Ecological site R064XY014NE
Clayey 14-17" PZ

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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.

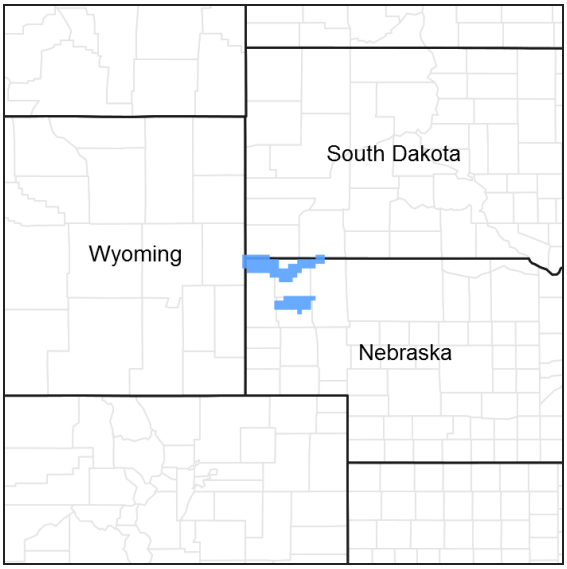

Figure 1. Mapped extent

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 Clayey 14-17” PZ ecological site occurs on the southern and western sides of the MLRA, south of the Pine Ridge Escarpment. It is located on upland landscapes and does not receive additional moisture from runoff or overflow. Typical slopes range from 0 to 30 percent. Soils are deep with surface textures 5 to 6 inches thick that range from silty clay loam to loamy. 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. Western and/or thickspike wheatgrass and green needlegrass are the dominant cool-season grasses, while sideoats grama and blue grama are the dominant warm-season grasses. Forbs are common and diverse. Shrubs include winterfat, saltbush, and rose. Wyoming big sagebrush may be found in minor amounts in the western portion of MLRA 64.

Associated sites

GX064X01X015	**Loamy 14-17" PZ** The Loamy 14-17” PZ site can be located adjacent to the Clayey 14-17” PZ site.

R064XY027NE	**Clayey Overflow** The Clayey Overflow site can be located on drainageways adjacent to the Clayey 14-17” PZ site.
R064XY039NE	**Shallow Clay** The Shallow Clay site is typically located up-slope of the Clayey 14-17” PZ site.
R064XY045NE	**Dense Clay** The Dense Clay site can be located adjacent to the Clayey 14-17” PZ site.

Similar sites

R064XY027NE	**Clayey Overflow** Clayey Overflow site will have more big bluestem and higher forage production.
GX064X01X015	**Loamy 14-17" PZ** The Loamy 14-17” PZ site will have less green needlegrass and more needle and thread.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Nassella viridula*

Physiographic features

This site occurs on nearly level to steep uplands and colluvial fans.

Table 2. Representative physiographic features

Landforms	(1) Fan (2) Plain (3) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	2,900–4,000 ft
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 this area's climate. 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)	16 in

Climate stations used

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

Influencing water features

No riparian areas or wetland features are directly associated with the Clayey 14-17” PZ ecological site.

Soil features

The soils in this site are well-drained and formed in alluvium, colluvium, and residuum derived primarily from shale and on slopes of 0 to 30 percent. The silty clay loam to loam surface layer is 5 to 6 inches thick. Subsoil textures in this site are silty clay loam to clay. The soils have a moderately slow to slow infiltration rate. When dry these soils crack. When wet surface compaction can occur with heavy traffic. This site typically 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 non-restrictive to water movement and root penetration.

Major soils correlated to the Clayey 14-17” PZ site include Bufton and Norrest.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about 5 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 location.

Table 4. Representative soil features

Surface texture	(1) Loam (2) Silty clay loam (3) Clay loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Slow to moderately slow
Soil depth	20–72 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	4–6 in
Calcium carbonate equivalent (0-40in)	0–30%

Electrical conductivity (0-40in)	0–4 mmhos/cm
Sodium adsorption ratio (0-40in)	0–10
Soil reaction (1:1 water) (0-40in)	6.6–9
Subsurface fragment volume <=3" (Depth not specified)	0–13%
Subsurface fragment volume >3" (Depth not specified)	0–6%

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/or 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/or 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 the Clayey 14-17” PZ ecological site to depart from the Rhizomatous Wheatgrass-Green Needlegrass Plant Community (1.1). Encroachment may occur from associated sites.

The plant community upon which interpretations are primarily based is the Reference 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.

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.

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

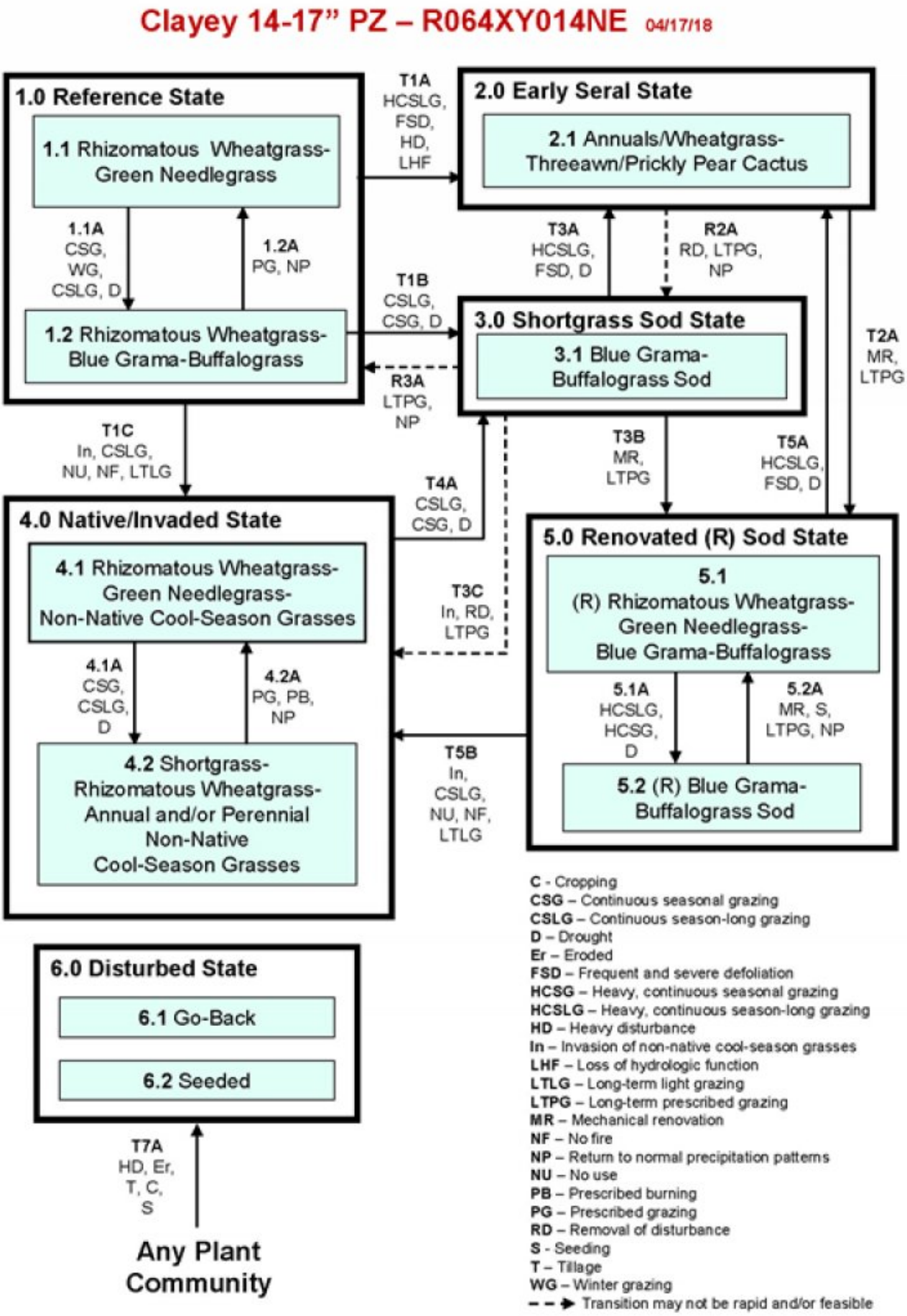

Figure 6. Clayey 14-17" PZ - R064XY014NE.

Diagram Legend - Clayey 14-17" PZ - R064XY014NE

T1A	Heavy, continuous season-long grazing without adequate recovery, or frequent and severe defoliation, heavy disturbance, or heavy grazing in combination with drought. Site has lost hydrologic function, with increased runoff and decreased infiltration.
T1B	Continuous season-long grazing or continuous seasonal grazing without adequate recovery, or heavy grazing in combination with drought.
T1C	Invasion of non-native cool-season grasses, continuous season-long grazing, or no use, no fire, or long-term light grazing.
T2A	Mechanical renovation to break up sod, followed by long-term prescribed grazing that includes proper stocking, change in season of use, and deferment which provides time for adequate recovery.
T3A	Heavy, continuous season-long grazing without adequate recovery, or frequent and severe defoliation, or heavy grazing in combination with drought.
T3B	Mechanical renovation to break up sod, followed by long-term prescribed grazing that included proper stocking, change in season of use, and deferment which provides time for adequate recovery.
T3C	Removal of grazing disturbance, and the invasion and establishment of non-native cool-season grasses. Long-term prescribed grazing that included proper stocking, change in season of use, and deferment which provides time for adequate recovery. Transition may not be fast or feasible.
T4A	Continuous season-long grazing or continuous seasonal grazing without adequate recovery, or heavy grazing in combination with drought.
T5A	Heavy, continuous season-long grazing without adequate recovery, or frequent and severe defoliation, or heavy grazing in combination with drought.
T5B	Invasion of non-native cool-season grasses, continuous season-long grazing, or no use, no fire, or long-term light grazing.
T7A	Heavy disturbance such as tillage, cropping, abandonment of cropland, long-term non-use, soil erosion, invasion of non-native weedy species, or seeding to perennial forage species.

R2A	Removal of disturbance, long-term prescribed grazing that includes proper stocking, change in season of use, deferment which provides time for adequate recovery, and a return to normal precipitation patterns. Transition may not be fast or feasible.
R3A	Long-term prescribed grazing with change is season of use, and time for adequate recovery, return to normal precipitation patterns. Transition may not be fast or feasible.

1.1A	1.1 - 1.2	Continuous seasonal grazing (spring), 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 may be a management option.
5.1A	5.1 - 5.2	Heavy, continuous season-long grazing; or heavy, 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 which provides time for adequate recovery, and a return to normal precipitation patterns. Interseeding may also be an optional accelerating practice.

State 1
Reference State

This 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) will be dominated by cool-season grasses and subdominant warm-season grass. Grazing and 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 (3.0). Invasion of non-native cool-season perennial or annual grasses will result in a transition to the Native/Invaded State (4.0).

Community 1.1
Rhizomatous Wheatgrass-Green Needlegrass

Interpretations are based primarily on the Rhizomatous Wheatgrass-Green Needlegrass Plant Community thick is considered to be the Reference Plant Community (1.1). This 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 or grass-like plants, 15 percent forbs, and 10 percent shrubs. Cool-season grasses dominate this plant community. The major grasses include western wheatgrass, thickspike wheatgrass, and green needlegrass. Other grasses occurring on the site include blue grama, buffalograss, sideoats grama, prairie Junegrass, and sedge. Significant forbs include scarlet globemallow, biscuitroot, deer vetch, wild parsley, American vetch, and milkvetch. The significant shrubs that occur include cactus, winterfat, rose, and fourwing saltbush. In the far western portion of MLRA 64, Wyoming big sagebrush can be found scattered across the site. 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). The diversity in plant species allows for high tolerance to drought. Moderate or high available water capacity provides a favorable soil-water-plant relationship. Overall the interpretive plant community has the appearance of being extremely stable, diverse, and productive. Litter normally falls in place, and does not occur in excess amounts. Most plant species have a wide range of age classes represented and reproduction is not limited. Plant roots occupy most of the soil profile, which provides for soil stability and promotes infiltration.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	730	1485	2015
Forb	85	180	300
Shrub/Vine	85	135	185
Total	**900**	**1800**	**2500**

Figure 8. 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
Rhizomatous Wheatgrass-Blue Grama-Buffalograss

This plant community develops under continuous seasonal grazing (i.e., grazing an area during the same season every year) or from over utilization during extended drought periods. The potential vegetation is made up of approximately 70 percent grasses and grass-like species, 15 percent forbs and 15 percent shrubs. The dominant grasses include blue grama, buffalograss, and western and/or thickspike wheatgrass. Other grasses may include green needlegrass, prairie Junegrass, and Sandberg bluegrass. Significant forbs include scarlet globemallow, wild parsley, biscuitroot, deer vetch, asters, and milkvetch. The significant shrubs that occur include cactus, broom snakeweed, and rose. Compared to the Rhizomatous Wheatgrass-Green Needlegrass Plant Community (1.1), the shortgrass species including blue grama and buffalograss have increased. The cool-season species including

western wheatgrass, thickspike wheatgrass, and green needlegrass have decreased in composition. Annual bromes, curlycup gumweed, sweetclover, and other annual grasses and forbs can invade the site. While plant diversity is relatively high, the structure of the community is dominated by shortgrasses. This plant community is resistant to change. The dominant herbaceous species are very adapted to grazing; however, the midgrass species and the more palatable forbs will decrease in the community through continuous seasonal grazing. If the herbaceous component is intact, it tends to be resilient if disturbance is not long-term. Because of the sod-forming habit of the dominant shortgrass species, water infiltration is low, and runoff is moderate to high. Typically the runoff is very clean because of the low potential for on-site soil erosion. However, off-site areas may be affected by increased runoff.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	550	1280	1600
Shrub/Vine	75	160	250
Forb	75	160	250
Total	**700**	**1600**	**2100**

Figure 10. Plant community growth curve (percent production by month). NE6402, Pine Ridge/Badlands, cool-season dominant, warm-season sub-dominant. Cool-season dominant, warm season, sub-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	10	25	30	15	5	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 below-normal precipitation and lead to the Rhizomatous Wheatgrass-Blue Grama- Buffalograss Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

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

Conservation practices

Prescribed Grazing

State 2
Early Seral State

The Early Seral State is dominated by weedy annuals, rhizomatous wheatgrass, threeawn, and pricklypear cactus. This State is the result of heavy disturbance such as frequent and severe defoliation, and/or heavy livestock concentrations coupled with grazing management that does not provide adequate recovery time for cool-season wheatgrasses and green needlegrass. The hydrologic function is also likely to be dramatically altered. Runoff is high and infiltration is low. This State is very resistant to change through grazing management alone.

Community 2.1
Annuals/Wheatgrass-Threeawn/Prickly Pear Cactus

This plant community develops under heavy, continuous season-long grazing and/or frequent and severe defoliation, and/or heavy disturbance such as livestock feeding areas. The potential plant community is made up of approximately 70 percent grasses and grass-like species, 25 percent forbs, and 5 percent shrubs. The dominant grasses include threeawn and annual brome grasses. Other grasses may include blue grama, buffalograss, sedges, western wheatgrass, thickspike wheatgrass, and sixweeks fescue. The dominant forbs include fringed sagewort, fetid marigold, western ragweed, pussytoes, prostrate verbena, and other annual invader-like species. Other plant species from adjacent ecological sites can become minor components of this plant community. This plant community is 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-Green Needlegrass Plant Community (1.1), red threeawn, annual brome grasses, and the percentage of bare ground has increased. Wheatgrasses, needlegrasses, and other cool-season grasses and grass-like species have decreased, as have the warm-season species including sideoats grama, blue grama, and buffalograss. Many annual and perennial forbs, including native and non-native species, have invaded the site. This plant community is resistant to change back to a higher successional plant community because of the loss of plant diversity and overall soil disturbance. It is very susceptible to invasion of non-native plant species. The potential for soil erosion is very high because of the bare ground and shallow-rooted herbaceous plant community. Water runoff will increase and infiltration will decrease due to animal-related soil compaction and loss of root mass due to low plant diversity and vigor. This plant community will require significant economic inputs and time to move toward another plant community. This movement is highly variable in its succession.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	305	472	605
Forb	65	140	240
Shrub/Vine	30	88	155
Total	**400**	**700**	**1000**

Figure 12. Plant community growth curve (percent production by month). NE6404, Pine Ridge/Badlands, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	8	15	24	23	15	5	5		

State 3
Shortgrass Sod State

The Shortgrass State is dominated by shortgrass species and upland sedges. This State is the result of grazing management that did not provide adequate recovery time for cool-season wheatgrasses and green needlegrass. The hydrologic function of this state is dramatically altered. Runoff is high and infiltration is low. This State is very resistant to change through grazing management alone.

Community 3.1
Blue Grama-Buffalograss Sod

This plant community develops under continuous season-long grazing, or with continuous seasonal grazing with concentrated use in the early part of the growing season (as in calving/lambing pastures). It is made up of approximately 90 percent grasses (primarily short, warm season grasses), 8 percent forbs, and 2 percent shrubs. The dominant grasses include blue grama and buffalograss. Other grasses may include western wheatgrass, prairie junegrass, threeawn, and annual brome. The dominant forbs include slimflower scurfpea, pussytoes, curlycup gumweed, and scarlet globemallow. The dominant shrub is cactus. Compared to the Rhizomatous Wheatgrass-Green Needlegrass Plant Community (1.1), short grasses have increased, and the cool-season mid-grasses have diminished greatly. Some forbs and cactus have either increased and/or invaded the site. Plant diversity is low. This plant community is very stable. Generally, this plant community will require significant management inputs (i.e., heavy animal impact, long term prescribed grazing, favorable climatic conditions, etc.), and time to move it towards

the Reference State (1.0). On-site soil erosion is low. Infiltration is low, and runoff is high. Typically the runoff is very clean because of the low potential for on-site soil erosion. However, off-site areas can be significantly impacted due to the increased runoff.

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	270	490	710
Shrub/Vine	65	105	145
Forb	65	105	145
Total	**400**	**700**	**1000**

Figure 14. Plant community growth curve (percent production by month). NE6404, Pine Ridge/Badlands, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	8	15	24	23	15	5	5		

State 4
Native/Invaded State

This State is dominated by rhizomatous wheatgrass, green needlegrass, and non-native cool-season annual and/or perennial grasses. The Native/Invaded State can resemble the Reference State (1.0) except that it is invaded by non-native cool-season grasses.

Community 4.1
Rhizomatous Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grasses

This plant community will look much like the Reference Plant Community (1.1), other than the non-native cool-season annual and/or perennial grasses that have invaded the plant community. Cheatgrass, field brome, smooth brome, or crested wheatgrass will make up to 15 percent (by air-dry weight) of the species composition. Cool-season midgrasses will make up approximately 85 percent of the plant community, warm-season shortgrasses account for approximately 10 percent, and forbs and shrubs are about 5 percent. The dominant grasses include rhizomatous wheatgrass, green needlegrass, annual bromegrass, blue grama, and buffalograss. Under long-term non-use, Kentucky bluegrass and/or smooth brome may become the dominant grass species. Forbs commonly found on this plant community include cudweed sagewort, scarlet globemallow, common yarrow, and scurfpea. Production in wet years may be very similar or slightly higher than the Reference Plant Community, but in dry years will be much lower. Under proper management, this plant community is stable. The soil erosion is low to moderate. Infiltration and runoff are moderate.

Table 9. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	730	1485	2015
Forb	85	180	300
Shrub/Vine	85	135	185
Total	**900**	**1800**	**2500**

Figure 16. 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
Shortgrasses-Rhizomatous Wheatgrasses-Annual and/or Perennial Non-Native Cool-Season Grasses

This plant community develops from the continuous seasonal or continuous season-long grazing 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, Kentucky bluegrass and/or smooth brome may invade. Forbs commonly found on this plant community include cudweed sagewort, scarlet globemallow, common yarrow, and scurfpea. 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 (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	550	1280	1600
Shrub/Vine	75	160	250
Forb	75	160	250
Total	**700**	**1600**	**2100**

Figure 18. 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, which allows for adequate plant recovery periods, and normal precipitation patterns following drought will move this plant community toward the Rhizomatous Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grasses Plant Community Phase (4.1). Prescribed burning may be a management option to help accelerate the change.

Conservation practices

Prescribed Grazing

State 5
Renovated (R) Sod State

The forage production potential of a shortgrass plant community can be quickly improved through mechanical renovation. Mechanical renovation creates microrelief that can restore hydrologic function by increasing infiltration and decreasing runoff. These factors favor cool- season species such as western wheatgrass, thickspike wheatgrass, green needlegrass, and a variety of forbs. Mechanical renovation may not be economically feasible, and the renovation will not be successful if the management activities that created the plant community are not changed. This State is also very susceptible to invasion of non-native cool-season grasses.

Community 5.1
(R) Rhizomatous Wheatgrass-Green Needlegrass-Blue Grama-Buffalograss

This plant community is an altered vegetation community achieved through mechanical renovation. Renovation creates microrelief that alters the water cycle by increasing infiltration and decreasing runoff. The renovation reduces the sod-bound conditions, increasing the vegetative production potential. These factors favor cool-season species such as western wheatgrass, thickspike wheatgrass, green needlegrass, and a variety of forbs. With proper management after renovation, this plant community will have similar plant composition and growth curve characteristics as the Reference Plant Community (1.1). Proper grazing management must be implemented to maintain this plant community.

Table 11. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	550	1280	1600
Shrub/Vine	75	160	250
Forb	75	160	250
Total	**700**	**1600**	**2100**

Figure 20. 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		

Community 5.2
(R) Blue Grama-Buffalograss Sod

This plant community will be similar to the Blue Grama-Buffalograss Sod Plant Community (3.1) 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.

Table 12. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	270	490	710
Shrub/Vine	65	105	145
Forb	65	105	145
Total	**400**	**700**	**1000**

Figure 22. Plant community growth curve (percent production by month). NE6404, Pine Ridge/Badlands, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	8	15	24	23	15	5	5		

Pathway 5.1A
Community 5.1 to 5.2

Heavy, continuous season-long grazing; or heavy, continuous seasonal grazing and drought will shift this plant community to the renovated (R) Blue Grama-Buffalograss Sod Plant Community (5.2). Proper grazing management must be included in order to derive any benefits of mechanical renovation.

Pathway 5.2A
Community 5.2 to 5.1

This plant community can be returned to the (R) Rhizomatous Wheatgrass-Green Needlegrass-Buffalograss-Blue Grama Plant Community Phase (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 difficult for vehicles and livestock.

Conservation practices

Grazing Land Mechanical Treatment

State 6
Disturbed State

Any plant community can transition to the Disturbed State (6.0). The two separate vegetative plant communities found in this State are highly variable in nature. They are derived through different management scenarios, and are not related successionally. Infiltration, runoff, and soil erosion vary depending upon the vegetation present on the site.

Community 6.1
Go-back Land

The Go-back plant community can be reached whenever severe mechanical disturbance occurs (e.g., tilled and abandoned cropland). 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 in this plant community can vary greatly, sometimes it is dominated by threeawn, dropseed, annual brome, crested wheatgrass, smooth brome, broom snakeweed, sweetclover, and non-native thistles. Other plants that commonly occur on the site can include western wheatgrass, deathcamas, prickly lettuce, mare’s tail, kochia, squirreltail, foxtail, and annual sunflower. Bare ground is prevalent due to the loss of organic matter and lower overall soil health.

Community 6.2
Seeded

The Seeded Plant Community normally includes those areas seeded to pubescent or intermediate wheatgrass, alfalfa, switchgrass, or other forage species. For adapted species, refer to the USDA-NRCS e-FOTG for the appropriate Forage Suitability Group description.

Transition T1A
State 1 to 2

Heavy, continuous season-long grazing, or 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 (2.0).

Transition T1B
State 1 to 3

With 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 (3.0). 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 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 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 3

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 (3.0). Periods of non-use or deferment may be a management option to facilitate this movement. This transition will not be rapid and/or meet management objectives.

Conservation practices

Prescribed Grazing

Transition T2A
State 2 to 5

Mechanical renovation will move this plant communities 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 1

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

Conservation practices

Prescribed Grazing

Transition T3A
State 3 to 2

Heavy, continuous season-long grazing without adequate recovery, or frequent and severe defoliation, or heavy grazing in combination with drought are conditions that will cause the community to transition. Examples include livestock concentration areas (feeding), prairie dog towns, small horse pastures, etc. These disturbances will cause a transition to the Early Seral State (2.0).

Transition T3C
State 3 to 4

Removal of management-induced disturbance, invasion of non-native cool-season grasses, and long-term prescribed grazing will cause a transition to the Native/Invaded State (4.0). This could require significant time and

input to achieve and a return to normal precipitation patterns, and in the end may not meet management objectives.

Transition T3B
State 3 to 5

Mechanical renovation will move this plant communities 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 seasonal grazing, 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 run-off 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 T5A
State 5 to 2

Heavy, continuous season-long grazing, or severe and frequent defoliation in combination with below-normal precipitation patterns will cause a transition to the Early Seral State (2.0).

Transition T5B
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 13. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrasses**			540–900	
	western wheatgrass	PASM	*Pascopyrum smithii*	540–900	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	90–360	–
2	**Cool-Season Mid Grasses**			450–720	

	green needlegrass	NAVI4	*Nassella viridula*	450–720	–
3	**Warm-Season Grasses**			36–180	
	sideoats grama	BOCU	*Bouteloua curtipendula*	90–270	–
	blue grama	BOGR2	*Bouteloua gracilis*	36–180	–
4	**Native Grasses and Grass-likes**			90–270	
	big bluestem	ANGE	*Andropogon gerardii*	0–90	–
	sedge	CAREX	*Carex*	0–90	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–90	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–90	–
	Grass, perennial	2GP	*Grass, perennial*	0–54	–
	threeawn	ARIST	*Aristida*	0–36	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–36	–
	dropseed	SPORO	*Sporobolus*	0–18	–
Forb					
6	**Forbs**			90–270	
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–36	–
	Forb, perennial	2FP	*Forb, perennial*	0–36	–
	dotted blazing star	LIPU	*Liatris punctata*	0–36	–
	beardtongue	PENST	*Penstemon*	0–36	–
	scurfpea	PSORA2	*Psoralidium*	0–36	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–36	–
	goldenrod	SOLID	*Solidago*	0–18	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–18	–
	desertparsley	LOMAT	*Lomatium*	0–18	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–18	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–18	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–18	–
	common yarrow	ACMI2	*Achillea millefolium*	0–18	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–18	–
	pussytoes	ANTEN	*Antennaria*	0–18	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–18	–
	aster	ASTER	*Aster*	0–18	–
	milkvetch	ASTRA	*Astragalus*	0–18	–
	false boneset	BREU	*Brickellia eupatorioides*	0–18	–
	thistle	CIRSI	*Cirsium*	0–18	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–18	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–18	–
	American vetch	VIAM	*Vicia americana*	0–18	–
	deathcamas	ZIGAD	*Zigadenus*	0–18	–
Shrub/Vine					
7	**Shrubs**			90–180	
	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–36	–
	big sagebrush	ARTR2	*Artemisia tridentata*	0–36	–

	fourwing saltbush	ATCA2	*Atriplex canescens*	0–36	–
	rose	ROSA5	*Rosa*	0–36	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–36	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–26	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–18	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–18	–
	pricklypear	OPUNT	*Opuntia*	0–18	–

Table 14. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrasses**			320–640	
	western wheatgrass	PASM	*Pascopyrum smithii*	320–640	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	80–240	–
2	**Cool-Season Mid Grasses**			160–320	
	green needlegrass	NAVI4	*Nassella viridula*	160–320	–
3	**Warm-Season Grasses**			240–480	
	blue grama	BOGR2	*Bouteloua gracilis*	160–320	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–80	–
4	**Native Grasses and Grass-likes**			80–400	
	sedge	CAREX	*Carex*	80–320	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–80	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–80	–
	dropseed	SPORO	*Sporobolus*	0–80	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–48	–
	Grass, perennial	2GP	*Grass, perennial*	0–48	–
	threeawn	ARIST	*Aristida*	0–32	–
	big bluestem	ANGE	*Andropogon gerardii*	0–16	–
Forb					
6	**Forbs**			80–240	
	scurfpea	PSORA2	*Psoralidium*	0–48	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–32	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–32	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–32	–
	pussytoes	ANTEN	*Antennaria*	0–32	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–32	–
	dotted blazing star	LIPU	*Liatris punctata*	0–32	–
	Forb, perennial	2FP	*Forb, perennial*	0–32	–
	beardtongue	PENST	*Penstemon*	0–32	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–16	–
	common yarrow	ACMI2	*Achillea millefolium*	0–16	–
	desertparsley	LOMAT	*Lomatium*	0–16	–
	American bird's-foot	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–16	–

	American bird's-foot trefoil	LOUNC	*Lotus unifoliolatus var. unifoliolatus*	0–16	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–16	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–16	–
	aster	ASTER	*Aster*	0–16	–
	milkvetch	ASTRA	*Astragalus*	0–16	–
	false boneset	BREU	*Brickellia eupatorioides*	0–16	–
	thistle	CIRSI	*Cirsium*	0–16	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–16	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–16	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–16	–
	American vetch	VIAM	*Vicia americana*	0–16	–
	deathcamas	ZIGAD	*Zigadenus*	0–16	–
	goldenrod	SOLID	*Solidago*	0–16	–
Shrub/Vine					
7	**Shrubs**			80–240	
	prairie sagewort	ARFR4	*Artemisia frigida*	0–48	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–48	–
	pricklypear	OPUNT	*Opuntia*	0–48	–
	rose	ROSA5	*Rosa*	0–48	–
	big sagebrush	ARTR2	*Artemisia tridentata*	0–36	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–36	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–32	–
	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–32	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–16	–

Table 15. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrasses**			35–105	
	western wheatgrass	PASM	*Pascopyrum smithii*	35–105	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–35	–
2	**Cool-Season Mid Grasses**			0–21	
	green needlegrass	NAVI4	*Nassella viridula*	0–21	–
3	**Warm-Season Grasses**			70–210	
	blue grama	BOGR2	*Bouteloua gracilis*	35–140	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–2	–
4	**Native Grasses and Grass-likes**			35–245	
	threeawn	ARIST	*Aristida*	35–140	–
	sedge	CAREX	*Carex*	14–70	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–35	–
	Grass, perennial	2GP	*Grass, perennial*	0–35	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–30	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–21	–

	prairie junegrass	KOMA	*Koeleria macrantha*	0–21	
	dropseed	SPORO	*Sporobolus*	0–21	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–14	–
5	**Non-Native Grasses**			35–105	
	field brome	BRAR5	*Bromus arvensis*	14–90	–
	cheatgrass	BRTE	*Bromus tectorum*	35–90	–
Forb					
6	**Forbs**			70–210	
	sweetclover	MELIL	*Melilotus*	0–70	–
	Forb, annual	2FA	*Forb, annual*	0–70	–
	fetid marigold	DYPA	*Dyssodia papposa*	14–70	–
	mustard	BRASS2	*Brassica*	0–56	–
	Forb, perennial	2FP	*Forb, perennial*	0–35	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	7–35	–
	pussytoes	ANTEN	*Antennaria*	0–35	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–35	–
	bigbract verbena	VEBR	*Verbena bracteata*	14–35	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–21	–
	common yarrow	ACMI2	*Achillea millefolium*	0–14	–
	aster	ASTER	*Aster*	0–14	–
	deathcamas	ZIGAD	*Zigadenus*	0–7	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–7	–
	beardtongue	PENST	*Penstemon*	0–7	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–7	–
	thistle	CIRSI	*Cirsium*	0–7	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–7	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–7	–
	goldenrod	SOLID	*Solidago*	0–7	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–7	–
	dotted blazing star	LIPU	*Liatris punctata*	0–7	–
	desertparsley	LOMAT	*Lomatium*	0–7	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–7	–
Shrub/Vine					
7	**Shrubs**			35–140	
	prairie sagewort	ARFR4	*Artemisia frigida*	14–105	–
	pricklypear	OPUNT	*Opuntia*	7–105	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	7–70	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–21	–
	rose	ROSA5	*Rosa*	0–7	–
	big sagebrush	ARTR2	*Artemisia tridentata*	0–7	–

Table 16. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grassl					

Grass/Grasslike					
1	**Rhizomatous Wheatgrasses**			35–105	
	western wheatgrass	PASM	*Pascopyrum smithii*	35–105	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	7–35	–
2	**Cool-Season Mid Grasses**			0–35	
	green needlegrass	NAVI4	*Nassella viridula*	0–35	–
3	**Warm-Season Grasses**			140–420	
	blue grama	BOGR2	*Bouteloua gracilis*	105–350	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–14	–
4	**Native Grasses and Grass-likes**			70–210	
	threeawn	ARIST	*Aristida*	7–105	–
	sedge	CAREX	*Carex*	35–105	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–70	–
	dropseed	SPORO	*Sporobolus*	7–70	–
	Grass, perennial	2GP	*Grass, perennial*	0–21	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–14	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–14	–
5	**Non-Native Grasses**			35–175	
	field brome	BRAR5	*Bromus arvensis*	35–175	–
	cheatgrass	BRTE	*Bromus tectorum*	35–175	–
Forb					
6	**Forbs**			70–140	
	scurfpea	PSORA2	*Psoralidium*	0–70	–
	pussytoes	ANTEN	*Antennaria*	0–35	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–35	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–35	–
	Forb, perennial	2FP	*Forb, perennial*	0–14	–
	common yarrow	ACMI2	*Achillea millefolium*	0–7	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–7	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–7	–
	goldenrod	SOLID	*Solidago*	0–7	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–7	–
	aster	ASTER	*Aster*	0–7	–
	false boneset	BREU	*Brickellia eupatorioides*	0–7	–
	thistle	CIRSI	*Cirsium*	0–7	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–7	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–7	–
	dotted blazing star	LIPU	*Liatris punctata*	0–7	–
	desertparsley	LOMAT	*Lomatium*	0–7	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–7	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–7	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–7	–
	beardtongue	PENST	*Penstemon*	0–7	–

	woolly plantain	PLPA2	*Plantago patagonica*	0–7	–
	American vetch	VIAM	*Vicia americana*	0–7	–
	deathcamas	ZIGAD	*Zigadenus*	0–7	–
Shrub/Vine					
7	**Shrubs**			70–140	
	prairie sagewort	ARFR4	*Artemisia frigida*	21–70	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	14–56	–
	pricklypear	OPUNT	*Opuntia*	14–56	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–26	–
	big sagebrush	ARTR2	*Artemisia tridentata*	0–20	–
	rose	ROSA5	*Rosa*	0–14	–

Table 17. Community 5.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrasses**			320–640	
	western wheatgrass	PASM	*Pascopyrum smithii*	320–640	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	80–240	–
2	**Cool-Season Mid Grasses**			160–320	
	green needlegrass	NAVI4	*Nassella viridula*	160–320	–
3	**Warm-Season Grasses**			240–480	
	blue grama	BOGR2	*Bouteloua gracilis*	160–320	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–80	–
4	**Native Grasses and Grass-likes**			80–400	
	sedge	CAREX	*Carex*	80–320	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–80	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–80	–
	dropseed	SPORO	*Sporobolus*	0–80	–
	Grass, perennial	2GP	*Grass, perennial*	0–48	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–32	–
	threeawn	ARIST	*Aristida*	0–32	–
	big bluestem	ANGE	*Andropogon gerardii*	0–16	–
5	**Non-Native Grasses**			30–140	
	field brome	BRAR5	*Bromus arvensis*	10–80	–
	cheatgrass	BRTE	*Bromus tectorum*	10–80	–
Forb					
6	**Forbs**			80–240	
	scurfpea	PSORA2	*Psoralidium*	0–48	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–32	–
	beardtongue	PENST	*Penstemon*	0–32	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–32	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–32	–
	pussytoes	ANTEN	*Antennaria*	0–32	

	pussytoes	ANTEN	*Antennaria*	0–32	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–32	–
	Forb, perennial	2FP	*Forb, perennial*	0–32	–
	dotted blazing star	LIPU	*Liatris punctata*	0–32	–
	desertparsley	LOMAT	*Lomatium*	0–16	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–16	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–16	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–16	–
	common yarrow	ACMI2	*Achillea millefolium*	0–16	–
	aster	ASTER	*Aster*	0–16	–
	false boneset	BREU	*Brickellia eupatorioides*	0–16	–
	thistle	CIRSI	*Cirsium*	0–16	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–16	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–16	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–16	–
	American vetch	VIAM	*Vicia americana*	0–16	–
	deathcamas	ZIGAD	*Zigadenus*	0–16	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–16	–
	goldenrod	SOLID	*Solidago*	0–16	–
Shrub/Vine					
7	**Shrubs**			80–240	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–48	–
	pricklypear	OPUNT	*Opuntia*	0–48	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–48	–
	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–32	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–20	–
	rose	ROSA5	*Rosa*	0–15	–
	big sagebrush	ARTR2	*Artemisia tridentata*	0–15	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–15	–

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 Clayey 14-17” PZ Ecological Site (ES) 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 requiring unfragmented grassland. Important habitat features and components found commonly or exclusively on the Clayey 14-17” PZ 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. Extirpated species 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 Clayey ecological 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 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-Green Needlegrass (1.1): The predominance of grasses plus high diversity of forbs and shrubs in this community favors grazers and mixed-feeders, such as deer and pronghorn. Insects, such as pollinators, play a large role in maintaining the forb community and provide a forage base for grassland birds and other species. The complex plant structural diversity provides habitat for a wide array of migratory and resident birds. Grasshopper sparrow, savannah sparrow, lark bunting, western meadowlark, and sharp-tailed grouse are common and benefit from the structure and composition this plant community provides. This site provides important breeding habitat for the loggerhead shrike. This site provides excellent nesting and brood rearing habitat for sharp-tailed grouse. Diverse prey populations are available for grassland raptors such as ferruginous hawk, Swainson’s hawk, golden eagle, and prairie falcon.

The diversity of grasses, forbs, and shrubs provide high nutrition levels for small and large herbivores including voles, mice, least chipmunk, spotted ground squirrel, desert cottontail rabbit, white-tailed and black-tailed jackrabbit, and deer. This ecological site provides excellent wintering habitat for pronghorn. The moderate stature of this plant community provides suitable thermal, protective, and escape cover for small herbivores and grassland birds. Predators utilizing this plant community include coyote, American badger, red fox, and long-tailed weasel. This plant community provides habitat for spade foot toad and Great Plains toads. Prey abundance and shade opportunities may attract multiple reptile species such as gopher snake, milk snake, prairie rattlesnake, and short-horned lizard to this site along with a lesser numbers of various other lizard species.

Rhizomatous Wheatgrass-Blue Grama-Buffalograss (1.2): Resulting from continuous seasonal grazing or from over-utilization during extended drought periods, blue grama and buffalograss will become dominant. The forb and shrub diversity and abundance increase. Density of species such as sharp-tail grouse and desert cottontail should remain unchanged. However, the shift to shorter plant structure will favor prairie dog expansion and associate species such as ferruginous hawk, burrowing owl, tiger salamander, and swift fox. Species such as the horned lark, long-billed curlew, upland sandpiper, and white-tailed and black-tailed jackrabbit will increase. This plant community may provide areas suitable for sharp-tailed grouse lek site development. The short stature of this plant community limits thermal, protective, and escape cover. Predators utilizing this plant community include the coyote, American badger, red fox, and long-tailed weasel.

Blue Grama-Buffalograss Sod (3.1): This plant community develops under heavy, continuous season-long grazing and with continuous seasonal grazing with concentrated use in the spring. Forb diversity and abundance and shrub abundance increases while shrub diversity declines. A shift to a short plant structure will favor prairie dog expansion with prairie dog town sites and associated species such as ferruginous hawk, burrowing owl, tiger salamander, and swift fox. Species such as the horned lark, long-billed curlew, upland sandpiper, and white- and black-tailed jackrabbit will increase. This plant community may provide areas suitable for sharp-tailed grouse lek site development. The short stature of this plant community limits thermal, protective, and escape cover. Predators utilizing this plant community include the coyote, American badger, red fox, and long-tailed weasel. Species such as the desert cottontail will rarely use this site.

Extreme impairment of the ecological processes impacts offsite aquatic habitats through excessive runoff and nutrient loads. Elevated surface temperatures resulting from reduced cover and litter will greatly reduce habitat for most amphibian species, grassland birds, and mammals.

Renovated (R) Sod State (5.0): See the wildlife interpretations for Plant Community Phases (PCP) 1.1 and 1.2. Go-back and Seeded PCP
This group includes separate vegetation states that are highly variable in nature. They are derived through distinct management scenarios.
These plant communities have been or are highly susceptible to invasion of annual brome grasses, bluegrasses, crested wheatgrass, and other non-native species.
Since secondary succession is highly variable, plant and wildlife species will vary. This plant community provides habitat for generalist or early successional species. In addition, these communities may contain prairie dog towns.

The Go-back PCP can be reached whenever severe mechanical disturbance (i.e., abandoned farmland) is eliminated. Early successional plant communities include annual and perennial weedy type species first to occupy the site. These sites provide diverse foraging, reproductive, and escape cover favoring multiple edge species. This pioneer plant community provides abundant opportunity for insect, bird, and small mammal foraging due to abundant flowers and seed sources.

The Seeded PCP provides increased forage and therefore a potential for increased herbivore populations such as deer, pronghorn, and various small mammals. These sites provide diverse foraging, reproductive, and escape cover favoring multiple edge species.

Grazing Interpretations:
The following table lists 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 ESD). 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 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 (refer to USDA NRCS, National Range and Pasture Handbook). 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.

Plant Community: Rhizomatous Wheatgrass-Green Needlegrass (1.1)
Average Production (lbs./acre, air-dry): 1,800
Stocking Rate (AUM/acre): 0.49

Plant Community: Rhizomatous Wheatgrass-Blue Grama-Buffalograss (1.2)
Average Production (lbs./acre, air-dry): 1,600
Stocking Rate (AUM/acre): 0.44

*Plant Community: Annuals/Wheatgrass-Threeawn/Prickly Pear (2.1)
Average Production (lbs./acre, air-dry): Variable
Stocking Rate (AUM/acre): Variable

Plant Community: Blue Grama-Buffalograss Sod (3.1)
Average Production (lbs./acre, air-dry): 700
Stocking Rate (AUM/acre): 0.19

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

Plant Community: Shortgrasses-Rhizomatous Wheatgrass-Annual and/or Perennial Non-Native Cool-Season Grasses (4.2)
Average Production (lbs./acre, air-dry): 1,600
Stocking Rate (AUM/acre): 0.44

Plant Community: (R) Rhizomatous Wheatgrass-Green Needlegrass-Blue Grama-Buffalograss (5.1)
Average Production (lbs./acre, air-dry): 1,600
Stocking Rate (AUM/acre): 0.44

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

* Total annual production and stocking rates are highly variable and will require on-site sampling.

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. The Clayey 14-17” PZ site is dominated by soils in hydrologic group C. Infiltration varies from very low to moderate, and runoff potential varies from moderate to very 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 high runoff when shortgrasses form a strong sod and dominate the site. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (Refer to the USDA-NRCS National Engineering Handbook for hydrologic soil groups, runoff quantities, and hydrologic curves, Part 630.).

Recreational uses

This site provides hunting, hiking, photography, bird watching, and other 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

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.

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; and Phil Young, Soil Scientist, NRCS.

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David Kraft, 2/05/2019

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ESD updated by Rick L. Peterson on 4/17/18.
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.

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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.

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

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.

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.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A-horizon should be 4 to 8 inches thick with mollic (dark) colors when moist. Structure typically is medium to fine granular or subangular blocky parting to granular.

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.

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.

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: Forbs > short, warm-season grasses >

Other: Grass-like species = 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.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Total annual production ranges from 900 pounds/acre to 2,500 pounds/acre, with the reference value being 1,800 pounds/acre (air-dry basis).

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

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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.
