USDA Natural Resources
Conservation Service

Ecological site R064XY046NE
Thin Claypan

Last updated: 12/16/2024
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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.

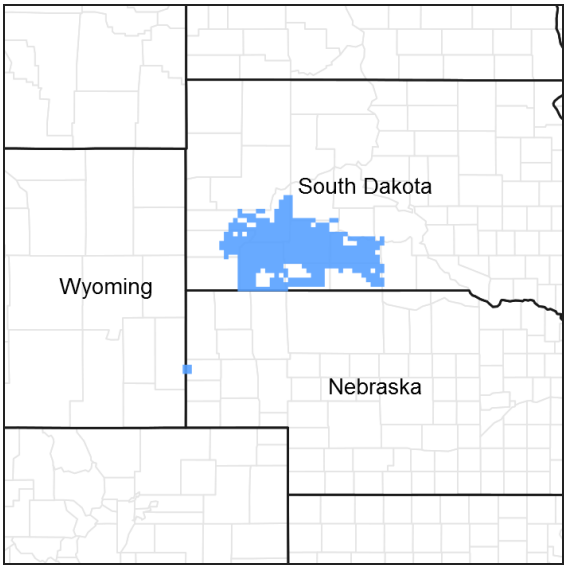

Figure 1. Mapped extent

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 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 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.
Keye Paha Tablelands—331Ft.

Powder River Basin Section—331G:
Subsection: Powder River Basin—331Ge.

Ecological site concept

The Thin Claypan ecological site occurs throughout the MLRA. It is located on level to gently undulating or rolling uplands. The slopes range from 0 to 6 percent. Soil surface textures vary from fine sandy loam to clay loam, 1 to 5 inches thick. The Btn horizon typically occurs within 4 inches of the surface and is extremely hard clay. The columnar- or prismatic-structured subsoil has a rounded or “biscuit-shaped” top. The Btn horizon is high in sodium and can have a whitish coloration.

The vegetation in the Reference State is a mix of cool- and warm-season grasses, mostly rhizomatous wheatgrass, blue grama, and buffalograss. Prickly pear or fragile cactus are often present. Bare ground will increase with erosion, resulting in exposed whitish “biscuit-tops.”

Slick spots (Non-Site) are typically associated with the Thin Claypan ecological site, but technically are not a plant community phase or state within the Thin Claypan site. For accurate representation of this overall landscape, a Slick Spot State (2.0) is included in the State-and-Transition model.

Associated sites

R064XY014NE	**Clayey 14-17" PZ** The Clayey 14-17” PZ ecological site can be found on landscapes adjacent to the Thin Claypan site.
R064XY035NE	**Clayey 17-20 PZ** The Clayey 17-20” PZ ecological site can be found on landscapes adjacent to the Thin Claypan site.
R064XY045NE	**Dense Clay** The Dense Clay ecological site can be found adjacent to or intermingled with the Thin Claypan site.
R064XY044NE	**Claypan** The Claypan ecological site can be found adjacent to or intermingled with the Thin Claypan site.

Similar sites

R064XY035NE	**Clayey 17-20 PZ** The Clayey 17-20” PZ ecological site will occur on higher landscapes positions with similar or greater slopes. Soils will be greater than 20 inches deep and will not have a claypan. The plant community will have more green needlegrass and higher forage production than the Thin Claypan site.
R064XY044NE	**Claypan** The Claypan ecological site can be found adjacent to or intermixed with the Thin Claypan site. It will have a claypan between 5 and 16 inches from the surface and it will have more wheatgrass and green needlegrass and higher forage production.
R064XY014NE	**Clayey 14-17" PZ** The Clayey 14-17” PZ ecological site will occur on higher landscapes positions with similar or greater slopes. Soils will be greater than 20 inches deep and will not have a claypan. The plant community will have more green needlegrass and higher forage production than the Thin Claypan site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Bouteloua gracilis*

Physiographic features

The Thin Claypan ecological site occurs on nearly level to gently undulating or rolling sedimentary uplands.

Table 2. Representative physiographic features

Landforms	(1) Alluvial fan (2) Alluvial flat (3) Hill (4) Terrace
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None to rare
Elevation	2,900–5,000 ft
Slope	0–6%
Water table depth	48–80 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)	92-120 days
Freeze-free period (characteristic range)	119-139 days
Precipitation total (characteristic range)	16-19 in
Frost-free period (actual range)	87-122 days
Freeze-free period (actual range)	110-149 days
Precipitation total (actual range)	15-20 in
Frost-free period (average)	107 days
Freeze-free period (average)	130 days
Precipitation total (average)	17 in

Climate stations used

- (1) LUSK 2 SW [USC00485830], Lusk, WY
- (2) TORRINGTON 29N [USC00488997], Jay Em, WY

- (3) CHADRON 3NE [USC00251578], Chadron, NE
- (4) MARTIN [USC00395281], Martin, SD
- (5) WOOD [USC00399442], Wood, SD
- (6) HARRISON 20 SSE [USW00094077], Harrison, NE
- (7) ALLIANCE 1WNW [USC00250130], Alliance, NE
- (8) HARRISON [USC00253615], Harrison, NE
- (9) HEMINGFORD [USC00253755], Hemingford, NE
- (10) INTERIOR 3 NE [USC00394184], Interior, SD

Influencing water features

No riparian or wetland features are directly associated with the Thin Claypan ecological site.

Wetland description

Not Applicable.

Soil features

The common features of soils in this site are the silt loam to loam surface layer 1 to 4 inches thick, and on slopes of 0 to 6 percent. The soils in this site are moderately well to well drained and formed in alluvium or residuum derived from soft sandstone, siltstone, or shale. The extremely hard clayey Btn horizon has round-topped or “bun-shaped” columnar- or prismatic-structured subsoil. These Btn horizons are high in sodium. The soils have a moderate to slow infiltration rate and very slow saturated hydraulic conductivity. Wet surface compaction can occur with heavy traffic. This site should show slight to no evidence of rills, wind-scoured areas, or pedestalled plants. Water flow paths are broken, irregular in appearance, or discontinuous with numerous debris dams or vegetative barriers. The soil surface is stable and intact.

Major soils correlated to the Thin Claypan ecological site: Arvada, Hisle, Minitare, Wanblee, and Weta.

The Slick Spot portion of the Thin Claypan ecological site does not have a corresponding soil component and is currently considered a Non-Site.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about 4 percent. Loss of 30 percent or more of the surface layer of the soils on this site can result in a shift in species composition and production.

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) Colluvium–shale and siltstone
Surface texture	(1) Silt loam (2) Loam (3) Very fine sandy loam
Family particle size	(1) Clayey
Drainage class	Moderately well drained to well drained
Permeability class	Very slow
Soil depth	20–80 in
Available water capacity (0-40in)	4–6 in
Calcium carbonate equivalent (0-40in)	0–25%

Electrical conductivity (0-40in)	0–30 mmhos/cm
Sodium adsorption ratio (0-40in)	0–30
Soil reaction (1:1 water) (0-40in)	5.6–9.6
Subsurface fragment volume <=3" (Depth not specified)	0–20%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

The Thin 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) 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-Blue Grama-Needlegrass Plant Community (1.1).

Interpretations are primarily based on the Rhizomatous Wheatgrass-Blue Grama Plant Community. 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.

In association with this site are sparsely vegetated areas called slick spots. They usually have considerably more bare ground, are typically dominated by cactus, and are affected by high sodium concentrations. Soil factors, primarily high content of sodium, are the dominant influence in creating slick spots. Grazing management does not necessarily influence this process. Slick spots areas occur as a complex within the Thin Claypan site and it can sometimes be difficult to differentiate between the two areas.

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

Thin Claypan – R064XY046NE 8/20/18

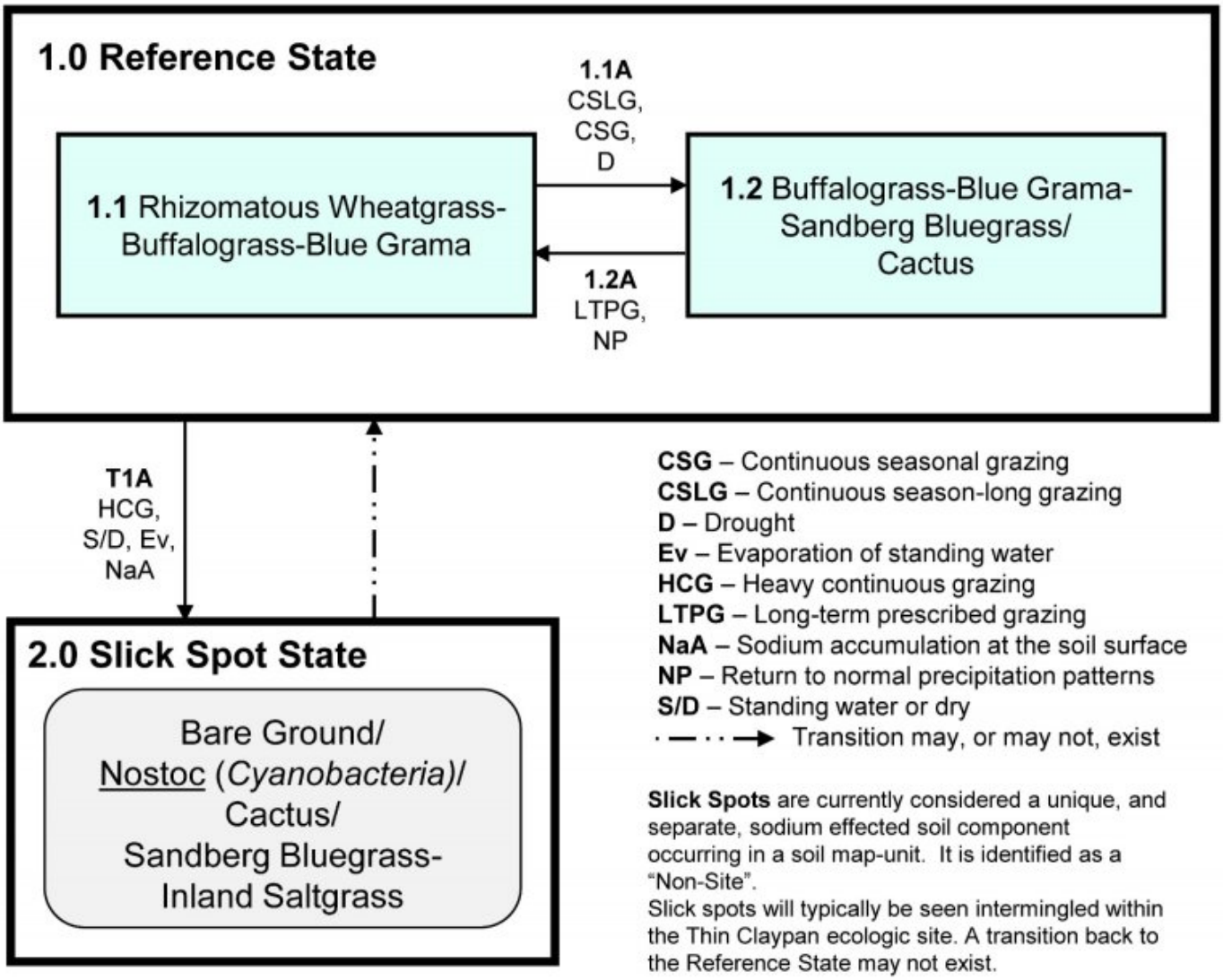

Diagram Legend - Thin Claypan - R064XY046NE

T1A	1.0 to 2.0	Heavy, continuous grazing, repeated wetting and drying of the soil surface, evaporation of standing water, and the accumulation of sodium on the soil surface and in the soil profile.
1.1A	1.1 to 1.2	Continuous season-long grazing or continuous seasonal grazing, or heavy grazing in combination with drought.
1.2A	1.2 to 1.1	Long-term prescribed grazing, including proper stocking rates, change in season of use, adequate time for recovery, and 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 the Thin Claypan ecological site prior to European settlement. This site, in the Reference State, is dominated by a mix of cool-season rhizomatous wheatgrasses and warm-season shortgrasses. Heavy grazing will cause the plant community to transition to a community dominated by warm-season shortgrasses and a minor amount of cool-

season rhizomatous wheatgrasses and needlegrasses. Cactus can increase dramatically and, in the western portion of the MLRA, greasewood can also establish. 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 the warm months of June through August. Today a similar state can be found in areas where proper livestock use has occurred. Non-native cool-season grasses typically will not make up more than 20 percent of any plant community within this State.

Community 1.1
Rhizomatous Wheatgrass-Blue Grama

Interpretations are based primarily on the Western Wheatgrass-Blue Grama Plant Community. This is also considered to be the Reference Plant Community (1.1). This site 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 80 percent grasses or grass-like plants, 10 percent forbs, and 10 percent shrubs. The rhizomatous wheatgrasses dominate the plant community, while blue grama is also prevalent. Other grasses and grass-like plants occurring on the site include green needlegrass, needle and thread, buffalograss, Sandberg bluegrass, and sedges. Significant forbs include scarlet globemallow, cudweed sagewort, and heath aster. Shrubs occurring in this plant community include cactus, saltbush and fringed sagewort. On the western portion of this MLRA, Wyoming big sagebrush and greasewood can occur. 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). Community dynamics, nutrient cycle, water cycle and energy flow are functioning at the potential of the site. Plant litter is properly distributed with some movement off-site and natural plant mortality is low. Low to moderate available water 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	440	865	1290
Forb	45	75	105
Shrub/Vine	15	60	105
Total	**500**	**1000**	**1500**

Figure 9. 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		

Community 1.2
Blue Grama-Sandberg Bluegrass/Cactus

This plant community can develop from heavy, continuous grazing, or annual, spring seasonal grazing, or heavy grazing in combination with drought. Shortgrasses and cactus increase to dominate the site and annual production decreases dramatically. Lack of litter and short plant heights result in higher soil temperatures, poor water infiltration rates, and high evaporation, which gives blue grama a competitive advantage over cool-season midgrasses. This plant community can occur throughout the site, on spot-grazed areas, and around water sources where season-long grazing patterns occur. Blue grama, Sandberg bluegrass, and cactus are the dominant species. Other grasses and grass-likes occurring include western wheatgrass, sedge, buffalograss, inland saltgrass, needle and thread, prairie Junegrass, and annual grasses. Forbs such as brome snakeweed, cudweed sagewort, heath aster, and western yarrow may also be present. Some non-native species will begin to invade this plant community including salsify, sweetclover and annual bromes. There is usually more than 25 percent bare ground. This plant community is quite resilient. The thick sod and competitive advantage prevents other species from establishing. This plant community is less productive than the Rhizomatous Wheatgrass-Blue Grama Plant Community (1.1). Runoff increases, and

infiltration will decrease. Soil erosion will be minimal due to the sod-forming habit of blue grama.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	260	400	740
Forb	20	50	80
Shrub/Vine	20	50	80
Total	**300**	**500**	**900**

Figure 11. Plant community growth curve (percent production by month). NE6404, Pine Ridge/Badlands, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

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

Pathway 1.1A
Community 1.1 to 1.2

Continuous season-long grazing, or continuous seasonal grazing or heavy grazing in combination with drought will convert this plant community to the Blue Grama-Sandberg Bluegrass/Cactus Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing that includes proper stocking rates, change in season of use, and adequate time for plant recovery following grazing, and a return to normal precipitation patterns following drought, will convert this plant community to the Rhizomatous Wheatgrass-Blue Grama Plant Community (1.1).

State 2
Slick Spot State

The soils definition of a slick spot is a small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity. Sodium naturally occurs in the parent materials and soil(s) of this site. Sodium accumulates at the surface of the slick spots through the processes of evaporation and evapotranspiration. When water stands on this site, it will eventually evaporate and draw more sodium near or to the surface. It can also be caused by evapotranspiration, wherein vegetation draws moisture from the soil profile, leaving sodium at or near the surface. Slick spots are currently considered a unique and separate sodium-affected soil component, occurring in a soil map unit, and is identified as a “Non-Site.” Slick spots will typically be seen intermingled within the Thin Claypan ecological site. A vegetation transition to and from the Slick Spot State may or may not exist. The plant community on these soils is typically very sparse, and consists of shallow-rooted perennial grasses, grass-likes, forbs, and shrubs. Brittle cactus and pricklypear tend to persist on these soils, as do Sandberg bluegrass, sedges, blue gramma, buffalograss, and inland saltgrass. The production will vary from almost none to 100 to 300 pounds per acre. Nostoc, a common genus of cyanobacteria, will almost always be found on slick spots. When dry, it is dark-colored and tends to look like a small, dry forb leaf. When wet, it swells up into a conspicuous, dark green jellylike mass. Nostoc species are native and are not considered a noxious plant or pest.

Community 2.1
Bare Ground/Nostoc/Cactus/Sandberg Bluegrass-Inland Saltgrass

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	10	96	196
Shrub/Vine	0	20	40
Forb	0	9	15
Total	**10**	**125**	**251**

Figure 13. Plant community growth curve (percent production by month). NE6404, Pine Ridge/Badlands, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

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

Transition T1A
State 1 to 2

Heavy, continuous grazing, repeated wetting and drying of the soil surface, evaporation of standing water, and the accumulation of sodium on the soil surface and in the soil profile will transition the Reference State (1.0) to the Slick Spot State (2.0). It is highly unlikely that once this transition occurs there is a restoration pathway back to the Reference State (1.0).

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			200–400	
	western wheatgrass	PASM	*Pascopyrum smithii*	200–400	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–100	–
2	**Short- Warm-Season Grasses**			150–250	
	buffalograss	BODA2	*Bouteloua dactyloides*	100–150	–
	blue grama	BOGR2	*Bouteloua gracilis*	50–100	–
3	**Cool-Season Bunchgrasses**			50–200	
	green needlegrass	NAVI4	*Nassella viridula*	10–100	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	10–100	–
	Sandberg bluegrass	POSE	*Poa secunda*	10–50	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–50	–
4	**Other Native Grasses & Grass-Likes**			50–150	
	sedge	CAREX	*Carex*	20–100	–
	Grass, perennial	2GP	*Grass, perennial*	10–50	–
	Grass, annual	2GA	*Grass, annual*	10–50	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–50	–
	saltgrass	DISP	*Distichlis spicata*	0–30	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	0–20	–
	dropseed	SPORO	*Sporobolus*	0–20	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–20	–
	threeawn	ARIST	*Aristida*	–	–

5	**Non-Native Cool-Season Grasses**			0	
	field brome	BRAR5	*Bromus arvensis*	–	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	–	–
	cheatgrass	BRTE	*Bromus tectorum*	–	–
Forb					
6	**Forbs**			50–100	
	white heath aster	SYER	*Symphyotrichum ericoides*	10–20	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	10–20	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	10–20	–
	Forb, perennial	2FP	*Forb, perennial*	0–20	–
	Forb, annual	2FA	*Forb, annual*	0–20	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	10–20	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	10–20	–
	sticky cinquefoil	POGL9	*Potentilla glandulosa*	0–10	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–10	–
	Nuttall's violet	VINU2	*Viola nuttallii*	0–10	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–10	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–10	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–10	–
	rosy pussytoes	ANRO2	*Antennaria rosea*	0–10	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–10	–
	spiny phlox	PHHO	*Phlox hoodii*	0–10	–
	onion	ALLIU	*Allium*	0–10	–
	American vetch	VIAM	*Vicia americana*	0–10	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–10	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	–	–
	goatsbeard	TRAGO	*Tragopogon*	–	–
	sweetclover	MELIL	*Melilotus*	–	–
Shrub/Vine					
7	**Shrubs**			20–100	
	prairie sagewort	ARFR4	*Artemisia frigida*	10–30	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–30	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–30	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–20	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–20	–
	saltbush	ATRIP	*Atriplex*	0–20	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	10–20	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–20	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–20	–
	greasewood	SARCO	*Sarcobatus*	0–10	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–10	–

Table 9. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			25–50	
	western wheatgrass	PASM	*Pascopyrum smithii*	25–50	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–25	–
2	**Short- Warm-Season Grasses**			125–225	
	buffalograss	BODA2	*Bouteloua dactyloides*	100–200	–
	blue grama	BOGR2	*Bouteloua gracilis*	25–75	–
3	**Cool-Season Bunchgrasses**			0–50	
	Sandberg bluegrass	POSE	*Poa secunda*	5–25	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–25	–
	green needlegrass	NAVI4	*Nassella viridula*	0–15	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–15	–
4	**Other Native Grasses & Grass-Likes**			25–125	
	sedge	CAREX	*Carex*	15–75	–
	threeawn	ARIST	*Aristida*	5–25	–
	saltgrass	DISP	*Distichlis spicata*	0–25	–
	dropseed	SPORO	*Sporobolus*	5–25	–
	Grass, perennial	2GP	*Grass, perennial*	0–25	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–15	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	0–15	–
	Grass, annual	2GA	*Grass, annual*	0–5	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	–	–
5	**Non-Native Cool-Season Grasses**			50–125	
	cheatgrass	BRTE	*Bromus tectorum*	40–100	–
	field brome	BRAR5	*Bromus arvensis*	10–25	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	0–25	–
Forb					
6	**Forbs**			25–75	
	sweetclover	MELIL	*Melilotus*	0–40	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–25	–
	Forb, annual	2FA	*Forb, annual*	0–20	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	5–15	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	5–15	–
	onion	ALLIU	*Allium*	0–15	–
	white heath aster	SYER	*Symphyotrichum ericoides*	5–15	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	5–15	–
	goatsbeard	TRAGO	*Tragopogon*	5–15	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	5–15	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	5–15	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–10	–

	rosy pussytoes	ANRO2	*Antennaria rosea*	5–10	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–10	–
	spiny phlox	PHHO	*Phlox hoodii*	5–10	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	5–10	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–10	–
	Forb, perennial	2FP	*Forb, perennial*	0–10	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–5	–
	sticky cinquefoil	POGL9	*Potentilla glandulosa*	0–5	–
	Nuttall's violet	VINU2	*Viola nuttallii*	–	–
	American vetch	VIAM	*Vicia americana*	–	–
Shrub/Vine					
7	**Shrubs**			25–75	
	brittle pricklypear	OPFR	*Opuntia fragilis*	5–30	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	5–25	–
	prairie sagewort	ARFR4	*Artemisia frigida*	5–25	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–25	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–25	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–25	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–15	–
	greasewood	SARCO	*Sarcobatus*	0–15	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–10	–
	saltbush	ATRIP	*Atriplex*	0–5	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	–	–

Table 10. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			0–1	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–1	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	–	–
2	**Short- Warm-Season Grasses**			6–19	
	buffalograss	BODA2	*Bouteloua dactyloides*	6–19	–
	blue grama	BOGR2	*Bouteloua gracilis*	1–6	–
3	**Cool-Season Bunchgrasses**			6–38	
	Sandberg bluegrass	POSE	*Poa secunda*	6–38	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	–	–
	green needlegrass	NAVI4	*Nassella viridula*	–	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	–	–
4	**Other Native Grasses & Grass-Likes**			1–25	
	saltgrass	DISP	*Distichlis spicata*	1–19	–
	sedge	CAREX	*Carex*	1–13	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	0–6	–
	dropseed	SPORO	*Sporobolus*	0–6	–

	little bluestem	SCSC	*Schizachyrium scoparium*	–	–
	threeawn	ARIST	*Aristida*	–	–
	Grass, perennial	2GP	*Grass, perennial*	–	–
	Grass, annual	2GA	*Grass, annual*	–	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	–	–
5	**Non-Native Cool-Season Grasses**			3–13	
	cheatgrass	BRTE	*Bromus tectorum*	3–13	–
	field brome	BRAR5	*Bromus arvensis*	–	–
	crested wheatgrass	AGCR	*Agropyron cristatum*	–	–
Forb					
6	**Forbs**			6–13	
	Forb, annual	2FA	*Forb, annual*	0–6	–
	onion	ALLIU	*Allium*	0–4	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–3	–
	woolly plantain	PLPA2	*Plantago patagonica*	1–3	–
	Forb, perennial	2FP	*Forb, perennial*	0–3	–
	goatsbeard	TRAGO	*Tragopogon*	0–1	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	–	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	–	–
	sticky cinquefoil	POGL9	*Potentilla glandulosa*	–	–
	sweetclover	MELIL	*Melilotus*	–	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	–	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	–	–
	American vetch	VIAM	*Vicia americana*	–	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	–	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	–	–
	white heath aster	SYER	*Symphyotrichum ericoides*	–	–
	spiny phlox	PHHO	*Phlox hoodii*	–	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	–	–
	Nuttall's violet	VINU2	*Viola nuttallii*	–	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	–	–
	rosy pussytoes	ANRO2	*Antennaria rosea*	–	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	–	–
Shrub/Vine					
7	**Shrubs**			3–38	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–25	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	3–19	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–6	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–6	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–4	–
	greasewood	SARCO	*Sarcobatus*	0–3	–

	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	–	–
	saltbush	ATRIP	*Atriplex*	–	–
	silver sagebrush	ARCA13	*Artemisia cana*	–	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	–	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	–	–

Animal community

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

The majority of the Thin Claypan ecological site remains intact and provides increasingly important habitat for grassland- and shrub steppe-nesting birds, small rodents, coyote, and a variety of reptiles, amphibians, and insects. Invasive species such as annual bromegrasses and cheatgrass 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-Blue Grama Plant Community (1.1): The predominance of grasses plus high diversity of forbs and shrubs in this community favors grazers and mixed-feeders, such as deer and pronghorn. Insects, such as pollinators, play a large role in maintaining the forb community and provide a forage base for grassland birds and other species. The complex plant structural diversity provides habitat for a wide array of migratory and resident birds. Grasshopper sparrow, lark bunting, western meadowlark, and sharp-tailed grouse are common and benefit from the structure and composition this plant community provides. The Thin Claypan ecological site provides important breeding habitat for the loggerhead shrike. This site provides excellent nesting and brood-rearing habitat for sharp-tailed grouse. Diverse prey populations are available for grassland raptors such as northern harrier, ferruginous hawk, Swainson’s hawk, golden eagle, and prairie falcon.

The diversity of grasses, forbs, and shrubs provide high nutrition levels for small and large herbivores including voles, mice, spotted ground squirrels, white- and black-tailed jackrabbit, and deer. The Thin Claypan ecological site provides excellent wintering habitat for pronghorn. The moderate stature of this plant community provides suitable

thermal, protective, and escape cover for small herbivores and grassland birds. Predators utilizing this plant community include coyote, American badger, red fox, and long-tailed weasel. This plant community provides habitat for spade foot toad, Great Plains toad, bull snake, and prairie rattlesnake.

Blue Grama-Sandberg Bluegrass/Cactus (1.2): Resulting from heavy, continuous grazing or annual, spring seasonal grazing, blue grama and cactus will dominate. Forb diversity decreases, and abundance has remained relatively unchanged. Shrub abundance significantly increases, especially cacti and, to a lesser extent, big sagebrush.
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, and white- and black-tailed jackrabbit may be present, while species such as desert cottontail will 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. This plant community provides habitat for spade foot toad, Great Plains toad, bull snake, and prairie rattlesnake.

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-Blue Grama (1.1)
Average Production (lb/acre, air-dry): 1,000
Stocking Rate (AUM/acre): 0.27

Plant Community: Blue Grama-Sandberg Bluegrass/Cactus (1.2)
Average Production (lb/acre, air-dry): 500
Stocking Rate (AUM/acre): 0.14

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 varies from moderately slow to moderate and runoff varies from low to high depending on slope and ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for

high infiltration and lower runoff. An 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, Wade Anderson, range professional and rancher, and Kent Cooley, area resource 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 1/10/2019.

Soils information from Kent Cooley.

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 the site.

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2. **Presence of water flow patterns:** Water flow patterns are common. Water flow patterns are broken or irregular in appearance, or discontinuous with numerous debris dams.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals are somewhat common, but few exposed roots would occur.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is typically 5 to 20 percent with patches up to 12 inches (30.5 cm) in diameter. This does not include associated slickspots which are not an ecological site.

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

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

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7. **Amount of litter movement (describe size and distance expected to travel):** Small size litter classes will generally move short (less than 6 inches or 15.25 cm) distances, some medium size-class litter will move very short distances. Litter debris dams are occasionally present.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability ratings should typically be 3 or greater. Surface organic matter adheres to the soil surface in most cases. Soil surface fragments will typically retain structure for short periods when dipped in distilled water. Some fragments will dissolve in less than 1 minute.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A-horizon not present, but soil has light colored E-horizon which is 1 to 4 inches (2.5 to 10.2 cm) thick. Soil colors range from gray, light gray, light brown, to light brownish gray (values of 5 to 7) when dry and very dark gray, very dark grayish brown, dark grayish brown or grayish brown (values of 3 to 5) when moist. Structure is thin platy parting to fine granular.

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

    Relative composition is approximately 80 percent grasses or grass-like plants, 10 percent forbs, and 10 percent shrubs. The grass and grass-like component is composed of C3, rhizomatous grasses (20-40%), C3, bunch grasses (5-20%), C4, short grasses (15-25%), grass-likes (2-10%), and C4, tall and midgrasses (0-5%).

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. The soils will have a natural platy structure near the surface. When wet, surface compaction due to heavy traffic (livestock or vehicle traffic) can occur.

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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, 200-400 #/ac, 20-40% (1 species minimum): western Wheatgrass, thickspike wheatgrass.
2. Native, perennial, C4, shortgrass, 150-250 #/ac, 15-25% (2 species minimum): blue grama, buffalograss, inland saltgrass, tumblegrass.

Phase 1.2
1. Native, perennial, C4, shortgrass, 125-250 #/ac, 25-50% (2 species minimum): buffalograss, blue grama, tumblegrass, saltgrass, threeawn.
2. Non-native grass, 50-125 #/ac, 10-25% (2 species minimum): cheatgrass, field brome, crested wheatgrass.

Sub-dominant: Phase 1.1
1. Native, perennial, C3, bunchgrass, 50-200 #/ac, 5-20% (3 species minimum): green needlegrass, needle and thread, prairie Junegrass, Sandberg bluegrass.

Phase 1.2
1.Native, perennial, C3 bunchgrass, 25-75 #/ac, 5-15% (1 species minimum): Sandberg bluegrass, prairie Junegrass, green needlegrass, needle and thread.
2. Native forbs, 25-75 #/ac, 5-15% (10 species minimum): wavyleaf thistle, western yarrow, white heath aster, upright prairie coneflower, goatsbeard, silverleaf Indian breadroot, white sagebrush, scarlet globemallow, spiny phlox, purple locoweed, and other forbs that vary from location to location.
3. Shrubs, 25-75 #/ac, 5-15%, 3 species minimum: brittle pricklypear, broom snakeweed, prairie sagewort and other shrubs that vary from location to location.
4. Native grass-likes, 15-75 #/ac, 3-15% (1 species minimum): sedges

Other: Minor - Phase 1.1
1. Native forbs, 50-100 #ac, 5-10%: forbs present vary from location to location.
2. Native grass-likes, 20-100 #/ac, 2-10%: sedges.
3. Shrubs, 20-100 #/ac, 2-10%: shrubs vary from location to location.
4. Native, perennial, C4, tall- and midgrass, 0-50 #/ac, 0-5%: dropseed, little bluestem, prairie sandreed.

Minor - Phase 1.2
1. Native, perennial, C3, rhizomatous grass, 25-50 #/ac, 5-10%: western wheatgrass, thickspike wheatgrass.
2. Native, perennial, C4, tall- and midgrass, 5-25 #/ac, 1-5%: dropseed, little bluestem, prairie sandreed.

Additional: The Rhizomatous Wheatgrass-Green Needlegrass Community or Reference Community (1.1) consists of seven F/S groups. These groups, in order of relative abundance, are native, perennial, C3 rhizomatous grass; native, perennial, C4 shortgrass; native, perennial, C3 bunchgrass; native forbs; shrubs, native, perennial, C4, tall- and midgrass; and native grass-likes.

The Rhizomatous Wheatgrass-Blue Grama-Buffalograss Community (1.2) consists of seven F/S groups, which in order of abundance, are native, perennial, C4 shortgrass; perennial, C3 bunchgrass; native forbs; shrubs; native grass-likes; native, perennial, C3, rhizomatous grass; native, and native, perennial, C4, tall- and midgrass.

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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.

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14. **Average percent litter cover (%) and depth (in):** Plant litter cover is evenly distributed throughout the site and is expected to be 20 to 50 percent and at a depth of approximately 0.25 inch (0.65 cm).

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Annual production is 1,000 pounds per acre in a year with normal precipitation and temperatures. Low and High production years should yield 500 and 1,500 pounds per acre respectively.

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 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.

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.