

Ecological site R064XY044NE **Claypan**

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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.

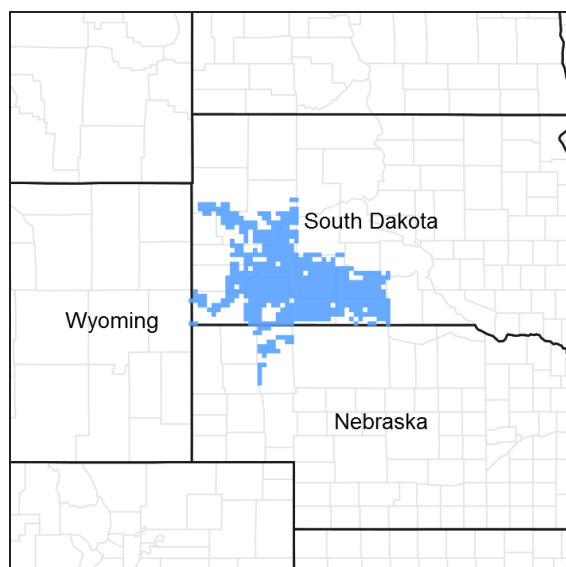


Figure 1. Mapped extent

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 shared almost equally between South Dakota (42 percent) and Nebraska (41 percent). A small portion is in Wyoming (17 percent). The MLRA consists of 11,895 square miles. The towns of Kadoka and Pine Ridge, South Dakota; Chadron and Alliance, Nebraska; and Lusk, Wyoming, are all within the boundaries of this MLRA.

The following areas of special interest are in this MLRA: Agate Fossil Beds National Monument, Chadron State Park, Fort Robinson State Park, and the Pine Ridge Indian Reservation; parts of the Oglala and Buffalo Gap National Grasslands, which are in the Nebraska National Forest; and nearly all of Badlands National Park. The Badlands are internationally renowned for their Oligocene vertebrate fossils.

The northern section of the MLRA consists 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 to 5,073 feet from east to west. The main drainageway through Badlands National Park is the White River. The headwaters of both the White and Niobrara Rivers are in MLRA 64. The Pine Ridge escarpment is 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. They are loamy or sandy. The Badlands consist of stream-laid layers of silt, clay, and sand mixed with layers of volcanic ash.

Average annual precipitation for the area is 14 to 20 inches. Most of the rainfall occurs as frontal storms in the spring and early summer. 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 grows 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 Ogala 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 4 percent is forested. Major resource concerns include wind erosion, 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 per year and 17 to 20 inches per year. The wetter 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 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).

A unique geologic area known as the Hartville Uplift is in the far southwest corner of the 14 to 17 inch precipitation zone. The Hartville Uplift is an elongated, north-northwest-oriented, broad domal arch of Laramide age (70-50 million years ago). 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 in the 14 to 17 inch precipitation zone of MLRA 64, three unique ecological site descriptions were developed to describe the soils and plant community dynamics 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

U.S. 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.
Sandy and Silty Tablelands—25g.
Northwestern Great Plains—43:
White River Badlands—43h.
Keya Paha Tablelands—43i.

USDA Forest Service
Ecological Subregions: Sections and Subsections of Conterminous United States:
Great Plains and Palouse Dry Steppe Province—331:
Western Great Plains Section—331F:
Subsections:
Shale Scablands—331Fb.
White River Badlands—331Fh.
Pine Ridge Escarpment—331Fj.
High Plains—331Fk.
Hartville Uplift—331Fm.
Western Nebraska Sandy and Silty Tablelands—331Fn.
Keya Paha Tablelands—331Ft.

Ecological site concept

The Claypan sites occurs throughout MLRA 64. It is located on gently undulating to rolling sedimentary uplands with slopes ranging from 0 to 6 percent. Soil are formed from soft siltstone, shales, and alluvium. The soil surface texture is loam to silt loam, 4 to 10 inches thick, and the subsurface textures range from silt loam to clay. The Btn horizon creates a claypan of extremely hard sodium-affected clay (natric), which occurs between 5 and 16 inches of the surface. This root-restricting layer has round-topped or “biscuit-shaped” columnar structure.

Vegetation in the Reference State (1.0) consists primarily of cool-season rhizomatous wheatgrasses and needlegrasses and warm-season shortgrasses. Prickly pear cactus is typically present in the plant community but in minor amounts. Wyoming big sagebrush can occur on this site, primarily in the western portion of the MLRA.

Associated sites

GX064X01X036	Loamy 17-20" PZ The Loamy 17-20" PZ ecological site can be found adjacent to the Claypan ecological site.
R064XY046NE	Thin Claypan The Thin Claypan ecological site can be found adjacent to or intermixed with the Claypan ecological site.
R064XY014NE	Clayey 14-17" PZ The Clayey 14-17" PZ ecological site can be found adjacent to the Claypan ecological site.
GX064X01X015	Loamy 14-17" PZ The Loamy 14-17" PZ ecological site can be found adjacent to the Claypan ecological site.
R064XY030NE	Saline Lowland On lower landscape positions the Saline Lowland ecological site can be found adjacent to or intermixed with the Claypan ecological site.
R064XY035NE	Clayey 17-20 PZ The Clayey 17-20" PZ ecological site can be found adjacent to the Claypan ecological site.

Similar sites

R064XY014NE	Clayey 14-17" PZ The Clayey 14-17" PZ ecological site will have more green needlegrass and higher forage production than the Claypan ecological site. The Clayey 14- 17" PZ site will not have the claypan soil feature in the soil profile.
R064XY035NE	Clayey 17-20 PZ The Clayey 17-20" PZ ecological site will have more green needlegrass and higher forage production than the Claypan ecological site. The Clayey 17- 20" PZ site will not have the claypan soil feature in the soil profile.
R064XY046NE	Thin Claypan The Thin Claypan ecological site will have more shortgrasses and salt-tolerant species and lower forage production than the Claypan ecological site. The claypan soil feature will occur within 4 inches of the surface in the Thin Claypan site and between 5 and 16 inches in the Claypan site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) <i>Pascopyrum smithii</i> (2) <i>Nassella viridula</i>

Physiographic features

The Claypan ecological site occurs on nearly level or gently sloping upland fans and flats. In some cases, it also

occurs on flood plains, terraces along drainageways and on foot slopes on uplands. This site receives runoff from adjacent sites.

Table 2. Representative physiographic features

Landforms	(1) Alluvial flat (2) Alluvial fan (3) Flood plain
Runoff class	High to very high
Flooding frequency	None to rare
Ponding frequency	None
Elevation	2,900–4,000 ft
Slope	0–6%
Water table depth	36–80 in
Aspect	Aspect is not a significant factor

Climatic features

MLRA 64 has a continental climate consisting of cold winters and hot summers, low humidity, light rainfall, and ample sunshine. Extremes in temperature are common in some years. The climate results from MLRA 64 being near the geographic center of North America. There are few natural barriers on the Northern Great Plains. Air masses move freely across the plains and account for rapid changes in temperature.

Average annual precipitation ranges from 14 to 20 inches per year. The normal average annual temperature is about 47 °F. January is the coldest month with average temperatures ranging from about 21 °F (Wood, SD) to about 25 °F (Hemingford, NE). July is the warmest month with average temperatures ranging from about 70 °F (Keeline 3 W, WY: 1953–1986) to about 76 °F (Wood, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 55 °F. This large annual range attests to the continental nature of the climate of this area. Wind speeds 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 winds. Occasionally, strong storms 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. Cool-season plants may green-up in September and October if adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (characteristic range)	89-119 days
Freeze-free period (characteristic range)	115-138 days
Precipitation total (characteristic range)	15-19 in
Frost-free period (actual range)	68-122 days
Freeze-free period (actual range)	96-148 days
Precipitation total (actual range)	15-20 in
Frost-free period (average)	102 days
Freeze-free period (average)	126 days
Precipitation total (average)	17 in

Climate stations used

- (1) AGATE 3 E [USC00250030], Harrison, NE
- (2) HARRISON [USC00253615], Harrison, NE
- (3) HEMINGFORD [USC00253755], Hemingford, NE
- (4) INTERIOR 3 NE [USC00394184], Interior, SD
- (5) MARTIN [USC00395281], Martin, SD
- (6) ALLIANCE 1WNW [USC00250130], Alliance, NE
- (7) CHADRON MUNI AP [USW00024017], Chadron, NE
- (8) WOOD [USC00399442], Wood, SD
- (9) LUSK 2 SW [USC00485830], Lusk, WY
- (10) TORRINGTON 29N [USC00488997], Jay Em, WY

Influencing water features

No riparian areas or wetland features are directly associated with this site.

Wetland description

Not Applicable.

Soil features

The features common to soils in this site is the silt loam surface texture, which changes abruptly at about 6 to 11 inches below the surface, to an extremely hard clayey Bt horizon having round-topped or “bun shaped” columnar or prismatic structured subsoil. These subsoils are high in sodium. Saturated hydraulic conductivity is very slow, available water capacity is moderate and permeability is very slow. Slopes range from 0 to 6 percent. The soils on this site are moderately deep to deep, somewhat poorly to well drained and were formed in residuum from siltstone or in silty and clayey alluvium. The surface layer is 4 to 10 inches thick. The texture of the subsoil ranges from loam to clay. The soils have a slow to very slow infiltration rate.

Major soils correlated to the Claypan ecological site, Beckton, Cedar Butte, Mosher, Weta, and Wortman.

This site should show slight to no evidence of rills, or wind-scoured areas, but can exhibit moderate pedestalling of plants. Water flow paths are sometimes apparent and somewhat continuous. The soil surface is stable and intact. Sub-surface soil layers are restrictive to water movement and root penetration.

More information regarding the soil is available in soil survey reports. Contact the local USDA Service Center for details specific to your area of interest, or go online to access USDA's Web Soil Survey.

Table 4. Representative soil features

Parent material	(1) Alluvium—shale and siltstone (2) Residuum—clayey shale
Surface texture	(1) Silt loam
Family particle size	(1) Clayey
Drainage class	Somewhat poorly drained to well drained
Permeability class	Very slow
Depth to restrictive layer	6–11 in
Soil depth	20–80 in
Available water capacity (0-40in)	5–6 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–16 mmhos/cm

Sodium adsorption ratio (0-40in)	0–20
Soil reaction (1:1 water) (0-40in)	5.6–9
Subsurface fragment volume <=3" (Depth not specified)	0–5%

Ecological dynamics

The Claypan ecological 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 and site development. Changes occur in the plant communities due to short-term weather variations, effects of native and exotic plant and animal species, and management actions. Although the following plant community descriptions are typical of the transitions between communities, 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-Needlegrass-Blue Grama Plant Community (1.1). Blue grama and buffalograss will increase and may eventually dominate the plant community. Western wheatgrass, thickspike wheatgrass, green needlegrass and needle and thread will decrease in frequency and production. Excessive defoliation can cause threeawns and annuals to increase and dominate the site. This site is also susceptible to the invasion of non-native cool-season grasses. In the drier 14-17 inch precipitation zone, cheatgrass and field brome are most likely to invade, where as in the wetter 17-20 inch precipitation zone annual and perennial non-native cool-season grasses are likely to invade.

Interpretations are primarily based on the Rhizomatous Wheatgrass-Needlegrass-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 state-and-transition diagram illustrates the common plant communities on the site and the transition pathways between communities. The ecological processes are discussed in more detail in the plant community descriptions following the diagram.

State and transition model

Claypan – R064XY044NE 5/30/18

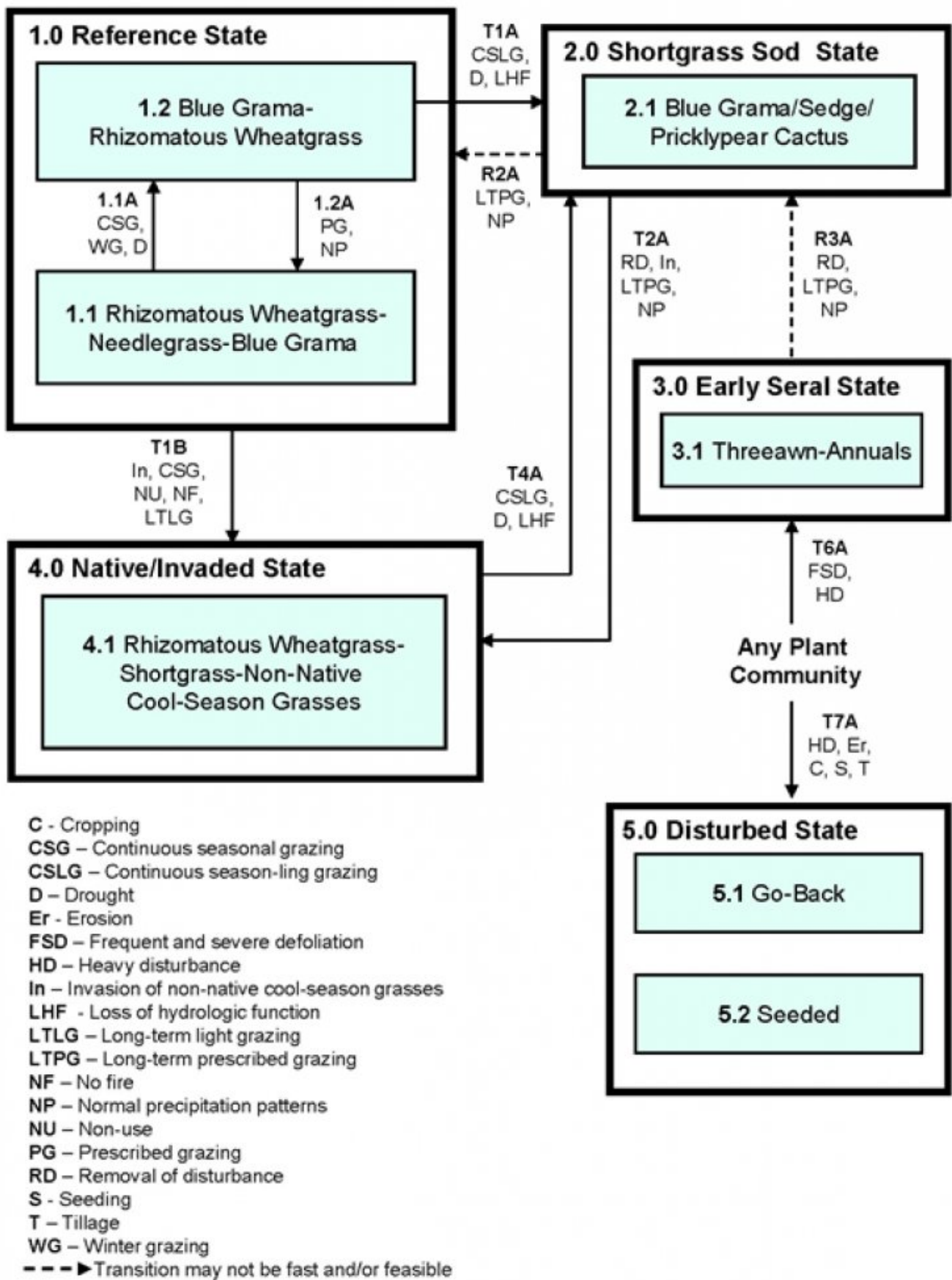


Figure 8. Claypan - R064XY044NE.

Diagram Legend - Claypan - R064XAY044NE

T1A	Continuous season-long grazing, without adequate time for recovery, or heavy grazing in combination with drought. Loss of hydrologic function resulting in increased runoff and decreased infiltration.	
T1B	Invasion of non-native cool-season grasses, continuous seasonal grazing, no use, no fire, or long-term light grazing.	
T2A	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. A return to normal precipitation patterns following drought. Transition may not be fast or feasible.	
T4A	Continuous season-long grazing without adequate recovery, or heavy grazing in combination with drought. Loss of hydrologic function resulting in increased runoff and decreased infiltration.	
T6A	Frequent and severe defoliation and/or heavy disturbance.	
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	Long-term prescribed grazing with change in season of use, adequate recovery time, and a return to normal precipitation pattern following drought. Recovery may not be fast and/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.	
CP 1.1A	1.1 - 1.2	Continuous seasonal grazing without adequate recovery, late winter grazing, or heavy grazing in combination with drought.
CP 1.2A	1.2 - 1.1	Prescribed grazing including change in season of use, proper stocking, adequate time for rest and recovery, a return to normal precipitation patterns following drought.

State 1

Reference State

The Reference State represents the best estimate of the natural range of variability that dominated the dynamics in this ecological site prior to European settlement. This site, in the Reference State, is dominated by a mix of cool-season rhizomatous wheatgrasses and needlegrasses, and warm-season shortgrasses. Heavy grazing will cause the plant community to transition to a community dominated by warm-season shortgrasses, and cool-season rhizomatous wheatgrasses. Erosion of the surface horizon is a potential outcome with heavy grazing. In pre-European times the primary disturbances included grazing by large ungulates and small mammals, and drought. Favorable growing conditions occurred during the spring and warm months of June through August. Today a similar state can be found in areas where proper livestock use has occurred.

Community 1.1

Rhizomatous Wheatgrass-Needlegrass-Blue Grama

Interpretations are based primarily on the Rhizomatous Wheatgrass-Needlegrass-Blue Grama Plant Community which is also considered to be Reference Plant Community (1.1). This plant community evolved with grazing by large herbivores and occasional prairie fires. This plant community can be found on areas having a history of proper grazing management, including adequate recovery periods between grazing events. The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs and 5 percent shrubs. Cool-season grasses dominate the community. The co-dominant grasses are western wheatgrass, thickspike wheatgrass, and green needlegrass. Other grasses and grass-like plants occurring include blue grama, needle and thread, buffalograss, dropseed, inland saltgrass, and sedges. Significant forbs include cudweed sagewort, biscuitroot, wild parsley,

scarlet globemallow, and scurfpea. Shrubs present on this plant community include fringed sagewort, silver sagebrush, rubber rabbitbrush, plains pricklypear, and brittle cactus. In the far western portion of MLRA 64, Wyoming big sagebrush can occur on this site in 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). The diversity in plant species allows for high drought tolerance. This is a fragile, but sustainable plant community. Low to moderate available water holding capacity coupled with high accumulations of sodium and slow permeability strongly influences the soil-water-plant relationships.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1110	1432	1750
Forb	75	120	165
Shrub/Vine	15	48	85
Total	1200	1600	2000

Figure 10. 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

This plant community develops under continuous seasonal grazing (i.e., grazing an area during the same season every year) or from overutilization during extended drought periods. The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs and 5 percent shrubs. A fairly even mix of cool-season grasses and short warm-season grasses dominate this plant community. Blue grama and western wheatgrass are the dominant grasses. Other grasses and grass-like plants occurring include green needlegrass, needle and thread, buffalograss, prairie Junegrass, threadleaf sedge, dropseed, Sandberg bluegrass, and inland saltgrass. Significant forbs include silverleaf scurfpea, cudweed sagewort, western yarrow, and heath aster. Shrubs include fringed sagewort, rubber rabbitbrush, broom snakeweed, and cactus. This plant community is somewhat resistant to change. The dominant herbaceous species are very adapted to grazing; however, the mid-grass 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 shortgrass species, water infiltration decreases and runoff increases when compared to the Reference Plant Community.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	925	1218	1510
Forb	65	140	215
Shrub/Vine	10	42	75
Total	1000	1400	1800

Figure 12. 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		

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 heavy grazing in combination with drought will lead to the Blue Grama-Rhizomatous Wheatgrass 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-Needlegrass-Blue Grama Plant Community (1.1). Periods of non-use or deferment may be a management option to reach the Plant Community Phase (1.1).

Conservation practices

Prescribed Grazing

State 2
Shortgrass Sod State

The Shortgrass Sod State is dominated by shortgrass species; blue grama, buffalograss, upland sedges, and pricklypear cactus. This state is the result of grazing patterns that did not provide adequate recovery time for cool-season wheatgrasses 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 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 2.1
Blue Grama/Sedge/Prickly Pear Cactus

This plant community results from heavy, continuous grazing and/or annual, early spring seasonal grazing. Shortgrasses and forbs increase to dominate the plant community and annual production decreases dramatically. Lack of litter and short plant heights result in high soil temperatures, high soil water loss, and poor water infiltration rates, which gives blue grama a competitive advantage over cool-season mid-grasses. The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs and 5 percent shrubs. Blue grama and sedge are the prominent species with the balance being lesser amounts of buffalograss, inland saltgrass, prairie Junegrass, western wheatgrass, thickspike wheatgrass, green needlegrass, and needle and thread. Forbs and shrubs such as fringed sagewort, cudweed sagewort, heath aster, broom snakeweed, cactus, and western yarrow may also be present. This plant community is very stable. The thick sod and competitive advantage prevents other species from establishing. This plant community is less productive than the Reference State (1.0). Soil erosion will be minimal due to the sod-forming habit of blue grama and buffalograss.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	330	680	1030
Forb	35	60	85
Shrub/Vine	35	60	85
Total	400	800	1200

Figure 14. 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

This State is the result of very heavy concentrated disturbance such as concentrated 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.

Community 3.1

Threeawn-Annual

This plant community develops under severe disturbance and/or excessive defoliation. This can result from heavy livestock or wildlife concentration (i.e., water locations, bedding, or loafing grounds, feeding areas), or prairie dog habitation. The dominant vegetation includes pioneer annual grasses and forbs and early successional biennial and perennial species. Grasses may include threeawn, sixweeks fescue, bluegrass, cheatgrass, needleandthread, prairie Junegrass, and western wheatgrass. The dominant forbs include curlycup gumweed, horseweed (marestail), salsify, kochia, field bindweed, thistles, fringed sagewort, pussytoes, prostrate verbena, and other early successional species. Shrubs that may be present include rubber rabbitbrush and broom snakeweed. Plant species from adjacent ecological sites may become minor components of this plant community. The community also is susceptible to invasion of non-native annual and perennial forbs due to severe soil disturbances and relatively high percent of bare ground. Compared to the Western Wheatgrass-Needlegrass-Blue Grama Plant Community (1.1), western wheatgrass, green needlegrass, needle and thread, and blue grama have decreased. This plant community is resistant to change as long as soil disturbance or severe vegetation defoliation persists, thus holding back secondary plant succession. Soil erosion is potentially high in this vegetation state. Reduced surface cover, low plant density, low plant vigor, loss of root biomass, and soil compaction, all contribute to decreased water infiltration, increased runoff, and accelerated erosion rates. Significant economic inputs and time would be required to move this plant community toward a higher successional stage and a more productive plant community. Secondary succession is highly variable, depending upon availability and diversity of a viable seed bank of higher successional species within the existing plant community and neighboring plant communities. The total annual production ranges from 200 to 1,000 lbs./ac. (air-dry weight) depending upon growing conditions.

Figure 15. 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

This State has been invaded by cheatgrass, field brome, crested wheatgrass, smooth brome, and/or Kentucky bluegrass, but not at the levels where the plant communities are dominated by these species. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent of the plant community composition (lbs./ac) and native grasses represent less than 40 percent of the plant community composition. (Toledo, D. et al., 2014). Other non-native perennial cool-season grasses may result in the same transition but is not documented. Long-term non-use and/or no fire, 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. Plant litter accumulation tends to favor the more shade-tolerant introduced grass species. The nutrient cycle is impaired, and the result is typically a higher level of nitrogen which also favors the introduced species. Increasing plant litter decreases the amount of sunlight reaching plant crowns thereby shifting competitive advantage to shade-tolerant, introduced grass species. This scenario has not been observed on this ecological site in MLRA 64, however it may exist. 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. Once these non-native cool-season species are established, it is unlikely that an invaded plant community will be returned to the Reference State (1.0).

Community 4.1
Rhizomatous Wheatgrass-Shortgrass-Non-Native Cool-Season Grasses

This plant community phase is similar to Rhizomatous Wheatgrass-Needlegrass-Blue Grama Plant Community (1.1), but it also contains minor amounts of non-native invasive grass species such as crested wheatgrass, smooth brome, and Kentucky bluegrass (up to about 15 percent by air-dry weight). Cheatgrass and field brome will almost always be present. The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. The community is dominated by cool-season grasses with subdominant warm-season shortgrasses. The major grasses include western wheatgrass, thickspike wheatgrass, green needlegrass, blue grama, and sideoats grama. Other grass or grass-like species include needle and thread, Sandberg bluegrass, buffalograss, and sedges. 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 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	850	1225	1530
Forb	90	105	180
Shrub/Vine	60	70	90
Total	1000	1400	1800

Figure 17. 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		

State 5
Disturbed State

The Disturbed State can be transitioned to from any Plant Community. 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. The Go-back (5.1) plant community was previously tilled for crop production and then abandoned. The plant community that develops on this site will be greatly influenced by the plant communities that are located on adjacent land. The Seeded (5.2) plant community was typically tilled and then seeded to a perennial forage species or mix of species. Infiltration, runoff, and soil erosion will vary depending upon the vegetation present on the site.

Community 5.1
Go-back

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 being replaced by both native and introduced perennials. The vegetation on this site varies greatly, sometimes being dominated by threeawn, crested wheatgrass, bluegrass, smooth brome, annual brome, broom snakeweed, sweetclover, and non-native thistles. Other plants that commonly occur on the site can include western wheatgrass, prickly lettuce, horseweed, kochia, foxtail, and sunflowers. Bare ground is prevalent due to the loss of organic matter and lower overall soil health.

Community 5.2

Seeded

The Seeded Plant Community normally consists of those areas seeded to pubescent or intermediate wheatgrass, alfalfa, switchgrass, or other 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

With continuous season-long grazing, or heavy grazing during extended period of drought will transition the Blue Grama-Rhizomatous Wheatgrass Plant Community (1.2) to the Shortgrass Sod 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 T6A

State 1 to 3

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

Transition T1B

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 5

Heavy disturbance including soil erosion, tillage, abandonment of cropland, or seeding to improved pasture species will result in a transition to the Disturbed State (5.0).

Restoration pathway R2A

State 2 to 1

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

Conservation practices

Prescribed Grazing

Transition T6A

State 2 to 3

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

Transition T2A

State 2 to 4

Removal of management-induced disturbance, the 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 T7A
State 2 to 5

Heavy disturbance including soil erosion, tillage, abandonment of cropland, or seeding to improved pasture species will result in a transition to the Disturbed State (5.0).

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 T7A
State 3 to 5

Heavy disturbance including soil erosion, tillage, abandonment of cropland, or seeding to improved pasture species will result in a transition to the Disturbed State (5.0).

Transition T4A
State 4 to 2

Continuous season-long grazing, or heavy grazing during extended period of drought will transition this plant community 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 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 run-off and less infiltration.

Transition T6A
State 4 to 3

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

Transition T7A
State 4 to 5

Heavy disturbance including soil erosion, tillage, abandonment of cropland, or seeding to improved pasture species will result in a transition to the Disturbed State (5.0).

Additional community tables

Table 9. Community 1.1 plant community composition

Code	Common Name	Symbol	Scientific Name	Annual Production (" L/A/yr)	Foliar Cover ("%)
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Group	Common name	Symbol	Scientific Name	(LB/Acre)	(%)
Grass/Grasslike					
1	Rhizomatous Wheatgrass			320–640	
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	320–600	—
	thickspike wheatgrass	ELLAL	<i>Elymus lanceolatus ssp. lanceolatus</i>	0–150	—
2	Cool-Season Bunchgrasses			400–560	
	green needlegrass	NAVI4	<i>Nassella viridula</i>	160–480	—
	needle and thread	HECOC8	<i>Hesperostipa comata ssp. comata</i>	80–320	—
	porcupinegrass	HESP11	<i>Hesperostipa spartea</i>	0–160	—
3	Short Warm-Season Grasses			80–240	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	80–240	—
	buffalograss	BODA2	<i>Bouteloua dactyloides</i>	0–80	—
4	Grass-Likes			32–80	
	sedge	CAREX	<i>Carex</i>	32–80	—
5	Other Native Grasses			32–160	
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–80	—
	prairie sandreed	CALO	<i>Calamovilfa longifolia</i>	0–64	—
	dropseed	SPORO	<i>Sporobolus</i>	16–48	—
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	16–48	—
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	0–32	—
	threeawn	ARIST	<i>Aristida</i>	0–32	—
	saltgrass	DISP	<i>Distichlis spicata</i>	0–16	—
Forb					
7	Forbs			80–160	
	scarlet globemallow	SPCO	<i>Sphaeralcea coccinea</i>	16–32	—
	leafy wildparsley	MUDI	<i>Musineon divaricatum</i>	16–32	—
	scurfpea	PSORA2	<i>Psoralidium</i>	16–32	—
	upright prairie coneflower	RACO3	<i>Ratibida columnifera</i>	16–32	—
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–32	—
	common yarrow	ACMI2	<i>Achillea millefolium</i>	16–32	—
	onion	ALLIU	<i>Allium</i>	16–32	—
	white sagebrush	ARLU	<i>Artemisia ludoviciana</i>	16–32	—
	desertparsley	LOMAT	<i>Lomatium</i>	16–32	—
	rush skeletonplant	LYJU	<i>Lygodesmia juncea</i>	0–16	—
	wavyleaf thistle	CIUN	<i>Cirsium undulatum</i>	0–16	—
	scarlet beeblossom	GACO5	<i>Gaura coccinea</i>	0–16	—
	rosy pussytoes	ANRO2	<i>Antennaria rosea</i>	0–16	—
	Missouri goldenrod	SOMI2	<i>Solidago missouriensis</i>	0–16	—
	woolly plantain	PLPA2	<i>Plantago patagonica</i>	0–16	—
	white heath aster	SYER	<i>Symphyotrichum ericoides</i>	0–16	—
	Forb, annual	2FA	<i>Forb, annual</i>	0–16	—
	deathcamas	ZIGAD	<i>Zigadenus</i>	0–16	—
Shrub/Vine					
8	Shrubs			16–80	

0	Succrubs			10-00	
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	16-32	—
	silver sagebrush	ARCA13	<i>Artemisia cana</i>	0-32	—
	prairie sagewort	ARFR4	<i>Artemisia frigida</i>	16-32	—
	Wyoming big sagebrush	ARTRW8	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	0-32	—
	rubber rabbitbrush	ERNA10	<i>Ericameria nauseosa</i>	0-32	—
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0-16	—
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0-16	—

Table 10. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	Rhizomatous Wheatgrass			210-420	
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	210-400	—
	thickspike wheatgrass	ELLAL	<i>Elymus lanceolatus</i> ssp. <i>lanceolatus</i>	0-80	—
2	Cool-Season Bunchgrasses			70-200	
	green needlegrass	NAVI4	<i>Nassella viridula</i>	70-180	—
	needle and thread	HECOC8	<i>Hesperostipa comata</i> ssp. <i>comata</i>	20-80	—
	porcupinegrass	HESP11	<i>Hesperostipa spartea</i>	0-70	—
3	Short Warm-Season Grasses			100-320	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	100-300	—
	buffalograss	BODA2	<i>Bouteloua dactyloides</i>	0-42	—
4	Grass-Likes			70-140	
	sedge	CAREX	<i>Carex</i>	70-140	—
5	Other Native Grasses			70-210	
	threeawn	ARIST	<i>Aristida</i>	28-140	—
	dropseed	SPORO	<i>Sporobolus</i>	28-140	—
	Grass, perennial	2GP	<i>Grass, perennial</i>	0-70	—
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	28-56	—
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	0-42	—
	saltgrass	DISP	<i>Distichlis spicata</i>	0-14	—
6	Non-Native Grasses			0-70	
	field brome	BRAR5	<i>Bromus arvensis</i>	0-70	—
	cheatgrass	BRTE	<i>Bromus tectorum</i>	0-70	—
Forb					
7	Forbs			70-210	
	Forb, annual	2FA	<i>Forb, annual</i>	0-70	—
	white sagebrush	ARLU	<i>Artemisia ludoviciana</i>	14-70	—
	curlycup gumweed	GRSQ	<i>Grindelia squarrosa</i>	0-70	—
	wavyleaf thistle	CIUN	<i>Cirsium undulatum</i>	14-42	—
	white heath aster	SYER	<i>Symphyotrichum ericoides</i>	14-42	—
	yellow salsify	TRDU	<i>Tragopogon dubius</i>	14-42	—
	deathcamas	ZIGAD	<i>Zigadenus</i>	0-28	—

	scurfpea	PSORA2	<i>Psoraleidium</i>	14–28	–
	upright prairie coneflower	RACO3	<i>Ratibida columnifera</i>	14–28	–
	Missouri goldenrod	SOMI2	<i>Solidago missouriensis</i>	14–28	–
	scarlet globemallow	SPCO	<i>Sphaeralcea coccinea</i>	14–28	–
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–28	–
	common yarrow	ACMI2	<i>Achillea millefolium</i>	14–28	–
	onion	ALLIU	<i>Allium</i>	0–14	–
	rosy pussytoes	ANRO2	<i>Antennaria rosea</i>	0–14	–
	scarlet beeblossom	GACO5	<i>Gaura coccinea</i>	0–14	–
	rush skeletonplant	LYJU	<i>Lygodesmia juncea</i>	0–14	–
Shrub/Vine					
8	Shrubs			14–70	
	prairie sagewort	ARFR4	<i>Artemisia frigida</i>	14–42	–
	Wyoming big sagebrush	ARTRW8	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	0–28	–
	silver sagebrush	ARCA13	<i>Artemisia cana</i>	0–28	–
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	14–28	–
	rubber rabbitbrush	ERNA10	<i>Ericameria nauseosa</i>	0–28	–
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–14	–
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	0–14	–

Table 11. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	Rhizomatous Wheatgrass			0–80	
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	0–80	–
	thickspike wheatgrass	ELLAL	<i>Elymus lanceolatus</i> ssp. <i>lanceolatus</i>	0–20	–
2	Cool-Season Bunchgrasses			40–80	
	needle and thread	HECOC8	<i>Hesperostipa comata</i> ssp. <i>comata</i>	40–80	–
3	Short Warm-Season Grasses			200–280	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	200–280	–
	buffalograss	BODA2	<i>Bouteloua dactyloides</i>	40–80	–
4	Grass-Likes			40–120	
	sedge	CAREX	<i>Carex</i>	40–120	–
5	Other Native Grasses			40–160	
	threeawn	ARIST	<i>Aristida</i>	16–80	–
	dropseed	SPORO	<i>Sporobolus</i>	16–80	–
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–40	–
	saltgrass	DISP	<i>Distichlis spicata</i>	8–24	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	8–24	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	0–24	–
6	Non-Native Grasses			20–80	
	smooth brome	BRIN2	<i>Bromus inermis</i>	0–80	–

	cheatgrass	BRTE	<i>Bromus tectorum</i>	16–80	–
	Kentucky bluegrass	POPR	<i>Poa pratensis</i>	0–80	–
	crested wheatgrass	AGCR	<i>Agropyron cristatum</i>	0–80	–
	field brome	BRAR5	<i>Bromus arvensis</i>	0–40	–
Forb					
7	Forbs			40–80	
	common yarrow	ACMI2	<i>Achillea millefolium</i>	16–40	–
	curlycup gumweed	GRSQ	<i>Grindelia squarrosa</i>	8–40	–
	Forb, annual	2FA	<i>Forb, annual</i>	0–24	–
	yellow salsify	TRDU	<i>Tragopogon dubius</i>	8–24	–
	wavyleaf thistle	CIUN	<i>Cirsium undulatum</i>	8–24	–
	deathcamas	ZIGAD	<i>Zigadenus</i>	0–24	–
	white sagebrush	ARLU	<i>Artemisia ludoviciana</i>	8–24	–
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–16	–
	rosy pussytoes	ANRO2	<i>Antennaria rosea</i>	8–16	–
	rush skeletonplant	LYJU	<i>Lygodesmia juncea</i>	8–16	–
	woolly plantain	PLPA2	<i>Plantago patagonica</i>	8–16	–
	Missouri goldenrod	SOMI2	<i>Solidago missouriensis</i>	8–16	–
	white heath aster	SYER	<i>Symphyotrichum ericoides</i>	8–16	–
	onion	ALLIU	<i>Allium</i>	8–16	–
	scurfpea	PSORA2	<i>Psoralegium</i>	0–8	–
	upright prairie coneflower	RACO3	<i>Ratibida columnifera</i>	0–8	–
	scarlet globemallow	SPCO	<i>Sphaeralcea coccinea</i>	0–8	–
Shrub/Vine					
8	Shrubs			40–80	
	prairie sagewort	ARFR4	<i>Artemisia frigida</i>	8–40	–
	silver sagebrush	ARCA13	<i>Artemisia cana</i>	0–32	–
	Wyoming big sagebrush	ARTRW8	<i>Artemisia tridentata ssp. wyomingensis</i>	0–24	–
	rubber rabbitbrush	ERNA10	<i>Ericameria nauseosa</i>	0–24	–
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	8–24	–
	brittle pricklypear	OPFR	<i>Opuntia fragilis</i>	8–16	–
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	8–16	–

Animal community

Wildlife Interpretations:

MLRA 64 is in the drier areas of a northern mixed-grass prairie ecosystem in which sagebrush steppes to the west yield to grassland steppes to the east. Prior to European settlement, this MLRA consisted of diverse grassland and shrubland habitats interspersed with varying densities of depressional, instream wetlands and woody riparian corridors. These habitats provided critical life cycle components for many users. Many species of grassland birds, small mammals, reptiles, and 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 species of small mammals and insects, were the primary consumers linking the grassland resources to large predators, such as the wolf, mountain lion, and grizzly bear, and to smaller carnivores, such as the coyote, bobcat, fox, and raptors. The prairie dog was once abundant and remains a keystone species within its range. The black-footed ferret, burrowing owl, ferruginous hawk, mountain plover, and swift fox are associated with prairie dog complexes.

Historically, the northern mixed-grass prairie was a disturbance-driven ecosystem in which fire, herbivory, and climate functioned 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 affected plant and animal communities. The bison was a historical keystone species but has been extirpated in this area as a free-ranging herbivore. The loss of the bison and the 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 reduced habitat quality for area-sensitive species.

Within MLRA 64, the Claypan ecological site provides upland grassland cover with an associated forb, and shrub component. It was typically part of an expansive grassland landscape that included combinations of Badlands, Thin Breaks, Clayey, Dense Clay, Loamy, Saline, Sandy, Shallow, Overflow, Subirrigated, and Terrace ecological sites. This site provided habitat for species requiring unfragmented grassland. Important habitat features include 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 include free-ranging American bison, grizzly bear, gray wolf, black-footed ferret, mountain plover, Rocky Mountain locust, and swift fox. Swift fox, black-footed ferret, and American bison have been reintroduced into certain areas within this MLRA. This site provides habitat for grassland nesting birds, small rodents, bats, mammalian predators, and a variety of reptiles and insects. Invasive species such as perennial non-native cool-season grasses, 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-Needlegrass-Blue Grama (1.1): This site is dominated by rhizomatous wheatgrass and green needlegrass with a minor shrub community generally dominated by cactus, broom snakeweed, sagewort, sagebrush, and rubber rabbitbrush. Raptors such as red-tailed hawk, Ferruginous hawk, northern harrier, and golden eagle may use this site. Insects, such as pollinators, play a limited role in maintaining the forb community but do provide a significant forage base for birds and various bats, especially species such as the Western small-footed *Myotis*, the fringe-tailed *Myotis*, and the Townsend's big-eared bat. Prey populations are available for grassland raptors and mammalian predators. Other mammalian predators utilizing this plant community include the coyote, red fox, and badger.

The relatively tall stature of this plant community provides suitable thermal, protective, and escape cover for small and large mammals. This site provides a diversity of grasses, forbs, and shrubs for small and large herbivores including shrews, mice, spotted ground squirrel, desert cottontail rabbit, white-tailed and black-tailed jackrabbits, deer and pronghorn. This site provides limited habitat for sharp-tailed grouse, white-tailed deer, and amphibians, mostly toads (i.e., Great Plains, Woodhouse's, and Plains spadefoot). Prey abundance and shade opportunities may attract multiple reptile species such as gopher snake, milk snake, prairie rattlesnake, and lesser numbers of various lizard species.

Blue Grama/Sedge/Pricklypear Cactus (2.1): Resulting from continuous season-long grazing or from heavy grazing, blue grama and buffalograss will become dominant. The forb diversity and abundance has remained relatively unchanged. Shrub abundance increases significantly, especially sagewort and sagebrush. A shift to shorter plant structures will favor prairie dog expansion and associate species such as ferruginous hawk, burrowing owl, and swift fox. Species such as horned lark, long-billed curlew, upland sandpiper, desert cottontail, and white-tailed jackrabbit may be present or increase. This plant community may provide areas suitable for sharp-tailed grouse lek site development. The short stature of this plant community limits suitable thermal, protective, escape cover. Predators utilizing this plant community include the coyote, American badger, red fox, and long-tailed weasel.

Threeawn-Annual Plant Community (3.1): This plant community develops under severe disturbance and/or excessive defoliation. This can result from heavy livestock or prairie dog concentration. The dominant vegetation includes pioneer annual grasses, forbs, invaders, and early successional biennial and perennial species. Plant species from adjacent ecological sites may become minor components of this plant community. A shift to shorter plant structure will favor prairie dog expansion and associate species such as ferruginous hawk, burrowing owl, and swift fox. Species such as horned lark, long-billed curlew, upland sandpiper, desert cottontail, and white-tailed jackrabbit may be present or increase. This plant community may provide areas suitable for sharp-tailed grouse lek site development. The short stature of this plant community limits suitable thermal, protective, and escape cover. Predators utilizing this plant community include the coyote, American badger, red fox, and long-tailed weasel.

Soil erosion is potentially high, impacting offsite aquatic habitats through increased runoff, nutrient, and sediment loads. Reduced surface cover, low plant density, low plant vigor, loss of root biomass, and soil compaction all contribute to decreased wildlife abundance and diversity. Since secondary succession is highly variable, plant and wildlife species will vary. This plant community provides habitat for generalist or early successional species.

Grazing Interpretations:

The following list suggests annual, initial stocking rates for average growing conditions. These estimates are conservative and should be used only as guidelines in the initial stages of conservation planning. Commonly, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Therefore, a resource inventory is necessary to document plant composition and production. More accurate estimates of carrying capacity 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. In consultation with the land manager, a more intensive grazing management program that results in improved harvest efficiencies and increased carrying capacity may be developed.

The following suggested initial stocking rates are based on 912 lb/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 or without calf, for one month.

Plant Community: Rhizomatous Wheatgrass-Needlegrass-Blue Grama (1.1)

Average Production (lb/acre, air-dry): 1,600

Stocking Rate (AUM/acre): 0.44

Plant Community: Blue Grama-Rhizomatous Wheatgrass (1.2)

Average Production (lb/acre, air-dry): 1,400

Stocking Rate (AUM/acre): 0.38

Plant Community: Blue Grama/Sedge/Pricklypear Cactus (2.1)

Average Production (lb/acre, air-dry): 800

Stocking Rate (AUM/acre): 0.22

*Plant Community: Threeawn-Annuals (3.1)

Average Production (lb/acre, air-dry): Variable

Stocking Rate (AUM/acre): Variable

*Plant Community: Rhizomatous Wheatgrass-Shortgrass-Non-Native Cool-Season Grasses (4.1)

Average Production (lb/acre, air-dry): 1,400

Stocking Rate (AUM/acre): 0.38

Plant Community: All other plant communities identified in this document have variable annual production values and require onsite sampling to determine initial stocking rates.

* Total annual production and stocking rates are highly variable and require onsite sampling.

** Total onsite annual production 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 for livestock. During the dormant period, the forage for livestock likely have insufficient protein to meet livestock requirements. Added protein allows 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 herbage production on this site. The site is dominated by soils in hydrologic

group D. 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 higher infiltration and lower runoff. An exception would be where shortgrasses form a dense 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, Part 630, for hydrologic soil groups, runoff quantities, and hydrologic curves.

Recreational uses

This site provides hunting opportunities for upland game species. The wide variety of plants that bloom from spring until fall have aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are present on the site.

Other products

Harvesting the seeds of native plants can provide additional income on this site.

Other information

Revision Notes: "Previously Approved" Provisional

This Provisional ecological site description (ESD) has passed Quality Control (QC) and Quality Assurance (QA) to ensure the it meets the 2014 NESH standards for a Provisional ecological site description.

This ESD is an updated "Previously Approved" ESD that represented 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 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 may not contain all tabular and narrative entries as required in the current "Approved" level of documentation, but it is expected that it will continue refinement toward an "Approved" status.

Site Development and Testing Plan

Future work, as described in an official project plan, is necessary to validate the information in this provisional ecological site description. The plan will include field activities for low-, medium-, and high-intensity sampling, soil correlations, and analysis of the data. Annual field reviews should be done by soil scientists and vegetation specialists. Final field review, peer review, quality control, and quality assurance reviews are 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 (RMS), NRCS; Jill Epley, RMS, NRCS; Rick Peterson, RMS, NRCS; David Steffen, RMS, NRCS; Jeff Vander Wilt; RMS, NRCS; Phil Young, soil scientist, NRCS.

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Contributors

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Approval

Suzanne Mayne-Kinney, 12/16/2024

Acknowledgments

This ecological site was reviewed and approved at the Provisional Level by David Kraft, Regional ESS, Salina, KS on 1/15/2019.

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- (3) email: program.intake@usda.gov.

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Stan Boltz, Mitch Faulkner, Emily Helms, John Hartung, Ryan Murray, George Gamblin, Rick Peterson, Nadine Bishop, Jeff Nichols
Contact for lead author	jeffrey.nichols@usda.gov
Date	12/12/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None. Rills are not expected on this site.
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2. **Presence of water flow patterns:** Typically, none. If present water flow patterns will be barely visible and discontinuous.

3. **Number and height of erosional pedestals or terracettes:** None. Pedestals and/or terracettes should not be present on this site.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is typically less than 10 percent, and bare ground patches less than 2 to 3 inches (5 to 8 cm) in diameter.

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

6. **Extent of wind scoured, blowouts and/or depositional areas:** None. Wind-scoured and/or depositional areas should not be present.

7. **Amount of litter movement (describe size and distance expected to travel):** Litter should fall in place. A slight amount (less than 6 inches or 10.5 cm) of movement of fine 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 should 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 4-10 inches (10-25.5 cm) thick. Soil colors range from dark gray, grayish brown to light grayish brown (values of 4 to 6) when dry and very dark gray to very dark grayish brown (value of 3) when moist.

Structure is typically medium to fine granular at least in the upper A-horizon. An abrupt texture change occurs at 6 to 11 inches (15.25-28 cm) below the surface to an extremely hard clayey Btn-horizon. The subsoil is sodium rich and has a very hard, columnar or prismatic structure.

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 and tall rhizomatous and tufted perennial cool season grasses) with fine and coarse roots positively influences infiltration. Invasion of introduced cool-season grasses such as Kentucky bluegrass, annual brome, smooth brome, and crested wheatgrass may have an adverse impact infiltration and runoff.

Relative composition is approximately 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. The grass and grass-like component is composed of C3, rhizomatous grasses (20-40%), C3 bunchgrasses (25-35%), C4 shortgrasses (4-15%), C4 tall- and midgrasses (1-5%), and grass-likes (2-5%).

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. There is a natural pan at approximately 6-11 inches (15.25-28 cm) below the surface which is described as "biscuit-top" pan. The subsoil is sodium rich and has a very hard, columnar or prismatic structure which occurs below the Btn-horizon.
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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: Phase 1.1
1. Native, perennial, C3, rhizomatous grass, 320-640 #/ac, 20-40% (2 species minimum): western wheatgrass, thickspike wheatgrass.
 2. Native, perennial, C3, bunchgrass, 400-560 #/ac, 25-35% (3 species minimum): green needlegrass, needle and thread, porcupinegrass, prairie Junegrass, Sandberg bluegrass.
- Phase 1.2
1. Native, perennial, C3, rhizomatous grass, 210-420 #/ac, 15-30%: western wheatgrass, thickspike wheatgrass.
 2. Native, perennial, C4, shortgrass, 140-350 #/ac, 10-25% (1 species minimum): blue grama, buffalograss, threeawn, saltgrass.
- Sub-dominant: Phase 1.1
1. Native, perennial, C4, shortgrass, 80-240 #/ac, 4-15% (1 species minimum): blue grama, inland saltgrass, buffalograss, threeawn.
- Phase 1.2
1. Native, perennial, C3, bunchgrass, 70-210 #/ac, 5-15%, 3 species minimum: green needlegrass, needle and thread, porcupinegrass, prairie Junegrass, Sandberg bluegrass.
- Other: Minor - Phase 1.1
1. Native forbs, 80-160 #/ac (5-10%): forbs present will vary from location to location.
 2. Native grass-like, 32-80 #/ac, 2-5%: sedges.
 3. Native, perennial, C4, tall- and midgrass, 16-80 #/ac, 1-5%: dropseed, prairie sandreed.
 4. Shrubs, 6-80 #/ac, 1-5%: shrubs present will vary from location to location.
- Minor - Phase 1.2
1. Native grass-like, 70-140 #/ac, 5-10%: sedge.
 2. Native forbs, 70-140 #/ac (5-10%): forbs present vary from location to location.
 3. Native, perennial, C4 midgrass, 28-140 #/ac, 2-10%: dropseed.
 4. Shrubs, 14-70 #/ac, 1-5%: shrubs present will vary from location to location.
 5. Non-native, C3, annual grass, 0-70 #/ac, 0-5%: field brome, cheatgrass
- Additional: The Blue grama-Rhizomatous Wheatgrass Community or Reference Community (1.1) is composed of seven F/S groups. These groups, in order of relative abundance, are native, perennial, C3, rhizomatous grass; native, perennial, C3, bunchgrass; native, perennial, C4 shortgrass; native forbs; native grass-like; native, perennial, C4 tall- and midgrass; and shrubs.
- The Rhizomatous Wheatgrass-Needlegrass-Blue Grama Community (1.2) is composed of eight F/S groups which are native, perennial, C3, rhizomatous grass; native, perennial, C3, bunchgrass; native, perennial, C4, shortgrass; native forbs; native, perennial, C4 midgrass; native grass-like; shrubs; and non-native C3, annual grasses.
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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or**

decadence): Bunchgrasses have strong, healthy centers with few (less than 3 percent) dead centers. Shrubs may show some dead branches (less than 5 percent) as plants age.

14. **Average percent litter cover (%) and depth (in):** Plant litter cover is evenly distributed throughout the site and is expected to be 40 to 70 percent and at a depth of 0.25 inch (0.65 cm). Kentucky bluegrass excessive litter can negatively impact the functionality of this site.
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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** The representative value (RV) for annual production is 1600 pounds per acre on an air dry basis. Low and high production years should yield 1,200 and 2,000 pounds per acre respectively.
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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:** No non-native invasive species are present. Annual bromes, Kentucky bluegrass, crested wheatgrass, and smooth brome are known invasives that have the potential to become dominant or co-dominant on this site. Consult the state noxious weed and state watch lists for potential invasive species. Note: species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants.
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17. **Perennial plant reproductive capability:** All perennial species exhibit high vigor relative to recent weather conditions. Perennial grasses should have vigorous rhizomes or tillers; vegetative and reproductive structures are not stunted. All perennial species should be capable of reproducing annually.
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