USDA Natural Resources Conservation Service

Ecological site R065XY029NE
Sandy Lowland

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

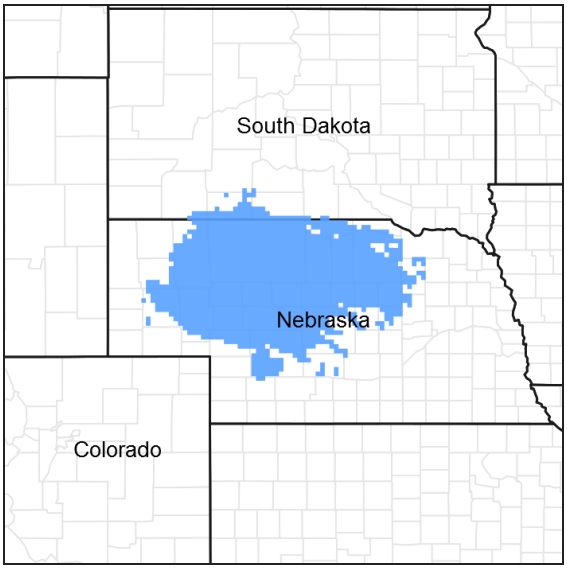


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 065X–Nebraska Sand Hills

The Nebraska Sand Hills (MLRA 65) is located in Nebraska (98 percent) and South Dakota (2 percent) and encompasses approximately 13.2 million acres (534,201 hectares) or 20,625 square miles (53,420 square kilometers). The largest town in the MLRA is North Platte, Nebraska and numerous small towns and villages are located within the MLRA, including the county seats of Arthur, Bartlett, Bassett, Brewster, Greeley, Hyannis, Mullen,

Thedford, and Tryon, Nebraska. The Niobrara River is near the northern boundary while the North Platte River flows along the southwest boundary of the area. The North Loup, Middle Loup, Calamus, Snake, and Dismal Rivers and Long Pine Creek occur in the central and eastern portion of the area.

Fort Niobrara, Crescent Lake, and Valentine National Wildlife Refuges and portions of the Nebraska National Forest, including the Bessey Ranger District and Samuel R. McKelvie National Forest, are located within this MLRA. The Bessey Ranger District includes the largest human-planted forest in the United States and is home to the Bessey Tree Nursery which is listed on the National Register of Historic Places.

This MLRA is defined by an 8,000 year-old landscape of sand hills dominated by rolling to steep sand dunes with narrow, elongated, nearly level to steeply sloping valleys between the dunes. Dune heights range from 10 to 400 feet (3 to 130 meters) and slopes may exceed twenty-five percent. Dune complexes often extend for several miles

in a northwest to southeast direction. These Quaternary sand dunes are derived from the underlying Tertiary Ogallala and Arikaree Groups, which formed when rivers deposited sediments from erosional detritus after the uplift of the Rocky Mountains to the west. The Nebraska Sand Hills are the largest sand dune area in the Western Hemisphere and one of the largest grass-stabilized dune regions in the world. The soils of the MLRA are principally derived from deep eolian sand.

The Ogallala aquifer underlies the MLRA and is the most extensive and heavily used aquifer of the high plains between the Rocky Mountains and Mississippi River. The aquifer is at its thickest in the Sand Hills which are a primary recharge are for the aquifer. Numerous small permanent and intermittent lakes and wetlands occur in the MLRA. While the dominant source of water for these lakes is precipitation, groundwater discharge is important to maintaining these lakes especially in drier years. A number of these lakes, especially in the western portion of the MLRA are alkaline.

Considered to be a western extension of the tallgrass prairie, the matrix vegetation is a unique mix of species that is sometimes identified as sandhills prairie. Sand bluestem, prairie sandreed, Indiangrass, switchgrass, sand lovegrass, little bluestem, and needle and thread are the primary grasses. Porcupinegrass is a significant cool-season grass in the eastern portion of the MLRA while blue grama and hairy grama are important warm-season grasses in the western portion due to differences in precipitation. Soils which have a high water table support a tallgrass prairie dominated by big bluestem, switchgrass, Indiangrass, prairie cordgrass, and a variety of grass-likes. The endangered plant blowout penstemon (Penstemon haydenii) is found in this MLRA.

More than ninety percent of the land in MLRA 65 is native grassland utilized by grazing livestock. Areas along streams and in subirrigated valleys are utilized for prairie hay. Wetlands, legume hay, and irrigated cropland make up the balance of the land area with corn being the principal irrigated crop.

Wildlife flourishes in this native grassland environment. Historically large bison herds occupied the landscape. White-tailed deer, mule deer, pronghorn, black tailed jackrabbit, and coyote are now the major mammalian species. Upland sandpiper, lark bunting, grasshopper sparrow, western meadowlark, long-billed curlew, sharp-tailed grouse, and greater prairie chicken are common avian species. The mosaic of grassland and wetlands provide excellent habitat for wading and shorebird species as well.

This landscape serves as a backdrop for a disturbance-driven ecosystem, which developed under the influences of herbivory, fire, and periodic long-term drought. Historically, these processes created a heterogeneous mosaic of plant communities and vegetative structure across the region. Any given site in this landscape experienced fire every six to ten years. Fires were caused by lightning strikes and also were set by Native Americans, who used fire for warfare, signaling, and to refresh the native grasses. Indigenous peoples 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 animals such as bison, elk, and pronghorn.

The natural fire regime has been disrupted by aggressive fire suppression policies which have facilitated woody species encroachment by both native and introduced shrubs and trees into the native prairie. The most common encroacher is eastern redcedar. While eastern redcedar is native to the landscape, it was present only in trace amounts due to the periodic fires. Widespread plantings of windbreaks with eastern redcedar as a primary component have provided a seed source for this aggressive woody plant causing encroachment into native grasslands, especially in the eastern and central Sand Hills. This encroachment causes significant forage loss for domestic livestock and degrades the native wildlife habit. Since it is not a root-sprouter, eastern redcedar is very susceptible to fire when under six feet tall making management with prescribed fire very effective when applied before trees reach this stage.

Classification relationships

►USDA-NRCS (2022)◄
Land Resource Region – G, Central Feed Grains and Livestock Region
Major Land Resource Area (MLRA) –65, Nebraska Sand Hills

►Fenneman (1916) Physiographic Regions ◄
Division – Interior Plains
Province – Great Plains

Section – High Plains

►USDA-USFS (2007) Ecoregions◄
Domain – Dry
Division – Temperate Steppe
Province – Great Plains Steppe (332)
Section – Mixed Grass Steppe

►EPA Ecoregions (Omernik 1997)◄
I – Great Plains (9)
II – West-Central Semi-Arid Prairies (9.3)
III – Nebraska Sandhills (44)
IV – Sandhills (44a), Alkaline Lakes Area (44b), Wet Meadow and Marsh Plain (44c), Lakes Area (44d)

Ecological site concept

The Sandy Lowland ecological site typically occurs on interdunes and stream terraces but may occur on floodplains. Slopes are less than 3 percent. The soils are very deep and formed primarily in eolian sand. Surface textures range from fine sandy loam to fine sand. This site has a seasonal high water table at a depth of 36 to 60 inches that typically remains throughout the growing season.

The historic native vegetation of the Sandy Lowland ecological site is Sandhills Prairie. Vegetation in the Reference Community (1.1) consists of a mixture of warm- season tall- and midgrasses with warm-season shortgrasses and cool-season grasses in the understory. Dominant grasses sand bluestem, prairie sandreed, little bluestem, and switchgrass. The plant community includes a diverse population of forbs. In the absence of periodic fire, the Sandy Lowland ecological site is susceptible to encroachment of woody species, especially eastern redcedar.

Associated sites

R065XY011NE	**Sandy 14-17" PZ** Sandy 14-17" PZ and Sandy Lowland ecological sites are often found interspersed on interdunes and valleys in the sandhills landscape but Sandy Lowland sites are typically found on a lower landscape position.
R065XY032NE	**Sandy 17-22" PZ** Sandy 17-22" PZ and Sandy Lowland ecological sites are often found interspersed on interdunes and valleys in the sandhills landscape but Sandy Lowland sites are typically found on a lower landscape position.
R065XY054NE	**Sandy 22-25" PZ** Sandy 22-25" PZ and Sandy Lowland ecological sites are often found interspersed on interdunes and valleys in the sandhills landscape but Sandy Lowland sites are typically found on a lower landscape position.
R065XY024NE	**Subirrigated** The Subirrigated ecological site is often found in the same landscape as Sandy Lowland ecological site but on a lower landscape position.

Similar sites

R065XY024NE	**Subirrigated** The Subirrigated and Sandy Lowland ecological sites are both found on interdunes and valleys, but the Subirrigated sites have a seasonal high water table at 18 to 36 inches while the water table on Sandy Lowland sites is below 36 inches.
R065XY011NE	**Sandy 14-17" PZ** Sandy 14-17" PZ and Sandy Lowland ecological sites are often found interspersed on interdunes and valleys in the sandhills landscape and have similar soil textures. Sandy Lowland sites are typically found on a lower landscape position and have a seasonal high water table at a depth of 36 to 60 inches during the majority of the growing season, while Sandy 14-17" PZ ecological site do not have a seasonal high water table.

R065XY032NE	**Sandy 17-22" PZ** Sandy 17-22" PZ and Sandy Lowland ecological sites are often found interspersed on interdunes and valleys in the sandhills landscape and have similar soil textures. Sandy Lowland sites are typically found on a lower landscape position and have a seasonal high water table at a depth of 36 to 60 inches during the majority of the growing season, while Sandy 17-22" PZ ecological site do not have a seasonal high water table.
R065XY054NE	**Sandy 22-25" PZ** Sandy 22-25" PZ and Sandy Lowland ecological sites are often found interspersed on interdunes and valleys in the sandhills landscape and have similar soil textures. Sandy Lowland sites are typically found on a lower landscape position and have a seasonal high water table at a depth of 36 to 60 inches during the majority of the growing season, while Sandy 22-25" PZ ecological site do not have a seasonal high water table.

Table 1. Dominant plant species

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

Physiographic features

The Sandy Lowland ecological site is found on nearly level to gently sloping interdunes, stream terraces, and high flood plains adjacent to streams, springs, and wetlands. The Sandy Lowland ecological site has a seasonal high water table at 36 to 60 inches throughout the growing season. This area consists of Quaternary sand dunes. The sands are derived from the underlying Tertiary Ogallala and Arikaree Groups. These units formed when rivers deposited sediments that originated as erosional detritus following the uplift of the Rocky Mountains to the west.

Table 2. Representative physiographic features

Landforms	(1) Sandhills > Interdune (2) River valley > Flood plain (3) Valley > Strath terrace
Runoff class	Negligible to low
Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to frequent
Ponding frequency	None
Elevation	1,970–3,940 ft
Slope	0–3%
Water table depth	36–72 in
Aspect	Aspect is not a significant factor

Climatic features

The mean average annual precipitation typically ranges from 14 to 25 inches but has varied from 12 to 34 inches in the driest to wettest season. Approximately 70 percent of the annual precipitation occurs during the growing season from mid- April to late September. The average annual snowfall varies from about 34 inches to about 42 inches. The wind velocity is high throughout the year, averaging 10 to 12 miles per hour. Maximum wind velocities generally occur in the spring.

The average date of first frost in the fall is September 25, and the last frost in the spring is about May 8. July is the hottest month and January is the coldest. It is not uncommon for the temperature to reach 100 degrees Fahrenheit during the summer. Summer humidity is low, and evaporation is high. The winters are characterized with frequent northerly winds, producing severe cold with temperatures dropping to as low as negative 30 degrees Fahrenheit.

Growth of native cool-season plants begins in late March and continues to late June. Native warm-season plants begin growth in mid-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)	109-126 days
Freeze-free period (characteristic range)	131-143 days
Precipitation total (characteristic range)	19-26 in
Frost-free period (actual range)	103-129 days
Freeze-free period (actual range)	129-146 days
Precipitation total (actual range)	18-27 in
Frost-free period (average)	118 days
Freeze-free period (average)	137 days
Precipitation total (average)	22 in

Climate stations used

- (1) ALLIANCE MUNI AP [USW00024044], Alliance, NE
- (2) ARTHUR [USC00250365], Arthur, NE
- (3) ATKINSON 3SW [USC00250420], Atkinson, NE
- (4) BARTLETT 1S [USC00250525], Bartlett, NE
- (5) BREWSTER [USC00251130], Brewster, NE
- (6) CHAMBERS [USC00251590], Chambers, NE
- (7) CRESCENT LAKE NWR [USC00252000], Oshkosh, NE
- (8) ELLSWORTH 15 NNE [USC00252647], Ellsworth, NE
- (9) ELSMERE 9 ENE [USC00252680], Johnstown, NE
- (10) ERICSON 8 WNW [USC00252770], Burwell, NE
- (11) GREELEY [USC00253425], Greeley, NE
- (12) HYANNIS [USC00254100], Hyannis, NE
- (13) KILGORE 1NE [USC00254432], Kilgore, NE
- (14) KINGSLEY DAM [USC00254455], Keystone, NE
- (15) MERRIMAN [USC00255470], Merriman, NE
- (16) MULLEN [USC00255700], Mullen, NE
- (17) MULLEN 21 NW [USC00255702], Whitman, NE
- (18) NEWPORT [USC00255925], Newport, NE
- (19) NORTH PLATTE RGNL AP [USW00024023], Maxwell, NE
- (20) PURDUM [USC00256970], Purdum, NE
- (21) ROSE 10 WNW [USC00257318], Long Pine, NE
- (22) SWAN LAKE [USC00258360], Amelia, NE
- (23) VALENTINE NWR [USC00258755], Valentine, NE
- (24) WHITMAN 5 ENE [USW00094079], Whitman, NE

Influencing water features

No riparian areas or wetland features are directly associated with this site.

Soil features

The soils associated to the Sandy Lowland ecological site are very deep and formed in eolian sands and sandy alluvium. Slopes range from 0 to 3 percent. Soil surface textures range from fine sandy loam to fine sand while the texture of the subsurface generally ranges from loam to sand. The combined thickness of the A horizons is typically 4 to 15 inches thick. Soil structure may be single grained, weak very fine granular, weak fine granular, weak coarse subangular blocky parting to weak fine or weak medium granular. The Sandy Lowland ecological site has a

seasonal high water table at 36 to 60 inches throughout the growing season.

This site should show no evidence of rills, wind scoured areas or pedestalled plants. Water flow paths are typically indistinguishable. The soil surface is stable and intact. Sub-surface soil layers are not restrictive to water movement and root penetration.

Ipage is the major soil series correlated to this ecological site. Other series that have been correlated to the site include Boel, Calamus, Doughboy, Dunn, Gosper, Libory, Munjor, and Natick. 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).

Table 4. Representative soil features

Surface texture	(1) Fine sand (2) Loamy fine sand (3) Fine sandy loam
Family particle size	(1) Sandy
Drainage class	Somewhat poorly drained to moderately well drained
Permeability class	Moderate to rapid
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	2.9–6.9 in
Calcium carbonate equivalent (0-40in)	0–10%
Electrical conductivity (0-40in)	0–4 mmhos/cm
Sodium adsorption ratio (0-40in)	0–6
Soil reaction (1:1 water) (0-40in)	5.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–6%
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 fire, and other biotic and abiotic factors that typically influence soil and site development. This continues to be a disturbance-driven site with herbivory, fire, and variable climate being the primary disturbances. Changes occur in the plant communities due to short-term weather variations, impacts of native and exotic plant and animal species, and management actions. The Sandy Lowland ecological site is often a transitional area between Sandy and Subirrigated ecological sites, although abrupt transitions to a Sands ecological site can occur. The Sandy Lowland ecological site includes depressional areas, which allow deep-rooted native warm-season grasses to utilize subsurface moisture. This ability to utilize subsurface moisture, along with the plant diversity on the site, allows for high resistance to drought. The site is extremely resilient, and well adapted to Northern Great Plains climatic conditions.

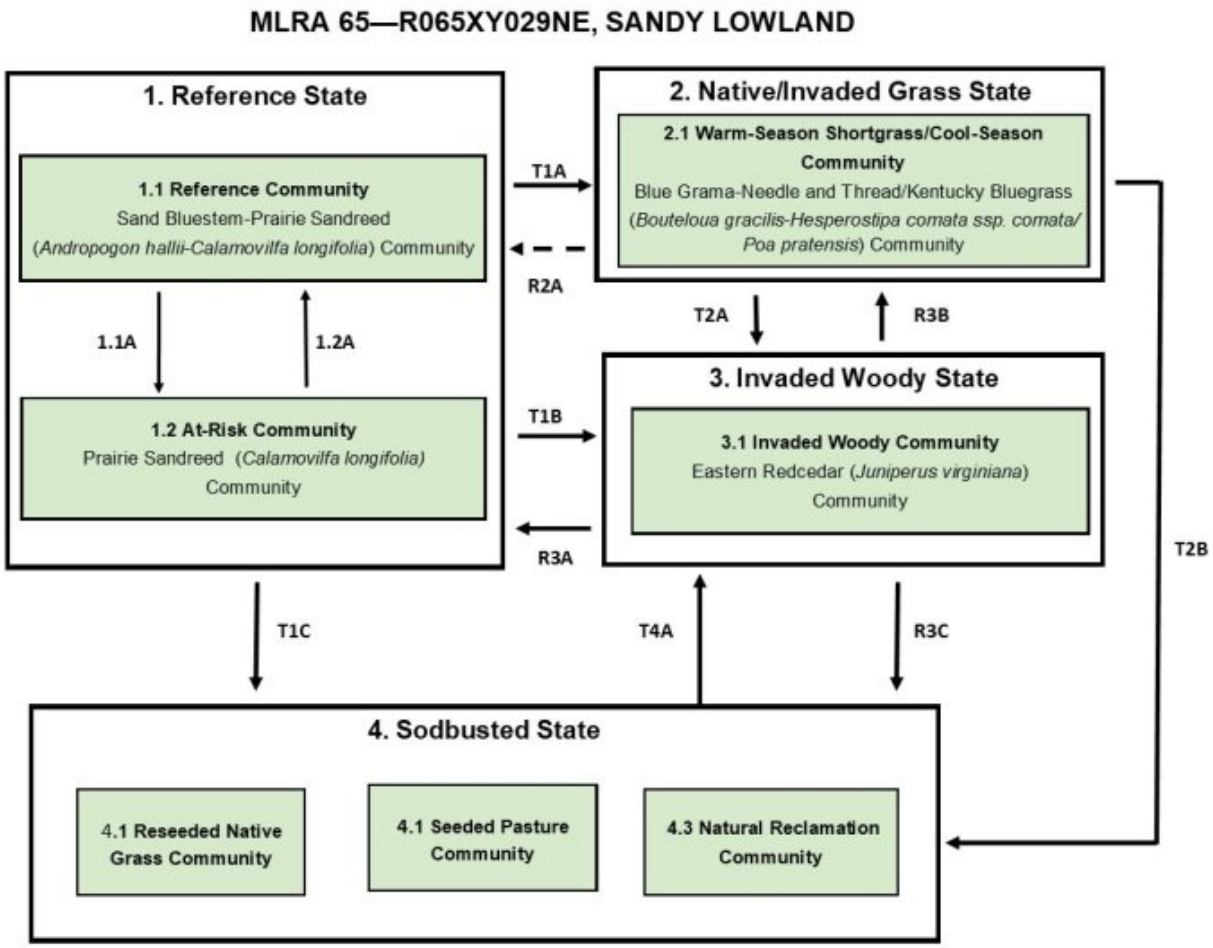
The introduction of domestic livestock by European settlers along with season-long, continuous grazing and annual late summer haying had a profound impact on the vegetation of the Sandy Lowland ecological site. Season-long, continuous grazing causes a repeated removal of the growing point and excessive defoliation of the leaf area of the more palatable warm-season tallgrasses, reducing the ability of the plants to harvest sunlight thereby depleting root

reserves and 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, sand dropseed and blue grama initially increase while sand bluestem and switchgrass decrease in frequency and production. As the management continues, prairie sandreed will decrease and warm-season shortgrasses, cool season grasses, forbs will significantly increase. The Sandy Lowland site can become dominated by native cool-season grasses and the site is susceptible to invasion by non-native cool-season grasses. In the absence of fire and woody species management this site is also susceptible to encroachment by woody species, especially eastern red cedar.

The State and Transition Model (STM is depicted below and includes a Reference State (1), a Native/Invaded Grass State (2), an Invaded Woody State (3), and a Sodbusted 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 function. 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 local climatic fluctuations especially 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 model diagram.

Interpretations are primarily based on the Reference Community (1.1), which 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:
T1A: Long-term (> 10 years) heavy, continuous, season long or heavy, rotational grazing with inadequate growing season recovery time. Annual haying.
T1B: Woody encroachment with no fire or brush management.
T1C: Tillage to facilitate production agriculture.
T2A: Woody encroachment with no fire or brush management.
T2B: Tillage to facilitate production agriculture.
T4A: Woody encroachment with no fire or brush management.
RestorationsR2A: Long-term (>15 years) prescribed grazing or biennial haying. This restoration may not be feasible.
R3A: Prescribed burning, timber harvest, brush management.
R3B: Prescribed burning, timber harvest, brush management.
R3C: Prescribed burning, timber harvest, brush management.
Community Pathways:
1.1A: Continuous season long, continuous seasonal, or rotational grazing with inadequate growing season recovery periods. Annual haying.
1.2A: Prescribed grazing with adequate growing season recovery periods. Biennial or rotational haying.

Figure 8. State and Transition Model Diagram and Legend, Sandy Lowland ecological site, MLRA 65.

State 1
Reference State

The Reference State (1) describes the range of vegetative communities that occur on the Sands 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 two community phases which are the Reference Community (1.1) and the At-Risk Community. The Reference Community serves as a description of the native plant community that 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. In the absence of fire and brush management, this state is susceptible to encroachment by eastern redcedar.

Dominant plant species

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

Community 1.1
Reference Community

Figure 9. Reference Community (1.1), Sandy Lowland ecological site, MLRA 65.

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 historic 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. This plant community consists chiefly of warm-season, tall- and midgrasses. Principle dominants are sand bluestem, prairie sandreed, switchgrass, and little bluestem. Grasses of secondary importance include Indiangrass, needle and thread, porcupinegrass, blue grama, and hairy grama. Sedges occur in the understory. The forb population is diverse. Leadplant, western sandcherry, and rose are common shrubs. The potential vegetative composition is 80 to 90 percent grasses and grass-likes, 5 to 10 percent forbs, and 1 to 10 percent shrubs by weight. Natural fire played a significant role in the succession of this site by limiting the extent of shrubs. Wildfires have been actively controlled in recent times, facilitating tree and shrub 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

- sand bluestem (*Andropogon hallii*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	2260	2610	2925
Forb	140	220	325
Shrub/Vine	0	70	150
Total	**2400**	**2900**	**3400**

Figure 11. 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 Prairie Sandreed (*Calamovilfa longifolia*) Community (1.2) develops with continuous season-long grazing, seasonal grazing, or rotational grazing with inadequate growing season recovery time. Most of the palatable plants of the Reference Community (1.1) are present and warm-season tallgrasses remain as a dominant component in the plant community but production from these grasses is reduced. Sand bluestem, little bluestem, and switchgrass are reduced while Indiangrass is significantly reduced or a absent from the plant community. As compared to the Reference Community, the At-Risk Community has a higher proportion of cool-season grasses and forbs. The reduction in desirable warm-season tallgrasses results in decreased production and reduces the community's ability to improve production during favorable years. Prairie sandreed is the dominant grass. Grasses of secondary importance include blue grama, hairy grama, needle and thread, sand dropseed, and western wheatgrass. The forb component is dominated by Cuman ragweed, white sagebrush, goldenrods, verbenas, and white heath aster. The potential vegetative composition is 75 to 85 percent grasses or grass-like plants, 5 to 15 percent forbs, and 5 to 10 percent shrubs. The soil surface remains intact and erosion is low as evidenced by the lack of rills, waterflow patterns, or pedestalled plants. Infiltration and runoff have not increased due to the nature of the soil. This plant community is considered stable but is at risk if increased disturbance such as drought or overgrazing occurs; this risk increases significantly when drought and overgrazing are combined. The resiliency of this plant community is moderate depending on the intensity and duration of disturbance. Grazing management that includes adequate growing season recovery time will move the plant community to the Reference Community while increased disturbance, such as drought or heavy grazing, will cause further loss of warm-season tall- and midgrasses and cause a transition to the Native/Invaded Grass State (2). The close proximity of Sand Lowland ecological sites to the Subirrigated ecological sites often leads to implementation of the same management scenarios for both sites. The lack of subsoil moisture on Sandy Lowland sites reduces the ability of the grasses to recover from annual haying resulting in lower plant health and vigor. Biennial haying on the Sandy Lowland sites combined with annual fall grazing in conjunction with annual haying on Subirrigated sites is a management alternative that will maintain the plant community in the Reference State. Fencing along ecological site boundaries provides additional management options for both Subirrigated and Sandy Lowland sites and should be considered if adequate water facilities are present.

Dominant plant species

- prairie sandreed (*Calamovilfa longifolia*), grass

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		

Pathway 1.1A
Community 1.1 to 1.2

Continuous season-long grazing, continuous seasonal grazing in the summer, or rotational grazing with inadequate recover periods will convert the Reference Community (1.1) to the At-Risk Community (1.2). Continuous heavy grazing tends to accelerate this movement. Annual haying will also cause this shift.

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing with adequate recovery periods will return the At-Risk Community to the Reference Community. When the land is managed as native hayland, biennial or rotational haying will move the community to the Reference Community.

State 2
Native/Invaded Grass State

The Native/Invaded Grass State (2) transitioned from the Reference State (1) and much of the native warm-season tall- and midgrass components have been replaced by warm-season shortgrasses and cool-season grasses. The Native/Invaded Grass State develops with long term grazing management that did not provide adequate recovery time for warm-season tall- and midgrasses. Non-native cool-season grasses are often present in the plant community and may become subdominant. The management that results in the Native/Invaded Grass State is typically heavy continuous season long grazing but heavy rotational grazing with inadequate growing season recovery periods can also cause this transition. Repeated annual haying during the rapid growth period of warm-season tallgrasses with inadequate growing recovery periods will also cause this transition over time. The loss of warm-season tall- and midgrasses negatively impacts energy flow and nutrient cycling and alters hydrologic function. Plant litter is decreased. Infiltration is lower than in the Reference State. Return to the Reference State will take a significant amount of time and if adequate amounts of warm-season tall- and midgrasses are not present, restoration to the Reference State will not be feasible. The Native/Invaded Grass State is very resistant to change; however, eastern redcedar encroachment can quickly convert this state to the Invaded Woody State (3). The Native/Invaded Grass State includes the Warm-Season Shortgrass/Cool-Season Grass Community (2.1).

Dominant plant species

- blue grama (*Bouteloua gracilis*), grass
- hairy grama (*Bouteloua hirsuta*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- Cuman ragweed (*Ambrosia psilostachya*), other herbaceous
- white sagebrush (*Artemisia ludoviciana*), other herbaceous

Community 2.1
Warm-Season Shortgrass/Cool-Season Grass Community

The Warm-Season Shortgrass/Cool-Season Grass or Blue Grama-Needle and Thread (*Bouteloua gracilis-Hesperostipa comata*) Community develops with heavy livestock grazing, usually season-long, or with annual haying followed by fall grazing. Deep rooted plants are replaced by shallow rooted, sod-forming grasses which tend to form root mats. This sod-bound condition reduces water infiltration. Forage production and plant species diversity has declined. Initially, the plant community will be a mosaic, with shortgrass and mixed grass communities intermingled but as the management continues the plant community becomes dominated by warm-season shortgrasses and cool-season grasses. Non-native grasses such as Kentucky bluegrass encroach into the community and may become subdominant. Small, isolated plants may exist in a prostrate form to avoid defoliation. Blue grama, hairy grama, needle and thread, and sand dropseed are the dominant grasses. Other grasses or grass-likes include annual brome, Kentucky bluegrass, prairie junegrass, Scribner panicum, western wheatgrass, and sedges. Dominant forbs include Cuman ragweed, verbena, white sagebrush, thistle, and white heath aster. Sand sagebrush increases significantly in the western portion of the MLRA, while cactus and rose increase in the central and eastern portions of the MLRA. Annual haying delays the increase of sand sagebrush and rose but increases

the cactus component in this community. The potential vegetative composition is 75 to 85 percent grasses and grass-likes, 5 to 10 percent forbs and 10 to 15 percent shrubs. This plant community is fairly resistant to change, but the low species diversity makes the community vulnerable to heavy disturbance events like drought or hailstorms. Soil erosion is low. The hydrologic cycle is negatively impacted due to the lack of surface litter, increased runoff, and the reduced water infiltration. However, due to the soil texture, the impact to runoff and infiltration is moderate.

Dominant plant species

- blue grama (*Bouteloua gracilis*), grass
- hairy grama (*Bouteloua hirsuta*), grass
- needle and thread (*Hesperostipa comata*), grass

Figure 13. Plant community growth curve (percent production by month). NE6540, NE/SD Sandhills, Native Grass, Grama/Wheatgrass. Warm-season and cool-season co-dominant, short and mid grasses.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	10	20	25	20	15	5	0	0	0

State 3
Invaded Woody State

The Invaded Woody State (3) 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, reduce 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 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 (3.1).

Community 3.1
Invaded Woody Community

The Invaded Woody Community or Eastern Redcedar (*Juniperus virginiana*) Community (3.1) 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 due to the 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
- Kentucky bluegrass (*Poa pratensis*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass

State 4
Sodbusted State

The threshold to the Sodbusted State (4) is crossed as a result of mechanical disturbance to facilitate production agriculture. If farming operations are suspended, the site can be seeded to native grasses and forms resulting in the Reseeded Native Grass Community (4.1), be seeded to a tame pasture forage mixture resulting in the Seeded Pasture Community (4.2) or be abandoned with no seeding which will result in the Natural Reclamation Community (4.3). Permanent alterations of the soil, plant community, and hydrologic cycle make restoration to the Reference State (1) extremely difficult, if not impossible.

Community 4.1
Reseeded Native Grass Community

The Reseeded Native Grass Community (4.1) 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 rangeland 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 4.2
Seeded Pasture Community

The Seeded Pasture Community (4.2) 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 4.3
Natural Reclamation Community

The Natural Reclamation Community (6.3) consists of annual and perennial early successional species. Perennial threeawns, sand dropseed, and annual grasses are common species. 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.

Transition T1A
State 1 to 2

The Reference State (1) transitions to the Native/Invaded Grass State (2) in response to long-term (greater than ten years), heavy, repeated defoliation of the key forage species by grazing or haying. This change typically occurs with long-term heavy, continuous season long grazing but heavy rotational grazing without adequate recovery periods may also cause this transition. Annual haying at the same time each year will also facilitate this change. Once the Reference State loses a significant proportion of warm-season, tall- and midgrasses it crosses a threshold to the Native/Invaded Grass State.

Transition T1B
State 1 to 3

Long-term (more than ten years) disruption of the natural fire regime and the encroachment of invasive exotic and native woody species with no woody species management can cause the Reference State (1) to transition to the Invaded Woody State (3).

Transition T1C
State 1 to 4

The Reference State (1) has been significantly altered by tillage to facilitate production agriculture. When the land is no longer cropped, the resulting state is the Sodbusted State (4). The disruption to the plant community, the soil, and the hydrology of the system prevent restoration to the Reference State.

Restoration pathway R2A
State 2 to 1

Long-term (more than 15 years) prescribed grazing with adequate growing season recovery periods will move the Native/Invaded Grass State (2) toward the Reference State (1). When the land is used for hay production, biennial haying may facilitate this restoration. The amount of time required for restoration, and feasibility of this restoration depends upon the abundance of warm-season tall- and midgrasses remaining in the plant community. This restoration may not be feasible.

Transition T2A
State 2 to 3

Long-term (more than ten years) disruption of the natural fire regime and the encroachment of invasive exotic and native woody species with no woody species management can cause the Native/Invaded Grass State (2) to transition to the Invaded Woody State (3).

Transition T2B
State 2 to 4

The Native/Invaded Grass State (2) has been significantly altered by tillage to facilitate production agriculture. When the land is no longer cropped, the resulting state is the Sodbusted State (4). The disruption to the plant community, the soil, and the hydrology of the system prevent restoration to the Native/Invaded Grass State.

Restoration pathway R3A
State 3 to 1

The Invaded Woody State (4) can be restored to the Reference State (1) through prescribed burning, wildfire, timber harvest, or brush management. 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. To maintain the site as grassland, maintenance burns will need to be conducted periodically to mimic the historical fire frequency of Sandhills grasslands. Land that transitioned to the Invaded Woody State from the Native/Invaded Grass State (2) or the Sodbusted State (4) cannot be restored to the Reference State through the removal of woody species as the native plant community, soils, and hydrologic function have been too severely impacted for that restoration to occur with woody species removal alone.

Restoration pathway R3B
State 3 to 2

The Invaded Woody State (4) can be restored to the Native/Invaded Grass State (2) through prescribed burning, wildfire, timber harvest, or brush management. 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 Native/Invaded Grass State. To maintain the site as grassland, maintenance burns will need to be conducted periodically to mimic the historical fire frequency of Sandhills grasslands. Land that transitioned to the Invaded Woody State from the Native/Invaded Grass State or the Sodbusted State (4) cannot be restored to the Reference State (1) through the removal of woody species as the native plant community, soils, and hydrologic function have been too severely impacted for that restoration to occur with woody species removal alone.

Restoration pathway R3C
State 3 to 4

The Invaded Woody State (4) can be restored to the Sodbusted State (4) through prescribed burning, wildfire, timber harvest, or brush management. 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 Sodbusted State by management practices. To maintain the site as grassland, maintenance burns will need to be conducted periodically to mimic the historical fire frequency of Sandhills grasslands. Land that transitioned to the Invaded Woody State from the Native/Invaded Grass State (2) or the Sodbusted State cannot be restored to the Reference State (1) through the removal of woody species as the native plant community, soils, and hydrologic function have been too severely impacted for that restoration to occur with woody species removal alone.

Transition T4A
State 4 to 3

Long-term (more than ten years) disruption of the natural fire regime and the encroachment of invasive exotic and native woody species with no woody species management can cause the Sodbusted State (4) to transition to the Invaded Woody State (3).

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-Season Tallgrass**			1160–1740	
	sand bluestem	ANHA	*Andropogon hallii*	580–1160	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	435–870	–
	switchgrass	PAVI2	*Panicum virgatum*	435–870	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–145	–
	Grass, perennial	2GP	*Grass, perennial*	0–58	–
2	**Warm-Season Midgrass**			580–870	
	little bluestem	SCSC	*Schizachyrium scoparium*	435–870	–

	sand lovegrass	ERTR3	*Eragrostis trichodes*	0–145	–
	purple lovegrass	ERSP	*Eragrostis spectabilis*	0–145	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–145	–
	Grass, perennial	2GP	*Grass, perennial*	0–58	–
4	**Warm-Season Shortgrass**			145–290	
	blue grama	BOGR2	*Bouteloua gracilis*	0–290	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–145	–
	thin paspalum	PASE5	*Paspalum setaceum*	0–58	–
	Grass, perennial	2GP	*Grass, perennial*	0–58	–
3	**Cool-Season Grass**			290–580	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	145–435	–
	western wheatgrass	PASM	*Pascopyrum smithii*	0–145	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–58	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–58	–
	Grass, perennial	2GP	*Grass, perennial*	0–58	–
5	**Grass-likes**			29–145	
	sedge	CAREX	*Carex*	29–145	–
Forb					
6	**Forb**			145–290	
	beardtongue	PENST	*Penstemon*	0–58	–
	dotted blazing star	LIPU	*Liatris punctata*	0–58	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–58	–
	goldenrod	SOLID	*Solidago*	0–58	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–58	–
	hoary verbena	VEST	*Verbena stricta*	0–29	–
	swamp verbena	VEHA2	*Verbena hastata*	0–29	–
	Forb, annual	2FA	*Forb, annual*	0–29	–
	Forb, perennial	2FP	*Forb, perennial*	0–29	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	0–29	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–29	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–29	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–29	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–29	–
	false boneset	BREU	*Brickellia eupatorioides*	0–29	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	0–29	–
	Carolina larkspur	DECAV2	*Delphinium carolinianum ssp. virescens*	0–29	–
Shrub/Vine					
7	**Shrub**			29–290	
	leadplant	AMCA6	*Amorpha canescens*	0–145	–
	rose	ROSA5	*Rosa*	0–145	–
	western sandcherry	PRPUB	*Prunus pumila var. besseyi*	0–145	–
	sand sagebrush	ARFI2	*Artemisia filifolia*	0–58	–

	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–58	–
	pricklypear	OPUNT	*Opuntia*	0–29	–

Animal community

LIVESTOCK - GRAZING INTERPRETATIONS:
Grazing by domestic livestock is the major income-producing industry 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*
►Reference Community (1.1)
Average Production (lb./acre, air-dry): 2,900
Stocking Rate (AUM/acre): 0.79

WILDLIFE INTERPRETATIONS:
The Sandhills Prairie ecosystem consists of diverse grassland habitats interspersed with varying densities of Sandhills lakes and limited woody riparian corridors. The majority of this ecosystem is intact. 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 Sandhills Prairie was a disturbance-driven ecosystem with fire, herbivory, and climate functioning as the primary disturbances. Following European settlement, elimination of fire and overgrazing altered the appearance and functionality of the 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 influenced the character of the remaining native grasslands and the habitats that they provide. Fragmentation in MLRA 65 is limited and area sensitive grassland birds such as greater prairie chicken and sharp-tailed grouse continue to thrive here. The mosaic of sites continues to provide habitat for species requiring unfragmented grasslands, 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.

In the absence of fire and grazing, heavy litter buildup can occur on this site hindering the movement of young birds, especially quail and prairie chickens. Increased litter buildup results in decreased forb abundance and diversity and an accompanying decrease in insects, a critical food source for young birds. Introduced species such as cheatgrass, Kentucky bluegrass, and introduced forbs may be present but degradation of the biotic integrity from non-native species in this precipitation zone on ecological site is limited.

Disruption of the natural fire regime and accompanying woody encroachment is the greatest threat to ecosystem dynamics in this MLRA. Lack of fire facilitates tree and shrub encroachment degrades grassland habitats and creates habitats that favor generalist species such as American robin and mourning dove. Woody species provide perches for raptors, increasing the predation mortality on native bird populations. Woody encroachment is most severe in the eastern half of the MLRA but is a threat across the MLRA.

Hydrological functions

Moisture conditions are ideal for forage production on this site. Soils on this site are in Hydrologic Soil Groups A and B. Although most of these soils are very permeable, water tables provide additional water for the deeper-rooted

grasses and forbs Surrounding upland areas tend to also have permeable soils and surface inflow peaks on these sites are often muted. These sites are not subject to flooding or rarely flooded. Refer to Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves.

For the interpretive plant community, rills, waterflow patterns, and gullies should not be present. Plants should not exhibit pedestalling. Litter typically falls in place and signs of movement are found only after periods of high precipitation. Chemical and physical crusts are rare to non-existent. Overall, this site has the appearance of being stable and productive.

Recreational uses

This site provides hunting, hiking, photography, bird watching and other opportunities. The wide varieties of plants that bloom from spring until fall have an esthetic value that appeals to visitors.

Wood products

Wood products are not generally in abundance enough to provide harvest opportunity.

Other products

Native seed collection and lease hunting are potential revenue creating industries for this site.

Other information

Revision Notes: “This PROVISIONAL ecological site concept has been through the quality control and quality assurance processes to ensure that the site meets the NESH standards for a provisional ecological site that provides basic compiled information in one location. This site should not be considered an Approved ESD until further data entry and editing is completed.

Site Development and Testing Plan:
Future work is needed to validate the information in this Provisional Ecological Site Description. Additional data collection and evaluation may also be needed to develop this ESD to the Approved, then Correlated level. This could include field activities to collect low, medium and high intensity sampling, soil correlations, and analysis of that data. Field reviews of the project plan should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document. Annual reviews of the Project Plan are to be conducted by the Ecological Site Technical Team. The project plan is ES-R065XY013NE - MLRA 65.

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 Dana Larsen, State Rangeland Management Specialist, NRCS, Nebraska, Chuck Markley, Soil Scientist, NRCS Nebraska; Stan Boltz, State Rangeland Management Specialist, NRCS, South Dakota.

There are four SCS-RANGE-414 records available from Cherry County.

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Contributors

Doug Whisenhunt
Nadine Bishop

Approval

Suzanne Mayne-Kinney, 2/04/2025

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: Dave Cook, Emily Helms, Jeff Nichols, Myra Richardson, Nadine Bishop
Contact for lead author	Jeff Nichols: jeffrey.nichols@usda.gov
Date	11/30/2024
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 5 percent or less.

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. Litter movement is not expected on this site.

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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 4 to 8 inches (10-20.5 cm) thick; some soil series will be up to 12 inches (30 cm) thick. Soil color will be dark grayish brown (values of 3 to 5) and very dark grayish brown (values of 2 to 3) when moist. Soil structure may be single grained, weak very fine granular, weak fine granular, weak coarse subangular blocky parting to weak fine or weak medium granular.

   Ipage is the major soil series correlated to this ecological site. Other soil series that have been correlated to this site include Boel, Calamus, Doughboy, Dunn, Gosper, Libory, Munjor, and Natick.

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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. Woody encroachment may adversely impact infiltration on this site.

    The expected composition of the plant community is 80 to 90 percent grasses and grass-likes, 5 to 10 percent forbs, and 1 to 10 percent shrubs. The perennial grass and grass-like component is made up of warm-season tallgrass (40-60%), warm-season midgrass (20-30%), cool-season grass (10-20%), warm-season shortgrass (5-10%), and grass-like (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. Compaction layers 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, warm-season tallgrass, 1160-1740 #/ac, 40-60%, 3 species minimum: sand bluestem, prairie sandreed, switchgrass, Indiangrass.
2. Native, perennial, warm-season midgrass, 580-870 #/ac, 20-30%, 1 species minimum: little bluestem, sand lovegrass, purple lovegrass, sand dropseed

Phase 1.2
1. Native, perennial, warm-season tallgrass, 2 species minimum: sand bluestem, prairie sandreed, switchgrass, Indiangrass.

Sub-dominant: Phase 1.1
1. Native, perennial, cool-season grass, 290-580 #/ac, 10-20%, 1 species minimum: needle and thread, western wheatgrass, prairie Junegrass, Scribner's rosette grass.

Phase 1.2
1. Native, perennial, cool-season grass, 2 species minimum: needle and thread, western wheatgrass, prairie Junegrass, Scribner's rosette grass.
2. Native, perennial, warm-season shortgrass, 1 species minimum: hairy grama, blue grama, thin paspalum.

Other: Minor - Phase 1.1
1. Native, perennial, warm-season shortgrass, 145-290 #/ac, 5-10%: hairy grama, blue grama, thin paspalum.
2. Native perennial and annual forb, 145-290 #/ac, 5-10%: forbs present vary from location to location.
3. Shrub, 29-290 #/ac, 1-10%: leadplant, rose, western sand cherry, and other shrubs that vary from location to location.
4. Grass-like, 29-145 #/ac, 1-5%: sedges.

Minor - Phase 1.2
1. Native, perennial, warm-season midgrass: little bluestem, sand lovegrass, purple lovegrass, sand dropseed.
2. Grass-like: sedge
3. Native perennial and annual forb: forbs present vary from location to location.
4. Shrub: leadplant, rose, western sand cherry, and other shrubs that vary from location to location.

Additional: The Reference Community (1.1) includes seven F/S groups. These groups are, in order of relative abundance, native, perennial, C4 tallgrass; native, perennial, C4 midgrass; native, perennial, C3 grass; native, perennial, C4 shortgrass=native perennial and annual forb; shrub; grass-like.

The At-Risk Community (1.2) includes seven F/S groups which are in order of relative abundance native, perennial, C4 tallgrass, native, perennial, C3 grass; native, perennial, warm-season shortgrass; native, perennial, C4 midgrass=grass-like=native perennial and annual forb; 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 75 to 85 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.

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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), smooth brome, leafy spurge, Kentucky bluegrass, and eastern redcedar are known invasives that have the potential to be dominant or co-dominant on the site. Consult the state noxious weed and state watch lists for potential invasive species.

    NOTE: Invasive plants (for the purposes of the IIRH protocol) are plant species that are typically not found on the ecological site or should only be in trace or minor categories under the natural disturbance regime and have the potential to become a dominant or codominant species on the site if their establishment and growth are not actively controlled by natural disturbances or management interventions. Species listed characterize degraded states AND have the potential to become a dominant or co-dominant species

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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.
