USDA Natural Resources
Conservation Service

Ecological site R066XY054NE
Sandy 22-25 P.Z.

Last updated: 11/18/2024
Accessed: 05/10/2025

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

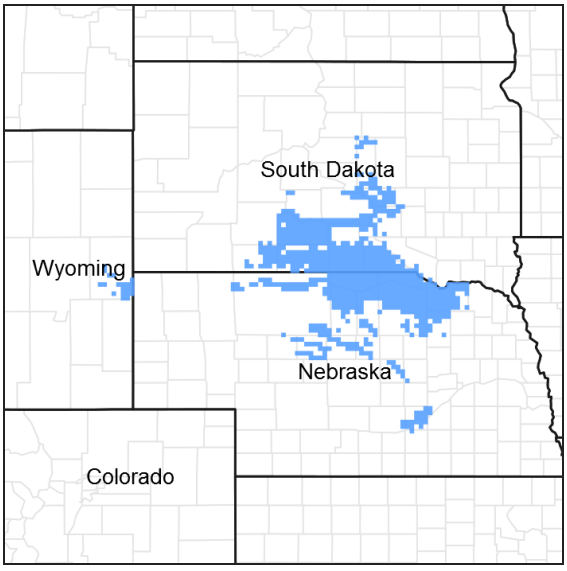


Figure 1. Mapped extent

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): 066X–Dakota-Nebraska Eroded Tableland

The Dakota-Nebraska Eroded Tableland (MLRA 66) occurs in north-central Nebraska (56 percent) and south-central South Dakota (44 percent). MLRA 66 is approximately 3.6 million acres and covers all or parts of twelve counties between the two states. The northern border of the MRLA bisects Tripp County, South Dakota, just south of the town of Winner. Valentine is in the northeastern corner of Cherry County, Nebraska and is located on the MLRA's southwestern border. From there, the MLRA stretches southeast to the northwestern corner of Antelope County, Nebraska and the town of O'Neil, Nebraska in Holt County its southeastern border.

The MLRA occupies a smooth fluvial plain primarily consisting of broad intervalley areas with terraces, river breaks, and local badlands along the well-defined major drainages. The slopes range from nearly level tablelands to steep ridges and drainages. The elevation ranges from 1,970 to 2,950 feet. The Keya Paha, Elkhorn, and the Niobrara Rivers flow through the MLRA. The Niobrara is a designated National Scenic River.

Layers of shaly chalk and limestone marine sediments overlaying the Cretaceous Niobrara Formation make up the bulk of the MLRA, though the western and southwestern portions exhibit surface eolian deposits. The floors of the major drainages are underlain by deposits of alluvial sand and gravel. The dominant soil orders in this MLRA are mesic, ustic or aridic Mollisols and Entisols. Loamy and sandy are the primary soil textures in this landscape.

Twenty-seven percent of the land in this MLRA has been broken out of native prairie and farmed, while 66 percent of the grasslands remain intact. The remaining acres are divided between forest, urban development, and other uses. Livestock grazing, primarily by cattle, is a major industry. Corn, winter wheat, and grain sorghum are the primary commodity crops but a significant number of acres are planted to forage sorghum and alfalfa for harvest as hay. With limited irrigation available, and annual precipitation averaging from 18 inches in the west to 25 inches in the east, crop production is marginal across most of the MLRA.

The historical matrix vegetation type is mixed-grass prairie. Bluestems, prairie sandreed, sideoats grama, and blue grama make up the bulk of the warm-season species. Western wheatgrass, green needlegrass, and needle and thread are the dominant cool-season grasses. Large- and small-patch vegetative communities are found primarily along the riparian zones, on lowland sites, and in closed depressions. Woodlands make up about 3 percent of MLRA 66 and consist primarily of green ash, bur oak, and hackberry. Ponderosa pines can be found on steeper sites in the western portion of the landscape.

Wildlife flourishes in this combination of crop and grassland environments. In a landscape historically occupied by bison herds, white-tailed and mule deer are now the most abundant wild ungulates. Pronghorns also number among the remaining native grazers. A variety of smaller species, including coyote, raccoon, opossum, porcupines, muskrat, beaver, squirrel, prairie dogs, and mink, thrive in the region. Grassland birds, including several upland game birds, are common across the MLRA.

This landscape serves as a backdrop for a disturbance-driven ecosystem, evolving under the influences of herbivory, fire, and variable climate. Historically, these processes created a heterogeneous mosaic of plant communities and structure heights across the region. Any given site in this landscape burned every six to ten years, with most of the MLRA experiencing a six to eight year fire regime. The fires were caused by lightning strikes and were also set by Native Americans, who used fire for warfare, signaling, and to refresh the native grasses. Indigenous inhabitants understood the value of fire as a tool, and that the highly palatable growth following a fire provided excellent forage for their horses and attracted grazing game animals such as bison and elk.

Land use patterns by post-European settlers have greatly altered the historical fire regime, allowing the expansion of woody species. Fragmentation of the native grasslands by conversion to cropland, transportation corridors, and other developments has contributed to disruption of the natural fire regime of this ecosystem. The most common encroaching woody species is eastern redcedar. While eastern redcedar is native to the landscape, the historic population in MLRA 66 was limited to isolated pockets in rugged river drainageways that were protected from wildfire. Widespread plantings of windbreaks with eastern redcedar as a primary component provide a seed source for the aggressive woody plant which further facilitates woody encroachment. Encroachment of native and introduced shrubs and trees into the native grasslands degrades wildlife habit and causes significant forage loss for domestic livestock. Aggressive fire suppression policies have exacerbated this process to the point that shrub and tree encroachment is a major ecological threat to grasslands throughout most of the MLRA.

Classification relationships

►EPA◄
Level IV Ecoregions of the Conterminous United States
43—Northwestern Great Plains:
43i—Keya Paha Tablelands.

►USDA◄
Land Resource Regions and Major Land Resource Areas (USDA-NRCS, 2006)
Land Resource Region: G—Western Great Plains Range and Irrigated Region:
Major Land Resource Area (MLRA): 66 Dakota-Nebraska Eroded Tableland.

Ecological site concept

There is a significant decline in precipitation from east to west across MLRA 66 which impacts plant community composition and annual production. For the purpose of ecological site development, the Sandy site is divided into two ecological sites to address this precipitation gradient and its impacts to the site. The Sandy 22 to 25"precipitation zone (PZ) typically occurs east of a line that extends from Johnstown, Nebraska to Witten, South

Dakota.

The Sandy 22-25" PZ ecological site occurs on upland landscapes and does not receive additional moisture from run-off or overflow. The slopes range from 0 to 30 percent. Soils are moderately deep to very deep and formed in eolian deposits, residuum, or alluvium. The surface layer is at least 7 inches thick and surface textures are typically fine sandy loam, or loamy fine sand but may be loamy sand, sandy loam, or loam.

The historical native vegetation is Mixed Grass Prairie. The vegetation in the Reference Plant Community (1.1) is dominated by warm-season tall- and midgrasses. Dominant grasses include prairie sandreed, big bluestem, Indiangrass, little bluestem, and needle and thread. Forbs are common and diverse. Shrubs include are a minor component of the vegetation. The site is susceptible to invasion of non-native, cool-season grasses, especially Kentucky bluegrass and smooth brome.

Associated sites

R066XY031NE	**Steep Sandy** The Steep Sandy ecological site is located in the steep breaks while Sandy 22-25" PZ sites are located on more gently sloping uplands above these breaks. Sandy 22-25" PZ sites may also occur on the lower, more gently sloping slopes below the breaks.
R066XY046NE	**Subirrigated** The Subirrigated ecological site is often found adjacent to the Sands 22-25
R066XY055NE	**Sands 22-25" P.Z.** The Sands 22-25" PZ ecological site is often located adjacent to but on a higher landscape position than the Sandy 22-25z" PZ ecological site.

Similar sites

R066XY055NE	**Sands 22-25" P.Z.** Sands 22-25" PZ and Sandy 22-25" PZ ecological site both have sandy surface textures but Sands 22-25" PZ site soils have coarser surface textures and a dark surface layer that is less than 7 inches thick.
R066XY031NE	**Steep Sandy** Steep Sandy and Sandy 22-25" PZ ecological sites both have sandy surface textures but Steep Sandy sites occur on steep breaks while Sandy 22-25" sites occur on more gently sloping upland sites.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon hallii* (2) *Calamovilfa longifolia*

Physiographic features

This site occurs on a variety of landforms ranging from ridges to swales to floodplains to alluvial fans, but is primarily found on plains, hillslopes, hummocks, and terraces.

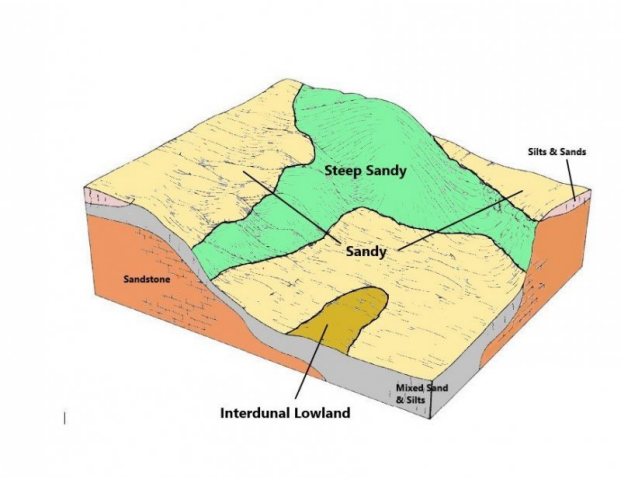


Figure 2. Sandy block diagram

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Plain (3) Hummock (4) Terrace
Runoff class	Negligible to high
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	None to occasional
Ponding frequency	None
Elevation	1,900–3,000 ft
Slope	0–30%
Water table depth	80 in
Aspect	Aspect is not a significant factor

Climatic features

MLRA 66 is considered to have a continental climate with cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. The climate is the result of this MLRA's location near the geographic center of North America. There are few natural barriers on the northern Great Plains and the winds move freely across the plains and account for rapid changes in temperature.

Annual precipitation ranges from 18 to 25 inches per year. The normal average annual temperature is about 48°F. January is the coldest month with average temperatures ranging from about 19°F (Bonesteel, SD) to about 23°F (Ainsworth, NE). July is the warmest month with temperatures averaging from about 73°F (Harrington, SD) to about 75°F (Gregory, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 54°F. This large annual range attests to the continental nature of the climate this area. Hourly winds average about ten miles per hour annually, ranging from about 11 miles per hour during the spring to about nine miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of native cool-season plants begins mid- to late March and continues to late June. Native warm-season plants begin growth in early May and continue to late August. Green-up of cool-season plants may occur in September and October when adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (characteristic range)	117-127 days

Freeze-free period (characteristic range)	137-147 days
Precipitation total (characteristic range)	25-26 in
Frost-free period (actual range)	113-129 days
Freeze-free period (actual range)	134-152 days
Precipitation total (actual range)	24-27 in
Frost-free period (average)	123 days
Freeze-free period (average)	143 days
Precipitation total (average)	25 in

Climate stations used

- (1) GREGORY [USC00393452], Gregory, SD
- (2) FAIRFAX #2 [USC00392822], Fairfax, SD
- (3) BUTTE [USC00251365], Butte, NE
- (4) O NEILL [USC00256290], Oneill, NE

Influencing water features

No significant water features influence this site.

Soil features

The soils of the Sandy 22-25" PZ ecological site are typically very deep to moderately deep and well to somewhat excessively drained. Soils are formed in eolian deposits, alluvium, or residuum weathered from sandstone. Soil surface textures are typically fine sandy loam or loamy fine sand but may be loamy sand, sandy loam, or loam. Soils have a darker surface layer ranging from 7 to 20 inches thick. Slopes range from 0 to 30 percent.

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. Sub-surface soil layers are not restrictive to water movement and root penetration. These soils are susceptible to wind erosion and water erosion is also a concern on slopes exceeding 10 percent.

The primary soil series correlated to this site are Anselmo, Dunday, Doger, Holt, O'Neill, Pivot, and Ronson. Additional information can be found in the various soil survey reports. Contact the local USDA Service Center for soil survey reports that include more details specific to your location or visit Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov).

Figure 9. Anselmo series profile

Table 4. Representative soil features

Parent material	(1) Eolian deposits (2) Residuum (3) Alluvium
Surface texture	(1) Fine sandy loam (2) Loamy fine sand (3) Loamy sand (4) Sandy loam (5) Loam
Family particle size	(1) Sandy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Slow to rapid
Soil depth	20–80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	2.5–7.1 in
Calcium carbonate equivalent (Depth not specified)	0–10%
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–9
Soil reaction (1:1 water) (Depth not specified)	5.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–15%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The Sandy 22-25" PZ ecological site developed under Northern Great Plains climatic conditions, light to severe grazing by bison and other large herbivores, sporadic natural or man-caused wildfire, and other biotic and abiotic factors that typically influence soil and site development. This continues to be a disturbance-driven site: by herbivory, fire, and variable climate. Changes occur in the plant communities due to short-term weather variations, impacts of native and/or exotic plant and animal species, and management actions. The site is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high resistance to drought.

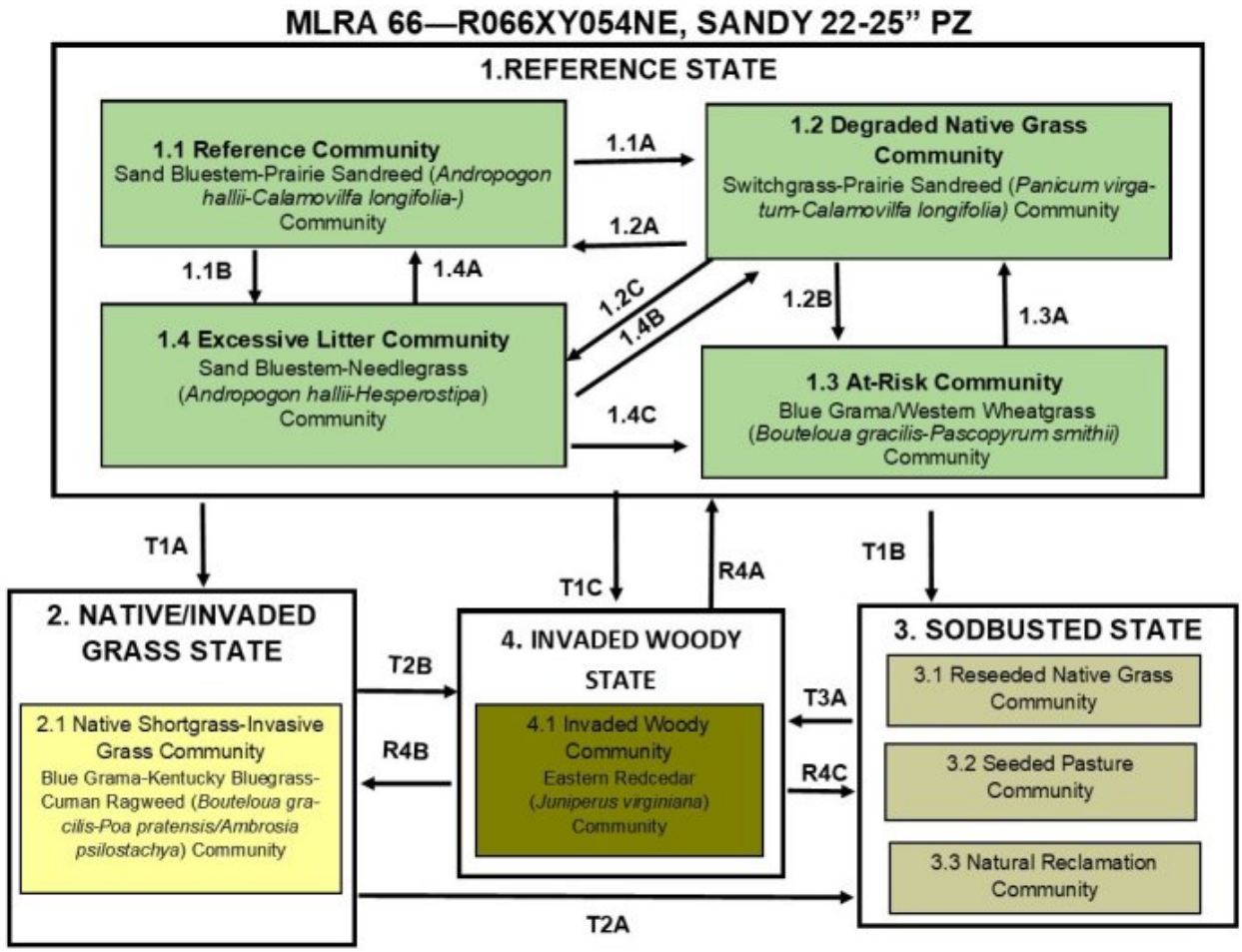
The introduction of domestic livestock by European settlers along with season-long, continuous grazing had a profound impact on the vegetation of the Sandy ecological site. Season-long, continuous grazing causes a repeated removal of the growing point and excessive defoliation of the leaf area of individual warm-season tallgrasses. The resulting reduction in the ability of the plants to harvest sunlight depletes root reserves, subsequently decreasing root mass. The ability of the plants to compete for nutrients is impaired, resulting in decreased vigor and eventual mortality. Species that evade negative grazing impacts through mechanisms such as a growing season adaptation (i.e., cool-season), growing points located near the soil surface, a shorter structure, or reduced palatability will increase. As this site deteriorates, species such as prairie sandreed, little bluestem, sand dropseed, and blue grama will increase initially. Species such as sand and big bluestem, switchgrass, and Indiangrass will decrease in frequency and production. As this management continues, prairie sandreed and little bluestem will also decrease.

The State and Transition Model (STM) is depicted below and includes a Reference State (1), a Native/Invaded Grass State (2), a Sodbusted State (3), and an Invaded Woody State (4). Each state represents the crossing of a

major ecological threshold due to the alteration of the functional dynamic properties of the ecosystem. The primary properties observed to determine this change are soil stability, vegetative communities, and the hydrologic cycle. Each state may have one or more plant communities that fluctuate in species composition and abundance within the normal parameters of the state. Within each state, communities may degrade or recover in response to natural and man caused disturbances such as variation in the degree and timing of herbivory, presence or absence of fire, and climatic and local fluctuations in the precipitation regime. The processes that cause the movement between the states and communities are discussed in more detail in the state and community descriptions following the diagram.

Interpretations are primarily based on the Reference Community (1.1). It has been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts have been used as well. Plant communities, states, transitional pathways, and thresholds have been determined through similar studies and experience.

State and transition model



Transitions and Restorations:

T1A: Long-term (> 10 years) heavy grazing, or haying, with inadequate growing season recovery periods.
T1B: Tillage to facilitate production agriculture.
T1C: Woody encroachment with no fire or brush management.
T2A: Tillage to facilitate production agriculture.
T2B: Woody encroachment with no fire or brush management.
T3A: Woody encroachment with no fire or brush management.
R4A: Prescribed burning, wildfire, mechanical harvest, brush management.
R4B: Prescribed burning, wildfire, mechanical harvest, brush management.
R4C: Prescribed burning, wildfire, mechanical harvest, brush management.

Community Pathways:

1.1A: Continuous, season long grazing or rotational grazing with inadequate recovery periods or repetitive haying.
1.1B: Prolonged (> 5 years) absence of herbivory and fire.
1.2A: Prescribed grazing with adequate, growing season recovery periods.
1.2B: Continued season long grazing or rotational grazing with inadequate recovery periods or repetitive haying.
1.2C: Prolonged (> 5 years) absence of herbivory and fire.
1.3A: Prescribed grazing, or haying, with adequate growing season recovery periods.
1.3B: Prolonged (> 5 years) absence of herbivory and fire.
1.4A: Prescribed grazing, prescribed burning.
1.4B: Prescribed grazing, prescribed burning.
1.4C: Heavy, continuous season long grazing.

Figure 10. State and Transition Model Diagram. MLRA 66, Sandy 22-25" PZ ecological site.

State 1
Reference State

The Reference State describes the range of vegetative community phases that occur on the Sandy 22-25 PZ ecological site where the natural processes are mostly intact. The Reference State developed under the combined influences of climatic conditions, periodic fire activity, grazing by large herbivores, and impacts from small mammals and insects. High perennial grass cover and production allows for increased soil moisture retention, vegetative production and overall soil quality. The Reference State includes the Reference Community (1.1), the Degraded Native Grass Community (1.2), the At-Risk Community (1.3), and the Excessive Litter Community (1.4). The Reference Community serves as a description of the native plant community that naturally occurs on the site when the natural disturbance regimes are intact or closely mimicked by management practices. The Degraded Native Grass and the At-Risk Grass Communities are the phases that result from management decisions that are unfavorable for a healthy Reference Community. The Excessive Litter Community results when herbivory and fire are removed from the land. In the absence of fire, all community phases are susceptible to eastern redcedar invasion and subject to crossing a threshold into the Invaded Woody State (4).

Dominant plant species

- sand bluestem (*Andropogon hallii*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- switchgrass (*Panicum virgatum*), grass

Community 1.1
Reference Community

Interpretations are primarily based on the Reference or Sand Bluestem-Prairie Sandreed (*Andropogon hallii-Calamovilfa longifolia*) Community (1.1). This plant community serves as a description of the native plant community that occurs on the site when the natural disturbance regimes are intact or are closely mimicked by management practices. This phase is dynamic, with fluid relative abundance and spatial boundaries between the dominant structural vegetative groups. These fluctuations are primarily driven by different responses of the species to changes in precipitation timing and abundance, and to fire and grazing events. Warm-season, tall- and midgrasses dominate this plant community. Principal grasses are prairie sandreed, sand bluestem, big bluestem, and little bluestem. The cool-season grasses, needle and thread, porcupinegrass, and western wheatgrass, are important. Blue grama, hairy grama, and sedges occur as an understory. Forbs and shrubs are not abundant. The potential vegetation is 85 to 95 percent grasses or grass-like plants, 5 to 10 percent forbs, and 1 to 5 percent shrubs by weight. Natural fire played a significant role in the succession of this site by preventing the establishment of eastern redcedar on the site. Wildfires have been actively controlled in recent times, allowing eastern redcedar encroachment. This plant community can be found on areas that are managed with prescribed grazing, prescribed burning, and may be found on areas receiving occasional periods of short-term rest. Management strategies to sustain this community include proper stocking rates, adequate growing season recovery times, monitoring key forage species, and prescribed fire every 6 to 8 years (R. P. Guyette and others, 2012). This resilient community is well adapted to the Northern Great Plains climatic conditions. Plant diversity promotes strong tolerance to drought, site and soil stability, a functional hydrologic cycle, and a high degree of biological integrity. These factors create a suitable environment for a healthy and sustainable plant community.

Dominant plant species

- sand bluestem (*Andropogon hallii*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- big bluestem (*Andropogon gerardii*), grass

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	2130	2685	3020
Forb	145	225	325
Shrub/Vine	25	90	155
Total	**2300**	**3000**	**3500**

Figure 12. Plant community growth curve (percent production by month). NE6637, Eroded Tableland, warm-season dominant, cool-season subdominant.

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

Community 1.2
Degraded Native Grass Community

The Degraded Native or Switchgrass-Prairie Sandreed (*Panicum virgatum-Calamovilfa longifolia*) Community (1.2) develops under grazing by domestic livestock with continuous, season-long grazing, continuous seasonal grazing, or rotational grazing with inadequate growing-season recovery periods. It also develops under repetitive haying with inadequate growing season recovery or annual haying during the same plant growth stage. Dominant grasses include switchgrass, little bluestem, and prairie sandreed. Other grasses include sand bluestem and Indiangrass. Dominant forbs include heath aster, blazing star, and Cuman ragweed. Dominant shrubs include leadplant and rose. The potential vegetation is 80 to 90 percent grasses or grass-like plants, 10 to 15 percent forbs, and 1 to 5 percent shrubs by weight. While slightly less productive and diverse than the Reference Community, root systems are still healthy allowing production on this plant community to increase with favorable precipitation. This plant community is drought resistant due to its mid- and tallgrass diversity. This plant community has slightly less litter than the Reference Community (1.1). This plant community is somewhat resistant to change; however, either improved management or increased disturbance can move the plant community to either the Reference Community, or the At-Risk Community (1.3). The resiliency of this plant community depends upon the type of management system implemented and the intensity and duration of disturbances.

Dominant plant species

- switchgrass (*Panicum virgatum*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1660	2174	2650
Forb	120	188	275
Shrub/Vine	20	138	275
Total	**1800**	**2500**	**3200**

Figure 14. Plant community growth curve (percent production by month). NE6637, Eroded Tableland, warm-season dominant, cool-season subdominant.

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

Community 1.3
At Risk Community

Figure 15. Sandy 22-25 PZ Ecological Site, At-Risk Community (1.3), Knox County, Nebraska.

The At-Risk or Blue Grama-Western Wheatgrass (*Bouteloua gracilis-Pascopyrum smithii*) Community (1.3) develops with continued season-long, seasonal, rotational grazing with inadequate growing season recovery periods. Plant diversity is diminished as the warm-season, tall- and midgrasses are reduced significantly reduced and may be present only as minor components of the plant community. Dominant grasses include blue grama, hairy grama, and western wheatgrass. Other grasses or grass-likes include sand dropseed, needle and thread, prairie sandreed, and sedges. Blue grama has increased due to its ability to withstand heavy grazing. Cool-season grasses such as western wheatgrass, prairie Junegrass, and Scribner's rosette grass increase have increased. Less palatable forbs such as tarragon, heath aster, blazing star, and Cuman ragweed increase in abundance and may appear to dominate the site. Shrubs present typically include rose and western sandcherry. The potential vegetation is 80 to 90 percent grasses or grass-like plants, 10 to 15 percent forbs, and 1 to 5 percent shrubs by weight. With continuation of this management, the warm-season tall- and midgrasses and cool-season bunch grasses will be further reduced while warm-season shortgrasses will increase causing the community to be at risk of crossing an ecological threshold and transitioning to the Native/Invaded Grass State (2).

Dominant plant species

- blue grama (*Bouteloua gracilis*), grass
- western wheatgrass (*Pascopyrum smithii*), grass

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1305	1479	1635
Forb	80	170	275
Shrub/Vine	15	51	90
Tree	–	–	–
Total	**1400**	**1700**	**2000**

Figure 17. Plant community growth curve (percent production by month). NE6636, Eroded Tableland, cool-season/warm-season codominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	10	20	25	20	10	5	5		

Community 1.4
Excessive Litter Community

The Excessive Litter or Sand Bluestem-Little Bluestem-Needlegrass (*Andropogon hallii-Schizachyrium scoparium*-Hesperostipa) Community (1.4) develops when the natural disturbances of livestock grazing and fire have been removed from the land for a prolonged period of time (more than five years). Periodic fire may extend the amount of

time it will take to reach this community. The litter amount has clearly increased and few or no sedges or understory shortgrasses are present. As the undisturbed duff layer deepens, infiltration of the precipitation is interrupted and evaporation increases significantly, simulating drought-like conditions. Typically, bunchgrasses have developed dead centers and rhizomatous grasses have formed small colonies due to a lack of tiller stimulation. Plant frequency and production have decreased. Pedestalling is usually evident. The dominant grasses include sand bluestem, little bluestem, and needle and thread. Other grasses present may include sand dropseed, porcupinegrass, and prairie Junegrass. The dominant forbs typically include Cuman ragweed, tarragon, blazing stars, and goldenrods. The shrubs present include rose, leadplant and western sandcherry. The potential vegetation is 85 to 95 percent grasses or grass-like plants, 1 to 5 percent forbs, and 1 to 5 percent shrubs. As compared to the Reference Community (1.1), plant diversity has decreased and native plants tend to occur in individual colonies. This plant community has a high amount of litter covering the soil between widely dispersed mature plants. As the litter layer thickens, the health and vigor of native, warm-season, tall- and midgrasses declines. Soil erosion is low and infiltration and runoff are not significantly different than the Reference Community. This plant community will change rapidly when grazing or fire is returned to the landscape.

Dominant plant species

- sand bluestem (*Andropogon hallii*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass
- porcupinegrass (*Hesperostipa spartea*), grass

Pathway 1.1A
Community 1.1 to 1.2

Continuous season-long grazing or rotational grazing with inadequate growing season recovery periods will convert the Reference Community (1.1) to the Degraded Native Grass Community (1.2). Annual haying during the same plant growth stage or will also cause this shift.

Pathway 1.1B
Community 1.1 to 1.4

Prolonged interruption (more than 5 years) of the natural disturbances of herbivory and fire will convert the Reference Community (1.1) to the Excessive Litter Community (1.4).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing with adequate recovery periods will move the Degraded Native Grass Community (1.2) to the Reference Community (1.1). Haying every other year will facilitate the return to the Reference Community.

Pathway 1.2B
Community 1.2 to 1.3

Continued season-long grazing, continuous seasonal grazing, or rotational grazing with inadequate growing-season recovery periods will move the Degraded Native Grass Community (1.2) to the At-Risk Community (1.3). Continued annual haying will also cause this shift in plant community.

Pathway 1.2C
Community 1.2 to 1.4

Prolonged interruption (more than five years) of the natural disturbances of herbivory and fire will convert the Degraded Native Grass Community (1.2) to the Excessive Litter Community (1.4).

Pathway 1.3A
Community 1.3 to 1.2

Prescribed grazing with adequate growing-season recovery periods will return the At-Risk Community (1.3) to the Degraded Native Grass Community (1.2). When the land is utilized as hayland, haying every other year will facilitate

this shift.

Pathway 1.3B
Community 1.3 to 1.4

Prolonged interruption (more than five years) of the natural disturbances of herbivory and fire will convert the At-Risk Community (1.3) to the Excessive Litter Community (1.4).

Pathway 1.4A
Community 1.4 to 1.1

Reintroduction of the natural processes of herbivory and fire will return the Excessive Litter Community (1.4) to the Reference Community (1.1).

Pathway 1.4B
Community 1.4 to 1.2

Reintroduction of the natural process of herbivory and fire will return the Excessive Litter Community (1.4) to the Degraded Native Grass Community (1.2).

Pathway 1.4C
Community 1.4 to 1.3

Reintroduction of the natural process of herbivory through heavy grazing will return the Excessive Litter Community (1.4) to the At Risk Community (1.3).

State 2
Native/Invaded Grass State

The Native/Invaded Grass State (2) has transitioned from the Reference State (1) and much of the native warm-season tall- and midgrass community has been replaced by warm-season shortgrasses or non-native cool-season grasses. This State develops with continuous season-long grazing or heavy rotational grazing with inadequate growing season recovery periods. It can also develop with extended periods (more than ten years) of non-use with no fire. The loss of warm-season tall- and midgrasses has negatively impacted energy flow and nutrient cycling. Water infiltration is reduced due to the shallow root system and rapid runoff characteristics of the grazing-evasive plant communities. The Native/Invaded Grass State includes the Shortgrass Sod/Invasive Grass (2.1) Community.

Dominant plant species

- blue grama (*Bouteloua gracilis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- Scribner's rosette grass (*Dichanthelium oligosanthes var. scribnerianum*), grass
- sand dropseed (*Sporobolus cryptandrus*), grass
- Cuman ragweed (*Ambrosia psilostachya*), other herbaceous

Community 2.1
Shortgrass Sod/Invasive Grass Community

The Shortgrass Sod/Invasive Grass or Blue Grama-Kentucky Bluegrass/Cuman Ragweed (*Bouteloua gracilis-Poa pratensis*/*Ambrosia psilostachya*) Community (2.1) represents a shift from the Reference State across an ecologic threshold. This community develops under long-term heavy grazing with inadequate growing season recovery periods. This may occur with rotational grazing where too little time is allowed for recovery before pastures are re-entered, in large pastures where animals graze individual plants repeatedly, or under continuous season-long grazing during the growing season. With continued grazing pressure, native shortgrasses and non-native invasive grass species become dominant, with only trace remnants of the more palatable warm-season midgrasses. This community may be a native, shortgrass community, a community invaded by non-native grass (typically, Kentucky bluegrass), or a community which includes a combination of native and introduced sod-forming grasses. A community dominated by Kentucky bluegrass may also develop when grazing and fire are eliminated from the site.

Dominant grasses include Kentucky bluegrass, blue grama, Scribner's rosette grass, and sand dropseed. In southern portions of the MLRA, smooth brome can be the dominant non-native grass. Other grasses or grass-likes include needle and thread, sedges, and cheatgrass. Dominant forbs include tarragon, Cuman ragweed, Rocky Mountain beeplant, and thistles. Sedges flourish in the understory. Invading thistles and annual forbs increase along with grazing resistant shrubs such as brittle pricklypear and small soapweed. The potential vegetation is 80 to 90 percent grasses or grass-like plants, 10 to 20 percent forbs, and 1 to 10 percent shrubs. Compared to the Reference Community (1.1), blue grama, hairy grama, sedges, Cuman ragweed, and rose have increased, while warm-season tall- and midgrasses have decreased significantly and may be present only as remnants. Plant diversity has decreased. Forb richness and diversity has decreased. With the decline and loss of deeper-penetrating root systems, a compacted layer may form in the soil profile below the shallower replacement root systems. Soil erosion is low. The high density of short-rooted grasses decreases water infiltration resulting in an impaired hydrologic cycle. Due to the sod-forming nature of plants present and the corresponding high level of ground cover, this community is resistant to change. With disturbance, this plant community is also highly resilient.

Dominant plant species

- Kentucky bluegrass (*Poa pratensis*), grass
- blue grama (*Bouteloua gracilis*), grass
- Scribner's rosette grass (*Dichanthelium oligosanthes var. scribnerianum*), grass
- sand dropseed (*Sporobolus cryptandrus*), grass
- Cuman ragweed (*Ambrosia psilostachya*), other herbaceous

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	835	1014	1185
Forb	55	150	250
Shrub/Vine	10	36	65
Total	**900**	**1200**	**1500**

Figure 19. Plant community growth curve (percent production by month). NE6635, Eroded Tableland, cool-season dominant, warm-season subdominant.

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

State 3
Sodbusted State

This threshold is crossed as a result of mechanical disturbance to facilitate production agriculture. If farming operations are suspended, the site can be abandoned, which will result in the Naturally Reclaimed Community (3.3), be re-seeded to a tame pasture forage mixture, the Seeded Pasture Community (3.2), or to a mixture of native grasses and forbs, the Reseeded Native Grass Community (3.1). Permanent alterations of the soil community and the hydrologic cycle make restoration to the original native Reference Community extremely difficult, if not impossible. Formation of a compacted plow pan in the soil profile is likely.

Community 3.1
Reseeded Native Grass Community

The Reseeded Native Grass Community (3.1) does not contain native remnants, and varies considerably depending upon the seed mixture, the degree of soil erosion, the age of the stand, nitrogen fertilizer use, and past grazing management. Native range and seeded grasslands are ecologically different and should be managed separately. Factors such as functional group, species, stand density, and improved varieties all impact the production level and palatability of the seedings. Species diversity is often limited, and when grazed in conjunction with native rangelands, uneven forage utilization may occur. Total annual production during an average year varies significantly depending upon precipitation, management, and grass species seeded. Prescribed grazing including appropriate

utilization levels, adequate growing-season recovery periods, and timing of grazing that favor the productivity, health, and vigor of the seeded species is required to maintain this community. Periodic prescribed burning and brush management may also be needed.

Community 3.2
Seeded Pasture Community

The Seeded Pasture Community (3.2) does not contain native remnants and varies considerably depending upon the extent of soil erosion, the species seeded, the quality of the stand that was established, the age of the stand, and management of the stand since establishment. There are several factors that make seeded tame pasture a different grazing resource than native rangeland and land seeded to a native grass mixture. Factors such as species selected, stand density, improved varieties, and harvest efficiency all impact production levels and palatability. Species diversity on seeded tame pasture is often limited to a few species. When seeded pasture and native rangelands or seeded pasture and seeded rangeland are in the same grazing unit, uneven forage utilization will occur. Improve forage utilization and stand longevity by managing this community separately from native rangelands or land seeded to native grass species. Total annual production during an average year varies significantly depending on the level of management and species seeded. Improved varieties of warm-season or cool-season grasses are recommended for optimum forage production. Fertilization, weed management, and prescribed grazing including appropriate utilization levels, adequate growing-season recovery periods, and timing of grazing that favor the productivity, health, and vigor of the seeded species are required to maintain this community. Periodic prescribed burning and brush management may also be needed.

Community 3.3
Natural Reclamation Community

The Natural Reclamation Community (3.3) consists of annual and perennial weeds and less desirable grasses. These sites have been farmed and abandoned without being reseeded. Soil organic matter and carbon reserves are reduced, soil structure is changed, and a plowpan or compacted layer can form, which decreases water infiltration. Residual synthetic chemicals may remain from farming operations. In early successional stages, this community is not stable. The hazard of erosion is a concern. Total annual production during an average year varies significantly depending on the succession stage of the plant community and any management applied to the system.

State 4
Invaded Woody State

The Invaded Woody State (4) is the result of woody encroachment. Once the tree canopy cover reaches 15 percent with an average tree height exceeding five feet, the threshold to the Invaded Woody State has been crossed. Woody species are increasing due to the lack of prescribed fire, brush management, or other woody tree removal. Typical ecological impacts are a loss of native grasses, reduced diversity of functional and structural groups, reduced Forage production, and reduced soil quality. Prescribed burning, wildfire, timber harvest, and brush management will move this state toward a grass dominated state. If the Invaded Woody State transitioned from the Native/Invaded Grass State (2) or the Sodbusted State (3), the land cannot transition to the Reference State (1) as the native plant community, soils, and hydrologic function had been too severely impacted prior to the woody encroachment to allow return to the Reference State. The Invaded Woody State includes one community, the Invaded Woody Community (4.1).

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- smooth sumac (*Rhus glabra*), shrub

Community 4.1
Invaded Woody Community

The Invaded Woody Community or Eastern Redcedar (*Juniperus virginiana*) Community (4.1) has at least 15 percent canopy cover consisting of trees generally 5 feet or taller. Encroaching trees are primarily eastern redcedar. Additional woody cover from deciduous trees and shrubs may be present. In the absence of fire and brush

management, this ecological site is very susceptible to eastern redcedar seedling invasion, especially when adjacent to a seed source. Eastern redcedar can eventually dominate the site resulting in a closed canopy monoculture which drastically reduces forage production and which has limited value for either livestock grazing or wildlife habitat. With long-term fire suppression, this plant community will develop extensive ladder fuels which can lead to a removal of most tree species with a wildfire. With properly managed intensive grazing, encroachment of deciduous trees will typically be minimal; however, this will not impact encroachment of coniferous species. The herbaceous component decreases proportionately in relation to the percent canopy cover, with the reduction being greater under a coniferous overstory. Eastern redcedar control can usually be accomplished with prescribed burning while the trees are six feet tall or less and fine fuel production is greater than 1,500 pounds per acres. Larger red cedars can also be controlled with prescribed burning, but successful application requires the use of specifically designed ignition and holding techniques (https://www.loesscanyonsburning group.com). Resprouting brush must be chemically treated immediately after mechanical removal to achieve effective treatment. The forb component will initially increase following tree removal. To prevent return to a woody dominated community, ongoing brush management such as hand cutting, chemical spot treatments, or periodic prescribed burning is required. This plant community is resistant to change and resilient given normal disturbances. In higher canopy cover situations, the soil erosion will increase in relation the plant community from which this plant community originated. The hydrologic function is also significantly altered under higher canopy cover. Infiltration is reduced and runoff is typically increased because of a lack of herbaceous cover and the rooting structure provided by the herbaceous species. Total annual production during an average year varies significantly, depending on the production level prior to encroachment and the percentage of canopy cover.

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- smooth sumac (*Rhus glabra*), shrub

Table 9. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	620	942	1265
Tree	60	130	200
Shrub/Vine	60	130	200
Forb	60	98	135
Total	**800**	**1300**	**1800**

Figure 21. Plant community growth curve (percent production by month). NE6644, Eroded Tableland, heavy conifer canopy.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3	7	10	20	28	15	5	4	4	2	1

Transition T1A
State 1 to 2

Heavy continuous, season-long grazing, heavy rotational grazing with inadequate growing season recovery periods, or haying without adequate recovery periods will cause the Reference State (1) to lose a significant proportion of warm-season, tall- and midgrass species and cross a threshold to the Native/Invaded Grass State (2). Water infiltration and other hydrologic functions will be reduced due to the root-matting presence of sod-forming grasses. With the decline and loss of deeper-penetrating root systems, soil structure and biological integrity are catastrophically degraded to the point that recovery is unlikely. Once this occurs, it is highly unlikely that grazing management alone will return the community to the Reference State.

Transition T1B
State 1 to 3

The Sodbusted State (3) is significantly altered by tillage to facilitate production agriculture. The disruption to the

plant community, the soil, and the hydrology of the system make restoration to a true Reference State (1) unlikely.

Transition T1C
State 1 to 4

Disruption of the natural fire regime and the encroachment of invasive exotic and native woody species can cause the Reference State (1) to shift to the Invaded Woody State (4).

Transition T2A
State 2 to 3

The Sodbusted State (3) is significantly altered by tillage to facilitate production agriculture. The disruption to the plant community, the soil, and the hydrology of the system make restoration to the Native/Invaded Grass State (2) unlikely.

Transition T2B
State 2 to 4

Disruption of the natural fire regime and the encroachment of invasive exotic and native woody species can cause the Native/Invaded Grass State (2) to shift to the Invaded Woody State (4).

Transition T3A
State 3 to 4

Disruption of the natural fire regime and the encroachment of invasive exotic and native woody species can cause the Sodbusted State (3) to shift to the Invaded Woody State (4).

Restoration pathway R4A
State 4 to 1

Prescribed burning, wildfire, mechanical harvest, and brush management will move Invaded Woody State (4) toward the Reference State (1). The forb component of a site with heavy tree density or canopy cover will initially increase following tree removal. If re-sprouting brush is present, stumps must be chemically treated immediately after mechanical removal. Ongoing brush management such as hand cutting, chemical spot treatments, or periodic prescribed burning is required to prevent a return to the Invaded Woody State. Land that transitioned to the Invaded Woody State from the Native/Invaded Grass State (2) or the Sodbusted State (3) cannot be restored to the Reference State (1) through removal of woody species.

Restoration pathway R4B
State 4 to 2

Prescribed burning, wildfire, mechanical harvest, and brush management will move Invaded Woody State (4) toward one of the herbaceous plant-dominated states. The forb component of a site with heavy tree density or canopy cover will initially increase following tree removal. If re-sprouting brush is present, stumps must be chemically treated immediately after mechanical removal. Ongoing brush management such as hand cutting, chemical spot treatments, or periodic prescribed burning is required to prevent a return to the Invaded Woody State. Land that transitioned to the Invaded Woody State from the Native/Invaded Grass State (2) or the Sodbusted State (3) cannot be restored to the Reference State (1) through removal of woody species.

Restoration pathway R4C
State 4 to 3

Prescribed burning, wildfire, mechanical harvest, and brush management will move Invaded Woody State (4) toward one of the herbaceous plant-dominated states. The forb component of a site with heavy tree density or canopy cover will initially increase following tree removal. If re-sprouting brush is present, stumps must be chemically treated immediately after mechanical removal. Ongoing brush management such as hand cutting, chemical spot treatments, or periodic prescribed burning is required to prevent a return to the Invaded Woody State.

Land that transitioned to the Invaded Woody State from the Native/Invaded Grass State (2) or the Sodbusted State (3) cannot be restored to the Reference State (1) through removal of woody species.

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-Season Tallgrass**			1500–1950	
	big bluestem	ANGE	*Andropogon gerardii*	600–1050	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	450–750	–
	Indiangrass	SONU2	*Sorghastrum nutans*	150–450	–
	switchgrass	PAVI2	*Panicum virgatum*	0–300	–
	sand bluestem	ANHA	*Andropogon hallii*	30–300	–
	Grass, perennial	2GP	*Grass, perennial*	0–60	–
2	**Warm-Season Midgrass**			450–750	
	little bluestem	SCSC	*Schizachyrium scoparium*	450–750	–
	sand lovegrass	ERTR3	*Eragrostis trichodes*	0–150	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–150	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–150	–
	purple lovegrass	ERSP	*Eragrostis spectabilis*	0–90	–
	Grass, perennial	2GP	*Grass, perennial*	0–60	–
3	**Cool-Season Bunchgrasses**			150–450	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	150–300	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–150	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	30–150	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–150	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–60	–
	Grass, perennial	2GP	*Grass, perennial*	0–60	–
4	**Warm-Season Shortgrass**			150–300	
	hairy grama	BOHI2	*Bouteloua hirsuta*	120–240	–
	thin paspalum	PASE5	*Paspalum setaceum*	0–150	–
	blue grama	BOGR2	*Bouteloua gracilis*	30–120	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–30	–
	Grass, perennial	2GP	*Grass, perennial*	0–30	–
5	**Cool-Season Rhizomatous Grass**			30–150	
	western wheatgrass	PASM	*Pascopyrum smithii*	30–150	–
6	**Grass-Like**			30–150	
	sedge	CAREX	*Carex*	30–150	–
Forb					
7	**Forb**			150–300	
	white heath aster	SYER	*Symphyotrichum ericoides*	0–60	–
	Forb, perennial	2FP	*Forb, perennial*	0–60	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–60	–

	blazing star	LIATR	*Liatris*	0–60	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–30	–
	beardtongue	PENST	*Penstemon*	0–30	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	0–30	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–30	–
	goldenrod	SOLID	*Solidago*	0–30	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–30	–
	thistle	CIRSI	*Cirsium*	0–30	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–30	–
	prairie spiderwort	TROC	*Tradescantia occidentalis*	0–30	–
	hoary verbena	VEST	*Verbena stricta*	0–30	–
	Forb, annual	2FA	*Forb, annual*	0–30	–
Shrub/Vine					
8	**Shrub**			30–150	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	30–90	–
	leadplant	AMCA6	*Amorpha canescens*	0–90	–
	pricklypear	OPUNT	*Opuntia*	0–60	–
	rose	ROSA5	*Rosa*	0–60	–
	western sandcherry	PRPUB	*Prunus pumila var. besseyi*	0–30	–
	soapweed yucca	YUGL	*Yucca glauca*	0–30	–

Table 11. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-Season Tallgrass**			1250–1500	
	prairie sandreed	CALO	*Calamovilfa longifolia*	500–750	–
	switchgrass	PAVI2	*Panicum virgatum*	250–625	–
	sand bluestem	ANHA	*Andropogon hallii*	25–500	–
	big bluestem	ANGE	*Andropogon gerardii*	250–500	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–375	–
2	**Warm-Season Midgrass**			500–750	
	little bluestem	SCSC	*Schizachyrium scoparium*	500–750	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–250	–
	purple lovegrass	ERSP	*Eragrostis spectabilis*	0–125	–
3	**Cool-Season Bunchgrasses**			125–250	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	125–250	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–125	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	25–125	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	25–125	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–50	–
4	**Warm-Season Shortgrass**			25–250	

	hairy grama	BOHI2	*Bouteloua hirsuta*	25–250	–
	thin paspalum	PASE5	*Paspalum setaceum*	0–125	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–125	–
5	**Cool-Season Rhizomatous Grass**			25–125	
	western wheatgrass	PASM	*Pascopyrum smithii*	25–125	–
6	**Grass-Like**			25–125	
	sedge	CAREX	*Carex*	25–125	–
9	**Non-native Cool-Season Grass**			0–50	
	Kentucky bluegrass	POPR	*Poa pratensis*	0–50	–
	cheatgrass	BRTE	*Bromus tectorum*	0–50	–
	smooth brome	BRIN2	*Bromus inermis*	0–50	–
Forb					
7	**Forb**			125–250	
	white heath aster	SYER	*Symphyotrichum ericoides*	0–50	–
	blazing star	LIATR	*Liatris*	0–50	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–50	–
	Forb, perennial	2FP	*Forb, perennial*	0–50	–
	Forb, annual	2FA	*Forb, annual*	0–25	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–25	–
	thistle	CIRSI	*Cirsium*	0–25	–
	hoary verbena	VEST	*Verbena stricta*	0–25	–
	goldenrod	SOLID	*Solidago*	0–25	–
	beardtongue	PENST	*Penstemon*	0–25	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–25	–
	pussytoes	ANTEN	*Antennaria*	0–25	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–25	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	0–25	–
	prairie spiderwort	TROC	*Tradescantia occidentalis*	0–25	–
Shrub/Vine					
8	**Shrub**			25–250	
	leadplant	AMCA6	*Amorpha canescens*	0–125	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–125	–
	rose	ROSA5	*Rosa*	0–75	–
	pricklypear	OPUNT	*Opuntia*	0–75	–
	soapweed yucca	YUGL	*Yucca glauca*	0–25	–
	western sandcherry	PRPUB	*Prunus pumila var. besseyi*	0–25	–

Table 12. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-Season Tallgrass**			85–255	
	prairie sandreed	CALO	*Calamovilfa longifolia*	85–255	–
	switchgrass	PAVI2	*Panicum virgatum*	0–85	

	switchgrass	PAVI2	*Panicum virgatum*	0–85	–
	sand bluestem	ANHA	*Andropogon hallii*	0–85	–
	big bluestem	ANGE	*Andropogon gerardii*	0–85	–
	Grass, perennial	2GP	*Grass, perennial*	0–34	–
2	**Warm-Season Midgrass**			170–425	
	little bluestem	SCSC	*Schizachyrium scoparium*	85–255	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	85–170	–
	purple lovegrass	ERSP	*Eragrostis spectabilis*	85–170	–
	Grass, perennial	2GP	*Grass, perennial*	0–34	–
3	**Cool-Season Bunchgrasses**			85–170	
	prairie Junegrass	KOMA	*Koeleria macrantha*	17–170	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	85–170	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–170	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–85	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–34	–
	Grass, perennial	2GP	*Grass, perennial*	0–34	–
4	**Warm-Season Shortgrass**			340–510	
	blue grama	BOGR2	*Bouteloua gracilis*	170–340	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	170–255	–
	thin paspalum	PASE5	*Paspalum setaceum*	0–85	–
5	**Cool-Season Rhizomatous Grass**			170–340	
	western wheatgrass	PASM	*Pascopyrum smithii*	170–340	–
6	**Grass-Like**			85–170	
	sedge	CAREX	*Carex*	85–170	–
7	**Non-Native Cool-Season Grass**			0–255	
	bluegrass	POA	*Poa*	0–255	–
	smooth brome	BRIN2	*Bromus inermis*	0–170	–
	cheatgrass	BRTE	*Bromus tectorum*	0–85	–
Forb					
8	**Forb**			85–255	
	white heath aster	SYER	*Symphyotrichum ericoides*	0–51	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–51	–
	Forb, perennial	2FP	*Forb, perennial*	0–34	–
	Forb, annual	2FA	*Forb, annual*	0–34	–
	blazing star	LIATR	*Liatris*	0–34	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–34	–
	thistle	CIRSI	*Cirsium*	0–17	–
	hoary verbena	VEST	*Verbena stricta*	0–17	–
	common sunflower	HEAN3	*Helianthus annuus*	0–17	–
	goldenrod	SOLID	*Solidago*	0–17	–
	beardtongue	PENST	*Penstemon*	0–17	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–17	–
	pussytoes	ANTEN	*Antennaria*	0–17	–

	Rocky Mountain beeplant	CLSE	*Cleome serrulata*	0–17	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–17	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	0–17	–
	prairie spiderwort	TROC	*Tradescantia occidentalis*	0–17	–
Shrub/Vine					
9	**Shrub**			17–85	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–85	–
	western sandcherry	PRPUB	*Prunus pumila var. besseyi*	0–17	–
	rose	ROSA5	*Rosa*	0–17	–
	pricklypear	OPUNT	*Opuntia*	0–17	–
	soapweed yucca	YUGL	*Yucca glauca*	0–17	–

Table 13. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-Season Tallgrass**			0–60	
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–60	–
	Grass, perennial	2GP	*Grass, perennial*	0–30	–
2	**Warm-Season Midgrass**			120–240	
	sand dropseed	SPCR	*Sporobolus cryptandrus*	120–240	–
	purple lovegrass	ERSP	*Eragrostis spectabilis*	0–120	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–60	–
	Grass, perennial	2GP	*Grass, perennial*	0–30	–
3	**Cool-Season Bunchgrasses**			60–180	
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	60–120	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	60–120	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–120	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–60	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	12–60	–
	Grass, perennial	2GP	*Grass, perennial*	0–30	–
4	**Warm-Season Shortgrass**			60–180	
	blue grama	BOGR2	*Bouteloua gracilis*	60–180	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–60	–
	Grass, perennial	2GP	*Grass, perennial*	0–30	–
5	**Cool-Season Rhizomatous Grass**			12–120	
	western wheatgrass	PASM	*Pascopyrum smithii*	12–120	–
6	**Grass-Like**			60–120	
	sedge	CAREX	*Carex*	60–120	–
9	**Non-native Cool-Season Grass**			120–360	
	smooth brome	BRIN2	*Bromus inermis*	0–240	–
	Kentucky bluegrass	POPR	*Poa pratensis*	120–240	–

	cheatgrass	BRTE	*Bromus tectorum*	0–120	–
Forb					
7	**Forb**			60–240	
	tarragon	ARDR4	*Artemisia dracunculus*	0–60	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–60	–
	thistle	CIRSI	*Cirsium*	0–36	–
	hoary verbena	VEST	*Verbena stricta*	0–36	–
	Rocky Mountain beeplant	CLSE	*Cleome serrulata*	0–36	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–36	–
	common sunflower	HEAN3	*Helianthus annuus*	0–36	–
	Forb, annual	2FA	*Forb, annual*	0–36	–
	Forb, perennial	2FP	*Forb, perennial*	0–24	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–12	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	0–12	–
	goldenrod	SOLID	*Solidago*	0–12	–
	pussytoes	ANTEN	*Antennaria*	0–12	–
Shrub/Vine					
8	**Shrub**			12–60	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–60	–
	rose	ROSA5	*Rosa*	0–12	–

Table 14. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-Season Tallgrass**			0–130	
	big bluestem	ANGE	*Andropogon gerardii*	0–65	–
	switchgrass	PAVI2	*Panicum virgatum*	0–65	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–26	–
	sand bluestem	ANHA	*Andropogon hallii*	0–13	–
2	**Warm-Season Midgrass**			65–195	
	little bluestem	SCSC	*Schizachyrium scoparium*	65–130	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	26–130	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	13–65	–
	purple lovegrass	ERSP	*Eragrostis spectabilis*	0–39	–
	sand lovegrass	ERTR3	*Eragrostis trichodes*	0–26	–
3	**Cool-Season Bunchgrass**			130–195	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	130–195	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–65	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	13–65	–
	Grass, perennial	2GP	*Grass, perennial*	0–65	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–13	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–13	–

4	**Warm-Season Shortgrass**			65–130	
	hairy grama	BOHI2	*Bouteloua hirsuta*	65–130	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–65	–
	Grass, perennial	2GP	*Grass, perennial*	0–65	–
	thin paspalum	PASE5	*Paspalum setaceum*	0–26	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–26	–
5	**Cool-Season Rhizomatous Grass**			26–130	
	western wheatgrass	PASM	*Pascopyrum smithii*	26–130	–
6	**Grass-Like**			26–104	
	sedge	CAREX	*Carex*	26–104	–
7	**Non-Native Cool-Season Grass**			13–65	
	cheatgrass	BRTE	*Bromus tectorum*	0–65	–
	bluegrass	POA	*Poa*	13–65	–
Forb					
8	**Forb**			65–130	
	Forb, annual	2FA	*Forb, annual*	0–65	–
	Forb, perennial	2FP	*Forb, perennial*	0–39	–
	vervain	VERBE	*Verbena*	13–39	–
	tarragon	ARDR4	*Artemisia dracunculus*	13–39	–
	goldenrod	SOLID	*Solidago*	13–39	–
	white heath aster	SYER	*Symphyotrichum ericoides*	13–26	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–26	–
	thistle	CIRSI	*Cirsium*	0–26	–
	spiderwort	TRADE	*Tradescantia*	0–26	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	13–26	–
	pussytoes	ANTEN	*Antennaria*	0–13	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–13	–
	scurfpea	PSORA2	*Psoralidium*	0–13	–
	beardtongue	PENST	*Penstemon*	0–13	–
	blazing star	LIATR	*Liatris*	0–13	–
Shrub/Vine					
9	**Shrub**			65–195	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	39–130	–
	rose	ROSA5	*Rosa*	13–65	–
	leadplant	AMCA6	*Amorpha canescens*	13–65	–
	western sandcherry	PRPUB	*Prunus pumila var. besseyi*	0–13	–
Tree					
10	**Tree**			65–195	
	eastern redcedar	JUVI	*Juniperus virginiana*	65–195	–

Animal community

LIVESTOCK - GRAZING INTERPRETATIONS:
Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area

may provide year-long forage for cattle, sheep, or horses. During the dormant period, the protein levels of the forage may be lower than the minimum needed to meet livestock (primarily cattle and sheep)requirements. The following table lists suggested stocking rates for cattle under continuous season-long grazing under normal growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity.

Production and Carrying Capacity*
Community 1.1, Reference Community: 3,000 lbs/acre, 0.82 AUM/acre
Community 1.2, Degraded Native Grass Community: 2,500 lbs/ac, 0.69 AUM/acre
Community 1.3, At-Risk Community: 1,700 lbs/acre, 0.47 AUM/acre
Community 2.1, Native Shortgrass-Invasive Grass Community: 1,200 lbs/acre, 0.33 AUM/acre
Community 4.1, Invaded Woody Community: 1,300 lbs/acre, 0.36 AUM/acre
*Based upon the following conditions: continuous season-long grazing by cattle under average growing conditions, 25 percent harvest efficiency. Air dry forage requirements based on 3 percent of animal body weight, or 912 lbs/AU/month.
**Forage production is highly variable depending upon the extent of woody encroachment.

WILDLIFE INTERPRETATIONS:
Major Land Resource Area (MLRA) 66 lies primarily within the Mixed-grass prairie ecosystem. Though European settlers have converted about a quarter of this landscape to farmland, the majority of the prairie is still intact. This area still consists of diverse grassland habitats interspersed with varying densities of depressional wetlands and limited woody riparian corridors. These habitats historically provided critical life cycle components for the grassland birds, prairie dogs, and herds of roaming bison, elk, and pronghorn. Bobcats, wolves, and mountain lions occupied the apex predator niche. Diverse populations of small mammals and insects still provide a bountiful prey base for raptors and omnivores such as coyotes, foxes, raccoons, and opossums. In addition, a wide variety of reptiles and amphibians thrive in this landscape.

The Mixed-Grass Prairie was a disturbance-driven ecosystem with fire, herbivory, and climate functioning as the primary disturbances. Following European settlement, elimination of fire, overgrazing, and some habitat fragmentation significantly altered the appearance and functionality of the entire ecosystem. Bison and prairie dogs were historically keystone species, but free-roaming bison herds have been extirpated in this region. The loss of bison and fire as ecological drivers greatly influenced the character of the remaining native grasslands and the habitats that they provide. Fragmentation has reduced habitat quality for numerous area-sensitive species, as highlighted by the decline of the greater prairie chicken.

Historically, an ecological mosaic of the sites provided habitat for species requiring unfragmented grasslands. Most of these important habitat features and components are intact, providing upland nesting habitat for grassland birds and game birds; nesting and escape cover for waterfowl; forbs and insects for brood-rearing habitat; and a forage source for small and large herbivores.

Disruption of the natural fire regime and lack of appropriate grazing management are the greatest threats to the ecosystem dynamics today. Tree and shrub encroachment from lack of fire creates habitat that favors generalist species such as American robin and mourning dove, and provides perches for raptors, increasing the predation mortality on native bird populations. Introduced species such as smooth bromegrass, Kentucky bluegrass, nodding plumeless thistle (musk thistle), and Canada thistle further degrade the biological integrity of many areas of the prairie.

Hydrological functions

Water is the principal factor limiting forage production on well drained portions of this site. Soils on this site are in Hydrologic Soil Group A and B. Some areas have high water tables. On well drained portions of this site, infiltration potential is high. On well drained areas, significant runoff is expected to occur only during intense storms (refer to Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

For the interpretive plant community, rills and gullies should not typically be present. Water flow patterns should be barely distinguishable if at all present in well drained areas. Pedestals are only slightly present in association with bunchgrasses such as little bluestem. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are rare to non-existent. Cryptogamic crusts are present but only cover 1-2 percent of the soil surface. Overall, this site has the appearance of being extremely stable and productive.

Recreational uses

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

Wood products

None.

Other products

Seed harvest of native plant species can provide additional income on this site.

Other information

Field Offices (Counties)
Nebraska:
Ainsworth, (Brown, Keya Paha, and Rock)
Bloomfield, (Knox,)
Spencer, (Boyd)
Neligh, (Antelope)
O'Neill, (Holt)
Valentine, (Cherry)

South Dakota:
Burke, (Gregory)
Martin, (Bennett and Shannon)
Winner, (Tripp)
White River, (Mellette and Todd)

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 Wayne Bachman, Soil Scientist, NRCS; Stan Boltz, Range Management Specialist, NRCS; Anna Ferguson, Soil Conservationist, NRCS; Roger Hammer, Soil Scientist, NRCS; Dana Larsen, Range Management Specialist, NRCS; Dave Schmidt, Rangeland Management Specialist, NRCS; Kim Stine, Rangeland Management Specialist, NRCS.

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Contributors

Dana Larsen
Doug Whisenhunt
Nadine Bishop

Approval

Suzanne Mayne-Kinney, 11/18/2024

Acknowledgments

Many thanks to the members of the soils, local practitioners and technical teams, as well as the editor.

This Ecological Site was approved for publication in March of 2021.

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)	Original Author: Stan Boltz Version V participants: Emily Helms, Nadine Bishop, Jeff Nichols
Contact for lead author	jeffrey.nichols@usda.gov
Date	11/18/2024

Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None. Rills are not expected on this site.

2. **Presence of water flow patterns:** None. Water flow patterns are not expected on this site.

3. **Number and height of erosional pedestals or terracettes:** None. Pedestals and terracettes are not expected 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 5 percent or less. Multi-year drought and/or wildfire can increase bare ground to 10 percent for up to two years following the disturbance.

   Bare ground is exposed mineral soil that is not covered by vegetation (basal and/or foliar canopy), standing dead vegetation, gravel/rock, and visible biological crust (e.g., lichen, mosses, algae).

5. **Number of gullies and erosion associated with gullies:** None. Gullies are not expected on this site.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None. Wind-scoured areas and depositional areas are not expected on this site.

7. **Amount of litter movement (describe size and distance expected to travel):** Litter should fall in place. Slight amount of movement (less than 12 inches or 30 cm) of fine litter from water is possible, but not normal. Litter movement from wind is not expected.

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 5 to 6, normally 6. Surface organic matter adheres to the soil surface. Soil surface fragments will typically retain structure indefinitely when dipped in distilled water.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The A-horizon should be 7 to 20 inches (17.8-50-8 cm) thick, with the deeper A-horizon occurring on interdunes and nearly level landscape positions. Soil is dark grayish brown to grayish brown (values of 4 to 5) when dry and very dark brown, very dark grayish brown, to dark grayish brown (values of 2 to 4) when moist. Structure is typically weak medium and coarse subangular blocky parting to weak fine medium to fine granular. Holt soils have a moderate medium granular structure.

The primary soil series correlated to this site include Anselmo, Dunday, Doger, Holt, O'Neill, Pivot, and Ronson.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The functional/structural groups provide a combination of rooting depths and structure which positively influences infiltration. Combination of shallow and deep rooted species (mid & tall rhizomatous and tufted perennial cool-season grasses) with fine and coarse roots positively influences infiltration. Invasion of introduced cool-season grasses such as annual bromes, Kentucky bluegrass, and smooth brome may have an adverse impact on infiltration and runoff. Woody encroachment may also negatively influence infiltration.

    The expected composition of the plant community is 85 percent perennial grasses and grass-likes, 10 percent forbs, and 5 percent shrubs. The perennial grass and grass-like component is made up of C4, tallgrasses (50-65%); C4, midgrasses (15-25%), C3, bunchgrasses (5-15%); C4, shortgrasses (5-10%); C3, rhizomatous grasses (1-5%); and grass-likes (1-5%).

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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. A compaction layer should not be present.

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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, C4, tallgrass, 1500-1950 #/ac, 50-65% (4 species minimum): big bluestem, Indiangrass, prairie sandreed, sand bluestem, switchgrass.

    Phase 1.2
    1. Native, perennial, C4, tallgrass, 1250-1500 #/ac, 50-60% (4 species minimum): big bluestem, Indiangrass, prairie sandreed, sand bluestem, switchgrass.

    Phase 1.3
    1. Native, perennial, C4, shortgrass, 340-510 #/ac, 20-30% (2 species minimum): blue grama, Fendler threeawn, hairy grama, thin paspalum.
    2. Native, perennial, C4, midgrass, 85-255 #/ac, 10-25% (3 species minimum): little bluestem, purple lovegrass, sand dropseed.

    Sub-dominant: Phase 1.1
    1. Native, perennial, C4, midgrass, 450-750 #/ac, 15-25 percent (1 species minimum): little bluestem, purple lovegrass, sand lovegrass, sand dropseed, sideoats grama.
    2. Native, perennial, C3, bunchgrass, 150-450 #/ac, 5-15 percent (2 species minimum): fall rosette grass, needle and thread, porcupinegrass, prairie Junegrass, Scribner’s rosette grass.

    Phase 1.2
    1. Native, perennial, C4, midgrass, 500-750 #/ac, 20-30% (1 species minimum): little bluestem, purple lovegrass, sand dropseed.

    Phase 1.3
    1. Native, perennial, C3, rhizomatous grass, 170-340 #/ac, 10-20%: western wheatgrass.
    2. Native, perennial, C4, tallgrass, 85-255 #/ac, 5-15% (1 species minimum): big bluestem, prairie sandreed, sand

bluestem, switchgrass.
3. Forb, 85-255 #/ac, 5-15%: forbs present vary from location to location.
4. Non-native, C3 grass, 0-255 #/ac, 0-15%: Kentucky bluegrass, cheatgrass, smooth brome.

Other: Minor - Phase 1.1
1. Native forb – 150-300 #ac, 5-10%: forbs present vary from location to location.
2. Native, perennial, C4, shortgrass, 150-300 #/ac, 5-10%: blue grama, Fendler threeawn, hairy grama, thin paspalum.
3. Native, perennial, C3, rhizomatous grass, 30-150 #/ac, 1-5%: western wheatgrass.
4. Grass-like, 30-150 #/ac, 1-5%: sedge.
5. Shrub, 30-150 #/ac, 1-5%: shrubs present vary from location to location.

Minor -Phase 1.2
1. Native, perennial, C3, bunchgrass, 125-250 #/ac, 5-10%: fall rosette grass, needle and thread, porcupinegrass, prairie Junegrass, Scribner's rosette grass.
2. Native forb, 125-250 #/ac, 5-10%: forbs present vary from location to location.
3. Native, perennial, C4, shortgrass, 25-250 #/ac, 1-10%: blue grama, Fendler threeawn, hairy grama, thin paspalum.
4. Shrub, 25-250 #/ac, 1-10%: shrubs present vary from location to location.
5. Native, perennial, C3, rhizomatous grass, 25-120 #/ac, 1-5%: western wheatgrass.
6. Grass-like, 25-120 #/ac, 1-5%: sedges.

Minor -Phase 1.3
1. Native, perennial, C3, bunchgrass, 85-170 #/ac, 5-10%: fall rosette grass, needle and thread, porcupinegrass, prairie Junegrass, Scribner's rosette grass.
2. Grass-like, 85-170 #/ac, 5-10%: sedges
3. Shrub, 17-85 #/ac, 1-5%: shrubs present vary from location to location.

Trace - Phase 1.2
1. Non-native, C3 grass, 0-50 #/ac, 0-2%: Kentucky bluegrass, cheatgrass, smooth brome.

Additional: The Reference Community or Bluestem-Prairie Sandreed Community (1.1) consists of eight F/S groups. These groups are, in order of relative abundance, native, perennial, C4, tallgrass; native, perennial, C4, midgrass; native, perennial, C3, bunchgrass; native, perennial, C4 shortgrass = native forb; native, C3 rhizomatous grass = grass-like = shrub.

The Degraded Native Community (1.2) also consists of nine F/S groups. These groups are, in order of relative abundance, native, perennial, C4, tallgrass; native, perennial, C4, midgrass; native, perennial, C3, bunchgrass = native forb; native, perennial, C4 shortgrass; = shrub; native, C3 rhizomatous grass = grass-like; and non-native, C3 grass.

The At Risk Community (1.3) consists of eight groups which are native, perennial, C4, shortgrass; native, perennial, C4 midgrass; native, perennial, C3 rhizomatous grass; native, perennial, C4 tallgrass = forb; non-native, C3 grass; native, perennial, C3 bunchgrass = grass-like, and shrub.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Bunch grasses 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 60 to 80 percent and at a depth of 0.25 to 0.50 inch (0.65-1.3 cm). Litter cover during and following drought can range from 50 to 60 percent.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** The representative value (RV) for annual production is 3,000 pounds per acre on an air dry weight basis. Low and High production years should yield 2,300 and 3,500 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 (cheatgrass and Japanese/field), leafy spurge, absinth wormwood, common mullein, sulphur cinquefoil, Canada thistle, eastern red cedar, smooth brome, and Kentucky bluegrass 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.