USDA Natural Resources Conservation Service

Ecological site R066XY051NE
Sandy Lowland

Last updated: 11/18/2024
Accessed: 05/12/2025

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.

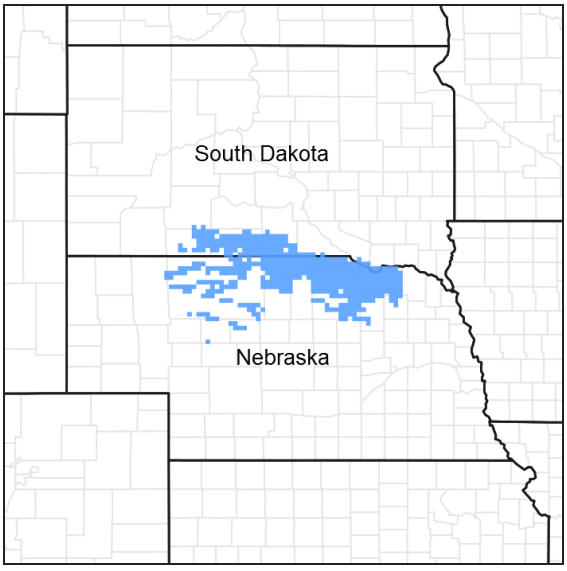


Figure 1. Mapped extent

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 sixty-six 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. Big bluestem, sand bluestem, prairie sandreed, little bluestem, 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

The Sandy Lowland ecological site occurs in river valley landscapes, on flood plains, and low terraces. The site may receive additional moisture from run off or overflow. Typical slopes range from 0 to 3 percent. Soils are very deep and formed in stratified sandy alluvium. Soil surface textures are sand, loamy sand, fine sandy loam, or loam and subsoil textures are sand, loamy sand, or fine sandy loam. Soil surface layers range from 2 to 12 inches thick. Soils

can be slightly calcareous.

The vegetation in the Reference State (1.0) consists primarily of warm- and cool-season grasses and grass-likes. Sand bluestem, prairie sandreed, switchgrass, and blue grama are dominant. Cool-season grasses and grass-like species including needle and thread, and various sedges. Forbs are common and diverse, shrubs can include leadplant, rose, and American plum. Trees include cottonwood and willows.

Associated sites

R066XY032NE	**Sandy 18-22" P.Z.** The Sandy 18-22 ecological site may be found adjacent to and on a higher landscape position than the Sandy Lowland ecological site.
R066XY033NE	**Sands 18-22" P.Z.** The Sands 18-22 ecological site may be found adjacent to and on a higher landscape position than the Sandy Lowland ecological site.
R066XY054NE	**Sandy 22-25 P.Z.** The Sandy 22-25 ecological site may be found adjacent to and on a higher landscape position than the Sandy Lowland ecological site.
R066XY055NE	**Sands 22-25" P.Z.** The Sands 22-25 ecological site may be found adjacent to and on a higher landscape position than the Sandy Lowland ecological site.
R066XY046NE	**Subirrigated** The Subirrigated ecological site may be found adjacent to but on a lower landscape position than the Sandy Lowland ecological site.
R066XY047NE	**Saline Subirrigated** The Saline Subirrigated ecological site may be found adjacent to but on a lower landscape position than the Sandy Lowland ecological site.

Similar sites

R066XY053NE	**Interdunal Lowland** The Interdunal Lowland ecological site is similar to the Sandy Lowland ecological site but is found on low areas between sandhill dunes rather than on active floodplains and low terraces.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Calamovilfa longifolia* (2) *Panicum virgatum*

Physiographic features

The Sandy Lowland ecological site occurs primarily on flood plains and low terraces. The site can receive additional moisture from run off or overflow. Slopes typically range from 0 to 3 percent.

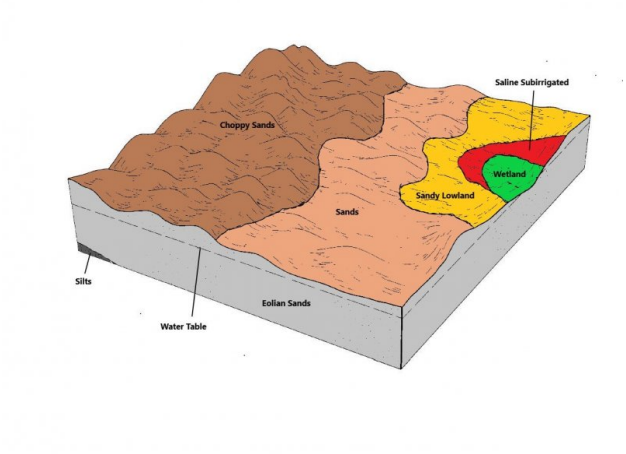


Figure 2. Block diagram of the Sandy Lowland site.

Table 2. Representative physiographic features

Landforms	(1) River valley > Flood plain (2) River valley > Stream terrace
Runoff class	Negligible to low
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	None to occasional
Elevation	579–914 m
Slope	0–3%
Water table depth	91–183 cm
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)	112-126 days
Freeze-free period (characteristic range)	129-148 days
Precipitation total (characteristic range)	533-635 mm
Frost-free period (actual range)	108-128 days

Freeze-free period (actual range)	128-149 days
Precipitation total (actual range)	508-660 mm
Frost-free period (average)	120 days
Freeze-free period (average)	139 days
Precipitation total (average)	584 mm

Climate stations used

- (1) O NEILL [USC00256290], Oneill, NE
- (2) HARRINGTON [USC00393574], Tuthill, SD
- (3) VALENTINE MILLER FLD [USW00024032], Valentine, NE
- (4) SPRINGVIEW [USC00258090], Springview, NE
- (5) AINSWORTH [USC00250050], Ainsworth, NE
- (6) FAIRFAX #2 [USC00392822], Fairfax, SD
- (7) BUTTE [USC00251365], Butte, NE

Influencing water features

While the hydrology of this site functions independently of the water table, the seasonal high water table at a depth of 36 inches allows the more deeply rooted native grasses have the competitive advantage.

Soil features

The soils associated with the Sandy Lowland ecological site are very deep and well to excessively drained. These soils formed in stratified sandy alluvium on flood plains or low terraces. Slopes range from 0 to 3 percent. Soil surface textures range from loam to sand, but are predominately loamy fine sand, fine sandy loam, or loamy sand. Saturated conductivity is high to very high.

Runoff as evidenced by patterns of rill, gully, or other water flow is negligible to low. Soil erosion is low. Cryptobiotic crusts are present, but their function is not well understood. Some pedestalling of plants occurs, but it is not very evident on casual observation and occurs on less than 5 percent of the plants.

Calamus, Cass, Dunn, Inavale, Inglewood, and Munjor are the soil series associated with this site. More information can be found in the various soil survey reports. Contact the local USDA Service Center for soil survey reports that include more detail specific to your location or visit Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov).

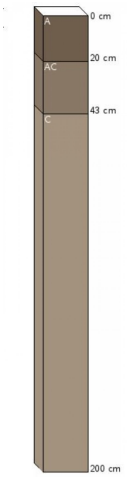


Figure 9. Inavale series profile

Table 4. Representative soil features

Parent material	(1) Alluvium

Surface texture	(1) Loamy fine sand (2) Fine sand (3) Loamy sand (4) Fine sandy loam (5) Sand (6) Loam
Family particle size	(1) Sandy
Drainage class	Moderately well drained to excessively drained
Permeability class	Moderate to rapid
Soil depth	203 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	5.08–11.18 cm
Calcium carbonate equivalent (Depth not specified)	0–10%
Electrical conductivity (Depth not specified)	0 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	5.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–8%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

Sandy Lowland ecological sites 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.

This site includes depressional areas which allow deep-rooted native warm-season grasses to utilize subsurface moisture. The site often occurs in a transitional area between Sandy and Subirrigated sites. If management common to Subirrigated sites extends onto Sandy Lowland sites, the plant community can quickly shift due to the limited availability of subsoil moisture present on Sandy Lowland sites.

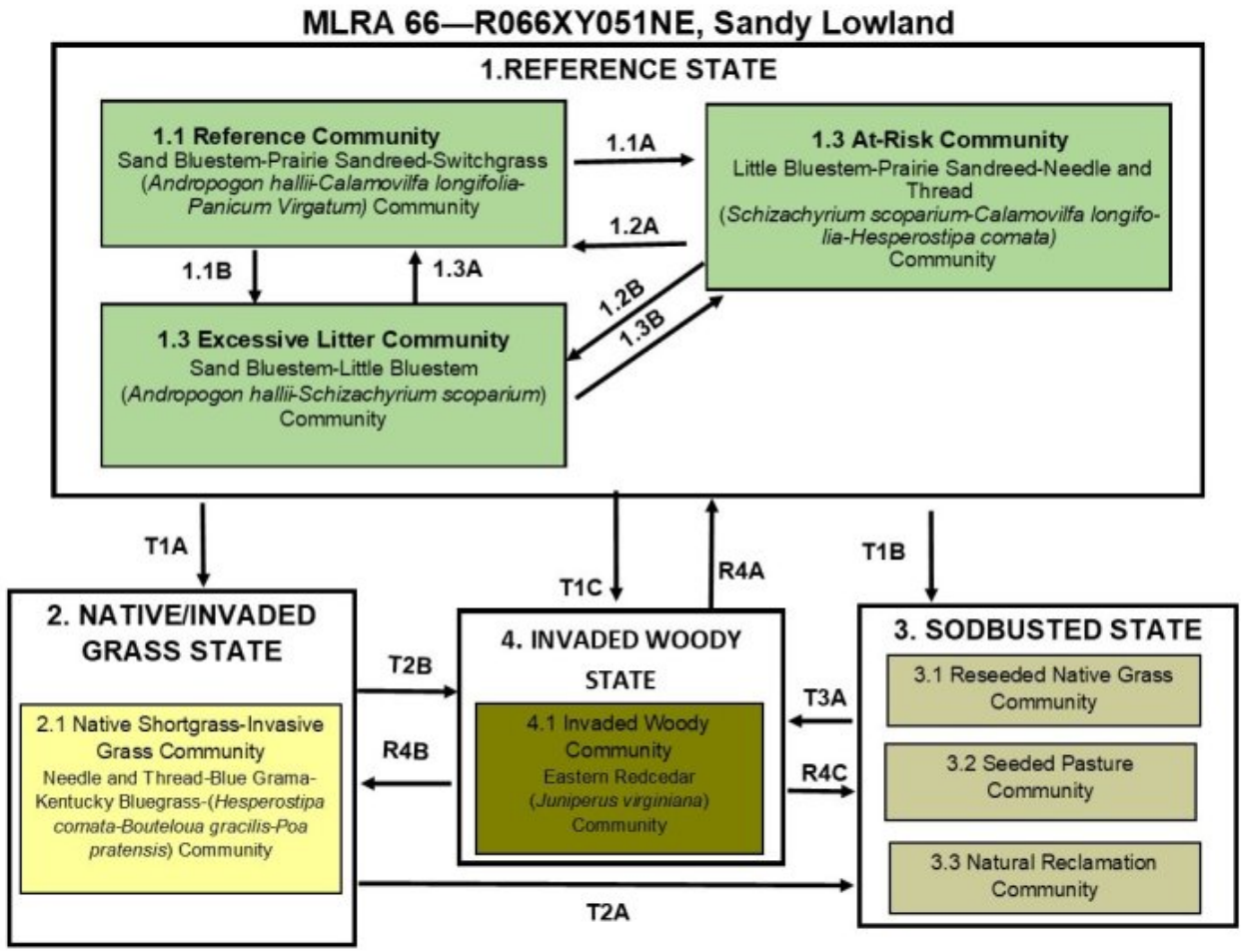
The introduction of domestic livestock by European settlers along with season-long, continuous grazing had a profound impact on the vegetation of the Thin Upland ecological site. Season-long, continuous grazing causes a repeated removal of the growing point and excessive defoliation of the leaf area 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.

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 repetitive 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 repetitive haying with inadequate growing season recovery periods.
1.1B: Prolonged (> 5 years) absence of herbivory and fire.
1.2A: Prescribed grazing with adequate, growing season recovery periods or biennial haying.
1.2B: Prolonged (> 5 years) absence of herbivory and fire.
1.3A: Prescribed grazing, prescribed burning.
1.3B: Prescribed grazing, prescribed burning.

Figure 10. State and Transition Model Diagram. Sandy Lowland Ecological Site, MLRA 66.

State 1
Reference State

The Reference State (1) describes the range of vegetative communities that occur on the Sandy Lowland ecological site where the range of natural variability under historic conditions and disturbance regimes is 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 At-Risk Community (1.2), and the Excessive Litter Community (1.3). The Reference Community (1.1) 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 At-Risk Community results from management actions that are unfavorable for a healthy Reference Community. The Excessive Litter Community results when herbivory and fire are removed from the landscape.

Dominant plant species

- sand bluestem (*Andropogon hallii*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- switchgrass (*Panicum virgatum*), grass
- blue grama (*Bouteloua gracilis*), grass

Community 1.1
Reference Community

Interpretations are primarily based on the Reference or Sand Bluestem-Prairie Sandreed-Switchgrass (*Andropogon hallii-Calamovilfa longifolia-Panicum virgatum*) Community. 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. This site developed with grazing by large herbivores and is well suited for grazing by domestic livestock. Warm-season, tallgrasses dominate the plant community. Major grasses include sand bluestem, prairie sandreed, switchgrass, and little bluestem. Other grasses include needle and thread, Indiangrass, hairy and blue grama, and grass-likes including sedges. The potential vegetation is 85 to 95 percent grasses, 5 to 15 percent forbs, 1 to 5 percent shrubs, and 0 to 2 percent trees. Natural fire played a significant role in the succession of this site by limiting the extent of woody species. Wildfires have been actively controlled in recent times, allowing eastern redcedar and other woody species 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. 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 biotic integrity. These factors create a suitable environment for a healthy and sustainable plant community.

Dominant plant species

- plains cottonwood (*Populus deltoides ssp. monilifera*), tree
- sand bluestem (*Andropogon hallii*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- switchgrass (*Panicum virgatum*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2533	2859	3166
Forb	157	244	364
Shrub/Vine	–	82	168
Tree	–	65	112
Total	**2690**	**3250**	**3810**

Figure 12. Plant community growth curve (percent production by month). NE6534, NE/SD Sandhills, Native Grasslands. Warm-season dominant, cool-season subdominant, mid- and tallgrasses.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	5	15	25	30	10	7	3		

Community 1.2
At-Risk Community

The At-Risk or Little Bluestem-Prairie Sandreed-Needle and Thread (*Schizachyrium scoparium-Calamovilfa longifolia-Hesperostipa comata*) Community (1.2) developed under continuous season-long grazing. Plants resistant to grazing are maintaining themselves in this plant community. Most of the palatable plants from the Reference Community (1.1) are present but occur in lesser amounts. The potential vegetation is 80 to 85 percent grasses or grass-like plants, 5 to 10 percent forbs, 0 to 10 percent shrubs and 5 to 10 percent trees. Dominant grasses include prairie sandreed and little bluestem. Grasses of secondary importance include blue or hairy grama, needle and thread, sand dropseed, and western wheatgrass. Forbs commonly found in this plant community include white sagebrush, heath aster, goldenrod, verbena, and Cuman ragweed. Indiangrass is no longer present and sand bluestem and palatable perennial forbs are present in lesser amounts. As compared to the Reference Community, this plant community has a higher percentage of cool-season grasses and forbs. Reduced amounts of warm-season tallgrasses reduce both production and the drought tolerance of the community. The soil surface has remained intact. This plant community is considered stable but is at risk if a major shift in climate or overgrazing occurs. The resiliency of this plant community is moderate depending on the intensity and duration of disturbance. Infiltration and runoff are generally not affected due to the nature of the soil. The close proximity of the Sandy Lowland site to the Subirrigated ecological site often leads to implementation of same management scenarios on both area and frequently that management scenario is annual haying. The lack of subsoil moisture, as compared to the Subirrigated site, reduces the ability of the grasses to adequately recover from annual mowing and eventually leads to a transition to the Native/Invaded Grass State (2). Biennial haying the Sandy Lowland portion of the area along with annual fall grazing will improve the health and vigor of the warm-season tallgrasses and is a viable management alternative. Fencing along ecological site boundaries allows additional management options for both Subirrigated and Sandy Lowland sites and should be considered when adequate water facilities are present.

Dominant plant species

- plains cottonwood (*Populus deltoides ssp. monilifera*), tree
- little bluestem (*Schizachyrium scoparium*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- blue grama (*Bouteloua gracilis*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1978	2135	2354
Forb	123	185	280
Tree	–	129	280
Shrub/Vine	84	129	280
Total	**2185**	**2578**	**3194**

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
Excessive Litter Community

The Excessive Litter or Sand Bluestem-Little Bluestem (*Andropogon hallii-Schizachyrium scoparium*) Community (1.3) 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. 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

- little bluestem (*Schizachyrium scoparium*), grass
- sand bluestem (*Andropogon hallii*), grass

Pathway 1.1A
Community 1.1 to 1.2

Continuous season-long grazing or repetitive haying will move the Reference Community (1.1) toward the At-Risk Community (1.2). Continuous heavy grazing tends to accelerate this movement. Rotational grazing with inadequate growing season recovery periods will also cause this shift over a longer period of time.

Pathway 1.1B
Community 1.1 to 1.3

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 (1.3).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing with adequate growing season recovery periods during the rapid growth period of the warm-season grasses or biennial haying will return the At-Risk Community (1.2) to the Reference Community (1.1). Prescribed fire will accelerate this process.

Pathway 1.2B
Community 1.2 to 1.3

Prolonged interruption (more than 5 years) of the natural disturbances of herbivory and fire will convert the At-Risk Community (1.2) to the Excessive Litter Community (1.3).

Pathway 1.3A
Community 1.3 to 1.1

Reintroduction of the natural processes of herbivory and fire will move the Excessive Litter Community (1.3) to the Reference Community (1.1).

Pathway 1.3B
Community 1.3 to 1.2

Reintroduction of heavy, continuous grazing will move the Excessive Litter Community (1.3) to the At-Risk

Community (1.2).

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 component has been replaced by warm-season shortgrasses and non-native, cool-season grasses. 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 shortgrass and invaded grass plant communities. Due to the changes in the plant community, soil stability, and hydrologic function, restoration to the Reference State is not feasible. However, renovation with seeding, herbicide treatment, and management can produce a plant community that is similar to the Reference Community (1.1). The Native/Invaded Grass State includes the Native Shortgrass-Invasive Grass (2.1) Community.

Dominant plant species

- needle and thread (*Hesperostipa comata ssp. comata*), grass
- blue grama (*Bouteloua gracilis*), grass
- sand dropseed (*Sporobolus cryptandrus*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

Community 2.1
Native Shortgrass-Invasive Grass Community

The Native Shortgrass-Invasive Grass or Needle and Thread-Blue Grama-Kentucky Bluegrass (*Hesperostipa comata-Bouteloua gracilis-Poa pratensis*) Community (2.1) develops with heavy livestock grazing, usually season-long, or with annual haying followed by fall grazing. Plant diversity is diminished as the bluestems, prairie sandreed and switchgrass are removed from the plant community. Small, isolated plants may exist in a prostrate form allowing them avoid defoliation. Annual haying prevents an increase of shrubs but causes an increase in the cactus component in this community. Dominant grasses include needle and thread, blue or hairy grama, and sand dropseed. Kentucky bluegrass has a significant presence in the plant community. Other grasses or grass-likes include annual bromes, prairie Junegrass, Scribner's rosette grass, western wheatgrass, and sedges. Dominant forbs include Cuman ragweed, hoary verbena, white sagebrush, thistle, and heath aster. Pricklypear and rose significantly increase. The potential vegetation is 80 to 90 percent grass or grass-like plants, 5 to 15 percent forbs and 1 to 10 percent shrubs. Plant diversity is low. Soil erosion is low. There is a lack of litter. Infiltration is moderate and runoff is low due to sandy nature of the soils and the relatively flat slopes. This plant community is fairly resistant to change. If disturbed, it is not resilient due to the low species diversity.

Dominant plant species

- needle and thread (*Hesperostipa comata ssp. comata*), grass
- blue grama (*Bouteloua gracilis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1586	1603	1603
Forb	95	202	336
Shrub/Vine	–	106	207
Tree	–	106	207
Total	**1681**	**2017**	**2353**

Figure 16. Plant community growth curve (percent production by month). NE6638, Eroded Tableland, warm-season dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	15	20	30	15	5	5	0	0

State 3
Sodbusted State

The threshold to the Sodbusted State (3) is crossed as a result of mechanical disturbance to facilitate production agriculture. If farming operations are suspended, the site can seeded to native grasses and forms resulting in the Reseeded Native Grass Community (3.1), be seeded to a tame pasture forage mixture resulting in the Seeded Pasture Community (3.2) or be abandoned with no seeding which will result in the Natural Reclamation Community (3.3). Permanent alterations of the soil, plant community, and hydrologic cycle make restoration to the Reference State (1) extremely difficult, if not impossible.

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, fertility management, and past grazing management. Native range and grasslands seeded to native species 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 (6.3) 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 resource 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 (5) 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 the Invaded Woody 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 return 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 the return to the Reference State through woody species removal alone. The Invaded Woody State includes one community, the Invaded Woody Community (4.1).

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- Kentucky bluegrass (*Poa pratensis*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass
- blue grama (*Bouteloua gracilis*), grass

Community 4.1
Invaded Woody Community

The Invaded Woody 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. Additionally, deciduous tree and shrub cover may exceed that present in the Reference State. 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.

Transition T1A
State 1 to 2

Long-term (more than 10 years) heavy, continuous grazing or repetitive 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, biotic integrity, and hydrologic function are degraded to the point that a return to the Reference State may not be feasible.

Transition T1B
State 1 to 3

The Reference State (1) 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 Reference State 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 Native/Invaded Grass State (2) 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 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, harvest, and brush management will move the Invaded Woody State (4) toward the Reference State (1). The forb component may initially increase following tree 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. The heavier the existing canopy cover, the greater the energy input required to return to the Reference State by management practices. The amount of time required for this restoration to occur depends on the severity and duration of the encroachment. Land that transitioned to the Woody Invaded State from the Native/Invaded Grass State (2) or the Sodbusted State (3), cannot be restored to the Reference State through removal of woody species as the native plant community, soils, and hydrologic function have been too severely impacted for that restoration to occur.

Restoration pathway R4B
State 4 to 2

Prescribed burning, wildfire, harvest, and brush management will move the Invaded Woody State (4) toward the Native/Invaded Grass State (2). The forb component may initially increase following tree 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. The heavier the existing canopy cover, the greater the energy input required to return to the Reference State by management practices. The amount of time required for this restoration to occur depends on the severity and duration of the encroachment. Land that transitioned to the Woody Invaded State from the Native/Invaded Grass State or the Sodbusted State (3), cannot be restored to the Reference State (1) through removal of woody species as the native plant community, soils, and hydrologic function have been too severely impacted for that restoration to occur.

Restoration pathway R4C
State 4 to 3

Prescribed burning, wildfire, harvest, and brush management will move the Invaded Woody State (4) toward the Sodbusted State (3). The forb component may initially increase following tree 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. The heavier the existing canopy cover, the greater the energy input required to return to the Reference State by management practices. The amount of time required for this restoration to occur depends on the severity and duration of the encroachment. Land that transitioned to the Woody Invaded State from the Native/Invaded Grass State (2) or the Sodbusted State, cannot be restored to the Reference State (1) through removal of woody species as the native plant community, soils, and hydrologic function have been too severely impacted for that restoration to occur.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-Season Tallgrass**			1463–1950	
	sand bluestem	ANHA	*Andropogon hallii*	650–1300	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	488–975	–
	switchgrass	PAVI2	*Panicum virgatum*	325–650	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–163	–
	Grass, perennial	2GP	*Grass, perennial*	0–65	–
2	**Warm-Season Midgrass**			488–975	
	little bluestem	SCSC	*Schizachyrium scoparium*	488–975	–
	sand lovegrass	ERTR3	*Eragrostis trichodes*	0–163	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–163	–
	purple lovegrass	ERSP	*Eragrostis spectabilis*	0–163	–
	Grass, perennial	2GP	*Grass, perennial*	0–65	–
3	**Cool-Season Bunchgrass**			163–488	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	163–488	–
	Grass, perennial	2GP	*Grass, perennial*	0–163	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–65	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–65	–
4	**Warm-Season Shortgrass**			163–325	
	blue grama	BOGR2	*Bouteloua gracilis*	163–325	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–163	–
	thin paspalum	PASE5	*Paspalum setaceum*	0–65	–
	Grass, perennial	2GP	*Grass, perennial*	0–65	–
5	**Cool-Season Rhizomatous Grasses**			0–163	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–163	–
6	**Grass-Like**			33–163	
	sedge	CAREX	*Carex*	33–163	–
Forb					
7	**Forbs**			163–325	
	beardtongue	PENST	*Penstemon*	0–65	–

	beardtongue	PENST	*Penstemon*	0–33	
	goldenrod	SOLID	*Solidago*	0–65	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–65	–
	Forb, perennial	2FP	*Forb, perennial*	0–65	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–65	–
	dotted blazing star	LIPU	*Liatris punctata*	0–65	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–33	–
	Carolina larkspur	DECAV2	*Delphinium carolinianum ssp. virescens*	0–33	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–33	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–33	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–33	–
	false boneset	BREU	*Brickellia eupatorioides*	0–33	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	0–33	–
	vervain	VERBE	*Verbena*	0–33	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–33	–
	Forb, annual	2FA	*Forb, annual*	0–33	–
Shrub/Vine					
8	**Shrubs**			0–163	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–98	–
	leadplant	AMCA6	*Amorpha canescens*	0–65	–
	rose	ROSA5	*Rosa*	0–65	–
Tree					
9	**Native Deciduous Trees**			0–65	
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–65	–
	willow	SALIX	*Salix*	0–65	–

Table 9. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-Season Tallgrass**			258–1031	
	prairie sandreed	CALO	*Calamovilfa longifolia*	129–516	–
	switchgrass	PAVI2	*Panicum virgatum*	129–258	–
	Indiangrass	SONU2	*Sorghastrum nutans*	129–258	–
	sand bluestem	ANHA	*Andropogon hallii*	129–258	–
	Grass, perennial	2GP	*Grass, perennial*	0–52	–
2	**Warm-Season Midgrass**			258–773	
	little bluestem	SCSC	*Schizachyrium scoparium*	129–773	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	26–258	–
	Grass, perennial	2GP	*Grass, perennial*	0–52	–
	purple lovegrass	ERSP	*Eragrostis spectabilis*	0–26	–
	sand lovegrass	ERTR3	*Eragrostis trichodes*	0–26	–
3	**Cool-Season Bunchgrass**			129–387	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	129–387	–
	Scribner's rosette grass	DICA8	*Dichanthelium oligosanthes*	0–129	–

	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–129	–
	Grass, perennial	2GP	*Grass, perennial*	0–52	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–26	–
4	**Warm-Season Shortgrass**			129–387	
	blue grama	BOGR2	*Bouteloua gracilis*	129–387	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–129	–
	thin paspalum	PASE5	*Paspalum setaceum*	0–52	–
	Grass, perennial	2GP	*Grass, perennial*	0–26	–
5	**Cool-Season Rhizomatous Grass**			0–129	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–129	–
6	**Grass-Like**			26–129	
	sedge	CAREX	*Carex*	26–129	–
7	**Non-Native Cool-Season Grass**			0–129	
	cheatgrass	BRTE	*Bromus tectorum*	0–129	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–129	–
Forb					
8	**Forb**			129–258	
	vervain	VERBE	*Verbena*	0–129	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–129	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–129	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–77	–
	Forb, perennial	2FP	*Forb, perennial*	0–52	–
	Forb, annual	2FA	*Forb, annual*	0–52	–
	goldenrod	SOLID	*Solidago*	0–52	–
	dotted blazing star	LIPU	*Liatris punctata*	0–26	–
	false boneset	BREU	*Brickellia eupatorioides*	0–26	–
	beardtongue	PENST	*Penstemon*	0–26	–
	Carolina larkspur	DECAV2	*Delphinium carolinianum ssp. virescens*	0–26	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–26	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–26	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	0–26	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–26	–
	thistle	CIRSI	*Cirsium*	0–26	–
Shrub/Vine					
9	**Shrub**			0–258	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–129	–
	rose	ROSA5	*Rosa*	0–77	–
	pricklypear	OPUNT	*Opuntia*	0–52	–
	leadplant	AMCA6	*Amorpha canescens*	0–26	–
Tree					
10	**Native Deciduous Tree**			129–258	
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–258	–
	willow	SALIX	*Salix*	0–258	–

	Tree	2TREE	*Tree*	0–52	–

Table 10. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-Season Tallgrass**			0–101	
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–101	–
	Grass, perennial	2GP	*Grass, perennial*	0–10	–
2	**Warm-Season Midgrass**			101–404	
	sand dropseed	SPCR	*Sporobolus cryptandrus*	101–404	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–101	–
	Grass, perennial	2GP	*Grass, perennial*	0–10	–
3	**Cool-Season Bunchgrass**			101–504	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	101–504	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	20–101	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–101	–
	Grass, perennial	2GP	*Grass, perennial*	0–20	–
4	**Warm-Season Shortgrass**			101–605	
	blue grama	BOGR2	*Bouteloua gracilis*	101–504	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–101	–
	thin paspalum	PASE5	*Paspalum setaceum*	0–101	–
	Grass, perennial	2GP	*Grass, perennial*	0–20	–
5	**Cool-Season Rhizomatous Grasses**			20–101	
	western wheatgrass	PASM	*Pascopyrum smithii*	20–101	–
7	**Grass-Like**			20–202	
	sedge	CAREX	*Carex*	20–202	–
8	**Non-Native Cool-Season Grass**			101–303	
	cheatgrass	BRTE	*Bromus tectorum*	101–202	–
	Kentucky bluegrass	POPR	*Poa pratensis*	101–202	–
Forb					
9	**Forb**			101–303	
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–303	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–101	–
	thistle	CIRSI	*Cirsium*	0–101	–
	vervain	VERBE	*Verbena*	0–101	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–101	–
	Forb, annual	2FA	*Forb, annual*	0–61	–
	goldenrod	SOLID	*Solidago*	0–40	–
	Forb, perennial	2FP	*Forb, perennial*	0–40	–
	Carolina larkspur	DECAV2	*Delphinium carolinianum ssp. virescens*	0–20	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	0–20	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–20	–

	dotted blazing star	LIPU	*Liatris punctata*	0–20	–
	false boneset	BREU	*Brickellia eupatorioides*	0–20	–
Shrub/Vine					
10	**Shrub**			0–202	
	pricklypear	OPUNT	*Opuntia*	0–202	–
	rose	ROSA5	*Rosa*	0–101	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–101	–
Tree					
11	**Native Deciduous Tree**			0–202	
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–202	–
	willow	SALIX	*Salix*	0–202	–
	Tree	2TREE	*Tree*	0–30	–

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.

Production and Carrying Capacity*
Community 1.1, Reference Community: 2,900 lbs/acre, 0.79 AUM/acre
Community 1.2, At-Risk Community: 2,300 lbs/ac, 0.63 AUM/acre
Community 2.1, Native Shortgrass/Invasive Grass Community: 1,800 lbs/ac, 0.49 AUM/ac

*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.

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 this site. Runoff is expected to occur only during the most intense storms (refer to Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

The high infiltration rate of these sands results in few rills and gullies or water flow patterns even though steep slopes may be included. Pedestals are only slightly present in association with bunchgrasses such as needle and thread. Litter typically falls in place on flat slopes. Chemical and physical crusts are rare to non-existent. Cryptogamic crusts are present but only cover 1-2 percent of the soil surface. This crusting is not significant for hydrologic considerations. Overall, this site has the appearance of being 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

No appreciable wood products are present on the site.

Other products

None noted.

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 used as well. Those involved in developing this site include Dave Cook,

Rangeland Management Specialist, NRCS; Dwight Hale, Engineer, NRCS; Sheila Luoma, Resource Conservationist, NRCS; Marla Shelbourn, Rangeland Management Specialist, NRCS; Dave Steffen, Rangeland Management Specialist, NRCS.

There are 5 SCS-RANGE-417 records available that were collected in Boyd, Holt, Brown, and Knox counties in Nebraska. The sample period was from 1968 to 1982.

There are also 4 ocular estimate records available from Keya Paha County, Nebraska and Todd County, South Dakota. The sample period was 2002.

Other references

High Plains Regional Climate Center, University of Nebraska.(http://www.hprcc.unl.edu/)
U.S. Department of Agriculture, Natural Resources Conservation Service. 2003.
National Range and Pasture Handbook. (https://www.nrcs.usda.gov/national-range-and-pasture-handbook).
U.S. Department of Agriculture, Natural Resources Conservation Service. National Water and Climate Center. (http://www.wcc.nrcs.usda.gov/climate).
U.S. Department of Agriculture, Natural Resources Conservation Service. 2021b. National Soil Information System. (https://www.nrcs.usda.gov/resources/education-and-teaching-materials/national-soil-information-system-nasis).
U.S. Department of Agriculture, Natural Resources Conservation Service. 2021c. National soil survey handbook, title 430-VI. (http://soils.usda.gov/technical/handbook/).
Soil Survey Staff. 2021. Web soil survey. U.S. Department of Agriculture, Natural Resources Conservation Service. (https://websoilsurvey.sc.egov.usda.gov/).
USDA, NRCS. 2001. The PLANTS Database, Version 3.1 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA USA.
USDA, NRCS, various published Soil Surveys.

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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.

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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)	Original Author: Stan Boltz Version V participants: Emily Helms, Nadine Bishop, Jeff Nichols
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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.

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

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3. **Number and height of erosional pedestals or terracettes:** None. Pedestals and terracettes are not expected on this site.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is typically 10 percent or less with patches of 2 to 3 inches (5 to 7.5 cm) in diameter.

   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).

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

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

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

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

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The A-horizon should be 5 to 20 inches (12.5 to 51 cm) thick. Soil is grayish brown to light brownish gray, (values of 4 to 6) when dry and very dark gray, to dark grayish brown (values of 3 to 4) when moist. Structure is typically weak medium granular but may be coarse granular or single grained. The soil series correlated to the Sandy Lowland ecological site are Calamus, Cass, Dunn, Inavale, Inglewood, and Munjor.

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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 to 95 percent perennial grasses and grass-likes, 5 to 15 percent forbs, 1 to 5 percent shrubs, and 0 to 2 percent trees. The perennial grass and grass-like component is made up of C4, tallgrasses (45-60%); C4, midgrasses (15-30%), C3, bunchgrasses (5-15%); C4, shortgrasses (5-10%); C3, rhizomatous grasses (0-5%); 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, 1305-1740 #/ac, 45-60%, (3 species minimum): sand bluestem, prairie sandreed, Indiangrass, switchgrass.
    2. Native, perennial, C4 midgrass, 435-870 #/ac, 15-30%, (1 species minimum): little bluestem, sand lovegrass, sand dropseed, purple lovegrass.

    Phase 1.2
    1. Native, perennial, C4 tallgrass, 230-920 #/ac, 10-40%, (4 species minimum): sand bluestem, prairie sandreed, Indiangrass, switchgrass.
    2. Native, perennial, C4 midgrass, 230-690 #/ac, 10-30%, (2 species minimum): little bluestem, sand lovegrass, sand dropseed, purple lovegrass.

    Phase 1.3

1. Native, perennial, C4 tallgrass (3 species minimum): sand bluestem, prairie sandreed, Indiangrass, switchgrass.
2. Native, perennial, C3 bunchgrass (2 species minimum): needle and thread, prairie Junegrass, Scribner's rosettegrass.

Sub-dominant: Phase 1.1
1. Native, perennial, C3 bunchgrass, 145-435 #/ac, 5-15%, (1 species minimum): needle and thread, prairie Junegrass, Scribner's rosettegrass.

Phase 1.2
1. Native, perennial, C3 bunchgrass, 115-345 #/ac, 5-15%, (1 species minimum): needle and thread, prairie Junegrass, Scribner's rosettegrass.
2. Native, perennial, C4 shortgrass, 115-345 #/ac, 5-15% (1 species minimum): blue grama, hairy grama, thin paspalum.

Phase 1.3
1. Native, perennial, C4 midgrass, (2 species minimum): little bluestem, sand lovegrass, sand dropseed, purple lovegrass.

Other: Minor - Phase 1.1
1. Native, perennial, C4 shortgrass, 145-290 #/ac, 5-10%: blue grama, hairy grama, thin paspalum.
2. Native forbs, 145-290 #/ac, 5-10%: forbs present vary from location to location.
3. Grass-like, 29-145 #/ac, 1-5%: sedges.
4. Native, perennial, C3 rhizomatous grass, 0-145 #/ac, 0-5%: western wheatgrass.
5. Shrub, 0-145 #/ac, 0-5%: leadplant, rose and other shrubs that vary from location to location.

Minor - Phase 1.2
1. Native forbs, 115-230 #/ac, 5-10%: forbs present vary from location to location.
2. Native, Deciduous trees, 115-230 #/ac, 5-10%: plains cottonwood, willows.
3. Shrub, 0-230 #/ac, 0-10%: leadplant, rose, pricklypear and other shrubs that vary from location to location.
4. Grass-like, 23-115 #/ac, 1-5%: sedges
5. Native, perennial, C3 rhizomatous grass, 0-115 #/ac, 0-5%: western wheatgrass.
6. Non-native, C3 grass, 0-115 #/ac, 0-5%: cheatgrass, Kentucky bluegrass.

Minor - Phase 1.3
1. Non-native, C3 grass: cheatgrass, Kentucky bluegrass.
2. Native, deciduous trees: plains cottonwood, willows.
3. Native, perennial, C4 shortgrass: blue grama, hairy grama, thin paspalum.
4. Native, perennial, C3 rhizomatous grass: western wheatgrass.
5. Forb: forbs present vary from location to location.
6. Grass-like: sedge.
7. Shrub: pricklypear, rose, and other shrubs that vary from location to location.

Trace - Phase 1.1
1. Native, deciduous trees, 0-58 #/ac, 0-2%: plains cottonwood, willows.

Additional: The Reference Community (1.1) 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, perennial, C4 shortgrass = native forb; grass-like; shrub = native, C3 rhizomatous grass; native, deciduous trees.

The At Risk Community (1.2) consists of ten F/S groups which are in order of relative abundance native, perennial, C4 tallgrass; native, perennial, C4 midgrass; native perennial, C3 bunchgrass = native, perennial, C4 shortgrass; native forbs; native, deciduous trees; shrubs; grass-like; native, perennial, C3 rhizomatous grass = non-native C3 grass.

The Excessive Litter Community (1.3) consists of ten F/S groups which include native, perennial, C4 tallgrass; native, perennial, C3 bunchgrass; native, perennial, C4 midgrass; non-native, C3 grass; native, perennial, C4 shortgrass; native

perennial, C3 rhizomatous grass; forb; grass-like; tree; shrub.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Bunchgrasses have strong, healthy centers with few (less than 3 percent) dead centers. Shrubs may show some dead branches (less than 5 percent) as plants age.

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14. **Average percent litter cover (%) and depth (in):** Plant litter cover is evenly distributed throughout the site and is expected to be 50 to 70 percent and at a depth of 0.25 to 0.50 inch (0.65-1.3 cm).

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** The representative value (RV) for annual production is 2,900 pounds per acre on an air dry weight basis. Low and High production years should yield 2,400 and 3,400 pounds per acre respectively.

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** No non-native invasive species are present. Annual bromes (cheatgrass and Japanese/field), leafy spurge, absinth wormwood, common mullein, sulphur cinquefoil, Canada thistle, eastern redcedar, 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.

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17. **Perennial plant reproductive capability:** All perennial species exhibit high vigor relative to recent weather conditions. Perennial grasses should have vigorous rhizomes or tillers; vegetative and reproductive structures are not stunted. All perennial species should be capable of reproducing annually.
