

# Ecological site R064XY049NE Badlands Overflow

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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 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.

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: 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—311Fh. Pine Ridge Escarpment—311Fj. High Plains—311Fk. Hartville Uplift-311Fm. Western Nebraska Sandy and Silty Tablelands—311Fn. Keye Paha Tablelands—331Ft.

## **Ecological site concept**

The Badlands Overflow ecological site is throughout MLRA 64 but is specifically described for those areas where the soils are derived from parent material weathered from the White River Group of geological formations. The Badlands Overflow site is on nearly level flood plains, drainageways, and alluvial fans. This site receives additional moisture from overflow of intermittent streams or runoff from adjacent slopes.

The soils of this site are very deep and well drained. They formed in sodium-enriched alluvium. These soils typically have dispersive characteristics due to the high content of sodium. This feature tends to cause the soils to be naturally erosive because the aggregate stability is low in the surface layer and all horizons lack structure. The surface layer is loam or silt loam from 2 to 4 inches in thickness. The subsurface is also loam or silt loam and is not restrictive to water movement or root penetration. Typically, available water capacity is high.

The characteristic vegetation in the Reference State (1.0) consists of a mix of warm- and cool-season grasses. Warm-season grasses, including switchgrass, little bluestem, and prairie sandreed, tend to be the dominant group. Rhizomatous wheatgrass and needlegrasses are the subdominant cool-season group. Forbs are common and diverse. Shrubs, such as rose and western snowberry, are common. Plains cottonwood grows in scattered areas.

# Associated sites

R064XY048NE	Badlands Terrace					
	The Badlands Terrace ecological site is on stream terraces above the Badlands Overflow site.					

## Similar sites

R064XY048NE	Badlands Terrace
	The Badlands Terrace ecological site is on stream terraces above the Badlands Overflow site. The plant
	community has very little switchgrass, more little bluestem, and lower forage production than the
	Badlands Overflow site.

#### Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) Panicum virgatum (2) Pascopyrum smithii

## **Physiographic features**

The Badlands Overflow ecological site is in the eroded badlands on nearly level areas that receive additional water from overflow of intermittent streams or runoff from adjacent slopes.



Figure 2. Badlands Overflow and Badlands Terrace complex in Pennington County, South Dakota.

Landforms	<ul><li>(1) Badlands &gt; Flood plain</li><li>(2) Drainageway</li><li>(3) Alluvial fan</li></ul>
Runoff class	Low to medium
Flooding duration	Brief (2 to 7 days)
Flooding frequency	Frequent
Ponding frequency	None
Elevation	2,900–5,000 ft
Slope	0–3%
Water table depth	80 in
Aspect	Aspect is not a significant factor

Table 2. Representative physiographic features

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

## Influencing water features

The Badlands Overflow ecological site is adjacent to intermittent streams and drainageways.

Stream Type: B6, C6 (Rosgen System)

## Wetland description

Not Applicable.

## Soil features

The soils of this site are very deep and well drained. They formed in sodium-enriched alluvium. These soils typically have dispersive characteristics due to the high content of sodium. This feature tends to cause the soils to be naturally erosive because the aggregate stability is low in the surface layer and all horizons lack structure. These soils have moderate or moderately slow permeability. The surface layer is loam or silt loam from 2 to 4 inches in thickness. Areas of this site receive additional water overflow of intermittent streams or runoff from adjacent slopes. Typically, available water capacity is high. This site shows slight to no evidence of rills, wind-scoured areas, or pedestalled plants. Water flow paths are broken, irregular in appearance, or are discontinuous and have numerous debris dams or vegetative barriers. The soil surface is relatively stable and intact. Subsurface soil layers do not restrict water movement and root penetration.

Soil Correlated to the Badlands Overflow Site: Interior, frequently flooded

Where the Interior soil is rarely flooded, it is correlated to the Badlands Terrace (R064XY048NE) ecological site. Where it is poorly drained, it is correlated to the Wet Land (R064XY022NE) ecological site.

These soils are susceptible to water erosion, resulting in either downcutting or deposition (aggradation). Headcuts may develop if adequate vegetative cover is not maintained or if a sinkhole occurs. They may also develop due to soil sloughing caused by piping as a result of natural features, such as animal burrows and root channels. Deposition of soil can also occur on this site during flooding events, essentially burying the existing overflow site and cutting a new channel. Drastic disturbance of the soil surface layer 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 or use the Web Soil Survey online for details specific to your area of interest.



Figure 9. The Interior soil in Sioux County, Nebraska. This soil profile illustrates the dynamics of deposition and downcutting on this ecological site.

Table 4. Representative son realures	Table 4	. Repres	entative	soil	features
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Parent material	(1) Alluvium–calcareous siltstone
Surface texture	(1) Silt Ioam (2) Loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately slow to moderate
Soil depth	80 in
Available water capacity (0-40in)	8–9 in
Calcium carbonate equivalent (0-40in)	5–30%
Electrical conductivity (0-40in)	0–4 mmhos/cm
Sodium adsorption ratio (0-40in)	10–35
Soil reaction (1:1 water) (0-40in)	7.4–9
Subsurface fragment volume <=3" (Depth not specified)	0–10%
Subsurface fragment volume >3" (Depth not specified)	0–5%

## **Ecological dynamics**

The most significant influence in the development of the Badlands Overflow ecological site is the episodes of geologic erosion on this and adjacent landscape positions in the White River Badlands. Due to the proximity of weathered and loose parent material, this site is constantly in flux.

A unique plant community grows on the alluvial fan that develops immediately below steep badlands outcrops. This

community provides insight into the development of the ecological site. The community (Wheatgrass-Indian Ricegrass/Low Shrubs) is the early successional stage of the Badlands Overflow ecological site, referred to as a "Badlands Fan". It is characterized by bare ground and scattered areas of western wheatgrass, thickspike wheatgrass, Indian ricegrass, fewflower buckwheat, and rubber rabbitbrush. Visher's buckwheat can also grow in this early successional plant community. These species are adapted to readily survive when buried by new soil. Some individual plants of silver sagebrush and rose grow sporadically. Erosion occurs but is usually not a concern because deposition is typically the dominant process. As deposition decreases and distance from the source of erosion increases, this site begins to stabilize and move gradually to the next successional stage, which is typified in the Wheatgrass-Needlegrass-Indian Ricegrass/Shrubs/50-80% *Bare Ground* Plant Community (1.3).

The Great Plains climate plays an important role because the sporadic heavy rainfall causes fluctuating erosion and deposition on this site. Recent grazing or browsing patterns also affect the site, but only if it is stable long enough to establish vegetation for an extended period of time. Although the following descriptions are typical of the transitions between communities, severe disturbances, such as periods of well-below average precipitation, 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 cause the site to depart from the Switchgrass-Wheatgrass-Needlegrass/Shrubs Plant Community (1.1). The abundance of wheatgrass increases initially but eventually decreases under continuous grazing. Grasses, including switchgrass and needlegrass decrease in extent and production. Reduction of vegetative cover can result in rapid degeneration of the site. Headcuts and downcutting are relatively common and can convert areas into the Badlands Terrace ecological site.

Interpretations are primarily based on the Switchgrass-Wheatgrass-Needlegrass/Shrubs Plant Community (1.1). The composition of this community was 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 were also used. Plant communities, states, transitional pathways, and thresholds were determined through similar studies and experience.

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

## State and transition model

# Badlands Overflow - R064XY049NE 8/16/19



LTPG - Long-term prescribed grazing NDC - No downcutting

NE - Natural erosion

PG - Prescribed grazing

## Diagram Legend - Badlands Overflow - R064XY049NE

T1A	Heavy, continuous season-long grazing or frequent and severe defoliation.							
R2A	Long-term prescribed grazing with proper stocking rates, change in season of use, and adequate time for recovery. This transition may not be fast or feasible.							
1.1A	1.1 to 1.3	Natural erosion and deposition of soil on the site, or continuous season-long grazing without adequate time for recovery and with management-induced erosion and deposition.						
1.2A	<b>1.2 to 1.1</b> Decreased channel deposition, no channel downcutting, and prescribed grazing proper stocking, change in season of use, and adequate time for recovery.							
1.2B	1.2 to 1.3	Natural erosion and deposition of soil on the site, or continuous season-long grazing without adequate time for recovery and with management-induced erosion and deposition.						
1.3A	1.3 to 1.2	Decreased channel deposition and no channel downcutting.						

# State 1 Reference Sate

The Reference State represents the best estimate of the natural range of variability that dominated the dynamics in this ecological site prior to European settlement. This site is dominated by warm- and cool-season grasses. In pre-European times, the primary disturbances included natural erosion, fire, and grazing by large ungulates, small mammals, and insects. Favorable growing conditions occur during the spring and the warm months of June through August. This state is in areas that have a history of proper grazing management, including adequate recovery periods between grazing events. Severe flooding and channel downcutting elevate this site to a higher landscape position and transition the plant community to one described in the Badlands Terrace (R064XY048NE) ecological site.

## Community 1.1 Switchgrass-Wheatgrass-Needlegrass/Shrubs

Interpretations are based primarily on the Switchgrass-Wheatgrass-Needlegrass/Shrubs Plant Community, which is also considered to be the Reference Plant Community (1.1). This plant community evolved with grazing by large herbivores and infrequent flooding. The potential vegetation is about 85 percent grasses and grass-like plants, 5 percent forbs, and 10 percent shrubs. The plant community is dominated by both warm- and cool-season grasses. The major grasses include switchgrass, western wheatgrass or thickspike wheatgrass, and needle and thread. Other grasses and grass-like plants include big bluestem, prairie sandreed, and tall dropseed. Significant forbs include white sagebrush (cudweed sagewort), goldenrod, and scurfpea. The dominant shrubs are rose, silver sagebrush, and western snowberry. Wyoming big sagebrush grows in this plant community in the western portions of MLRA 64. Plains cottonwood also grows in scattered areas. This plant community is productive and diverse. The diversity in plant species allows for high drought tolerance. This plant community is sustainable in regard to site stability, soil stability, watershed function, and biologic integrity as long as extreme erosion or deposition events do not occur. This plant community is well adapted to the climatic conditions of the Northern Great Plains. Individual species can vary greatly in production depending on growing conditions (timing and amount of precipitation and temperature). Community dynamics, nutrient and water cycles, and energy flow function properly. Plant litter is properly distributed with very little movement offsite. Natural plant mortality is very low. Drought tolerance is high. Runoff from adjacent sites and the moderate or high available water capacity provide a favorable soil-water-plant relationship.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1835	2172	2500
Shrub/Vine	45	144	250
Forb	20	72	125
Tree	0	12	25
Total	1900	2400	2900

Figure 11. Plant community growth curve (percent production by month). NE6408, Pine Ridge/Badlands, lowland cool-season/warm-season co-dominant. Cool-season, warm-season co-dominant, lowland.

J	an	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			5	12	20	25	19	11	5	3		

# Community 1.2 Wheatgrass-Needlegrass-Prairie Sandreed/Shrubs

This plant community results from either continuous season-long grazing and management-induced erosion and deposition or from natural erosion and deposition. Western wheatgrass and thickspike wheatgrass increase in abundance. Switchgrass, big bluestem, and green needlegrass decrease in abundance, while prairie sandreed and needle and thread increase. Other grasses and grass-like plants include tall dropseed, little bluestem, sideoats grama, inland saltgrass, and blue grama. Potential vegetation is about 80 percent grasses or grass-like plants, 10 percent forbs, and 10 percent shrubs. Production and diversity decline somewhat compared to the Switchgrass-Wheatgrass- Needlegrass/Shrubs Plant Community (1.1). Typically, as a result of erosion and deposition, more bare ground is in areas of Phase 1.2 than in areas of Phase 1.1. The plant community is still relatively stable but is more prone to continued erosion.

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1370	1720	2065
Forb	95	150	205
Shrub/Vine	35	120	205
Tree	0	10	25
Total	1500	2000	2500

#### Table 6. Annual production by plant type

Figure 13. Plant community growth curve (percent production by month). NE6407, Pine Ridge/Badlands, cool-season dominant, warm-season sub-dominant. Cool-season dominant, warm-season sub-dominant, lowland.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	8	25	30	15	10	2	5		

# Community 1.3 Wheatgrass-Needlegrass-Indian Ricegrass/Shrubs/50-80% Bare Ground

This plant community results from continuous season-long grazing, natural erosion, and deposition. Western wheatgrass and thickspike wheatgrass continue to increase in composition. Switchgrass and big bluestem are no longer present, and green needlegrass is nearly absent. Although Indian ricegrass increases in extent and is relatively abundant, it stands out when looking across the aspect of the site. Other grasses and grass-like plants include needle and thread, inland saltgrass, and little bluestem. Shrubs of significance include silver sagebrush, rose, rubber rabbitbrush, fewflower buckwheat, and, in the western portions of the MLRA, Wyoming big sagebrush. Potential vegetation is about 75 percent grasses or grass-like plants, 10 percent forbs, and 15 percent shrubs.

Production and diversity decline considerably compared to the Switchgrass-Wheatgrass- Needlegrass/Shrubs Plant Community (1.1). Bare ground is evident and occupies 50 to 80 percent of the ground surface. The plant community has a greatly diminished effect on site stability, and future weather events determine site aggradation or degradation.

#### Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	440	835	1225
Shrub/Vine	45	100	155
Forb	15	60	105
Tree	0	5	15
Total	500	1000	1500

Figure 15. Plant community growth curve (percent production by month). NE6401, Pine Ridge/Badlands, cool-season dominant. Cool-season dominant.

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

# Pathway 1.1A Community 1.1 to 1.3

Either natural erosion and deposition or continuous season-long grazing and management-induced erosion and deposition convert Plant Community 1.1 to the Wheatgrass-Needlegrass-Indian Ricegrass/Shrubs/50-80% *Bare Ground* Plant Community (1.3).

# 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, decreased deposition, and no downcutting of the channel convert Plant Community 1.2 to the Switchgrass-Wheatgrass-Needlegrass/Shrubs Plant Community (1.1).

# Pathway 1.2B Community 1.2 to 1.3

Either natural erosion and deposition or continuous season-long grazing and management induced erosion and deposition convert Plant Community 1.2 to the Wheatgrass-Needlegrass-Indian Ricegrass/Shrubs/50-80% *Bare Ground* Plant Community (1.3).

# Pathway 1.3A Community 1.3 to 1.2

Decreased deposition and no downcutting of the channel convert Plant Community 1.3 to the Wheatgrass-Needlegrass-Prairie Sandreed/Shrubs Plant Community (1.2).

# State 2 Disturbed State

The Disturbed State results from heavy, continuous season-long grazing or from frequent and severe defoliation. In most cases, this state is dominated by grazing resistant grasses, pioneer perennials, and annual grasses and by forbs. The extent of bare ground is also much greater than in any other plant community phase. This state is at risk for further degradation or aggradation caused by water erosion.

# Community 2.1 Wheatgrass-Inland Saltgrass/Knotweed

This plant community develops from heavy, continuous season-long grazing. The vegetation is mainly western wheatgrass, thickspike wheatgrass, inland saltgrass, and knotweed. Most other species are either greatly diminished or absent. Silver sagebrush, rose, and broom snakeweed may survive under these extreme conditions. This plant community is susceptible to increased erosion because the vigor of most plants is reduced, and bare ground is prevalent. At times, however, the inland saltgrass and knotweed, both of which are less subject to grazing, can persist and stabilize the site.

#### Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	265	441	610
Forb	25	90	155
Shrub/Vine	10	66	125
Tree	0	3	10
Total	300	600	900

Figure 17. Plant community growth curve (percent production by month). NE6409, Pine Ridge/Badlands, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant, lowlands.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		3	8	18	27	23	12	6	3		

# Transition T1A State 1 to 2

Heavy, continuous season-long grazing or frequent and severe defoliation transition the Reference State (1.0) to the Disturbed State (2.0).

# Restoration pathway R2A State 2 to 1

Long-term prescribed grazing may eventually convert the Disturbed State (2.0) closer to the Reference State (1.0). This transition is difficult to achieve because inland saltgrass and knotweed are persistent and competitive.

# Additional community tables

#### Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass	/Grasslike	•	•		
1	Rhizomatous Wheatgras	S		240–600	
	thickspike wheatgrass	ELLAL	Elymus lanceolatus ssp. lanceolatus	240–600	-
	western wheatgrass	PASM	Pascopyrum smithii	240–600	-
2	Cool-Season Bunchgras	s		120–360	
	needle and thread	HECOC8	Hesperostipa comata ssp. comata	120–360	-
	green needlegrass	NAVI4	Nassella viridula	120–360	-
3	Tall- and Mid- Warm-Sea	son Grass	es	480–840	
	switchgrass	PAVI2	Panicum virgatum	120–480	-
	big bluestem	ANGE	Andropogon gerardii	120–360	_

	prairie sandreed	CALO	Calamovilfa longifolia	48–240	-				
	marsh muhly	MURA	Muhlenbergia racemosa	0–120	_				
	prairie cordgrass	SPPE	Spartina pectinata	0–120	_				
4	Other Native Grasses	•		120–600					
	composite dropseed	SPCOC2	Sporobolus compositus var. compositus	48–240	-				
	blue grama	BOGR2	Bouteloua gracilis	0–120	-				
	hairy grama	BOHI2	Bouteloua hirsuta	0–120	_				
	buffalograss	BODA2	Bouteloua dactyloides	0–120	-				
	little bluestem	SCSC	Schizachyrium scoparium	24–120	-				
	sideoats grama	BOCU	Bouteloua curtipendula	48–120	-				
	Grass, perennial	2GP	Grass, perennial	0–120	-				
	saltgrass	DISP	Distichlis spicata	0–72	-				
	plains muhly	MUCU3	Muhlenbergia cuspidata	0–72	_				
	Indian ricegrass	ACHY	Achnatherum hymenoides	0–72	_				
	prairie Junegrass	KOMA	Koeleria macrantha	0–72	-				
	Sandberg bluegrass	POSE	Poa secunda	0–72	_				
5	Grass-Likes			0–72					
	Grass-like (not a true grass)	2GL	Grass-like (not a true grass)	0–72	-				
	sedge	CAREX	Carex	0–72	-				
Forb		•		•					
7	Forbs			24–120					
	American licorice	GLLE3	Glycyrrhiza lepidota	0–72	_				
	white sagebrush	ARLU	Artemisia ludoviciana	24–72	-				
	false boneset	BREU	Brickellia eupatorioides	0–72	-				
	Forb, perennial	2FP	Forb, perennial	24–72	-				
	goldenrod	SOLID	Solidago	24–72	-				
	Cuman ragweed	AMPS	Ambrosia psilostachya	0–48	-				
	western yarrow	ACMIO	Achillea millefolium var. occidentalis	24–48	-				
	upright prairie coneflower	RACO3	Ratibida columnifera	24–48	-				
	scarlet beeblossom	GACO5	Gaura coccinea	24–48	-				
	scurfpea	PSORA2	Psoralidium	24–48	-				
	white heath aster	SYER	Symphyotrichum ericoides	24–48	-				
	American vetch	VIAM	Vicia americana	24–48					
	dotted blazing star	LIPU	Liatris punctata	0–48					
	vervain	VERBE	Verbena	0–24	-				
	Forb, annual	2FA	Forb, annual	0–24					
	knotweed	POLYG4	Polygonum						
	curly dock	RUCR	Rumex crispus						
	curlycup gumweed	GRSQ	Grindelia squarrosa						
	cocklebur	XANTH2	Xanthium	_	-				
Shrub	hrub/Vine								
8	Shrubs			48–240					
		011040		0,400					

	broom snakeweed	GUSAZ	Gutierrezia sarotnrae	0–120	-
	silver sagebrush	ARCA13	Artemisia cana	0–120	_
	western snowberry	SYOC	Symphoricarpos occidentalis	24–120	_
	Wyoming big sagebrush	ARTRW8	Artemisia tridentata ssp. wyomingensis	0–120	-
	willow	SALIX	Salix	0–120	-
	Shrub (>.5m)	2SHRUB	Shrub (>.5m)	0–72	-
	silver buffaloberry	SHAR	Shepherdia argentea	0–72	-
	rose	ROSA5	Rosa	24–72	-
	rubber rabbitbrush	ERNA10	Ericameria nauseosa	0–24	-
	fewflower buckwheat	ERPA9	Eriogonum pauciflorum	-	-
Tree					
9	Trees			0–24	
	plains cottonwood	PODEM	Populus deltoides ssp. monilifera	0–24	-
	Tree	2TREE	Tree	0–24	-

#### Table 10. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass	/Grasslike	•	••		
1	Rhizomatous Wheatgras	S		300–600	
	western wheatgrass	PASM	Pascopyrum smithii	300–600	_
	thickspike wheatgrass	ELLAL	Elymus lanceolatus ssp. lanceolatus	300–600	_
2	Cool-Season Bunchgras	S		100–500	
	needle and thread	HECOC8	Hesperostipa comata ssp. comata	100–400	_
	green needlegrass	NAVI4	Nassella viridula	20–100	_
3	Tall- and Mid- Warm-Sea	son Grass	es	200–400	
	prairie sandreed	CALO	Calamovilfa longifolia	200–400	_
	switchgrass	PAVI2	Panicum virgatum	0–60	_
	big bluestem	ANGE	Andropogon gerardii	0–60	_
	prairie cordgrass	SPPE	Spartina pectinata	0–20	_
	spiked muhly	MUGL3	Muhlenbergia glomerata	-	_
4	Other Native Grasses	•		100–300	
	little bluestem	SCSC	Schizachyrium scoparium	40–300	_
	sideoats grama	BOCU	Bouteloua curtipendula	40–160	_
	composite dropseed	SPCOC2	Sporobolus compositus var. compositus	40–160	_
	blue grama	BOGR2	Bouteloua gracilis	20–100	_
	hairy grama	BOHI2	Bouteloua hirsuta	0–100	_
	buffalograss	BODA2	Bouteloua dactyloides	0–100	_
	saltgrass	DISP	Distichlis spicata	20–100	_
	Indian ricegrass	ACHY	Achnatherum hymenoides	0–100	_
	prairie Junegrass	KOMA	Koeleria macrantha	0–60	_
	Sandberg bluegrass	POSE	Poa secunda	0–60	_
	Grass, perennial	2GP	Grass, perennial	0–60	_
	nlaina muhlu	MILOUIS	Muhlanharaia avanidata	0 10	

		NIUCUS	wumenbergia cuspidata	0-40	
5	Grass-Likes			0–60	
	Grass-like (not a true grass)	2GL	Grass-like (not a true grass)	0–60	_
	sedge	CAREX	Carex	0–60	-
6	Non-Native Cool-Season	Grasses		20–100	
	Kentucky bluegrass	POPR	Poa pratensis	0–100	-
	cheatgrass	BRTE	Bromus tectorum	20–60	-
Forb		1			
7	Forbs			100–200	
	American licorice	GLLE3	Glycyrrhiza lepidota	0–100	-
	white heath aster	SYER	Symphyotrichum ericoides	20–100	-
	white sagebrush	ARLU	Artemisia Iudoviciana	20–100	-
	western yarrow	ACMIO	Achillea millefolium var. occidentalis	20–100	-
	Forb, annual	2FA	Forb, annual	0–100	_
	Forb, perennial	2FP	Forb, perennial	20–60	-
	scurfpea	PSORA2	Psoralidium	20–60	-
	Cuman ragweed	AMPS	Ambrosia psilostachya	20–60	-
	upright prairie coneflower	RACO3	Ratibida columnifera	0–60	_
	goldenrod	SOLID	Solidago	20–60	_
	American vetch	VIAM	Vicia americana	0–60	-
	cocklebur	XANTH2	Xanthium	0–40	-
	scarlet beeblossom	GACO5	Gaura coccinea	0–40	-
	curly dock	RUCR	Rumex crispus	0–40	-
	curlycup gumweed	GRSQ	Grindelia squarrosa	0–40	-
	dotted blazing star	LIPU	Liatris punctata	0–40	_
	vervain	VERBE	Verbena	0–40	_
	false boneset	BREU	Brickellia eupatorioides	0–20	_
	knotweed	POLYG4	Polygonum	0–20	_
Shru	b/Vine				
8	Shrubs			40–200	
	Wyoming big sagebrush	ARTRW8	Artemisia tridentata ssp. wyomingensis	0–200	_
	silver sagebrush	ARCA13	Artemisia cana	0–200	_
	western snowberry	SYOC	Symphoricarpos occidentalis	20–100	_
	rose	ROSA5	Rosa	20–100	_
	broom snakeweed	GUSA2	Gutierrezia sarothrae	0–60	_
	silver buffaloberry	SHAR	Shepherdia argentea	0–60	
	rubber rabbitbrush	ERNA10	Ericameria nauseosa	0–40	
	Shrub (>.5m)	2SHRUB	Shrub (>.5m)	0–40	_
	fewflower buckwheat	ERPA9	Eriogonum pauciflorum	0–20	
	willow	SALIX	Salix	_	_
Tree					
9	Trees			0–20	
	plains cottonwood	PODEM	Populus deltoides ssp. monilifera	0–20	_

1	1		1		
	Tree	2TREE	Tree	0–20	-

#### Table 11. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass	/Grasslike		•		
1	Rhizomatous Wheatgras	is		300–500	
	western wheatgrass	PASM	Pascopyrum smithii	300–500	_
	thickspike wheatgrass	ELLAL	Elymus lanceolatus ssp. lanceolatus	300–500	_
2	Cool-Season Bunchgras	S		50–200	
	needle and thread	HECOC8	Hesperostipa comata ssp. comata	50–200	_
	green needlegrass	NAVI4	Nassella viridula	0–30	_
3	Tall- and Mid- Warm-Sea	son Grass	es	0–50	
	prairie sandreed	CALO	Calamovilfa longifolia	0–50	_
	switchgrass	PAVI2	Panicum virgatum		
	big bluestem	ANGE	Andropogon gerardii		
	prairie cordgrass	SPPE	Spartina pectinata	-	-
	spiked muhly	MUGL3	Muhlenbergia glomerata	-	_
4	Other Native Grasses			20–100	
	plains muhly	MUCU3	Muhlenbergia cuspidata	20–100	-
	saltgrass	DISP	Distichlis spicata	20–80	_
	little bluestem	SCSC	Schizachyrium scoparium	20–50	_
	sideoats grama	BOCU	Bouteloua curtipendula	0–50	_
	composite dropseed	SPCOC2	Sporobolus compositus var. compositus	0–50	_
	blue grama	BOGR2	Bouteloua gracilis	0–30	-
	buffalograss	BODA2	Bouteloua dactyloides	0–30	-
	Grass, perennial	2GP	Grass, perennial	0–20	_
	prairie Junegrass	KOMA	Koeleria macrantha	0–10	
	Sandberg bluegrass	POSE	Poa secunda	-	
	hairy grama	BOHI2	Bouteloua hirsuta	-	
	Indian ricegrass	ACHY	Achnatherum hymenoides	-	
5	Grass-Likes			0	I
	sedge	CAREX	Carex	-	
	Grass-like (not a true grass)	2GL	Grass-like (not a true grass)	-	_
6	Non-Native Cool-Season	Grasses	·	10–50	
	cheatgrass	BRTE	Bromus tectorum	10–50	_
	Kentucky bluegrass	POPR	Poa pratensis	0–30	
Forb		1	<u> </u>		
7	Forbs			20–100	
	knotweed	POLYG4	Polygonum	0–50	
	curlycup gumweed	GRSQ	Grindelia squarrosa	0–30	_
	Forb, annual	2FA	Forb, annual	0–30	_
	Forb, perennial	2FP	Forb, perennial	10–20	_

	Cuman ragweed	AMPS	Ambrosia psilostachya	0–20	1	
	western yarrow	ACMIO	Achillea millefolium var. occidentalis	0–20	1	
	white sagebrush	ARLU	Artemisia ludoviciana	0–20	-	
	scurfpea	PSORA2	Psoralidium	0–20	-	
	white heath aster	SYER	Symphyotrichum ericoides	0–20	-	
	vervain	VERBE	Verbena	0–10	_	
	cocklebur	XANTH2	Xanthium	0–10	_	
	American licorice	GLLE3	Glycyrrhiza lepidota	-	_	
	American vetch	VIAM	Vicia americana	-	_	
	dotted blazing star	LIPU	Liatris punctata	-	_	
	false boneset	BREU	Brickellia eupatorioides	-	_	
	goldenrod	SOLID	Solidago	-	_	
	curly dock	RUCR	Rumex crispus	-	_	
	upright prairie coneflower	RACO3	Ratibida columnifera	-	_	
	scarlet beeblossom	GACO5	Gaura coccinea	-	_	
Shrub	Shrub/Vine					
8	Shrubs			50–150		
	rose	ROSA5	Rosa	0–100	1	
	silvor sagobrush					
	Silver sayebiusii	ARCAIS	Artemisia cana	0–100	-	
	Wyoming big sagebrush	ARTRW8	Artemisia cana Artemisia tridentata ssp. wyomingensis	0–100 0–100	-	
	Wyoming big sagebrush Shrub (>.5m)	ARTRW8 2SHRUB	Artemisia cana Artemisia tridentata ssp. wyomingensis Shrub (>.5m)	0–100 0–100 0–50	-	
	Wyoming big sagebrush Shrub (>.5m) broom snakeweed	ARTRW8 2SHRUB GUSA2	Artemisia cana Artemisia tridentata ssp. wyomingensis Shrub (>.5m) Gutierrezia sarothrae	0–100 0–100 0–50 0–50		
	Wyoming big sagebrush Shrub (>.5m) broom snakeweed fewflower buckwheat	ARTRW8 2SHRUB GUSA2 ERPA9	Artemisia cana Artemisia tridentata ssp. wyomingensis Shrub (>.5m) Gutierrezia sarothrae Eriogonum pauciflorum	0–100 0–100 0–50 0–50 10–50		
	Wyoming big sagebrush Shrub (>.5m) broom snakeweed fewflower buckwheat western snowberry	ARTRW8 2SHRUB GUSA2 ERPA9 SYOC	Artemisia cana Artemisia tridentata ssp. wyomingensis Shrub (>.5m) Gutierrezia sarothrae Eriogonum pauciflorum Symphoricarpos occidentalis	0-100 0-100 0-50 0-50 10-50 0-30	_ 	
	Wyoming big sagebrush Shrub (>.5m) broom snakeweed fewflower buckwheat western snowberry rubber rabbitbrush	ARTRW8 2SHRUB GUSA2 ERPA9 SYOC ERNA10	Artemisia cana Artemisia tridentata ssp. wyomingensis Shrub (>.5m) Gutierrezia sarothrae Eriogonum pauciflorum Symphoricarpos occidentalis Ericameria nauseosa	0-100 0-100 0-50 0-50 10-50 0-30 0-30	- - - - - -	
	Wyoming big sagebrush Shrub (>.5m) broom snakeweed fewflower buckwheat western snowberry rubber rabbitbrush silver buffaloberry	ARTRW8 2SHRUB GUSA2 ERPA9 SYOC ERNA10 SHAR	Artemisia cana Artemisia tridentata ssp. wyomingensis Shrub (>.5m) Gutierrezia sarothrae Eriogonum pauciflorum Symphoricarpos occidentalis Ericameria nauseosa Shepherdia argentea	0-100 0-100 0-50 0-50 10-50 0-30 0-30 -		
	Wyoming big sagebrush Shrub (>.5m) broom snakeweed fewflower buckwheat western snowberry rubber rabbitbrush silver buffaloberry willow	ARTRW8 2SHRUB GUSA2 ERPA9 SYOC ERNA10 SHAR SALIX	Artemisia cana Artemisia tridentata ssp. wyomingensis Shrub (>.5m) Gutierrezia sarothrae Eriogonum pauciflorum Symphoricarpos occidentalis Ericameria nauseosa Shepherdia argentea Salix	0-100 0-100 0-50 0-50 10-50 0-30 0-30 	- - - - - - - - -	
Tree	Wyoming big sagebrush Shrub (>.5m) broom snakeweed fewflower buckwheat western snowberry rubber rabbitbrush silver buffaloberry willow	ARTRW8 2SHRUB GUSA2 ERPA9 SYOC ERNA10 SHAR SALIX	Artemisia cana Artemisia tridentata ssp. wyomingensis Shrub (>.5m) Gutierrezia sarothrae Eriogonum pauciflorum Symphoricarpos occidentalis Ericameria nauseosa Shepherdia argentea Salix	0-100 0-100 0-50 0-50 10-50 0-30 0-30 - -	- - - - - - - - - -	
 Тгее 9	Wyoming big sagebrush Shrub (>.5m) broom snakeweed fewflower buckwheat western snowberry rubber rabbitbrush silver buffaloberry willow	ARTRW8 2SHRUB GUSA2 ERPA9 SYOC ERNA10 SHAR SALIX	Artemisia cana Artemisia tridentata ssp. wyomingensis Shrub (>.5m) Gutierrezia sarothrae Eriogonum pauciflorum Symphoricarpos occidentalis Ericameria nauseosa Shepherdia argentea Salix	0-100 0-100 0-50 0-50 10-50 0-30 0-30 - - -	- - - - - - - - - -	
<b>Tree</b> 9	Silver sageblusit         Wyoming big sagebrush         Shrub (>.5m)         broom snakeweed         fewflower buckwheat         western snowberry         rubber rabbitbrush         silver buffaloberry         willow         Trees         Tree	ARTRW8 2SHRUB GUSA2 ERPA9 SYOC ERNA10 SHAR SALIX 2TREE	Artemisia cana Artemisia tridentata ssp. wyomingensis Shrub (>.5m) Gutierrezia sarothrae Eriogonum pauciflorum Symphoricarpos occidentalis Ericameria nauseosa Shepherdia argentea Salix Tree	0-100 0-100 0-50 0-50 10-50 0-30 0-30 	- - - - - - - - - -	
<b>Tree</b> 9	Silver sageblusit         Wyoming big sagebrush         Shrub (>.5m)         broom snakeweed         fewflower buckwheat         western snowberry         rubber rabbitbrush         silver buffaloberry         willow         Trees         Tree         plains cottonwood	ARTRW8 2SHRUB GUSA2 ERPA9 SYOC ERNA10 SHAR SALIX 2TREE PODEM	Artemisia cana Artemisia tridentata ssp. wyomingensis Shrub (>.5m) Gutierrezia sarothrae Eriogonum pauciflorum Symphoricarpos occidentalis Ericameria nauseosa Shepherdia argentea Salix Tree Populus deltoides ssp. monilifera	0-100 0-100 0-50 0-50 10-50 0-30 0-30 	- - - - - - - - - -	

#### Table 12. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass	/Grasslike	•			
1	Rhizomatous Wheatgrass			90–240	
	western wheatgrass	PASM	Pascopyrum smithii	90–240	_
	thickspike wheatgrass	ELLAL	Elymus lanceolatus ssp. lanceolatus	90–240	_
2	Cool-Season Bunchgrass		0–30		
	needle and thread	HECOC8	Hesperostipa comata ssp. comata	0–30	_
	green needlegrass	NAVI4	Nassella viridula	-	_
3	Tall- and Mid- Warm-Se	eason Gras	ses	0	
4	Other Native Grasses			60–240	

I I I					
	saltgrass	DISP	Distichlis spicata	60–240	_
	Grass, perennial	2GP	Grass, perennial	0–12	_
	plains muhly	MUCU3	Muhlenbergia cuspidata	-	_
	Indian ricegrass	ACHY	Achnatherum hymenoides	-	_
	prairie Junegrass	KOMA	Koeleria macrantha	-	_
	Sandberg bluegrass	POSE	Poa secunda	-	_
	sideoats grama	BOCU	Bouteloua curtipendula	-	_
	composite dropseed	SPCOC2	Sporobolus compositus var. compositus	-	_
	blue grama	BOGR2	Bouteloua gracilis	-	_
	hairy grama	BOHI2	Bouteloua hirsuta	-	_
	buffalograss	BODA2	Bouteloua dactyloides	_	_
	little bluestem	SCSC	Schizachyrium scoparium	-	_
5	Grass-Likes			0	
6	Non-Native Cool-Seaso	n Grasses		0–30	
	cheatgrass	BRTE	Bromus tectorum	0–30	_
	bluegrass	POA	Poa	0	_
Forb					
7	Forbs			30–150	
	knotweed	POLYG4	Polygonum	30–150	_
	cocklebur	XANTH2	Xanthium	0–30	_
	curlycup gumweed	GRSQ	Grindelia squarrosa	0–30	_
	Forb, perennial	2FP	Forb, perennial	0–18	_
	Cuman ragweed	AMPS	Ambrosia psilostachya	0–6	_
	Forb, annual	2FA	Forb, annual	0–6	_
	vervain	VERBE	Verbena	-	_
	western yarrow	ACMIO	Achillea millefolium var. occidentalis	-	_
	scarlet beeblossom	GACO5	Gaura coccinea	-	_
	dotted blazing star	LIPU	Liatris punctata	-	_
	false boneset	BREU	Brickellia eupatorioides	-	_
	goldenrod	SOLID	Solidago	-	_
	white heath aster	SYER	Symphyotrichum ericoides	-	_
	American licorice	GLLE3	Glycyrrhiza lepidota	-	-
	American vetch	VIAM	Vicia americana	-	_
	white sagebrush	ARLU	Artemisia ludoviciana	-	_
	curly dock	RUCR	Rumex crispus	-	_
	upright prairie coneflower	RACO3	Ratibida columnifera	-	-
	scurfpea	PSORA2	Psoralidium	-	_
Shrub	/Vine				
8	Shrubs			12–120	
	silver sagebrush	ARCA13	Artemisia cana	0–120	_
	rubber rabbitbrush	ERNA10	Ericameria nauseosa	6–60	_
	fewflower buckwheat	ERPA9	Eriogonum pauciflorum	0–30	_

	broom snakeweed	GUSA2	Gutierrezia sarothrae	0–18	_
	rose	ROSA5	Rosa	0–6	_
	western snowberry	SYOC	Symphoricarpos occidentalis	-	_
	willow	SALIX	Salix	-	-
	Wyoming big sagebrush	ARTRW8	Artemisia tridentata ssp. wyomingensis	_	-
	silver buffaloberry	SHAR	Shepherdia argentea	-	_
	Shrub (>.5m)	2SHRUB	Shrub (>.5m)	-	_
Tree	-				
9	Trees			0–6	
	plains cottonwood	PODEM	Populus deltoides ssp. monilifera	0–6	_
	Tree	2TREE	Tree	0–6	_

# **Animal community**

## Wildlife Interpretations:

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

Historically, the northern mixed-grass prairie was a disturbance-driven ecosystem in which fire, herbivory, and climate functioned as the primary disturbance factors, either singly or in combination. Following European settlement, livestock grazing, cropland conversion, elimination of fire, energy development, and other anthropogenic factors influenced species composition and abundance. Introduced and invasive species further affected plant and animal communities. The bison was a historical keystone species but has been extirpated in this area as a free-ranging herbivore. The loss of the bison and the reduction of prairie dog populations and fire as ecological drivers greatly influenced the character of the remaining native plant communities and altered wildlife habitats. Human development reduced habitat quality for area-sensitive species.

Within MLRA 64, the Badlands Overflow ecological site includes upland grassland cover with an associated forb and shrub component. It was typically part of an expansive grassland landscape that included combinations of Thin Breaks, Clayey, Claypan, Dense Clay, Loamy, Saline, Sandy, Shallow, Overflow, Subirrigated, and Terrace ecological sites.

Although this ecological site is primarily dominated by tall and medium warm- and cool-season grasses, it can support a shrub community composed of big sagebrush, silver sagebrush, rose, silver buffaloberry, and western snowberry. The presence or absence of this shrub component is an important factor influencing wildlife species composition.

Some areas of the site contain remnant stands of plains cottonwood and other trees. Multiple successional changes can occur as a result of stream channel aggradation and degradation. During periods of favorable climatic conditions in areas that are not significantly grazed, midgrass- and tallgrass-habitat provides denser cover and stabilizes the area along the stream channel. When present, seeps and springs provide vital water supply and localized wildlife habitat, especially for reptiles, amphibians, bats, and game species (both predators and prey).

This site provides habitat for mule deer and pronghorn antelope; grassland- and shrub-steppe-nesting birds; small mammals; mammalian predators; and a variety of reptiles, amphibians, and insects. Within the MLRA, this site

provides important riparian habitat. The site also provides foraging and brood rearing habitat for upland game birds, such as the sharp-tailed grouse.

Reference State (1.0): Multiple successional changes can occur in the Reference State as a result of stream channel aggradation and degradation. During periods of favorable climatic conditions in areas that are not significantly grazed, midgrass- and tallgrass-habitat provides denser cover and stabilizes the area along the stream channel. When present, seeps and springs provide vital water supply and localized wildlife habitat, especially for reptiles, amphibians, bats, and game species (both predators and prey).

This site is dominated by medium to tall warm- and cool-season grasses and has a shrub community that is generally dominated by big sagebrush, silver sagebrush, rose, willow, western snowberry, and silver buffaloberry. The plant community favors grazers and mixed-feeders, such as mule deer and pronghorn antelope. This site may contain a substantial amount (50-80 percent) of bare ground as a result of channel evolution. The interspersion of bare ground and shrubs provides habitat for some species, such as desert cottontail, white-tailed jackrabbit, and black-tailed jackrabbit, but also diminishes foraging opportunities for ungulate wildlife. As prairie ricegrass abundance increases, however, grazing wildlife, such as mule deer, begin to heavily use the site. As silver buffaloberry and other fruiting shrubs increase in abundance, then other species, such as brown thrasher, Say's phoebe, and loggerhead shrike, may use this site. The complex diversity of plant structures provides habitat for a wide array of migratory and resident birds. Grasshopper sparrow, lark bunting, chestnut-collared longspur, horned lark, western meadowlark, and sharp-tailed grouse are common and benefit from the structure and composition of this plant community.

This site provides a diversity of grasses, forbs, and shrubs for small and large herbivores, including shrews, voles, mice, spotted ground squirrel, desert cottontail rabbit, white-tailed jackrabbit, black-tailed jackrabbit, and deer. Raptors, such as red-tailed hawk, ferruginous hawk, Swainson's hawk, American kestrel, and barn owl, may use this site. Insects, including pollinators, play only a limited role in maintaining the forb community. They do, however, provide a significant forage base for birds and various bats, especially such species as the Western small-footed Myotis, the fringe-tailed Myotis, and the Townsend's big-eared bat. Diverse prey populations are available for grassland raptors and mammalian predators, especially bobcat and mountain lion. Other mammalian predators using this plant community include the coyote, mink, long-tailed weasels, least weasels, spotted skunks, and striped skunks.

This site provides foraging and brood rearing habitat for sharp-tailed grouse and fawning habitat for deer. The relatively tall stature of the stable plant community provides suitable thermal, protective, and escape cover for small and large mammals. This plant community provides limited habitat for amphibians, mostly toads (i.e., Great Plains, Woodhouse's, and Plains spade-foot). Prey abundance and shade opportunities may attract multiple reptile species, such as gopher snake, milk snake, prairie rattlesnake, and western ornate box turtle along with lesser numbers of various lizard species.

Wheatgrass-Inland Saltgrass/Knotweed (2.1): Heavy, continuous season-long grazing results in the plant community becoming dominated by inland saltgrass and wheatgrass. The warm-season grass component virtually vanishes, especially switchgrass, bluestem, prairie sandreed, and Indian ricegrass. The loss of the warm-season grass component significantly reduces the abundance and diversity of wildlife species using this site. Fewer small mammals and large herbivores use the site. Raptor and mammalian predators continue to use the site. Sharp-tailed grouse, reptiles, and amphibians may not fully utilize the site. Forb diversity decreases substantially; however, knotweed abundance increases substantially. Knotweeds are a food source for songbirds, sharp-tailed grouse, small mammals, antelope, and deer. Shrub diversity substantially decreases, but silver sagebrush and rubber rabbitbrush abundance increases, favoring mule deer and pronghorn antelope.

## 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: Switchgrass-Wheatgrass-Needlegrass/Shrubs (1.1) Average Production (lb/acre, air-dry): 2,400 Stocking Rate (AUM/acre): 0.66

Plant Community: Wheatgrass-Needlegrass-Prairie Sandreed/Shrubs (1.2) Average Production (lb/acre, air-dry): 2,000 Stocking Rate (AUM/acre): 0.55

Plant Community: Wheatgrass-Needlegrass-Indian Ricegrass/Shrubs (1.3) Average Production (lb/acre, air-dry): 1,000 Stocking Rate (AUM/acre): 0.27

\*Plant Community: Wheatgrass-Inland Saltgrass/Knotweed (2.1) Average Production (lb/acre, air-dry): 600 Stocking Rate (AUM/acre): Variable

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 B. The infiltration rate is moderate. Runoff potential varies from moderate to high depending on soil hydrologic group and ground cover. In many cases, areas that have greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An exception occurs 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 this 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; Kent Cooley, soil scientist, NRCS; Rick Peterson, RMS, NRCS; L. Michael Stirling, RMS, NRCS; and Wade Anderson, range professional and rancher.

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# Contributors

Stan C. Boltz Rick L. Peterson

# 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.

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Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

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## Rangeland health reference sheet

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

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

## Indicators

- 1. Number and extent of rills: This site is composed of areas of active deposition and erosion (early development phase), and areas which have stabilized. The early development phase is located close to the badland outcrop and is receiving runoff from the badlands. There should be no rills in the stable areas; some rills will be present during early development phase.
- 2. Presence of water flow patterns: Typically, none or barely visible on stable areas. In the early development phase, water flow patterns will be conspicuous and are usually wide (up to 3 feet or 0.91 m) and shallow (less than 6 inches or 15 cm) deep.
- 3. Number and height of erosional pedestals or terracettes: None. Pedestals and/or terracettes should not be present on this site.
- 4. Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground): Bare ground is typically less than 5 percent in areas that have entered the stabilized phase. On areas under the early development phase, 50 to 80 percent bare ground may occur.
- 5. Number of gullies and erosion associated with gullies: Typically, none, however limited head cutting may form after high runoff or flooding events. Existing gullies should be stabilized with good vegetative cover. Severe downcutting results in a shift to the Badlands Terrace ecological site.

from water may occur after major runoff or flooding events. Major deposition can occur on areas under the early development phase, especially adjacent to badlands.

- 7. Amount of litter movement (describe size and distance expected to travel): Litter of small and medium size classes will move after average to high rainfall events. Litter does not travel far (less than 6 inches) typically being trapped in small bunches by the extensive vegetative cover. After heavy rainfall events, small woody material may move up to 1 foot (30.5 cm) and fine litter may move up to 3 feet (0.91 m). Litter transport in early development areas can be significantly higher.
- 8. Soil surface (top few mm) resistance to erosion (stability values are averages most sites will show a range of values): Soil aggregate stability ratings should typically be 3 to 4.
- Soil surface structure and SOM content (include type of structure and A-horizon color and thickness): A-horizon should be 2 to 4 inches (5 to 10.1 cm) thick. Soil color is light gray dry (values of 5 to 8) and brown when moist (values of 4-7). Soil structure is typically weak, very thin platy in the A-horizon. Soils can be dispersive due to their high sodium content.
- 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 85 percent grasses or grass-like plants, 5 percent forbs, and 10 percent shrubs. The grass and grass-like component is composed of C4, tallgrasses (20-35%), C3, rhizomatous grasses (10-25%), C3, bunchgrasses (5-15%), C4, midgrasses (5-10%), C4, shortgrasses (0-10%), and grass-likes (0-3%). This plant community is representative of stable areas.

- 11. Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site): None; when dry, the A-horizon can appear to be compacted as platy structure is common.
- 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, C4 tallgrass, 480-840 #/ac 20-35% (3 species minimum): switchgrass, big bluestem, prairie sandreed, marsh muhly, prairie cordgrass.

2. Native, perennial, C3, rhizomatous grass, 240-600 #/ac, 10-25% (2 species minimum): thickspike wheatgrass, western wheatgrass.

Phase 1.2

1. Native, perennial, C3, rhizomatous grass, 300-600 #/ac, 15-30% (2 species minimum): thickspike wheatgrass, western wheatgrass.

2. Native, perennial, C3, bunchgrass, 100-500 #/ac, 5-25% (2 species minimum): green needlegrass, needle and thread, Indian ricegrass, prairie Junegrass, Sandberg bluegrass.

#### Phase 1.3

1. Native, perennial, C3, rhizomatous grass, 300-500 #/ac, 30-50% (2 species minimum): thickspike wheatgrass, western wheatgrass.

#### Sub-dominant: Phase 1.1

1. Native, perennial, C3, bunchgrass, 120-360 #/ac, 5-15% (2 species minimum): green needlegrass, needle and thread, Indian ricegrass, prairie Junegrass, Sandberg bluegrass.

#### Phase 1.2

1. Native, perennial, C4 midgrass, 100-300 #/ac, 5-15% (2 species minimum): little bluestem, sideoats grama, plains muhly, composite dropseed.

2. Native, perennial, C4 tallgrass, 200-400 #/ac 10-20% (1 species minimum): switchgrass, big bluestem, prairie sandreed, marsh muhly, prairie cordgrass.

#### Phase 1.3

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

2. Shrubs, 50-150 #/ac, 5-15%: fewflower buckwheat and various other shrubs that vary from location to location.

#### Other: Minor - Phase 1.1

1. Native, perennial, C4 midgrass, 120-240 #/ac, 5-10%: little bluestem, sideoats grama, plains muhly.

- 2. Native, perennial, C4 shortgrass, 0-240 #/ac, 0-10%: blue grama, buffalograss, hairy grama, saltgrass.
- 3. Shrubs, 48-240 #/ac, 2-10%: shrubs present vary from location to location.
- 4. Native forbs, 24-120 #/ac, 1-5%: forbs present vary from location to location.
- 5. Grass-likes, 0-72#/ac, 0-3%: sedges.

#### Minor - Phase 1.2

- 1. Native, perennial, C4 shortgrass, 40-100 #/ac, 2-5%: blue grama, buffalograss, hairy grama, saltgrass.
- 2. Native forbs, 100-200, 5-10%%: forbs present will vary from location to location.
- 3. Shrubs, 40-200 #/ac, 2-10%: shrubs present vary from location to location.
- 4. Grass-likes, 0-60 #/ac, 0-3%: sedges.
- 5. Non-native C3 grass, 0-60 #/ac, 0-3%: Kentucky bluegrass, cheatgrass.

#### Minor - Phase 1.3

1. Native, perennial, C4 midgrass, 20-100 #/ac, 2-10% (2 species minimum): little bluestem, sideoats grama, plains muhly, composite dropseed.

- 2. Native forbs, 20-100, 2-10%: forbs present vary from location to location.
- 3. Non-native C3 grass, 10-50 #/ac, 1-5%: Kentucky bluegrass, cheatgrass.
- 4. Native, perennial, C4 shortgrass, 20-80 #/ac, 1-4%: blue grama, buffalograss, saltgrass.
- 5. Native, perennial, C4 tallgrass, 0-50 #/ac 0-5%: prairie sandreed.

#### Trace - Phase 1.1

1. Native, deciduous trees, 0-24 #/ac, 0-1%: plains cottonwood.

Trace - Phase 1.2

1. Native, deciduous trees, 0-20 #/ac, 0-1%: plains cottonwood.

#### Trace - Phase 1.3

1. Native, deciduous trees, 0-10 #/ac, 0-1%: plains cottonwood and other trees which vary from location to location.

Additional: The Switchgrass-Wheatgrass-Needlegrass/Shrubs Community or Reference Community (1.1) is composed of nine F/S groups. These groups, in order of relative abundance, are native, perennial, C4 tallgrass; native, perennial,

C3, rhizomatous grass; native, perennial, C3, bunchgrass; native, perennial, C4, midgrass; native, perennial, C4 shortgrass; shrubs; native forbs; grass-likes; and native, deciduous trees.

The Wheatgrass-Needlegrass-Prairie Sandreed/Shrubs Community (1.2) is composed of ten F/S groups which are native, perennial, C3, rhizomatous grass; native, perennial, C3, bunchgrass; native, perennial, C4 midgrass; native, perennial, C4 tallgrass; native, perennial, C4 shortgrass native forbs; shrubs; grass-likes; non-native C3 grasses; and native, deciduous trees.

The Wheatgrass-Needlegrass-Indian Ricegrass/Shrubs/50-80% *Bare Ground* Community (1.3) includes nine F/S groups.

- Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence): Bunchgrasses have strong, healthy centers with few (less than 3 percent) dead centers. Shrubs may show some dead branches (less than 5 percent) as plants age.
- 14. Average percent litter cover (%) and depth ( in): In the stable areas, plant litter cover is evenly distributed throughout the stable portions of the site and is expected to be 50 to 70 percent and at a depth of 0.2 to 0.50 inch (0.65-1.3 cm). In the early development stage vegetation is sparse and litter is nearly absent.
- 15. Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annualproduction): The representative value (RV) for annual production is 2,400 pounds per acre on an air dry basis. Low and high production years should yield 1,900 and 2,900 pounds per acre respectively. Areas that are in the early development stage will have significantly less production with an RV of 1,000 pounds per acre and ranging from 500 to 1,500 pounds per acre in low and high production years 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, Kentucky bluegrass, crested wheatgrass, smooth brome, and eastern red cedar 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.