USDA Natural Resources Conservation Service

Ecological site R064XY065NE
Closed Depression

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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.

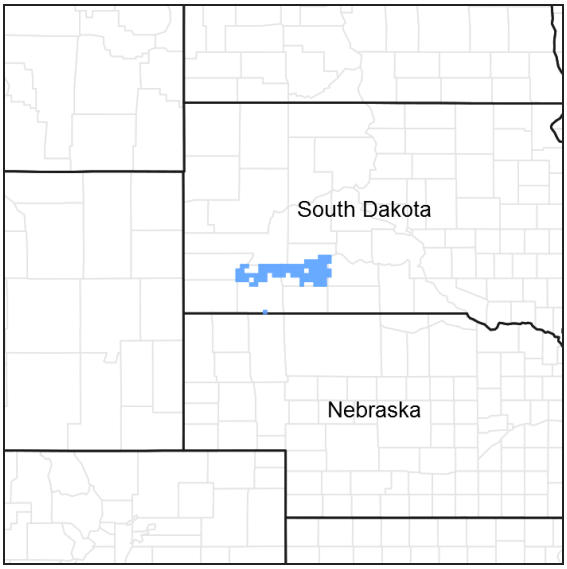


Figure 1. Mapped extent

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 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 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 of precipitation per year. The drier zone, 14 to 17 inches, extends from Wyoming eastward to Alliance and Oshkosh, Nebraska, south of the Pine Ridge Escarpment. 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. MLRA 64 stops at the western edge of the Nebraska Sand Hills (MLRA 65).

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 Closed Depression ecological site occurs throughout MLRA 64. It is located on level or nearly level upland landscapes with slopes ranging from 0 to 1 percent. The site is a poorly drained upland depression that will pond water from 15 to 60 days in the spring and after heavy rain events. Soils are formed from clayey alluvium. The texture of the surface layer is silty loam to clay. The high clay content of the subsurface soil layers is restrictive to water movement and root penetration. Depending on climatic cycles, the vegetation can range from nearly pure stands of rhizomatous wheatgrass in dry years to rushes, sedges, and smartweed during wet years.

Some, but not all, Hoven soils will have a Btn horizon that is high in sodium. This soil may have plant communities where inland saltgrass makes up a significant portion of the total annual production during dry weather cycles.

Associated sites

GX064X01X015	**Loamy 14-17" PZ** The Loamy 14-17” PZ ecological site can be found on landscapes surrounding the Closed Depression site.
GX064X01X036	**Loamy 17-20" PZ** The Loamy 17-20” PZ ecological site can be found on landscapes surrounding the Closed Depression site.

R064XY014NE	**Clayey 14-17" PZ** The Clayey 14-17” PZ ecological site can be found on landscapes surrounding the Closed Depression site.
R064XY035NE	**Clayey 17-20 PZ** The Clayey 17-20” PZ ecological site can be found on landscapes surrounding the Closed Depression site.

Similar sites

R064XY027NE	**Clayey Overflow** The Clayey Overflow ecological site will have more plant diversity, tall,- warm-season grasses like big bluestem, more green needlegrass, and shrub species than does the Closed Depression site.
R064XY044NE	**Claypan** The Claypan ecological site will not typically occur in a concave depression, will not pond water for any length of time, will have more shortgrass species, and will have lower forage production than does the Closed Depression site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Eleocharis acicularis var. acicularis*

Physiographic features

The Closed Depression ecological site occurs on concave to nearly level depressions on uplands.

Table 2. Representative physiographic features

Landforms	(1) Plains > Depression
Runoff class	Negligible
Flooding frequency	None
Ponding duration	Long (7 to 30 days)
Ponding frequency	Occasional to frequent
Elevation	884–1,524 m
Slope	0–1%
Ponding depth	0–61 cm
Water table depth	0–203 cm

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 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 temperatures averaging 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. Hourly winds 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 (characteristic range)	92-120 days
Freeze-free period (characteristic range)	119-139 days
Precipitation total (characteristic range)	406-483 mm
Frost-free period (actual range)	87-122 days
Freeze-free period (actual range)	110-149 days
Precipitation total (actual range)	381-508 mm
Frost-free period (average)	107 days
Freeze-free period (average)	130 days
Precipitation total (average)	432 mm

Climate stations used

- (1) HARRISON 20 SSE [USW00094077], Harrison, NE
- (2) ALLIANCE 1WNW [USC00250130], Alliance, NE
- (3) HARRISON [USC00253615], Harrison, NE
- (4) HEMINGFORD [USC00253755], Hemingford, NE
- (5) INTERIOR 3 NE [USC00394184], Interior, SD
- (6) MARTIN [USC00395281], Martin, SD
- (7) WOOD [USC00399442], Wood, SD
- (8) LUSK 2 SW [USC00485830], Lusk, WY
- (9) TORRINGTON 29N [USC00488997], Jay Em, WY
- (10) CHADRON 3NE [USC00251578], Chadron, NE

Influencing water features

This site is occasionally to frequently flooded, in the spring to the late summer months. Annual ponding lasts between 15 and 60 days.

Wetland description

Wetland Description: (Cowardin System)
System: Palustrine
Subsystem Class: Emergent Wetland

Stream Type: None

Soil features

The common features of soils in this site are the silty loam to clay-textured surface layer, and slopes that range from 0 to 1 percent. The soils in this site are poorly drained and formed in alluvium. The surface layer is 2 to 9 inches thick. Subsoil textures consist of clay and clay loam.
Subsurface soil layers are restrictive to water movement and root penetration and have a very slow infiltration rate. Available water capacity is 4 to 6 inches. Soils will tend to crack when dry, and when they are wet, heavy traffic can cause surface compaction.

Major soils correlated to the Closed Depression ecological site include Hoven, Kolls, and Lodgpole.

The Hoven soil will exhibit an extremely hard clay Btn horizon that has a round-topped columnar structure. The Btn

horizon is high in sodium.

This site should show slight to no evidence of rills, wind-scoured areas, or pedestalled plants. Water flow paths are broken, irregular in appearance, or discontinuous. The soil surface is stable and intact.

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

Parent material	(1) Alluvium–clayey shale (2) Loess
Surface texture	(1) Silt loam (2) Clay (3) Silty clay
Family particle size	(1) Clayey
Drainage class	Poorly drained to moderately well drained
Permeability class	Very slow to slow
Soil depth	203 cm
Available water capacity (Depth not specified)	2.54–15.24 cm
Calcium carbonate equivalent (Depth not specified)	0–15%
Electrical conductivity (Depth not specified)	0–16 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–20
Soil reaction (1:1 water) (Depth not specified)	5.6–9
Subsurface fragment volume <=3" (Depth not specified)	0–5%

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.

This site is very sensitive to precipitation fluctuations from year to year. With above average precipitation, the site becomes very wet, leading to a much different plant community than what would be present with average to below average precipitation. In dry years, plant density becomes very low. The two plant community phases are influenced strongly by precipitation alone. Wheatgrass, grass-likes, and aquatic forbs make up the natural fluctuation of what could be considered the Reference Plant Community (1.1).

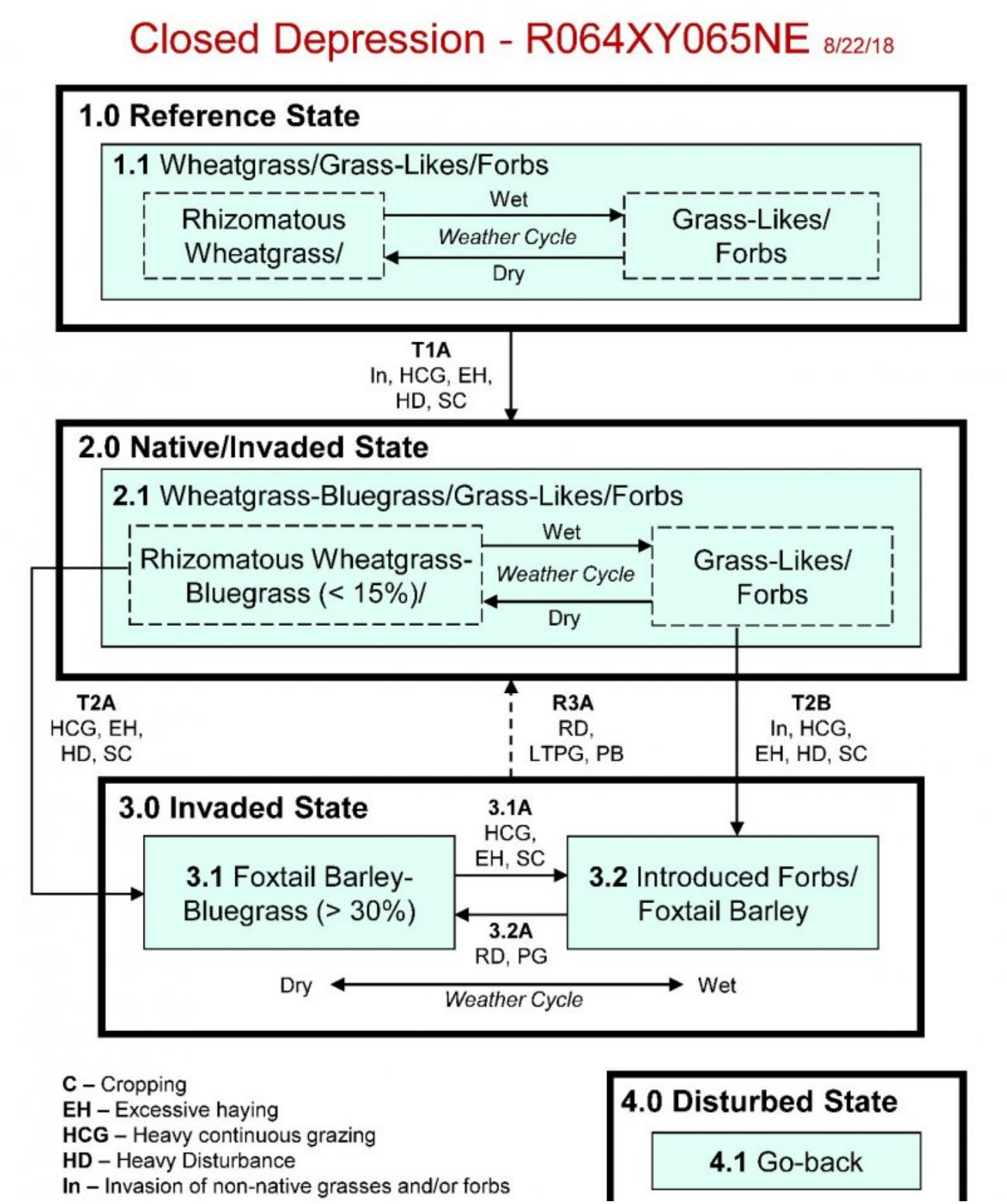
Interpretations are primarily based on the Wheatgrass/Grass-Likes/Forbs Plant Community (1.1). These have been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from 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 Reference State may be difficult to locate in MLRA 64 after the introduction of non-native cool-season grasses.

Plant Community Phase 2.1 is most similar to the Reference Plant Community, but a restoration pathway to the Reference State is not believed to be achievable because of the persistence of non-native cool-season grasses.

The following is a diagram that illustrates the common plant community phases that can occur on the site, and the transition pathways between communities, and states. These are the most common plant community phases based on current knowledge and experience, and changes may be made as more data is collected. Narratives following the diagram contain more detail pertaining to the ecological processes.

State and transition model



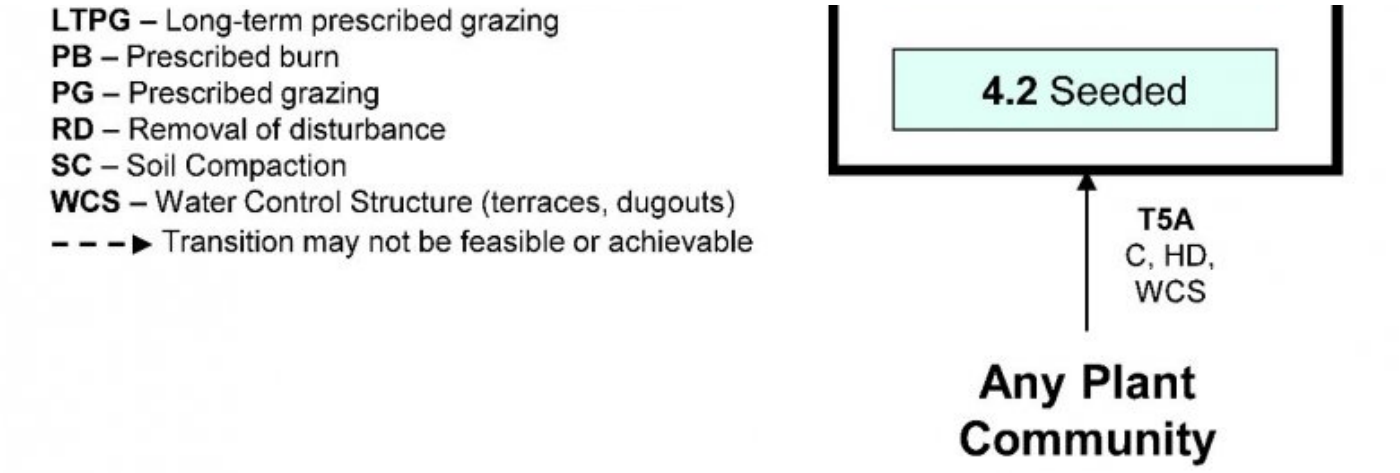


Diagram Legend - Closed Depression - R064XY065NE

T1A	**Invasion of non-native, cool-season grasses; heavy, continuous grazing without change in season of use or adequate recovery time; and/or excessive haying, heavy disturbance, and soil compaction.**
T2A	**Heavy, continuous grazing without change in season of use or adequate recovery time, and/or excessive haying, heavy disturbance, and soil compaction.**
T2B	**Invasion of non-native forbs; heavy, continuous grazing without change in season of use or adequate recovery time; and/or excessive haying, heavy disturbance, and soil compaction.**
T5A	**Abandoned cropland, heavy disturbance, or installation of water control structures.**

R3A	**Removal of management-induced disturbance followed by long-term prescribed grazing, including change in season of use and adequate time for plant recovery, long- or short-term rest (non-use), and/or prescribed burning. Recovery may not be fast and/or meet management goals.**

CP 3.1A	**3.1 - 3.2**	**Heavy, continuous grazing without adequate recovery, and/or excessive haying, and/or soil compaction.**
CP 3.2A	**3.2 - 3.1**	**Removal of disturbance followed by prescribed grazing, including change in season of use, proper stocking and adequate time for rest and recovery, possibly long- or short-term rest (non-use).**

State 1
Reference State

The Reference State represents the natural range of variability that dominates the dynamics of this ecological site. This State is dominated by cool- season grasses, grass-likes, and forbs. In pre-European times, the primary disturbance mechanisms for this site in the Reference condition included periods of below-average and above-average precipitation (resulting in alternating periods of ponding and drying) and grazing by large herding ungulates. Timing of grazing coupled with weather events dictated the dynamics that occurred within the natural range of variability. Today, this State 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. Wheatgrass species can decline and a corresponding increase in foxtail barley, warm-season shortgrasses, and forbs will occur. Under extended periods of disturbance, the main change is a reduction in vigor and production and an increase in bare ground and forb composition. The Reference State (1.0) has one plant community (1.1) with two distinct sub-phases as a result of the alternating periods of ponding and drying.

Community 1.1
Wheatgrass/Grass-Likes/Forbs

Interpretations are based primarily on the Wheatgrass/Grass-likes/Forbs Plant Community, which are also

considered to be Reference Plant Community (1.1). This plant community evolved with grazing by large herbivores and occasional fire, as well as periodic ponding and drying, and can be maintained with prescribed grazing, prescribed burning, or receiving occasional short periods of rest or deferment. This plant community phase has two sub-phases, referred to as phases in this ecological site description. These sub-phases are mainly driven by precipitation and ponding/drying sequences. Wheatgrass Phase (shorter ponding interval): Following several years of above-average precipitation, the plant community stabilizes and becomes dominated with perennial grasses such as western wheatgrass. Other grasses and grass-likes present can include Nuttall's alkaligrass, sedge, rush, thickspike wheatgrass and slender wheatgrass. The occurrence of forbs will be considerably lower including some species such as American licorice, curlytop knotweed, Pennsylvania smartweed, Pursh seepweed, and western dock. The plant community is made up of about 70 percent grasses and grass-likes and about 30 percent forbs. The total annual production (air-dry weight) of this plant community is typically about 2,200 pounds per acre. Grass-Likes/Forbs Phase (longer ponding interval): This plant community often occurs after a period of higher precipitation that follows an extended dry cycle. Grasses and grass-likes that commonly occur include sedge, spikerush, rush, foxtail barley, western wheatgrass, and bluegrasses. The forbs commonly found include western dock, mint, Pursh seepweed, lambsquarters, knotweed, evening-primrose, golden tickseed (plains coreopsis), and New England aster. The plant community is made up of about 10 percent grasses, 40 percent grass-likes, and about 50 percent forbs. The total annual production (air-dry weight) is about 1,400 pounds per acre.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1451	1849	3475
Forb	118	616	1009
Total	**1569**	**2465**	**4484**

Figure 9. 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		

State 2
Native/Invaded State

The Native/Invaded State is dominated by native and non-native cool-season grasses. The non-native cool-season grasses, primarily Kentucky bluegrass, make up less than 15 percent of the total annual production. This State is the result of heavy, continuous grazing and/or excessive haying, or heavy disturbance which can create soil compaction. The Native/Invaded State is very resilient and resistant to change. This State, like the Reference State (1.0), will have one plant community (2.1) with two distinct sub-phases as a result of the alternating periods of ponding and drying.

Community 2.1
Wheatgrass-Bluegrass/Grass-Likes/Forbs

This plant community is the result of invasion of non-native cool-season grasses, heavy, continuous grazing and/or excessive haying. Repeated removal of the leaf area, without adequate time for recovery, will adversely affect the health and vigor of the plant community. Other grass and grass-like species will increase including; Nuttall's alkaligrass, plains bluegrass, common spikerush, needle Spikerush, and other sedges and rushes. Early cool-season grasses, including Kentucky bluegrass (greater than15 percent), foxtail barley, and fowl bluegrass will invade. Inland saltgrass will increase on sites where salts accumulate in the soil. Forbs that will invade are curly dock, lambsquarters, and cocklebur. Common forbs to the site include, Pennsylvania smartweed, curlytop knotweed, plantain, and Pursh povertyweed. This plant community is relatively stable, but at-risk if Kentucky bluegrass becomes a dominant component. Plant vigor, frequency, and production have decreased. The biological integrity, water, and nutrient cycles of this plant community are becoming impaired. This plant community is less productive than the Reference Plant Community (1.1).

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1250	1664	2018
Forb	95	353	673
Total	**1345**	**2017**	**2691**

Figure 11. 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		

State 3
Invaded State

The Invaded State is the result of heavy, continuous grazing and/or excessive haying, or heavy disturbance that creates soil compaction. It is dominated by native and non-native cool-season grasses. The non-native cool-season grasses make up more than 30 percent of the total annual production. Preliminary studies tend to indicate a threshold may be crossed when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community. Plant communities dominated by Kentucky bluegrass will have significantly less cover and diversity of native grasses and forb species (Toledo, D. et al., 2014). This State is very resilient and resistant to change.

Community 3.1
Foxtail Barley-Bluegrass (Greater Than 30 Percent)

This plant community can be reached with heavy, continuous grazing coupled with compaction due to grazing when the soil is saturated. This plant community can also result from long-term ponding and occasional subsequent drying as when this site is developed for a water source. The dominant vegetation includes pioneer annual grasses, forbs, invaders, and early successional biennial and perennial species. Grasses may include foxtail barley, which may become dominant along with fowl bluegrass, Nuttall’s alkaligrass, and western wheatgrass. The dominant forbs include curly dock, curlycup gumweed, kochia, cocklebur, and other early successional species. The community is susceptible to invasion of non-native species due to severe soil disturbances and relatively high percent of bare ground. This plant community is resistant to change as long as soil disturbance or severe vegetation defoliation persists, thus holding back secondary plant succession. 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.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	521	785	1048
Forb	39	112	185
Total	**560**	**897**	**1233**

Figure 13. 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 3.2

Introduced Forbs/Foxtail Barley

This plant community can be reached with heavy, continuous grazing coupled with compaction due to grazing when the soil is saturated. This plant community can also result from long-term ponding and occasional subsequent drying as when this site is developed for a water source. The dominant vegetation includes pioneer annual grasses, forbs, invaders, and early successional biennial and perennial species. Grasses may include foxtail barley, which may become dominant along with fowl bluegrass, Nuttall's alkaligrass, and western wheatgrass. The dominant forbs include curly dock, curlycup gumweed, kochia, cocklebur, and other early successional species. The community is susceptible to invasion of non-native species due to severe soil disturbances and relatively high percent of bare ground. This plant community is resistant to change as long as soil disturbance or severe vegetation defoliation persists, thus holding back secondary plant succession. 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.

Pathway 3.1A
Community 3.1 to 3.2

Heavy, continuous grazing (grazing at full to heavy levels for extended portions of the growing season without adequate recovery periods) in conjunction with compaction resulting from grazing that occurs when the soil is saturated will cause this site to shift to the Introduced Forbs/Foxtail Barley Plant Community Phase (3.2). Plant Community 3.2 tends to develop during wetter precipitation cycles when ponding intervals are longer in duration.

Pathway 3.2A
Community 3.2 to 3.1

Removal of management-induced disturbances coupled with prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing, possibly including periodic rest, will potentially convert this plant community to the Foxtail Barley-Bluegrass (greater than 30 percent) Plant Community Phase (3.1). This pathway also requires the return of more normal ponding and drying cycles.

Conservation practices

Prescribed Grazing

State 4
Disturbed State

This State developed through mechanical manipulation of the watershed causing the loss of hydrologic function, biotic integrity, and soil site stability. On existing rangeland, hydrologic function is disrupted through terracing, contour furrowing, or pitting in the area surrounding the closed depression. Other causes include installation of dugouts, severe mechanical disturbance through tillage, and the conversion to cropland or pastureland.

Community 4.1
Go-Back

During the early successional stages, on Go-back lands (abandoned cropland), the species that dominate are annual grasses and forbs, later replaced by both native and introduced perennials. The vegetation on this site varies greatly, sometimes dominated by bluegrass, smooth brome, annual brome, crested wheatgrass, broom snakeweed, sweetclover, and non-native thistles. Other plants that commonly occur on the site include western wheatgrass, deathcamas, prickly lettuce, horseweed, kochia, and foxtail barley. Bare ground is prevalent due to the loss of organic matter and lower overall soil health. When runoff flowing into this site is eliminated though construction of water control structures such as terraces or dugouts, this site is likely to resemble the Claypan ecological site and have similar ecological dynamics.

Community 4.2
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

Invasion of non-native herbaceous species; heavy, continuous grazing (grazing at full to heavy levels for extended portions of the growing season without adequate recovery periods); and/or excessive haying, or heavy disturbance may cause a shift to the Native/Invaded State (2.0). During the wet cycles prior to soils drying, the Reference Plant Community (1.1) is highly susceptible to compaction if heavy grazing occurs when the soil is saturated. This type of disturbance can cause a rapid decline in the native vegetation and a subsequent influx of non-native forb species to occur.

Transition T5A
State 1 to 4

Heavy disturbance, installation of water control structures (terraces or dugouts), or land use conversion to crop or pasture will transition any plant community in this ecological site to the Degraded State (4.0).

Transition T2A - T2B
State 2 to 3

T2A) Heavy, continuous grazing (grazing at full to heavy levels for extended portions of the growing season without adequate recovery periods) and/or excessive haying, or heavy disturbance causing soil compaction will likely lead to the Foxtail Barley-Bluegrass (greater than 30 percent) Plant Community Phase (3.1) within the Invaded State. This transition is most likely to originate from the drier sub-phase of the Native/Invaded State to the drier 3.1 Plant Community. T2B) Soil compaction due to heavy disturbance when the soils are saturated coupled with heavy, continuous grazing and/or excessive haying, and invasion of non-native species may cause a shift to the Introduced Forbs/Foxtail Barley Plant Community (3.2). This combination of disturbances can cause a rapid decline in the native vegetation and a subsequent influx of non-native grasses and forb species to occur. This transition is most likely to originate from the wetter sub-phase of the Native/Invaded State to the wetter 3.2 Plant Community.

Transition T5A
State 2 to 4

Heavy disturbance, installation of water control structures (terraces or dugouts), or land use conversion to crop or pasture will transition any plant community in this ecological site to the Degraded State (4.0).

Restoration pathway R3A
State 3 to 2

Removal of heavy disturbance combined with long-term prescribed grazing that includes alternating season of use and allowing adequate recovery periods between grazing events, and possibly the use of prescribed burning, may eventually lead this plant community back to the Native/Invaded State (2.0). Due to soil compaction and the high percentage of non-native cool-season grasses, this transition may not be feasible or meet management goals.

Conservation practices

Prescribed Burning
Prescribed Grazing

Transition T5A
State 3 to 4

Heavy disturbance, installation of water control structures (terraces or dugouts), or land use conversion to crop or pasture will transition any plant community in this ecological site to the Degraded State (4.0).

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			493–1480	
	western wheatgrass	PASM	*Pascopyrum smithii*	493–1480	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–123	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–123	–
2	**Cool-Season Bunchgrasses**			123–740	
	foxtail barley	HOJU	*Hordeum jubatum*	49–740	–
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	49–247	–
3	**Short Warm-Season Grasses**			25–247	
	saltgrass	DISP	*Distichlis spicata*	25–247	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–123	–
4	**Other Grasses**			49–247	
	Grass, perennial	2GP	*Grass, perennial*	0–247	–
	plains bluegrass	POAR3	*Poa arida*	25–123	–
	fowl bluegrass	POPA2	*Poa palustris*	25–123	–
5	**Grass-Likes**			247–740	
	common spikerush	ELPA3	*Eleocharis palustris*	123–986	–
	needle spikerush	ELAC	*Eleocharis acicularis*	25–370	–
	sedge	CAREX	*Carex*	49–247	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–247	–
	rush	JUNCU	*Juncus*	0–123	–
6	**Non-Native Cool-Season Grasses**			–	
	Kentucky bluegrass	POPR	*Poa pratensis*	–	–
	smooth brome	BRIN2	*Bromus inermis*	–	–
	cheatgrass	BRTE	*Bromus tectorum*	–	–
Forb					
7	**Forbs**			123–1110	
	Forb, perennial	2FP	*Forb, perennial*	0–493	–
	pale dock	RUAL4	*Rumex altissimus*	0–370	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	0–370	–
	curlytop knotweed	POLA4	*Polygonum lapathifolium*	0–370	–
	lambsquarters	CHAL7	*Chenopodium album*	0–247	–
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	0–247	–
	New England aster	SYNO2	*Symphyotrichum novae-angliae*	0–247	–
	western dock	RUAQ	*Rumex aquaticus*	0–247	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–123	–
	bushy knotweed	PORA3	*Polygonum ramosissimum*	0–123	–
	cinquefoil	POTEN	*Potentilla*	0–123	–
	mealy goosefoot	CHIN2	*Chenopodium incanum*	0–123	–

	[illegible]	[illegible]	[illegible]	[illegible]	
	golden tickseed	COTI3	*Coreopsis tinctoria*	0–123	–
	plantain	PLANT	*Plantago*	0–123	–
	povertyweed	IVAX	*Iva axillaris*	0–123	–
	mint	MENTH	*Mentha*	0–123	–
	evening primrose	OENOT	*Oenothera*	0–123	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–123	–
	creeping woodsorrel	OXCO	*Oxalis corniculata*	0–74	–
	tall fringed bluebells	MECI3	*Mertensia ciliata*	0–74	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–74	–
	cocklebur	XANTH2	*Xanthium*	–	–
	Forb, introduced	2FI	*Forb, introduced*	–	–
	curly dock	RUCR	*Rumex crispus*	–	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	–	–

Table 9. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			303–807	
	western wheatgrass	PASM	*Pascopyrum smithii*	17–45	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–6	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	–	–
2	**Cool-Season Bunchgrasses**			101–404	
	foxtail barley	HOJU	*Hordeum jubatum*	61–303	–
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	20–202	–
3	**Short Warm-Season Grasses**			20–303	
	saltgrass	DISP	*Distichlis spicata*	101–303	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–61	–
4	**Other Native Grasses**			0–101	
	Grass, perennial	2GP	*Grass, perennial*	0–101	–
	plains bluegrass	POAR3	*Poa arida*	0–61	–
	fowl bluegrass	POPA2	*Poa palustris*	0–61	–
5	**Grass-Likes**			101–504	
	common spikerush	ELPA3	*Eleocharis palustris*	40–303	–
	sedge	CAREX	*Carex*	0–161	–
	rush	JUNCU	*Juncus*	0–101	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–101	–
	needle spikerush	ELAC	*Eleocharis acicularis*	0–101	–
6	**Non-Native Cool-Season Grasses**			101–303	
	Kentucky bluegrass	POPR	*Poa pratensis*	101–202	–
	smooth brome	BRIN2	*Bromus inermis*	0–101	–
	cheatgrass	BRTE	*Bromus tectorum*	20–101	–
Forb					

7	**Forbs**			101–605	
	Forb, introduced	2FI	*Forb, introduced*	0–202	–
	lambsquarters	CHAL7	*Chenopodium album*	0–202	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	0–202	–
	Forb, perennial	2FP	*Forb, perennial*	0–101	–
	plantain	PLANT	*Plantago*	0–101	–
	povertyweed	IVAX	*Iva axillaris*	0–101	–
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	0–101	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–61	–
	western dock	RUAQ	*Rumex aquaticus*	0–61	–
	New England aster	SYNO2	*Symphyotrichum novae-angliae*	0–61	–
	pale dock	RUAL4	*Rumex altissimus*	0–61	–
	mealy goosefoot	CHIN2	*Chenopodium incanum*	0–61	–
	curlytop knotweed	POLA4	*Polygonum lapathifolium*	0–11	–
	bushy knotweed	PORA3	*Polygonum ramosissimum*	0–6	–
	cocklebur	XANTH2	*Xanthium*	0–6	–
	creeping woodsorrel	OXCO	*Oxalis corniculata*	0–6	–
	curly dock	RUCR	*Rumex crispus*	0–3	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–3	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–3	–
	evening primrose	OENOT	*Oenothera*	0–3	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–3	–
	cinquefoil	POTEN	*Potentilla*	0–1	–
	mint	MENTH	*Mentha*	–	–
	golden tickseed	COTI3	*Coreopsis tinctoria*	–	–
	tall fringed bluebells	MECI3	*Mertensia ciliata*	–	–

Table 10. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			0–45	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–45	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	–	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	–	–
2	**Cool-Season Bunchgrasses**			179–448	
	foxtail barley	HOJU	*Hordeum jubatum*	179–448	–
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	0–27	–
3	**Short Warm-Season Grasses**			9–224	
	saltgrass	DISP	*Distichlis spicata*	9–224	–
	buffalograss	BODA2	*Bouteloua dactyloides*	–	–
4	**Other Native Grasses**			0–45	
	Grass, perennial	2GP	*Grass, perennial*	0–45	–
	plains bluegrass	POAR3	*Poa arida*		

	plains bluegrass	POAR3	*Poa arida*	–	–
	fowl bluegrass	POPA2	*Poa palustris*	–	–
5	**Grass-Like**			45–179	
	common spikerush	ELPA3	*Eleocharis palustris*	18–135	–
	needle spikerush	ELAC	*Eleocharis acicularis*	0–45	–
	sedge	CAREX	*Carex*	0–45	–
	rush	JUNCU	*Juncus*	0–27	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–27	–
6	**Non-Native Cool-Season Grasses**			135–269	
	Kentucky bluegrass	POPR	*Poa pratensis*	90–269	–
	smooth brome	BRIN2	*Bromus inermis*	0–90	–
	cheatgrass	BRTE	*Bromus tectorum*	45–90	–
Forb					
7	**Forbs**			45–179	
	lambsquarters	CHAL7	*Chenopodium album*	0–135	–
	Forb, introduced	2FI	*Forb, introduced*	0–90	–
	Forb, perennial	2FP	*Forb, perennial*	0–45	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–27	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	0–27	–
	plantain	PLANT	*Plantago*	0–27	–
	povertyweed	IVAX	*Iva axillaris*	0–27	–
	mealy goosefoot	CHIN2	*Chenopodium incanum*	0–18	–
	curly dock	RUCR	*Rumex crispus*	0–11	–
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	0–9	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–6	–
	cocklebur	XANTH2	*Xanthium*	0–6	–
	creeping woodsorrel	OXCO	*Oxalis corniculata*	0–3	–
	bushy knotweed	PORA3	*Polygonum ramosissimum*	0–3	–
	curlytop knotweed	POLA4	*Polygonum lapathifolium*	0–3	–
	evening primrose	OENOT	*Oenothera*	–	–
	Indianhemp	APCA	*Apocynum cannabinum*	–	–
	cinquefoil	POTEN	*Potentilla*	–	–
	golden tickseed	COTI3	*Coreopsis tinctoria*	–	–
	mint	MENTH	*Mentha*	–	–
	New England aster	SYNO2	*Symphyotrichum novae-angliae*	–	–
	pale dock	RUAL4	*Rumex altissimus*	–	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	–	–
	tall fringed bluebells	MECI3	*Mertensia ciliata*	–	–
	western dock	RUAQ	*Rumex aquaticus*	–	–

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- and

shrubland 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, and also 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.

Grazing Interpretations
The following table lists the 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 Ecological Site Description). Therefore, a resource inventory is necessary to document plant composition and production. More accurate carrying capacity estimates should eventually be calculated using the following stocking rate information along with animal preference data and actual stocking records, particularly when grazers other than cattle are involved. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity.

The following initial suggested stocking rates are based on 912 lbs./acre (air-dry weight) per Animal-Unit-Month (AUM), with a 25 percent harvest efficiency of preferred and desirable forage species (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: Wheatgrass/Grass-Like/Forbs (1.1)
Average Production (lbs./acre, air-dry): 2,200
Stocking Rate (AUM/acre): 0.60

Plant Community: Wheatgrass-Bluegrass/Grass-Like/Forbs (2.1)
Average Production (lbs./acre, air-dry): 1,800
Stocking Rate (AUM/acre): 0.49

*Plant Community: Foxtail Barley-Bluegrass (3.1)
Average Production (lbs./acre, air-dry): 800
Stocking Rate (AUM/acre): 0.22

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

* Total annual production 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 for livestock. During the dormant period, the forage for livestock will likely be lacking protein to meet livestock requirements, and added protein will allow ruminants to better utilize the energy stored in grazed plant materials. A forage quality test (either directly or through fecal sampling) should be used to determine the level of supplementation needed.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group D. Infiltration is slow and runoff potential for this site is high. In many cases, areas with greater than 75 percent ground cover have the greatest potential for higher infiltration and lower runoff. An example of an exception would be an area where shortgrasses form a strong sod and dominate the site.
Dominance by inland saltgrass will result in reduced infiltration and increased runoff. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (Refer to the USDA-NRCS National Engineering Handbook for hydrologic soil groups, runoff quantities, and hydrologic curves, Part 630.)

Recreational uses

This site provides hunting opportunities for upland game and water fowl species, bird watching, and other opportunities. The wide variety of plants which bloom from spring until fall have an aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are typically present on this site.

Other products

No appreciable wood products are typically present on this site.

Other information

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

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

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Inventory data references

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

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Approval

David Kraft, 1/10/2019

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Editorial Review by Carla Green-Adams.

Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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

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

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

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

7. **Amount of litter movement (describe size and distance expected to travel):**

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

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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:

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17. **Perennial plant reproductive capability:**
