expected composition of the plant community is 75 to 85 percent perennial grasses and grass-likes, 15 to 20 percent forbs, and 0 to 5 percent shrubs. The grass and grass-like component is made up of warm-season tall and mid-grasses (20 to 40 percent); cool-season, bunch grasses (10 to 30 percent); cool-season, rhizomatous grasses (2 to 10 percent), warm-season short grasses (10 to 15 percent); and grass-likes (3 to 5 percent).

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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. A compaction layer is not expected on this site.
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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: 1. Native, C4, tall and mid-grasses – 160-320 #/ac (20-40%), 2 species minimum

Sub-dominant: 2. Native, C3, bunch grasses – 80-240 #/ac (10-30%), 2 species minimum

3. Native, Perennial and Annual Forbs – 80-160 #/ac (10-15%), 5 species minimum

4. Native, C4 short grasses - 80-120 #/ac (10-15%), 1 species minimum

Other: 5. Minor: Native, C3, rhizomatous grasses - 28-80 (2-10%)

6. Minor: Grass-likes – 24-40 #/ac (3-5%)

7. Minor: Shrubs, Vines, Cacti – 8-24 #/ac: (1-3%)

Additional: 12a. Relative Dominance:

Community 1.1: Native, C4, tall and mid-grasses > Native, C3 bunch grasses > Native, C4, short grasses = Native, Perennial and Annual Forbs > Native, C3, rhizomatous grasses > Grass-likes > Shrubs, vines, cacti.

12b. F/S Groups not expected for the site: Introduced annual grasses, perennial introduced and naturalized grasses, trees.

12c. Number of F/S Groups: 7

12d. Species number in Dominant and Sub-dominant F/S Groups: 10

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Some plant mortality and decadence is expected
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14. **Average percent litter cover (%) and depth (in):** Plant litter cover is evenly distributed throughout the site and is expected to be 30 to 50 percent. Litter depth is approximately 0.25 inches (0.65 cm).
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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Annual production ranges from 550 to 1,100 pounds per acres (air dry basis). Average annual production is 800 pounds per acre under normal precipitation and weather conditions.
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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:** Annual bromes, common mullein, broom snakeweed, fringed sagewort, pricklypear, burningbush, and Russian thistle, and others as they become known.

See:

Colorado Department of Agriculture Invasive Species Website:

<https://www.colorado.gov/pacific/agconservation/noxious-weed-species>

Wyoming Weed and Pest Council Website: <https://wyoweed.org/>

Nebraska Invasive Species website: <https://neinvasives.com/plants>.

17. **Perennial plant reproductive capability:** All perennial species exhibit high vigor relative to recent weather conditions. Perennial grasses should have vigorous rhizomes or tillers; vegetative and reproductive structures are not stunted. All perennial species should be capable of reproducing annually.
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