USDA Natural Resources Conservation Service

Ecological site GX064X01X015
Loamy 14-17" PZ

Last updated: 1/23/2019
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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.

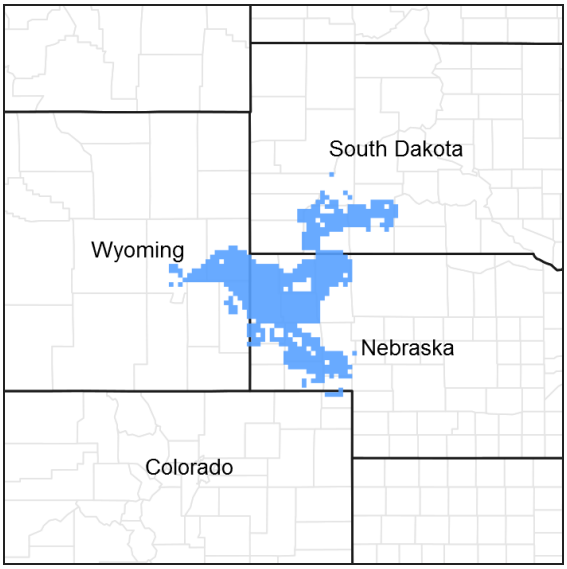

Figure 1. Mapped extent

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): 064X–Mixed Sandy and Silty Tableland and Badlands

The Mixed Sandy and Silty Tableland and Badlands (MLRA 64) is almost equally shared between South Dakota (42 percent) and Nebraska (41 percent), with a small portion in Wyoming (17 percent). The MLRA is 11,895 square miles. The towns of Kadoka and Pine Ridge, South Dakota; Chadron, Alliance, and Scottsbluff, Nebraska; and Lusk, Wyoming are all within the boundaries of this MLRA.

Badlands National Park, a portion of the Nebraska National Forest, and parts of the Oglala and Buffalo Gap National Grasslands, Agate Fossil Beds National Monument, Chadron State Park, Fort Robinson State Park, and the Pine Ridge Indian Reservation are in this MLRA. The Badlands are internationally renowned for their Oligocene vertebrate fossils.

The northern section of the MLRA consist of old plateaus and terraces that have been deeply eroded by wind, water, and time. The southern section consists of nearly level to broad intervalley remnants of smooth fluvial plains. These two sections are separated by the Pine Ridge escarpment. Elevations gradually increase from 2,950 feet to 5,073 feet as one moves east to west. The main drainageway through the Badlands National Park is the White River. The headwaters of both the White and Niobrara Rivers are located in MLRA 64. The Pine Ridge escarpment is located at the northernmost extent of the Ogallala Aquifer.

Tertiary continental sediments consisting of sandstone, siltstone, and claystone underlie most of the area. Many of the bedrock units in the southern third of the MLRA are covered by loess. Soils range from shallow to very deep, and from generally well-drained to excessively drained, and are loamy or sandy. The Badlands consist of stream-laid layers of silt, clay, and sand mixed with layers of volcanic ash.

Annual precipitation for the area is 14 to 20 inches. Most of the rainfall occurs as frontal storms in the spring and early summer months. This area supports a mixture of short-, mid-, and tall-statured warm- and cool-season grasses. On the Pine Ridge Escarpment, these plants grow in association with ponderosa pine, Rocky Mountain juniper, western snowberry, skunkbush sumac, common chokecherry, and rose. Wyoming big sagebrush occurs in minor amounts in the drier far western portion of the MLRA; however, small remnant stands can be found in the eastern portion of the Oglala National Grassland in Nebraska.

Sixty percent of the MLRA is grassland, 11 percent of which is under Federal management. Twenty-two percent of the area is used as cropland, and four percent is forested. Major resource concerns include the hazards of wind and water erosion, and surface water quality (USDA, NRCS. 2006. Ag Handbook 296).

For development of ecological sites, MLRA 64 is divided into two precipitation zones (PZ): 14 to 17 inches and 17 to 20 inches per year. The wetter 17 to 20 inches zone extends from the western end of the Pine Ridge Escarpment near Lusk, Wyoming, eastward along the escarpment through Nebraska and into the Big Badlands area of South Dakota. The drier zone, 14 to 17 inches, extends from Wyoming eastward to Alliance and Oshkosh, Nebraska, south of the Pine Ridge Escarpment. MLRA 64 stops at the western edge of the Nebraska Sand Hills (MLRA 65).

In the far southwest corner of the 14 to 17-inch PZ, there is a unique geologic area known as the Hartville Uplift. The Hartville Uplift is an elongated, north-northwest oriented, broad domal arch, of Laramide age (70-50 Ma). It extends approximately 45 miles between Guernsey and Lusk, Wyoming and is 15 miles wide at its widest point. Erosion has exposed a core of granite and Precambrian metasedimentary and metavolcanic rocks (Steele et al., 2018). In addition to the ecological sites that occur in the 14-17-inch PZ of MLRA 64, three unique ecological sites were added to help describe the soils and plant community dynamics that occur in the Hartville Uplift.

Classification relationships

USDA - Land Resource Region G – Western Great Plains Range and Irrigated Region, Major Land Resource Area (MLRA) 64 – Mixed Sandy and Silty Tableland and Badlands

US Environmental Protection Agency (EPA) Level IV Ecoregions of the Conterminous United States:
High Plains—25; Pine Ridge Escarpment—25a, Flat to Rolling Plains—25d, Pine Bluffs and Hills—25f, and Sandy and Silty Tablelands—25g
Northwestern Great Plains—43; White River Badlands—43h, and Keya Paha Tablelands—43i

Ecological site concept

The Loamy 14-17" PZ ecological site occurs throughout the drier portion of MLRA 64. It is located on upland landscapes and does not receive additional moisture from runoff or overflow. The typical slopes range is from 0 to 30 percent. Soils are deep, (greater than 20 inches) with surface textures range from very fine sandy loam to loam. Subsurface textures range from loam to clay loam. The vegetation in the Reference State consists of a mix of cool- and warm-season grasses, however, mid-statured cool-season grasses will be the dominant group. Rhizomatous wheatgrass, needle and thread, and green needlegrass are the dominant cool-season grasses, while blue grama and buffalograss are the dominant warm-season grasses. Forbs are common and diverse. Dominant shrubs include rose, winterfat, cactus, and occasionally Wyoming big sagebrush in the far western portion of the MLRA. The Loamy 14-17” PZ site is susceptible to invasion of non- native, cool-season grasses, especially field brome and cheatgrass.

Associated sites

R064XY011NE	**Sandy 14-17" PZ** The Sandy 14-17” PZ site can be found adjacent to the Loam 14-17” PZ sites.

R064XY026NE	**Loamy Overflow** The Loamy Overflow sites can be found on lower landscape position adjacent to the Loamy 14-17” PZ sites.
R064XY037NE	**Thin Upland** The Thin Upland site will be found on steeper slopes, typically on higher landscape positions than the Loamy 14-17” PZ site.

Similar sites

R064XY014NE	**Clayey 14-17" PZ** The Clayey 14-17” PZ site will have more green needlegrass and less needle and thread than the Loamy 14-17” PZ site.
R064XY026NE	**Loamy Overflow** The Loamy Overflow site will have more big bluestem, less needle and thread, and higher forage production than the Loamy 14-17” PZ site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Hesperostipa comata subsp. comata*

Legacy ID

R064XY015NE

Physiographic features

This Loamy 14-17” PZ ecological site occurs on gently undulating to rolling plains and low hills.

Table 2. Representative physiographic features

Landforms	(1) Alluvial fan (2) Alluvial flat (3) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	884–1,219 m
Slope	0–30%
Aspect	Aspect is not a significant factor

Climatic features

MLRA 64 is considered to have a continental climate consisting of cold winters and hot summers, low humidity, light rainfall, and ample sunshine. Extremes in temperature may also abound. The climate is the result of the location of MLRA 64 near the geographic center of North America. There are few natural barriers on the Northern Great Plains, and air masses move freely across the plains and account for rapid changes in temperature. Annual precipitation ranges from 14 to 17 inches per year. The normal average annual temperature is about 46°F. January is the coldest month with average temperatures ranging from about 24°F (Lusk 2 SW, WY) to about 26°F (Hemingford, NE). July is the warmest month with temperatures averaging from about 69°F (Lusk 2 SW, WY) to about 73°F (Hemingford, NE). The range of normal average monthly temperatures between the coldest and warmest months is about 50°F. This large annual range attests to the continental nature of the climate of this area. Hourly winds are estimated to average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms

may bring brief periods of high winds with gusts to more than 50 miles per hour. Growth of cool-season plants begins in early to mid-March, slowing or ceasing in late June. Warm-season plants begin growth about mid-May and continue to early or mid-September. Green-up of cool-season plants may occur in September and October when adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (average)	114 days
Freeze-free period (average)	133 days
Precipitation total (average)	406 mm

Climate stations used

- (1) AGATE 3 E [USC00250030], Harrison, NE
- (2) HEMINGFORD [USC00253755], Hemingford, NE
- (3) HAY SPRINGS 12 S [USC00253715], Hay Springs, NE
- (4) LUSK 2 SW [USC00485830], Lusk, WY
- (5) TORRINGTON 29N [USC00488997], Jay Em, WY
- (6) ALLIANCE 1WNW [USC00250130], Alliance, NE

Influencing water features

No significant water features influence this site.

Soil features

The features common to soils in the Loamy 14-17” PZ ecological site are the very fine sandy loam- to loam-textured surface soils and slopes of 0 to 30 percent. The soils in this site are well to somewhat excessively drained and formed in soft siltstone, sandstone, or alluvium. The surface layer is 5 to 25 inches thick. The texture of the profile ranges from loamy very fine sand to clay loam. The soils have a moderate infiltration rate. This site should show slight to no evidence of rills, wind-scoured areas, or pedestalled plants. Water flow paths are broken, irregular in appearance or discontinuous with numerous debris dams or vegetative barriers. The soil surface is stable and intact. Subsurface soil layers are not restrictive to water movement and root penetration.

Major soils correlated to the Loamy 14-17” PZ ecological site include: Alliance, Creighton, Duroc, Hemingford, Kadoka, Keith, Oglala, Rosebud, Satanta, and Thirtynine.

These soils are susceptible to wind and water erosion. The hazard of water erosion increases on slopes greater than about 15 percent. Loss of 50 percent or more of the surface layer of the soils on this site can result in a shift in species composition and/or production.

More information can be found in the various soil survey reports. Contact the local USDA Service Center for soil survey reports that include more detail specific to your area of interest, or use the internet to access USDA’s Web Soil Survey.

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Table 4. Representative soil features

Parent material	(1) Alluvium–sandstone and siltstone
Surface texture	(1) Very fine sandy loam (2) Loam
Family particle size	(1) Loamy

Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately slow to moderate
Soil depth	51–203 cm
Available water capacity (0-101.6cm)	12.7–22.86 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–5
Soil reaction (1:1 water) (0-101.6cm)	6.1–9
Subsurface fragment volume <=3" (Depth not specified)	0–30%
Subsurface fragment volume >3" (Depth not specified)	0–15%

Ecological dynamics

This site developed under Northern Great Plains climatic conditions, light to severe grazing by bison and other large herbivores, sporadic natural or human-caused wildfire (often of light intensities), and other biotic and abiotic factors that typically influence soil/site development. Changes will occur in the plant communities due to short-term weather variations, impacts of native and exotic plant and animal species, and management actions. While the following plant community descriptions specify more typical transitions between communities that will occur, severe disturbances, such as periods of well below-average precipitation and the introduction of non-native cool-season grasses, can cause significant shifts in plant communities and species composition.

Continuous season-long grazing (during the typical growing season of May through October) and/or repeated seasonal grazing (e.g., every spring, every summer) without adequate recovery periods following each grazing occurrence causes this site to depart from the Rhizomatous Wheatgrass-Needle and Thread-Blue Grama Plant Community (1.1). Blue grama will increase and eventually develop into a sod.
Rhizomatous wheatgrass will increase initially and then begin to decrease. Needle and thread, green needlegrass, and sideoats grama will decrease in frequency and production. Frequent and severe defoliation or heavy disturbance will cause threeawns and annuals to increase and dominate the site. Extended periods of non-use, lack of fire, or continuous seasonal grazing will result in a plant community dominated by cool-season grasses and excessive litter and annuals.

Historically, rangeland mechanical treatment of this site was an option used to improve forage production and plant species composition on rangeland. These mechanical treatments include such things as contour furrowing, contour pitting, terracing, chiseling, and disking. The purpose of the practice is to mechanically break up a sod-bound vegetative condition or compacted soils, resulting in less runoff and better infiltration. Many of these treatments were implemented during the 1930s through the 1970s and have shown to have no real long-term benefits for improving production. This is primarily due to improper grazing management following the renovation practice. Another drawback, in addition to the cost, is the practices result in a permanently rough ground surface.

Interpretations are primarily based on the Rhizomatous Wheatgrass-Needle and Thread-Blue Grama Plant Community (1.1). It has been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been used. Plant communities, states, transitional pathways, and thresholds have been determined through similar studies and experience.

The following is a diagram that illustrates the common plant communities that can occur on the site and the transitions between communities. The ecological processes will be discussed in more detail in the plant community

narratives following the diagram.

State and transition model

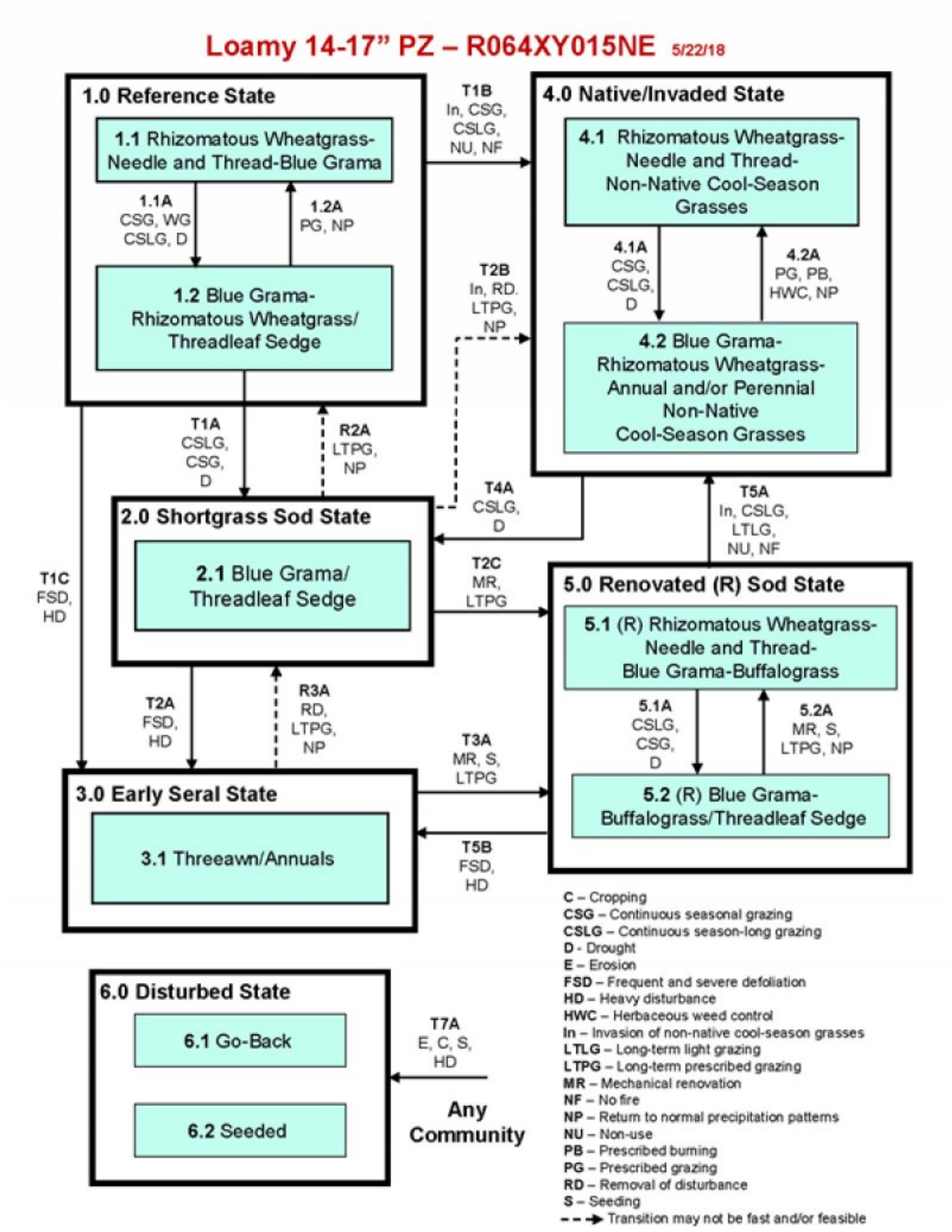

Figure 4. Loamy 14-17" PZ - R064XY015NE.

Diagram Legend - Loamy 14-16" PZ - R064XY015NE

T1A	Continuous season long grazing, continuous seasonal grazing, or heavy grazing in combination with drought.
T1B	Invasion of non-native cool-season grasses, continuous seasonal grazing, or continuous season-long grazing, or non-use and no fire.
T1C	Frequent and severe defoliation and/or heavy disturbance.
T2A	Frequent and severe defoliation and/or heavy disturbance.
T2B	Invasion of non-native cool-season grasses, removal of management-induced disturbance, long-term prescribed grazing with change in season of use, adequate time for recovery, and a return to normal precipitation patterns.
T2C	Mechanical renovation to break up sod, followed by long-term prescribed grazing that includes proper stocking, change in season of use, and deferment that provides time for adequate recovery.
T3A	Mechanical renovation and possibly seeding, followed by long-term prescribed grazing that includes proper stocking, change in season of use, and deferment that provides time for adequate recovery.
T4A	Continuous season long grazing or heavy grazing in combination with drought.
T5A	Invasion of non-native cool-season grasses, continuous season-long grazing, or long-term light grazing, or non-use and no fire.
T5B	Frequent and severe defoliation and/or heavy disturbance.
T7A	Heavy disturbance such as soil erosion, tillage, abandoned cropland, or tillage and seeding to introduced perennial forage crops.

R2A	Long-term prescribed grazing with change in season of use, adequate time for recovery, and a return to normal precipitation patterns. This transition may not be fast or feasible.
R3A	Removal of disturbance coupled with long-term prescribed grazing with change in season of use, adequate recovery time, and a return to normal precipitation patterns. Transition may not be fast or feasible.

1.1A	1.1 - 1.2	Continuous seasonal grazing (spring), late winter grazing, continuous season-long grazing, or heavy grazing in combination with drought.
1.2A	1.2 - 1.1	Prescribed grazing with proper stocking, change in season of use, adequate time for recovery, and a return to normal precipitation patterns following drought.
4.1A	4.1 - 4.2	Continuous seasonal grazing (spring), continuous season-long grazing, or heavy grazing in combination with drought.
4.2A	4.2 - 4.1	Prescribed grazing with proper stocking, change in season of use, adequate time for recovery, and a return to normal precipitation patterns following drought. Prescribed burning and/or herbacious weed control may be management options.
5.1A	5.1 - 5.2	Continuous season-long grazing, or continuous seasonal grazing without adequate recovery, or heavy grazing in combination with drought.
5.2A	5.2 - 5.1	Mechanical renovation to break up sod, followed by long-term prescribed grazing that includes proper stocking, change in season of use, and deferment that provides time for adequate recovery, and a return to normal precipitation patterns. Interseeding may also be an optional accelerating practice.

State 1
Reference State

The Reference State represents what is believed to show the natural range of variability that dominated the dynamics of the ecological site prior to European settlement. This site in the Reference State (1.0) is dominated by

cool-season grasses and subdominant warm-season grass. Grazing or the lack of grazing, fire, and drought are the major drivers between plant communities. Continuous season-long grazing can push this State to a warm-season shortgrass-dominated State (2.0). Non-use, no fire, and invasion of non-native cool-season grasses will result in a transition to a Native/Invaded State (4.0).

Community 1.1
Rhizomatous Wheatgrass-Needle and Thread-Blue Grama

Interpretations are based primarily on the Western Wheatgrass-Needle and Thread-Blue Grama Plant Community. This is also considered to be the Reference Plant Community (1.1). The plant community can be found on areas that are properly managed with grazing and/or prescribed burning, and sometimes on areas receiving occasional short periods of rest. The potential vegetation is about 75 percent grasses, 10 percent grass-like plants, 10 percent forbs, and 5 percent shrubs. The dominant grasses include western wheatgrass, thickspike wheatgrass, needle and thread, and blue grama. Other grasses and grass-likes may include buffalograss, green needlegrass, and threadleaf sedge. The dominant forbs include fringed sagewort, Cuman ragweed, cudweed sagewort, and prairie coneflower. Dominant shrubs in this community include rose, winterfat, cactus and occasionally snowberry. In the far western portion of the MLRA, Wyoming big sagebrush may be present is small amounts. This plant community is well adapted to the Northern Great Plains climatic conditions. Individual species can vary greatly in production depending on growing conditions (timing and amount of precipitation and temperature). Plant litter is properly distributed with some movement off-site and natural plant mortality is low. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community in terms of soil stability and watershed function. Moderate or high available water capacity provides a favorable soil-water- plant relationship.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1026	1765	2387
Shrub/Vine	–	101	207
Forb	95	151	207
Total	**1121**	**2017**	**2801**

Figure 6. Plant community growth curve (percent production by month). NE6401, Pine Ridge/Badlands, cool-season dominant. Cool-season dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	15	28	30	10	2	5	5		

Community 1.2
Blue Grama-Rhizomatous Wheatgrass/Threadleaf Sedge

This plant community develops with early continuous seasonal grazing and late winter grazing (i.e., grazing at the onset of the growth curve every year). This plant community can also develop from continuous season-long grazing and heavy grazing in combination with drought. The potential vegetation is made up of approximately 75 percent grasses, 10 percent grass-likes, 10 percent forbs, and 5 percent shrubs. The dominant grasses include blue grama and rhizomatous wheatgrass. Other grasses or grass-like species are threadleaf sedge, buffalograss, and needle and thread. Forbs include scarlet globemallow, scurfpea, Cuman ragweed, fringed sagewort, and perennial aster species. Shrubs include rose, broom snakeweed, and pricklypear cactus. Compared to the Rhizomatous Wheatgrass-Needle and Thread-Blue Grama Plant Community (1.1), blue grama and threadleaf sedge have increased. Rhizomatous wheatgrass and needle and thread have decreased in composition. Annual bromes and annual forbs can invade the site. Plant diversity is moderate. Shortgrasses dominate the structure of the community. The plant community tends to be resilient if disturbance is not long term. Species such as blue grama and threadleaf sedge are very adapted to grazing; however, western wheatgrass, needle and thread, and the more palatable forbs will decrease in the community with recurrent disturbance and/or climatic fluctuations. Soil erosion is low. Compared to the Rhizomatous Wheatgrass-Needle and Thread-Blue Grama Plant Community, water infiltration is slightly lower, and runoff is somewhat higher. Typically, the runoff is very clean because of the low

potential for soil erosion.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	835	1143	1446
Forb	62	135	207
Shrub/Vine	–	67	140
Total	**897**	**1345**	**1793**

Figure 8. Plant community growth curve (percent production by month). NE6403, Pine Ridge/Badlands, cool-season/warm-season co-dominant. Cool-season, warm-season co-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	10	20	25	20	10	5	5		

Pathway 1.1A
Community 1.1 to 1.2

Continuous seasonal grazing during the active growing period of cool-season plants, or late-season winter grazing, or continuous season-long grazing, or heavy grazing in combination with drought will lead to the Blue Grama-Rhizomatous Wheatgrass/Threadleaf Sedge Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing that allows for adequate plant recovery periods and a return to normal precipitation patterns will move this plant community to the Rhizomatous Wheatgrass-Needle and Thread-Blue Grama Plant Community (1.1). Periods of non-use or deferment may be a management option to reach the Rhizomatous Wheatgrass-Needle and Thread-Blue Grama Plant Community.

Conservation practices

Prescribed Grazing

State 2
Shortgrass Sod State

The Shortgrass Sod State is dominated by shortgrass species and upland sedges. This State is the result of grazing patterns that did not provide adequate recovery time for cool-season wheat grasses and needlegrasses. If heavy disturbance such as frequent and severe defoliation and livestock concentration continues, pioneer perennials and annual grass and forb species may become dominant. The hydrologic function is dramatically altered in the Shortgrass Sod State. Runoff is high, and infiltration is low. This State is very resistant to change through grazing management alone.

Community 2.1
Blue Grama/Threadleaf Sedge

This plant community develops with continuous season-long grazing, continuous seasonal grazing or heavy grazing in combination with drought. It is a dense sod, made up of primarily warm-season shortgrasses and grass-like sedges. The cool-season mid-grasses have been significantly reduced. The dominant grass is blue grama. Other grasses include buffalograss, and threeawn. Palatable forbs initiate avoidance mechanisms and are difficult to find on the site. Species such as scarlet globemallow, Cuman ragweed, and cudweed sagewort increase. When compared to the Rhizomatous Wheatgrass-Needle and Thread-Blue Grama Plant Community (1.1), blue grama and threadleaf sedge increase significantly. The mid-grass has declined dramatically. Annual brome may invade this

plant community. Annual production has decreased significantly. This plant community is resistant to change. The thick sod prevents other species from establishing. Often, a seed source is not readily available. Infiltration decreases as runoff increases. The hydrologic cycle is impaired. There is less than 10 percent bare ground.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	308	555	796
Forb	28	84	140
Shrub/Vine	–	34	73
Total	**336**	**673**	**1009**

Figure 10. Plant community growth curve (percent production by month). NE6405, Pine Ridge/Badlands, warm-season dominant. Warm-season dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		3	7	15	20	30	15	5	5		

State 3
Early Seral State

The Early Seral State is the result of very heavy, disturbance such as rodent activity or livestock concentration areas. Extended periods of drought accompanied by heavy grazing can also push an ‘At Risk’ Plant Community Phase to this State. In most cases, this phase is dominated by pioneer perennial and annual grass and forb species. The percentage of bare ground is also much higher than on any other plant community phase in this ecological site.

Community 3.1
Threeawn/Annuals

This plant community developed with frequent and severe defoliation and/or heavy disturbance. The plant composition is made up of annuals with a few species of perennial forbs and grasses that are tolerant to frequent and severe defoliation. Grasses and grass-like species include threeawn, annual brome, blue grama, threadleaf sedge, sixweeks fescue, and scattered patches of buffalograss. The dominant perennial forbs include curlycup gumweed, hairy false goldenaster, verbena, and fringed sagewort. Broom snakeweed, cactus, and tarragon (green sagewort) increase. This plant community is also susceptible to invasion of Canada thistle and other non-native species because of the relatively high percentage of bare ground. Compared to the Rhizomatous Wheatgrass-Needle and Thread-Blue Grama Plant Community (1.1), all perennial plant species have been greatly reduced with only remnants of the most grazing-tolerant species present. Desirable native plant (i.e., those plants that maintain a healthy soil and plant community) diversity is low. This plant community is resistant to change because of the loss of plant diversity and overall soil disturbance. The hazards of wind and water erosion are high due to increased bare ground and the shallow-rooted herbaceous plant community. Loss of root mass and rodent-related soil disturbance has altered the hydrology.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	247	454	661
Forb	62	135	207
Shrub/Vine	28	84	140
Total	**337**	**673**	**1008**

Figure 12. Plant community growth curve (percent production by month). NE6403, Pine Ridge/Badlands, cool-season/warm-season co-dominant.

Cool-season, warm-season co-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	10	20	25	20	10	5	5		

State 4
Native/Invaded State

The Native/Invaded State has been invaded by field brome, cheatgrass, crested wheatgrass, smooth brome, and/or Kentucky bluegrass, but not at the levels at which the plant communities are dominated by these species. Long-term non-use, in combination with above-average precipitation, may transition a Native/Invaded plant community to a plant community phase that consists predominantly of non-native cool-season grasses. This scenario has been observed on this ecological site in small acreage fields, but not on larger tracts of land in this portion of MLRA 64. This transition can be observed in the northern portion of the MLRA, and in adjacent MLRAs. Once these species are established, it is unlikely that an invaded plant community can be returned to the Reference State (1.0). Cheatgrass and field brome will always be present in these plant communities, but during years with very wet falls and early springs, these two species can make up a significant percentage of the total annual production. As the seed bank of these species grows, the more difficult they will be to control.

Community 4.1
Rhizomatous Wheatgrass-Needle and Thread-Non-Native Cool-Season Grasses

This plant community phase is similar to the Rhizomatous Wheatgrass-Needle and Thread-Blue Grama Plant Community (1.1), but it also contains minor amounts of non-native invasive grass species such as cheatgrass, field brome, crested wheatgrass, and/or smooth brome (up to about 15 percent by air-dry weight). The potential vegetation consists of about 80 percent grasses, 5 percent grass-like plants, 10 percent forbs, and 5 percent shrubs. The community is dominated by cool-season grasses. The major grasses include rhizomatous wheatgrass, needle and thread, and blue grama. Other grass or grass-like species include prairie Junegrass, Sandberg bluegrass, buffalograss. Cheatgrass and field brome will always be present in this plant community, but during years with very wet falls and early springs, these two species can make up make up a significant percentage of the total annual production. As the seed bank of these species grows the more difficult they will be to control. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high tolerance to drought. This is a sustainable plant community regarding site/soil stability, watershed function, and biologic integrity.

Table 9. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1026	1765	2387
Shrub/Vine	–	101	207
Forb	95	151	207
Total	**1121**	**2017**	**2801**

Figure 14. Plant community growth curve (percent production by month). NE6401, Pine Ridge/Badlands, cool-season dominant. Cool-season dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	15	28	30	10	2	5	5		

Community 4.2
Blue Grama-Rhizomatous Wheatgrass-Annual and/or Perennial Non-Native Cool-Season Grasses

This plant community develops from continuous seasonal or continuous season-long grazing, or non-use and no fire, and the invasion of non-native cool-season grasses. Species composition is made up of 85 percent warm-

season shortgrasses and cool-season mid-grasses, 10 percent forbs, and approximately 5 percent shrubs. The dominant grasses and grass-like species include blue grama, buffalograss, threadleaf sedge, rhizomatous wheatgrass, prairie Junegrass, Sandberg bluegrass, cheatgrass, and field brome. Under long-term non-use, crested wheatgrass, smooth brome, and/or Kentucky bluegrass may invade. Forbs commonly found on this plant community include cudweed sagewort, scarlet globemallow, and Cuman ragweed. Under proper management, this plant community is stable. The soil erosion is low to moderate. Infiltration and runoff are moderate.

Table 10. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	835	1143	1446
Forb	62	135	207
Shrub/Vine	–	67	140
Total	**897**	**1345**	**1793**

Figure 16. Plant community growth curve (percent production by month). NE6403, Pine Ridge/Badlands, cool-season/warm-season co-dominant. Cool-season, warm-season co-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	10	20	25	20	10	5	5		

Pathway 4.1A
Community 4.1 to 4.2

Continuous seasonal grazing during the active growing period of cool-season plants, or continuous season-long grazing and drought will lead to Plant Community Phase (4.2).

Pathway 4.2A
Community 4.2 to 4.1

Prescribed grazing that allows for adequate plant recovery periods and normal precipitation patterns following drought will move this plant community toward the Rhizomatous Wheatgrass-Needle and Thread-Non-Native Cool-Season Grasses Plant Community Phase (4.1). Prescribed burning and/or chemical herbaceous weed control may be management options to help accelerate the change.

Conservation practices

Prescribed Burning
Prescribed Grazing
Herbaceous Weed Control

State 5
Renovated (R) Sod State

The Renovated (R) Sod State has been invaded by field brome, cheatgrass, crested wheatgrass, smooth brome, and/or Kentucky bluegrass, but not at the levels at which the plant communities are dominated by these species. Long-term non-use, in combination with above-average precipitation, may transition a Native/Invaded plant community to a plant community phase that is predominantly non-native cool-season grasses. This scenario has been observed on this ecological site in small acreage fields but not on larger tracts of land in this portion of MLRA 64. This transition can be observed in the northern portion of the MLRA and in adjacent MLRAs. Once these species are established it is unlikely that an invaded plant community can be returned to the Reference State (1.0). Cheatgrass and field brome will always be present in these plant communities, but during years with very wet falls and early springs, these two species can make up a significant percentage of the total annual production. As the seed bank of these species grows, the more difficult they will be to control.

Community 5.1
(R) Rhizomatous Wheatgrass-Needle and Thread-Blue Grama-Buffalograss

With proper management after renovation (R), this plant community will have similar plant composition and growth curve characteristics as the Reference Plant Community (1.1), however, the production will likely be slightly higher, depending on the degree of alteration. Proper grazing management must be implemented to maintain this plant community.

Community 5.2
(R) Blue Grama-Buffalograss/Threadleaf Sedge

This plant community will be similar to the Blue Grama-Buffalograss Sod Plant Community (2.1) in most respects. The main difference is the microrelief created by the renovation. Depending on the renovation technique, the microrelief can remain on the landscape for many decades, making vehicular travel across the landscape uncomfortable, if not extremely difficult. The forage production potential of a shortgrass plant community can be quickly improved through mechanical renovation. Mechanical renovation creates microrelief through practices including contour furrowing, contour pitting, terracing, chiseling, and disking. The purpose of the practice is to mechanically break up a sod-bound vegetative condition, or compacted soils. Renovation can restore hydrologic function by increasing infiltration and decreasing runoff. These factors favor cool-season species such as rhizomatous wheatgrasses, needle and thread, green needlegrass, and a variety of forbs. Mechanical renovation may not be economically feasible and if the management activities that created the plant community are not changed, the renovation will not be successful.

Pathway 5.1A
Community 5.1 to 5.2

Continuous season-long grazing, or continuous seasonal grazing, or heavy grazing in combination with drought will shift this plant community to the Renovated (R) Blue Grama-Buffalograss Sod Plant Community (5.2).

Pathway 5.2A
Community 5.2 to 5.1

This plant community can be returned to the (R) Rhizomatous Wheatgrass-Needle and Thread-Blue Grama-Buffalograss Plant Community (5.1) through another mechanical renovation treatment and possibly seeding, followed by long-term prescribed grazing and normal precipitation patterns. The second mechanical treatment may make travel across the landscape very difficult for vehicles and livestock.

Conservation practices

Grazing Land Mechanical Treatment
Prescribed Grazing

State 6
Disturbed State

The Disturbed State can be transitioned to from any Plant Community. It is the result of prior cultivation and abandonment of cropland (go-back), or tillage and seeding to a forage crop, or extensive soil disturbance and/or soil erosion. The two separate vegetative plant communities are highly variable in nature. They are derived through different management scenarios, and are not related successionally. Infiltration, runoff, and soil erosion varies depending on the vegetation present on the site.

Community 6.1
Go-Back

The Go-Back Plant Community can be reached whenever severe mechanical disturbance occurs (e.g., tilled and abandoned land). During the early successional stages, the species that mainly dominate are annual grasses and forbs, later replaced by both native and introduced perennials. The vegetation on this site vary greatly, sometimes

being dominated by threeawn, annual brome, crested wheatgrass, dropseed, broom snakeweed, verbena, sweet clover, mullein, and non-native thistles. Other plants that commonly occur on the site include western wheatgrass, deathcamas, prickly lettuce, mare's-tail, kochia, foxtail, and sunflowers. Bare ground is prevalent due to the loss of organic matter and lower overall soil health.

Community 6.2
Seeded

The Seeded Plant Community consists of those areas seeded to pubescent or intermediate wheatgrass, alfalfa, crested wheatgrass, or other introduced forage species. For adapted species and expected production, refer to the USDA-NRCS eFOTG for the appropriate Forage Suitability Group description.

Transition T1A
State 1 to 2

Continuous seasonal grazing or continuous season-long grazing, or heavy grazing during extended period of drought will transition this plant community (1.2) to the Shortgrass State (2.0). Once this site becomes sod-bound there will be a loss of hydrologic function resulting in increased run-off and less infiltration.

Transition T1C
State 1 to 3

Frequent and severe defoliation, or heavy disturbance causing a loss of hydrologic function. Examples include livestock concentration areas (feeding), prairie dog towns, small horse pastures, etc. Runoff will increase, and infiltration will decrease. These disturbances will cause a transition to the Early Seral State (3.0).

Transition T1B
State 1 to 4

Continuous season-long grazing, or continuous seasonal grazing, or non-use and no fire, and invasion of non-native cool-season grasses will cause a transition to the Native/Invaded State (4.0).

Transition T7A
State 1 to 6

Heavy disturbance including soil erosion, tillage, abandonment of cropland, or seeding to improved pasture species will result in a transition to the Disturbed State (6.0).

Restoration pathway R2A
State 2 to 1

Long-term prescribed grazing may potentially convert the plant community to the Blue Grama-Rhizomatous Wheatgrass/Threadleaf Sedge Plant Community (1.2), assuming an adequate seed/vegetative source is present. A return to normal precipitation patterns will help to expedite this transition. This could require significant time and input to achieve and, in the end, may not meet management objectives.

Conservation practices

Prescribed Grazing

Transition T2A
State 2 to 3

Frequent and severe defoliation and/or heavy disturbance including livestock concentration areas (feeding), prairie dog towns, small horse pastures, etc. will cause a transition to the Early Seral State (3.0). Runoff will increase, and infiltration will decrease.

Transition T2B
State 2 to 4

Removal of management-induced disturbance, invasion of non-native cool-season grasses, and long-term prescribed grazing may result in a transition to the Native/Invaded State (4.0). A return to normal precipitation patterns will help expedite this transition. This could require significant time and input to achieve and, in the end, may not meet management objectives.

Transition T2C
State 2 to 5

Mechanical renovation will move this plant community to the Renovated (R) Sod State (5.0). Proper grazing management must be included in order to derive the benefits of renovation.

Transition T7A
State 2 to 6

Heavy disturbance including soil erosion, tillage, abandonment of cropland, or seeding to improved pasture species will result in a transition to the Disturbed State (6.0).

Restoration pathway R3A
State 3 to 2

Removal of the management-induced disturbance, in association with long-term prescribed grazing and favorable climatic conditions, may allow for adequate plant recovery and a transition to the Shortgrass Sod State (2.0). Periods of non-use or deferment may be a management option to facilitate this movement. This transition will not be rapid and may not meet management objectives.

Conservation practices

Prescribed Grazing

Transition T3A
State 3 to 5

Mechanical renovation, and possibly seeding, will move this plant community to the Renovated (R) Sod State (5.0). Proper grazing management must be included in order to derive the benefits of renovation.

Transition T7A
State 3 to 6

Heavy disturbance including soil erosion, tillage, abandonment of cropland, or seeding to improved pasture species will result in a transition to the Disturbed State (6.0).

Transition T4A
State 4 to 3

Continuous season-long grazing or heavy grazing during extended period of drought will transition this plant community to the Shortgrass State (3.0). Once this site becomes sod-bound there will be a loss of hydrologic function, resulting in increased runoff and less infiltration.

Transition T7A
State 4 to 6

Heavy disturbance including soil erosion, tillage, abandonment of cropland, or seeding to improved pasture species will result in a transition to the Disturbed State (6.0).

Transition T5B
State 5 to 3

Frequent and severe defoliation, and/or heavy disturbance including livestock concentration areas (feeding), prairie dog towns, small horse pastures, etc. will cause a transition to the Early Seral State (3.0). Runoff will increase and infiltration will decrease.

Transition T5A
State 5 to 4

Continuous season-long grazing, or long-term light grazing, or non-use and no fire, and invasion of non-native cool-season grasses will cause a transition to the Native/Invaded State (4.0).

Transition T7A
State 5 to 6

Heavy disturbance including soil erosion, tillage, abandonment of cropland, or seeding to improved pasture species will result in a transition to the Disturbed State (6.0).

Additional community tables

Table 11. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			404–605	
	western wheatgrass	PASM	*Pascopyrum smithii*	404–605	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	101–280	–
2	**Needlegrass**			303–504	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	303–404	–
	green needlegrass	NAVI4	*Nassella viridula*	101–202	–
3	**Warm Season Short-Grasses**			101–303	
	blue grama	BOGR2	*Bouteloua gracilis*	101–303	–
4	**Native Grasses and Grass-likes**			101–404	
	threadleaf sedge	CAFI	*Carex filifolia*	101–202	–
	big bluestem	ANGE	*Andropogon gerardii*	0–101	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–101	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–101	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–40	–
Forb					
6	**Forbs**			101–202	
	scurfpea	PSORA2	*Psoralidium*	0–40	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–40	–
	milkvetch	ASTRA	*Astragalus*	0–40	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–40	–
	pussytoes	ANTEN	*Antennaria*	0–40	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–40	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–40	–
	bush morning-glory	IPLE	*Ipomoea leptophylla*	0–40	–

	bush morning glory	IPLE	*Ipomoea leptophylla*	0–40	
	goldenrod	SOLID	*Solidago*	0–40	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–40	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–20	–
	vervain	VERBE	*Verbena*	0–20	–
	dotted blazing star	LIPU	*Liatris punctata*	0–20	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–20	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–20	–
	beardtongue	PENST	*Penstemon*	0–20	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–20	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–20	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–20	–
	false boneset	BREU	*Brickellia eupatorioides*	0–20	–
	corn gromwell	BUAR3	*Buglossoides arvensis*	0–20	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–20	–
Shrub/Vine					
7	**Shrubs**			0–202	
	leadplant	AMCA6	*Amorpha canescens*	0–101	–
	rose	ROSA5	*Rosa*	0–101	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–73	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–73	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–40	–
	snowberry	SYMPH	*Symphoricarpos*	0–40	–
	soapweed yucca	YUGL	*Yucca glauca*	0–40	–
	pricklypear	OPUNT	*Opuntia*	0–20	–

Table 12. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			67–269	
	western wheatgrass	PASM	*Pascopyrum smithii*	67–269	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–101	–
2	**Needlegrass**			27–135	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	27–135	–
	green needlegrass	NAVI4	*Nassella viridula*	0–67	–
3	**Warm-Season Short Grasses**			269–538	
	blue grama	BOGR2	*Bouteloua gracilis*	135–404	–
4	**Native Grasses and Grass-likes**			67–269	
	threadleaf sedge	CAFI	*Carex filifolia*	67–135	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–67	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	13–54	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–40	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–27	–

	Sandberg bluegrass	POSE	*Poa secunda*	0–27	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–27	–
	big bluestem	ANGE	*Andropogon gerardii*	0–27	–
	threeawn	ARIST	*Aristida*	0–27	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–13	–
5	**Non-Native Grasses**			0–67	
	field brome	BRAR5	*Bromus arvensis*	0–67	–
	cheatgrass	BRTE	*Bromus tectorum*	0–67	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–67	–
Forb					
6	**Forbs**			67–202	
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–135	–
	sweetclover	MELIL	*Melilotus*	0–67	–
	vervain	VERBE	*Verbena*	0–67	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–40	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–40	–
	milkvetch	ASTRA	*Astragalus*	0–27	–
	pussytoes	ANTEN	*Antennaria*	0–27	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–27	–
	scurfpea	PSORA2	*Psoralidium*	0–27	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–27	–
	goatsbeard	TRAGO	*Tragopogon*	0–27	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–27	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–13	–
	bush morning-glory	IPLE	*Ipomoea leptophylla*	0–13	–
	dotted blazing star	LIPU	*Liatris punctata*	0–13	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–13	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–13	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–13	–
	goldenrod	SOLID	*Solidago*	0–13	–
	beardtongue	PENST	*Penstemon*	0–13	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–13	–
	false boneset	BREU	*Brickellia eupatorioides*	0–13	–
	corn gromwell	BUAR3	*Buglossoides arvensis*	0–13	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–13	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–13	–
Shrub/Vine					
7	**Shrubs**			0–135	
	prairie sagewort	ARFR4	*Artemisia frigida*	0–67	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–67	–
	pricklypear	OPUNT	*Opuntia*	0–67	–
	snowberry	SYMPH	*Symphoricarpos*	0–67	–

	soapweed yucca	YUGL	*Yucca glauca*	0–67	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–50	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–50	–
	rose	ROSA5	*Rosa*	0–27	–
	leadplant	AMCA6	*Amorpha canescens*	0–13	–

Table 13. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			7–34	
	western wheatgrass	PASM	*Pascopyrum smithii*	7–34	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–11	–
2	**Needlegrass**			0–13	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–13	–
3	**Warm Season Short-Grasses**			269–437	
	blue grama	BOGR2	*Bouteloua gracilis*	135–336	–
4	**Native Grasses and Grass-likes**			67–135	
	threeawn	ARIST	*Aristida*	7–34	–
	threadleaf sedge	CAFI	*Carex filifolia*	7–34	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	7–34	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–34	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–13	–
5	**Non-Native Grasses**			7–34	
	cheatgrass	BRTE	*Bromus tectorum*	7–34	–
	field brome	BRAR5	*Bromus arvensis*	0–22	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–7	–
Forb					
6	**Forbs**			34–135	
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–67	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–34	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–34	–
	sweetclover	MELIL	*Melilotus*	0–34	–
	scurfpea	PSORA2	*Psoralidium*	0–34	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–34	–
	vervain	VERBE	*Verbena*	0–34	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–20	–
	goatsbeard	TRAGO	*Tragopogon*	0–13	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–7	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–7	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–7	–
	milkvetch	ASTRA	*Astragalus*	0–7	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–7	–
Shrub/Vine					

7	**Shrubs**			0–67	
	prairie sagewort	ARFR4	*Artemisia frigida*	0–34	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–34	–
	pricklypear	OPUNT	*Opuntia*	0–34	–
	soapweed yucca	YUGL	*Yucca glauca*	0–34	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–28	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–11	–

Table 14. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			0–34	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–34	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–11	–
3	**Warm Season Short-Grasses**			0–67	
	blue grama	BOGR2	*Bouteloua gracilis*	0–67	–
4	**Native Grasses and Grass-likes**			269–504	
	threeawn	ARIST	*Aristida*	67–235	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–34	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–34	–
	threadleaf sedge	CAFI	*Carex filifolia*	0–20	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–7	–
5	**Non-Native Grasses**			7–67	
	cheatgrass	BRTE	*Bromus tectorum*	7–67	–
	field brome	BRAR5	*Bromus arvensis*	0–39	–
Forb					
6	**Forbs**			67–202	
	thistle	CIRSI	*Cirsium*	0–101	–
	vervain	VERBE	*Verbena*	0–34	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–34	–
	pussytoes	ANTEN	*Antennaria*	0–34	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–20	–
	milkvetch	ASTRA	*Astragalus*	0–7	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–7	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–7	–
Shrub/Vine					
7	**Shrubs**			34–135	
	prairie sagewort	ARFR4	*Artemisia frigida*	13–101	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	7–67	–
	pricklypear	OPUNT	*Opuntia*	7–67	–

Animal community

Wildlife Interpretations
MLRA 64 lies within the drier portion of northern mixed-grass prairie ecosystem where sagebrush steppes to the west yield to grassland steppes to the east. Prior to European settlement, this area consisted of diverse grass/shrub land habitats interspersed with varying densities of depressional, instream wetlands, and woody riparian corridors. These habitats provided critical life cycle components for many of its users. Many species of grassland birds, small mammals, reptiles, amphibians, and herds of roaming bison, elk, and pronghorn were among the inhabitants adapted to this semi-arid region. Roaming herbivores, as well as, several small mammal and insect species, were the primary consumers linking the grassland resources to predators such as the wolf, mountain lion, and grizzly bear, as well as, smaller carnivores such as the coyote, bobcat, fox, and raptors. The prairie dog was once abundant; however, the species remains a keystone species within its range. The black-footed ferret, burrowing owl, ferruginous hawk, mountain plover, and swift fox were associated with prairie dog complexes. Historically, the northern mixed-grass prairie was a disturbance-driven ecosystem with fire, herbivory, and climate functioning as the primary disturbance factors either singly or in combination. Following European settlement, livestock grazing, cropland conversion, elimination of fire, energy development, and other anthropogenic factors influenced species composition and abundance. Introduced and invasive species further impacted plant and animal communities. The bison was a historical keystone species but have been extirpated as a free-ranging herbivore. The loss of the bison and reduction of prairie dog populations, and fire as ecological drivers greatly influenced the character of the remaining native plant communities, and altered wildlife habitats. Human development has reduced habitat quality for area-sensitive species.

Within MLRA 64, the Loamy 14-17” PZ ecological site provides upland grassland cover with an associated forb, shrub, and tree component. It was typically part of an expansive grassland landscape that included combinations of Badlands, Thin Breaks, Clayey, Claypan, Dense Clay, Loamy, Saline, Sandy, Shallow, Overflow, Subirrigated, and Terrace ecological sites. This site provided habitat for species that require unfragmented grassland. Important habitat features and components found commonly or exclusively on this site may include sharp-tailed grouse leks; upland nesting habitat for grassland birds, forbs and insects for brood habitat; and a forage source for small and large herbivores. Many grassland- and shrub steppe-nesting bird populations are declining. Species extirpated in MLRA 64 include free-ranging American bison, grizzly bear, gray wolf, black-footed ferret, mountain plover, Rocky Mountain locust, and swift fox.

The majority of the Loamy 14-17” PZ site remains intact and provides increasingly important habitat for grassland- and shrub steppe-nesting birds, small rodents, coyote, and a variety of reptiles, amphibians, and insects. Invasive species such as annual brome grasses, including cheatgrass and field brome, have impacted the biological integrity of the site for some grassland birds. Changes in historic fire regime and domestic grazing have impacted the forb/shrub/grass percentages.

Rhizomatous Wheatgrass-Needle and Thread Blue Grama Plant Community (1.1): The predominance of grasses in this vegetative state favors grazers and mixed-feeders, such as bison and antelope. Suitable thermal and escape cover for deer may be limited due to the low quantities of woody plants; however, topographical variations could provide some escape cover. Portions along woody vegetative states may provide brood-rearing and foraging areas for sage grouse, as well as lek sites. Other birds that would frequent this plant community include Western meadowlarks, horned larks, and golden eagles. Many grasslands obligate small mammals would occur here. Swift fox and a number of non-game grassland bird species will do better in some of the other plant communities on this site that have less height or density of the cool-season grasses.

Blue Grama-Rhizomatous Wheatgrass/Threadleaf Sedge Plant Community (1.2): Wildlife, such as shortgrass prairie bird species and swift fox would benefit from the reduced cover. Upland game bird habitat quality would decline. The diversity of this plant community is still high enough to support many of the species that would be present with the Rhizomatous Wheatgrass-Needle and Thread-Blue Grama Plant Community.

Blue Grama/Threadleaf Sedge Plant Community (2.1): This plant community provides limited foraging for antelope and other grazers. It may be used as a foraging site by sage grouse if proximal to woody cover and the Rhizomatous Wheatgrass-Needle and Thread-Blue Grama Plant Community. Generally, this plant community is not a target for wildlife habitat management. Wildlife, such as shortgrass prairie bird species and swift fox, would benefit from the reduced cover. Upland game bird habitat quality would decline.

Threeawn/Annuals Plant Community (3.1): Benefits to other wildlife are largely due to the subterranean structure

created by the prairie dogs. It may be a desirable plant community if the goal is to provide habitat for burrowing owls or black-footed ferrets, or if maintenance of the dog town is desired for sport shooting purposes. Many native grassland wildlife species are directly or indirectly reliant on prairie dog habitat. As a result, this type of habitat is very important from an ecosystem management basis.

Grazing Interpretations
The following list provides annual, suggested initial stocking rates with average growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of conservation planning. Often, the current plant composition does not entirely match any particular plant community (as described in this ES description). Because of this, a resource inventory is necessary to document plant composition and production. More accurate carrying capacity estimates should eventually be calculated using the following stocking rate information along with animal preference data and actual stocking records, particularly when grazers other than cattle are involved. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity.

The following initial suggested stocking rates are based on 912 lbs./acre (air-dry weight) per Animal-Unit-Month (AUM), with a 25 percent harvest efficiency of preferred and desirable forage species. An AUM is defined as the equivalent amount of forage required by a 1,000-pound cow with calf up to 6 months of age for one month (refer to USDA NRCS, National Range and Pasture Handbook).

Plant Community: Rhizomatous Wheatgrass-Needle and Thread-Blue Grama (1.1)
Average Production (lbs./acre, air-dry): 1,800
Stocking Rate (AUM/acre): 0.49

Plant Community: Blue Grama-Rhizomatous Wheatgrass/Threadleaf Sedge (1.2)
Average Production (lbs./acre, air-dry): 1,200
Stocking Rate (AUM/acre): 0.33

Plant Community: Blue Grama-Threadleaf Sedge (2.1)
Average Production (lbs./acre, air-dry): 600
Stocking Rate (AUM/acre): 0.16

*Plant Community: Threeawn/Annuals (3.1)
Average Production (lbs./acre, air-dry): 600
Stocking Rate (AUM/acre): Variable

Plant Community: Rhizomatous Wheatgrass-Needle and Thread-Non-Native Cool-Season Grasses (4.1)
Average Production (lbs./acre, air-dry): 1,800
Stocking Rate (AUM/acre): 0.49

Plant Community: Blue Grama-Rhizomatous Wheatgrass-Annual and/or Perennial Non-Native Cool-Season Grasses (4.2)
Average Production (lbs./acre, air-dry): 1,200
Stocking Rate (AUM/acre): 0.33

*Plant Community: (R) Rhizomatous Wheatgrass-Needle and Thread-Blue Grama-Buffalograss (5.1)
Average Production (lbs./acre, air-dry): Variable
Stocking Rate (AUM/acre): Variable

*Plant Community: (R) Blue Grama-Buffalograss/Threadleaf Sedge (5.2)
Average Production (lbs./acre, air-dry): Variable
Stocking Rate (AUM/acre): Variable

*Plant Community: All other plant communities identified in this document will have variable annual production values and will require on-site sampling to determine suggested initial stocking rates.

Total annual production on-site may contain vegetation deemed undesirable or untargeted by the grazing animal. Therefore, AUM values may have been reduced to reflect only preferred or desirable forage species.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage. During the dormant period, the forage for livestock will likely be lacking protein to meet livestock requirements, and added protein will allow ruminants to better utilize the energy stored in grazed plant materials. A forage quality test (either directly or through fecal sampling) should be used to determine the level of supplementation needed.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B, with localized areas in hydrologic group C. Infiltration and runoff potential for this site varies from moderate to high depending upon soil hydrologic group, slope, 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 and dominate the site. Dominance by blue grama, buffalograss, Kentucky bluegrass, and/or smooth brome will result in reduced infiltration and increased runoff. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (refer to Part 630, USDA, NRCS. National Engineering Handbook for hydrologic soil groups, runoff quantities, and hydrologic curves).

Recreational uses

This site provides hunting, hiking, photography, bird watching, and other opportunities. The wide variety 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

Seed harvest of native plant species can provide additional income on this site.

Other information

Revision Notes: “Previously Approved” Provisional
This Provisional ecological site concept has passed Quality Control (QC) and Quality Assurance (QA) to ensure that the site meets the 2014 NESH standards for a Provisional ecological site description. This is an updated “Previously Approved” ESD that represents a first-generation tier of documentation that, prior to the release of the 2014 National Ecological Site Handbook (NESH), met all requirements as an “Approved” ESD as laid out in the 1997 (rev.1, 2003) National Range and Pasture Handbook (NRPH). The document fully described the Reference State and Community Phase in the State-and-Transition model. All other alternative states are at least described in narrative form. The “Previously Approved” ESD has been field-tested for a minimum of five years and is a proven functional document for conservation planning. The “Previously Approved” ESD does not contain all tabular and narrative entries as required in the current “Approved” level of documentation, but it is expected that the “Previously Approved” ESD will continue refinement toward an “Approved” status.

Site Development and Testing Plan:
Future work, as described in a Project Plan, is necessary to validate the information in this Provisional Ecological Site Description. This will include field activities to collect low-, medium-, and high-intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. The final field review, peer review, quality control, and quality assurance reviews of the ESD will be required to produce the final document.

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Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel were also used. Those involved in developing this site include: Stan Boltz, Range Management Specialist, NRCS; Jill Epley, Range Management Specialist, NRCS; Rick Peterson, Range Management Specialist, NRCS; David Steffen, Range Management Specialist, NRCS; Jeff Vander Wilt; Range Management Specialist, NRCS; Phil Young, Soil Scientist, NRCS; and George Gamblin, Rangeland Management Specialist, NRCS.

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Approval

David Kraft, 1/23/2019

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ESD updated by Rick L. Peterson on 1/22/19
Editorial Review by Carla Green Adams

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.

Author(s)/participant(s)	Stan Boltz
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Date	03/31/2004
Approved by	Stan Boltz
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None.

2. **Presence of water flow patterns:** None, or barely visible and discontinuous.

3. **Number and height of erosional pedestals or terracettes:** None.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground typically less than 10 percent, and patches less than 2 inches in diameter.

5. **Number of gullies and erosion associated with gullies:** None should be present.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None.

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter should fall in place. Slight amount of movement of smallest size class litter is possible, but not normal.

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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 aggregate stability ratings are typically be 5 to 6, normally 6. Surface organic matter adheres to the soil surface. Soil surface fragments will typically retain structure indefinitely when dipped in distilled water.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A-horizon should be 5 to 10 inches thick with mollic (dark) colors when moist. Structure typically is medium to fine granular or subangular blocky parting to granular.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Combination of shallow and deep rooted species (mid & tall rhizomatous and tufted perennial cool-season grasses) with fine and coarse roots positively influences infiltration.

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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 – when dry, B horizons can be hard and appear to be compacted, but no platy structure will be present.

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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: Rhizomatous wheatgrasses (mid, cool-season) > mid and tall, cool-season bunchgrasses >>

    Sub-dominant: Short, warm-season grasses >

    Other: Grass-like species = forbs = shrubs

    Additional: Other grasses in other functional groups occur but in minor amounts.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very little evidence of decadence or mortality. Bunch grasses have strong, healthy centers and shrubs are vigorous.

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14. **Average percent litter cover (%) and depth (in):** Litter cover about 60 to 70 percent, with depths about 0.25 to 0.5 inch.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Total annual production ranges from 1,000 pounds/acre to 2,500 pounds/acre, with the reference value being 1,800 pounds/acre (air-dry basis).

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:** State and local noxious weeds; also Kentucky bluegrass and annual bromegrasses.

17. **Perennial plant reproductive capability:** All species exhibit high vigor relative to climatic conditions. Do not rate based solely on seed production. Perennial grasses should have vigorous rhizomes or tillers.