USDA Natural Resources Conservation Service

Ecological site R066XY059NE
Thin Upland

Last updated: 11/18/2024
Accessed: 05/13/2025

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.

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 Thin Upland ecological site occupies summits and shoulders of hills and ridges. The slopes typically range from 0 to 40 percent but may be steeper in some landscapes. The surface layer is typically less than three to four inches thick with a silt loam texture. The moderately deep to very deep soils formed in calcareous loess, calcareous residuum weathered from siltstone or shale and are calcareous within six inches of the surface.

Vegetation in the Reference Plant Community (1.1) is a mix of cool- and warm-season grasses. Dominant species include needle and thread, little bluestem, sideoats grama, and blue grama. Forbs are common and diverse. Shrubs include rose, fringed sagewort, and broom snakeweed. This site is susceptible to invasion of non-native, cool-season grasses, especially Kentucky bluegrass. In the absence of periodic fire, encroachment of woody species, especially eastern redcedar, will occur. About fifteen percent of this site has been converted to farmland, with the majority of the remaining acreage in native rangeland, which is usually grazed by domestic livestock.

Associated sites

R066XY036NE	**Loamy 18-22 P.Z.** The Loamy 18-22 PZ ecological site is often located adjacent to and on a landscape position below Thin Upland ecological sites.
R066XY040NE	**Shallow Limy** The Shallow Limy ecological site is often located adjacent to and on a landscape position above Thin Upland ecological sites.
R066XY062NE	**Shallow To Gravel** The Shallow to Gravel ecological site is adjacent to and interspersed throughout an area with Thin Upland ecological sites.

R066XY059NE	**Thin Upland** The Loamy 22-25 PZ ecological site is often located adjacent to and on a landscape position below Thin Upland ecological sites.

Similar sites

R066XY058NE	**Loamy 22-25 P.Z.** The Loamy 22-25 PZ and Thin Upland ecological sites have similar soil surface textures but Loamy 22-25 PZ sites are not calcareous within in the top six inches of the soil surface while Thin Upland sites are.
R066XY040NE	**Shallow Limy** The Shallow Limy and Thin Upland ecological sites are both calcareous in the upper A-horizon but there is a presence of a root restrictive layer within twenty inches of the surface on Shallow Limy sites which is not present on Thin Upland sites.
R066XY036NE	**Loamy 18-22 P.Z.** The Loamy 18-22 PZ and Thin Upland ecological sites have similar soil surface textures but Loamy 18-22 PZ sites are not calcareous within in the top six inches of the soil surface while Thin Upland sites are.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Bouteloua gracilis*

Physiographic features

The Thin Upland ecological site occurs on summits, steep shoulders, and backslopes of ridges and hills.

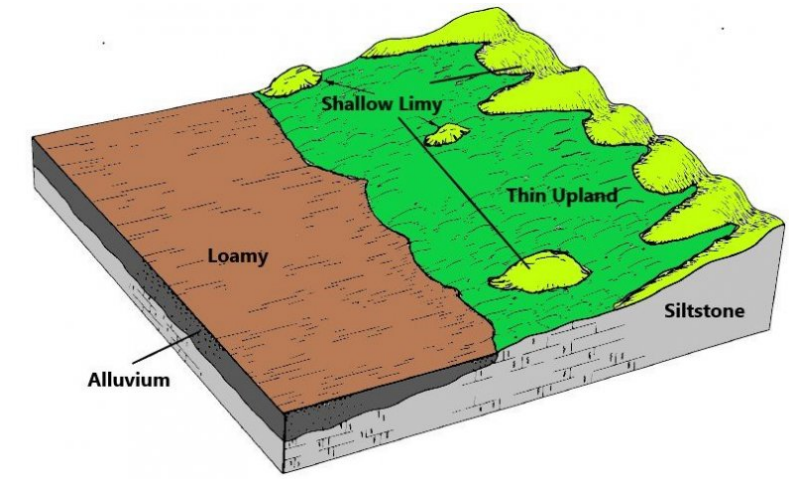


Figure 1. Block diagram of the Thin Upland site.

Table 2. Representative physiographic features

Landforms	(1) Loess hill (2) Hillslope
Runoff class	Medium to very high
Flooding frequency	None
Ponding frequency	None
Elevation	579–914 m
Slope	5–40%
Water table depth	203 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)	112-120 days
Freeze-free period (characteristic range)	132-138 days
Precipitation total (characteristic range)	533-635 mm
Frost-free period (actual range)	72-126 days
Freeze-free period (actual range)	83-149 days
Precipitation total (actual range)	508-660 mm
Frost-free period (average)	110 days
Freeze-free period (average)	129 days
Precipitation total (average)	584 mm

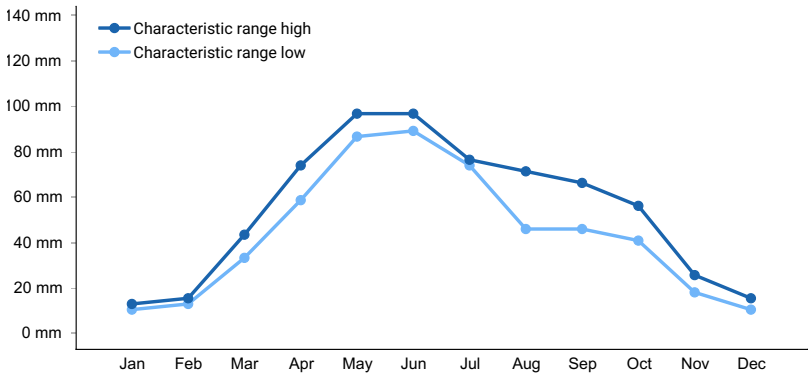


Figure 2. Monthly precipitation range

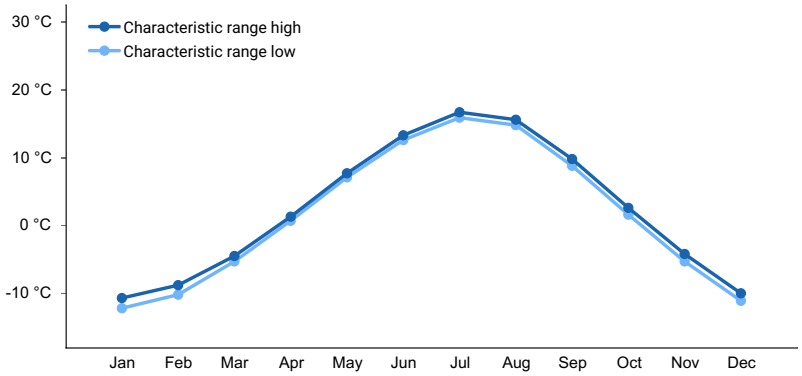


Figure 3. Monthly minimum temperature range

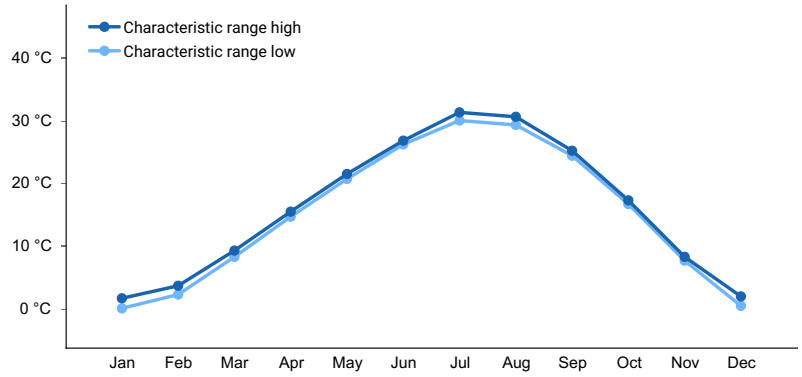


Figure 4. Monthly maximum temperature range

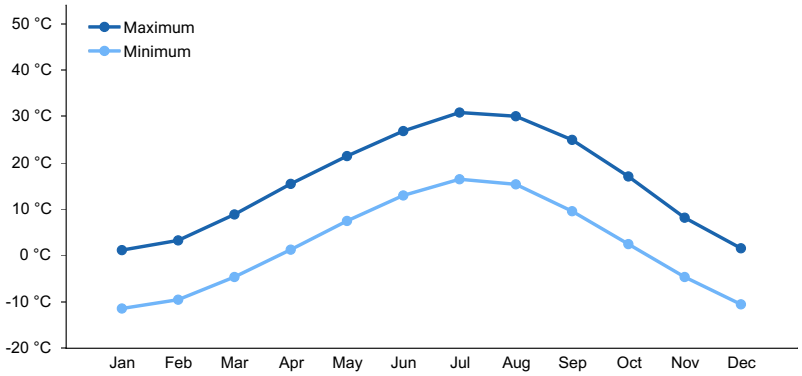


Figure 5. Monthly average minimum and maximum temperature

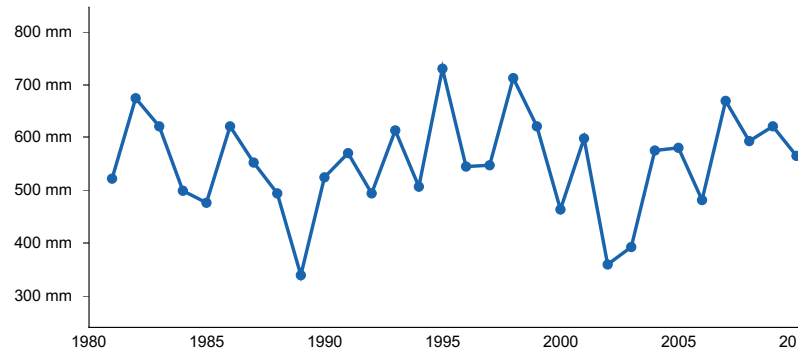


Figure 6. Annual precipitation pattern

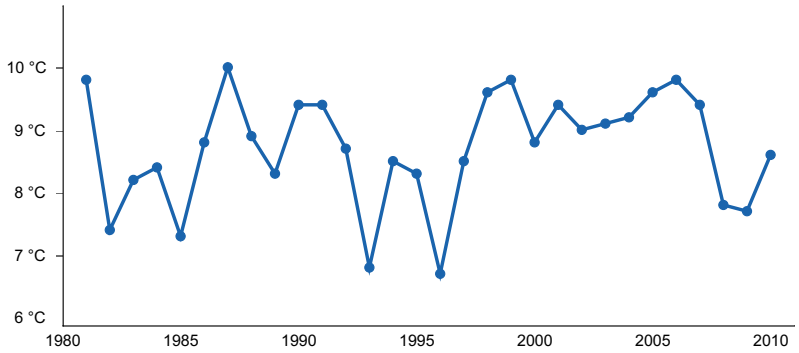


Figure 7. Annual average temperature pattern

Climate stations used

- (1) HARRINGTON [USC00393574], Tuthill, SD
- (2) SPRINGVIEW [USC00258090], Springview, NE
- (3) FAIRFAX #2 [USC00392822], Fairfax, SD
- (4) BUTTE [USC00251365], Butte, NE
- (5) LYNCH [USC00255040], Lynch, NE
- (6) NIOBRARA [USC00255960], Niobrara, NE
- (7) MISSION [USC00395620], Mission, SD
- (8) WOOD [USC00399442], Wood, SD
- (9) WINNER WILEY FLD [USW00094990], Winner, SD
- (10) GREGORY [USC00393452], Gregory, SD
- (11) MISSION 14 S [USC00395638], Mission, SD

Influencing water features

No significant water features influence this site.

Soil features

The soils correlated to the Thin Upland ecological site are moderately deep and very deep, well drained, and formed in calcareous loess or residuum of calcareous siltstone. Soil surface textures are typically silt loam. The soil surface layer is 3 to 4 inches thick and soils are calcareous at or near (within inches) the surface. Slopes typically range from 0 to 45 percent but may be as steep as 60 percent in some landscapes.

The site is susceptible to wind and water erosion when cover is reduced, with the likelihood of water erosion increasing on slopes greater than 15 percent. This site should show slight to no evidence of rills, wind-scoured areas or pedestalled plants. Water flow paths are broken, irregular in appearance, or discontinuous, with numerous debris dams or vegetative barriers. The soil surface is stable and intact.

Crofton and Keota are the two major soil series correlated to the 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).

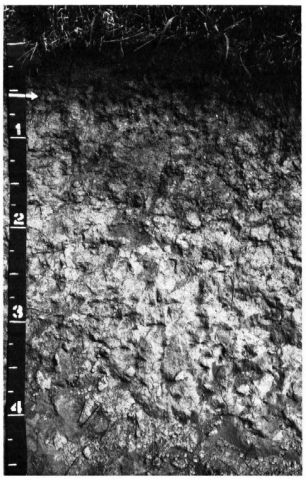


Figure 8. Crofton Series Profile

Table 4. Representative soil features

Parent material	(1) Calcareous loess (2) Residuum–calcareous siltstone
Surface texture	(1) Silt loam
Drainage class	Well drained
Permeability class	Very slow to moderate
Depth to restrictive layer	203 cm
Soil depth	51–203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	12.7–22.35 cm
Calcium carbonate equivalent (Depth not specified)	0–30%
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–4%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

Thin Upland ecological sites developed under Northern Great Plains climatic conditions, light to severe grazing by bison and other large herbivores, sporadic natural or human-caused wildfire, 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.

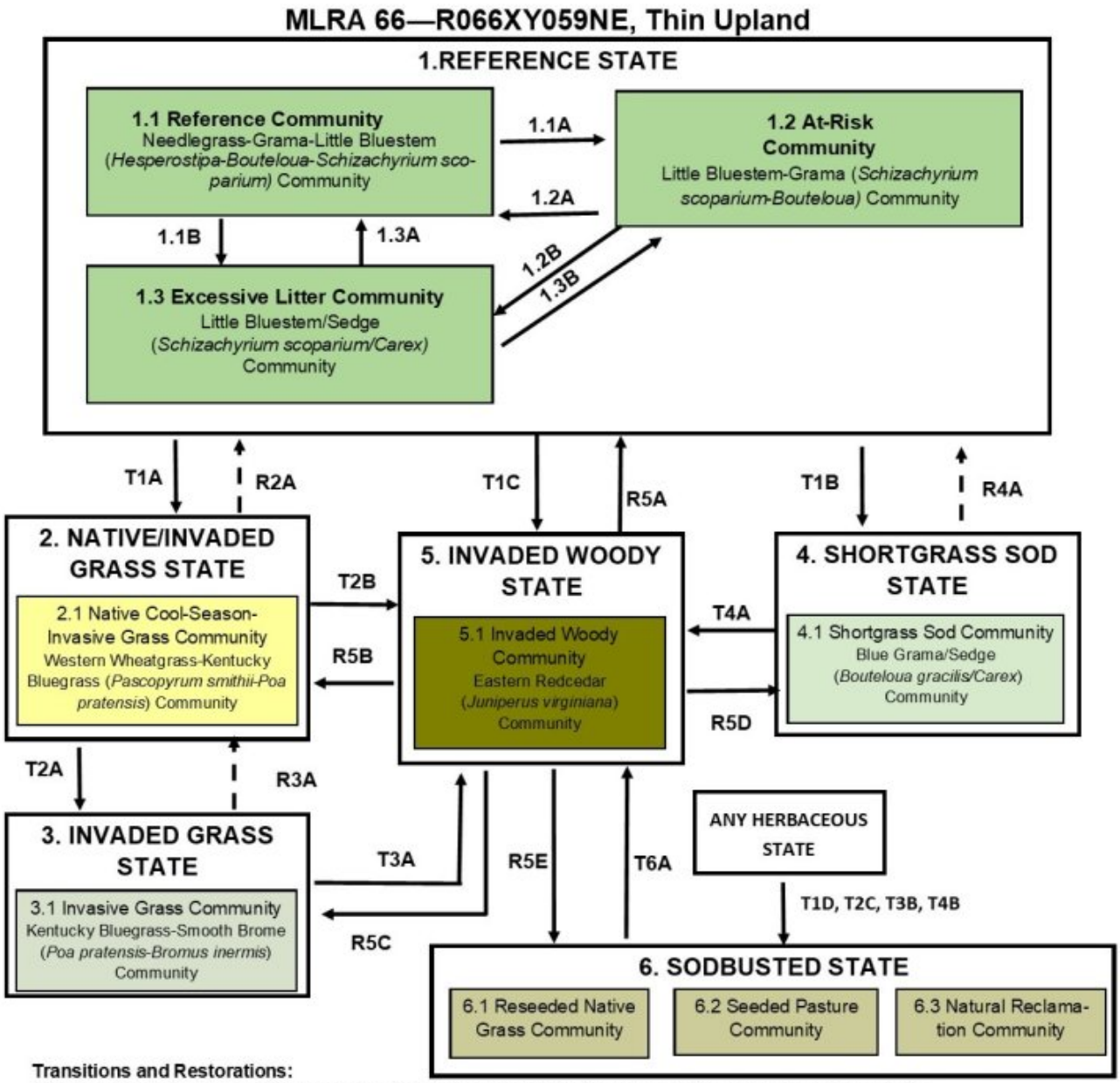
The introduction of domestic livestock by European settlers along with season-long, continuous grazing had a profound impact on the vegetation of the Thin Upland ecological site. Season-long, continuous grazing causes a repeated removal of the growing point and excessive defoliation of the leaf area 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. As this site deteriorates, little bluestem and sideoats grama will decrease in frequency and production while blue grama and needle and thread increase.

The State and Transition Model (STM) is depicted below and includes a Reference State (1), a Native/Invaded Grass State (2), an Invaded Grass State (3), a Shortgrass Sod State (4), an Invaded Woody State (5) and a Sodbusted State (6). 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) and have 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 have been interpreted from heavily grazed to lightly grazed areas, seasonal-use pastures, and historical accounts. 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 during summer with inadequate growing season recovery periods.

T1B: Long-term (> 10 years) continuous season long grazing or rotational grazing with inadequate growing season recovery periods.

T2A: Long-term (> 10 years) heavy grazing with inadequate growing season recovery periods.

T1C, T2B, T3A, T4A, T6A: Woody encroachment with no fire or brush management.

T1D, T2C, T3B, T4B: Tillage to facilitate production agriculture.

R2A: Long-term (> 15 years) prescribed grazing with adequate growing season recovery periods. This restoration may not be feasible.

R3A, R4A: Long-term (> 15 years) prescribed grazing with concentrated, spring grazing with no summer grazing. This restoration may not be feasible.

R5A, R5B, R5C, R5D, R5E: Prescribed burning, wildfire, mechanical harvest, brush management.

Community Pathways:

1.1A: Continuous, season long grazing or rotational grazing with inadequate recovery periods.

1.1B: Prolonged (> 5 years) absence of herbivory and fire.

1.2A: Prescribed grazing with adequate, growing season recovery periods.

1.2B: Continued season long grazing or rotational grazing with inadequate recovery periods or repetitive haying.

1.3A: Prescribed grazing, prescribed burning.

1.3B: Heavy, continuous season long grazing.

Figure 9. State and Transition Model Diagram. MLRA 66, Thin Upland Ecological Site.

State 1
Reference State

The Reference State (1) describes the range of vegetative communities that occur on the Thin Upland 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 site. All community phases are susceptible to eastern redcedar invasion and subject to crossing a threshold into the Invaded Woody State (4).

Dominant plant species

- little bluestem (*Schizachyrium scoparium*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- blue grama (*Bouteloua gracilis*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass

Community 1.1
Reference Community

Interpretations are primarily based on the Reference or Needlegrass-Grama-Little Bluestem (Hesperostipa-Bouteloua-*Schizachyrium scoparium*) Community (1.1). This community serves as a description of the native 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. The plant community is dominated by a mixture of cool- and warm-season grasses. The major grasses include little bluestem, needle and thread, sideoats grama, and blue grama. Other grasses and grass-likes occurring include several species of sedge, western wheatgrass, green needlegrass, and prairie Junegrass. Dominant forb species include black samson, dotted blazingstar, and purple prairie clover. Significant shrubs include fringed prairie sagewort, rose, and yucca. The potential vegetation is about 75 to 85 percent grasses or grass-like plants, 5 to 15 percent forbs, and 5 to 10 percent shrubs. Natural fire played a significant role in the succession of this site by limiting eastern redcedar from becoming established. Wildfires have been actively controlled in recent times, allowing occasional eastern redcedar encroachment. This plant community can be found on areas that are managed with prescribed grazing, prescribed burning, and may be found on areas receiving occasional periods of short-term rest. This resilient community is well adapted to the Northern Great Plains climatic conditions. The high species diversity allows for high drought tolerance. The nutrient and water cycles are highly functional, as is the energy flow through the system. Plant litter is uniformly distributed with very little movement off-site and natural mortality is very low. High perennial grass cover and production allows for increased soil moisture retention, vegetative production, and overall soil quality.

Dominant plant species

- little bluestem (*Schizachyrium scoparium*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass
- porcupinegrass (*Hesperostipa spartea*), grass
- blue grama (*Bouteloua gracilis*), grass
- sideoats grama (*Bouteloua curtipendula*), grass

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	123	2578	3138
Grass/Grasslike	1771	2126	2438
Forb	123	258	420
Total	**2017**	**4962**	**5996**

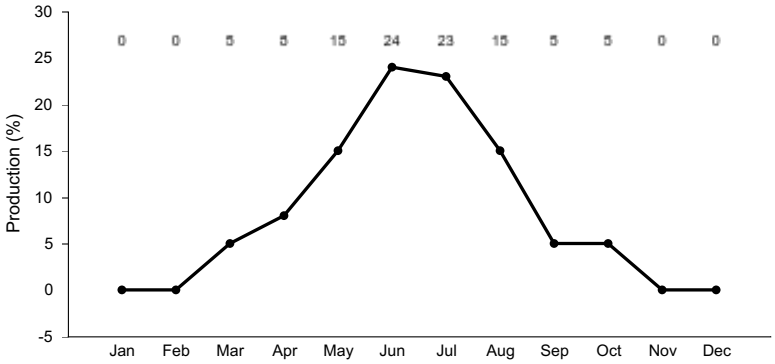


Figure 11. Plant community growth curve (percent production by month). NE6637, Eroded Tableland, warm-season dominant, cool-season subdominant.

Community 1.2
At-Risk Community

The At-Risk or Little Bluestem-Grama (*Schizachyrium scoparium*-Bouteloua) Community (1.2) signals a significant loss of production. This shift is often due to continuous season-long grazing with inadequate recovery periods. Warm-season mid- and shortgrasses, especially little bluestem and blue grama increase while cool-season grasses decrease. The composition of the forb component remains diverse. The potential for encroachment by invasive woody species increases due to fewer deep-rooted species and a reduced fuel load to carry fire. Little bluestem dominates this plant community, as it takes advantage of increased soil disturbance. Other significant grasses or grass-likes include blue grama, sideoats grama, and sedge species. Forbs commonly found in this plant community include white sage, blacksamson echinacea, Nuttall's sensitive-briar, and dotted blazing star. Significant shrubs include prairie sagewort and rose. Although production remains relatively high, little bluestem plants often become decadent and unavailable to most herbivores. The potential vegetation is about 80 to 90 percent grasses or grass-like plants, 5 to10 percent forbs, and 5 to 10 percent shrubs. This plant community is moderately resistant to change. The herbaceous species present are well adapted to grazing, but the species composition can be negatively affected through long-term overgrazing. While this plant community is less productive and less diverse than the Reference Plant Community (1.1), it remains sustainable in regard to site and soil stability, hydrologic function, and biotic integrity.

Dominant plant species

- blue grama (*Bouteloua gracilis*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- sedge (*Carex*), other herbaceous

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1255	1809	2253
Forb	101	160	219
Shrub/Vine	101	160	219
Total	**1457**	**2129**	**2691**

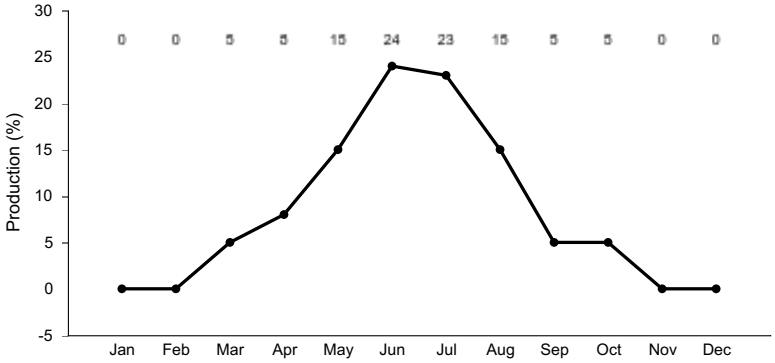


Figure 13. Plant community growth curve (percent production by month). NE6637, Eroded Tableland, warm-season dominant, cool-season subdominant.

Community 1.3
Excessive Litter Community

The Excessive Litter or Little Bluestem/Sedge (*Schizachyrium scoparium*/Carex) 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
- sedge (*Carex*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

A shift from the Reference Community (1.1) to the At-Risk Community (1.2) occurs with continuous seasonal grazing, continuous season-long grazing, or rotational grazing with inadequate growing season recovery periods. Early season grazing with high stock densities results in increased soil disturbance and favors little bluestem and negatively impacts native cool-season grasses. Continuous season-long grazing with low to moderate stocking rates results in repetitive grazing of preferred plants shifting the plant community to one dominated by little bluestem. Rotational grazing without allowing adequate growing season recovery time results in reduction in the health and vigor of preferred plants.

Pathway 1.1B
Community 1.1 to 1.3

Prolonged periods (more than five years) of non-use and absence of fire will convert the Reference Community (1.1) to the Excessive Litter Community (1.3). Herbivory and fire are natural disturbances and are necessary to maintain a vigorous plant community.

Pathway 1.2A
Community 1.2 to 1.1

A shift from the At-Risk Community (1.2) toward the Reference Community (1.1) can be achieved through

prescribed grazing. Appropriate stocking rates with adequate growing season recovery periods with timing and duration of the grazing to suppress little bluestem and favor the needlegrass will facilitate the return to the Reference Community. Appropriately timed prescribed fire will accelerate this process.

Pathway 1.2B
Community 1.2 to 1.3

Prolonged periods of non-use (more than five years) and absence of fire will convert the At-Risk Community (1.2) to the Excessive Litter Community (1.3). Herbivory and fire are natural disturbances and are necessary to maintain a vigorous plant community.

Pathway 1.3A
Community 1.3 to 1.1

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

Pathway 1.3B
Community 1.3 to 1.2

Reintroduction of grazing with heavy continuous use will convert 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 been degraded from the Reference State (1) and much of the native warm-season grass community has been replaced by native cool-season grasses and non-native cool-season grasses. Non-native species are typically 15 percent or less of the annual production. The Native/Invaded Grass State occurs with either continuous seasonal grazing during the summer months or with prolonged periods of non-use with no fire. The loss of warm-season, tall- and midgrasses has negatively impacted energy flow and nutrient cycling. Water infiltration is reduced due to the shallow root system and rapid runoff characteristics of the current plant communities. The Native/Invaded Grass State includes the Native Cool-Season-Invasive Grass Community (2.1).

Dominant plant species

- Kentucky bluegrass (*Poa pratensis*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass

Community 2.1
Native Cool-Season-Invasive Grass Community

Figure 14. MLRA 66, Thin Upland Ecological Site, Native Cool-Season-Invasive Grass Community (2.1), Knox County, Nebraska.

In the Native Cool-Season-Invasive Grass or Western Wheatgrass-Kentucky Bluegrass (*Pascopyrum smithii-Poa pratensis*) Community (2.1) develops under annual heavy continuous grazing or excessive disturbance. Warm-season shortgrasses and cool-season grasses have increased significantly. Initially, the dominant grasses include western wheatgrass, needle and thread, and green needlegrass. Other grasses may include blue grama, buffalograss, threeawn, and prairie Junegrass. Sedges flourish in the understory. The dominant forbs include cuman ragweed, scurfpeas, white sagebrush, and tarragon. Compared to the Reference Community (1.1), cool-season bunchgrasses and the warm-season tall- and midgrasses have decreased and plant diversity has declined. Kentucky bluegrass and smooth brome have become established on the site and these grasses and other non-native cool-season grasses are less than 15 percent of the plant community. These non-native grasses will continue to increase with repeated seasonal grazing during the summer or extended periods of nonuse with no fire. Cool, moist climatic conditions will tend to increase the dominance of Kentucky bluegrass. When the non-native cool-season grasses becomes dominant and exceed 30 percent of the plant community composition the site has transitioned to the Invaded Grass State (3). Soil erosion remains low. Soil health is affected by reduced efficiency in the nutrient, mineral, and hydrologic cycles as a result of decreased rooting depths. When Kentucky bluegrass is dominant due to nonuse with no fire, the increasing thatch layer inhibits water infiltration and increases runoff. Total annual vegetative production has declined significantly.

Dominant plant species

- western wheatgrass (*Pascopyrum smithii*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- smooth brome (*Bromus inermis*), grass

State 3
Invaded Grass State

The Invaded Grass State (3) occurs when non-native cool-season grasses have invaded and dominate the site. Non-native cool-season grasses make up more than thirty percent of the plant community. Smooth brome tends to dominate the site with long term heavy grazing. Kentucky bluegrass tends to dominate the site when the site is unused and fire is also eliminated from the system due to the buildup of thatch which effectively prevents other plants from establishing. The loss of warm-season, tall- and midgrasses and increase of non-native cool-season grasses has negatively impacted energy flow and nutrient cycling. Water infiltration is reduced due to the shallow root system and rapid runoff characteristics of the current plant community. Long term (more than 15 years) prescribed grazing which includes concentrated grazing in the spring and fall and no grazing during the summer months may restore the plant community to the Native/Invaded Grass State (2). The feasibility of this restoration depends upon the amount of native grasses remaining in the plant community. The fewer the native grasses present, the less feasible the restoration. The Invaded Grass State includes the Invasive Grass Community (3.1).

Community 3.1
Invasive Grass Community

The Invasive Grass or Kentucky Bluegrass-Smooth Brome (*Poa pratensis-Bromus inermis*) Community (3.1) developed under no use with no fire, continuous season long grazing, or continuous season (summer) grazing. The plant community is dominated by non-native cool-season grasses, typically Kentucky bluegrass or smooth brome. Western wheatgrass, needlegrass, or other native cool-season grasses may be present. Forbs present typically include white sagebrush, goldenrod, scurfpea, and Cuman ragweed. Infiltration is moderately reduced as is energy capture while runoff has increased. Soil erosion is low. and plant diversity is significantly reduced. When the plant community is dominated by smooth brome production can be relatively high but the grass matures early in the growing season resulting in a forage that is palatable for a brief period of time. When managed as pastureland with prescribed grazing, herbaceous weed control, and fertilization, production can be increased significantly.

State 4
Shortgrass Sod State

The Shortgrass Sod State (4) has been degraded from the Reference State (1) and most of the native warm-season tall- and midgrasses and cool-season bunchgrasses have been replaced by warm-season shortgrasses and sedges. The loss of most of the native grass component has negatively impacted energy flow and nutrient cycling. Water infiltration has been reduced while runoff has been increased due to the shallow root systems of existing

plant community. The Shortgrass Sod State includes the Shortgrass Sod Community (4.1).

Dominant plant species

- blue grama (*Bouteloua gracilis*), grass
- Fendler's threeawn (*Aristida purpurea var. fendleriana*), grass
- sedge (*Carex*), grass

Community 4.1
Shortgrass Sod Community

The Shortgrass Sod or Blue Grama/Sedge (*Bouteloua gracilis*/Carex) Community (4.1) is the result of heavy continuous season-long grazing and repeated seasonal grazing, especially when grazing occurs in the spring and early summer. Blue grama, sedges, and buffalograss are the dominant species. Minor species include western wheatgrass, threeawn, needle and thread, and sand dropseed. Common forbs include Cuman ragweed, white sagebrush, curlycup gumweed, and tarragon. Prairie sagewort and pricklypear are the dominant shrubs. When compared to the Reference Community (1.1), blue grama and buffalograss have increased significantly. The tallgrasses are minor, trace or missing from the plant community .Midgrasses, other than sand dropseed, are present only in minor or trace amounts. Annual production has decreased significantly. This plant community is resistant to change, as the dominant species tolerate overgrazing. The thick sod prevents other species from becoming established. Bare ground is usually less than 10 percent bare ground. Infiltration has decreased and runoff has increased. Soil erosion is low due to the sod forming habit of blue grama and threadleaf sedge. This could be advantageous for heavy use areas such as calving and lambing units since the grazing tolerant species will control erosion. In these situations, nutrient runoff could be a potential problem.

Dominant plant species

- blue grama (*Bouteloua gracilis*), grass
- buffalograss (*Bouteloua dactyloides*), grass
- sedge (*Carex*), other herbaceous

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	460	925	1278
Forb	50	112	174
Shrub/Vine	50	84	118
Total	**560**	**1121**	**1570**

State 5
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 Native/Invaded Grass State (2), Invaded Grass State (3), Shortgrass Sod State (4), or the Sodbusted State (6), 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 (5.1).

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- blue grama (*Bouteloua gracilis*), grass

- needle and thread (*Hesperostipa comata ssp. comata*), grass

Community 5.1
Invaded Woody Community

The Invaded Woody Community or Eastern Redcedar (*Juniperus virginiana*) Community (5.1) has at least 15 percent canopy cover consisting of trees generally 5 feet or taller. Encroaching trees are primarily eastern redcedar. Additional woody cover from deciduous trees and shrubs may be present. In the absence of fire and brush management, this ecological site is very susceptible to eastern redcedar seedling invasion, especially when adjacent to a seed source. Eastern redcedar can eventually dominate the site resulting in a closed canopy monoculture which drastically reduces forage production and which has limited value for either livestock grazing or wildlife habitat. With long-term fire suppression, this plant community will develop extensive ladder fuels which can lead to a removal of most tree species with a wildfire. With properly managed intensive grazing, encroachment of deciduous trees will typically be minimal; however, this will not impact encroachment of coniferous species. The herbaceous component decreases proportionately in relation to the percent canopy cover, with the reduction being greater under a coniferous overstory. Eastern redcedar control can usually be accomplished with prescribed burning while the trees are six feet tall or less and fine fuel production is greater than 1,500 pounds per acres. Larger red cedars can also be controlled with prescribed burning, but successful application requires the use of specifically designed ignition and holding techniques (https://www.loesscanyonsburning group.com). Resprouting brush must be chemically treated immediately after mechanical removal to achieve effective treatment. The forb component will initially increase following tree removal. To prevent return to a woody dominated community, ongoing brush management such as hand cutting, chemical spot treatments, or periodic prescribed burning is required. This plant community is resistant to change and resilient given normal disturbances. In higher canopy cover situations, the soil erosion will increase in relation the plant community from which this plant community originated. The hydrologic function is also significantly altered under higher canopy cover. Infiltration is reduced and runoff is typically increased because of a lack of herbaceous cover and the rooting structure provided by the herbaceous species. Total annual production during an average year varies significantly, depending on the production level prior to encroachment and the percentage of canopy cover.

State 6
Sodbusted State

The threshold to the Sodbusted State (6) is crossed as a result of mechanical tillage to facilitate production agriculture. When the land is no longer cropped, the resulting state is the Sodbusted State. When farming operations are suspended, the site can seeded to native grasses and forms resulting in the Reseeded Native Grass Community (6.1), be seeded to a tame pasture forage mixture resulting in the Seeded Pasture Community (6.2) or be abandoned with no seeding which will result in the Natural Reclamation Community (6.3). Permanent alterations of the soil community and the hydrologic cycle make restoration to the Reference State (1) extremely difficult, if not impossible. Formation of a compacted plowpan in the soil profile is likely.

Community 6.1
Reseeded Native Grass Community

The Reseeded Native Grass Community (6.1) 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 6.2
Seeded Pasture Community

The Seeded Pasture Community (6.2) 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 6.3
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.

Transition T1A
State 1 to 2

Long-term (more than ten years) heavy continuous grazing or heavy rotational grazing with inadequate growing season recovery periods during the summer will cause the Reference State (1) to lose a significant proportion of the warm-season grass species and cross a threshold to the Native/Invaded Grass State (2). Water infiltration and other hydrologic functions will be reduced due to the root-matting presence of sod-forming grasses. With the decline and loss of deeper-penetrating root systems, soil structure and biotic integrity are significantly degraded. This transition may also occur when non-use without implementing prescribed fire is continued long-term.

Transition T1B
State 1 to 4

The Reference State (1) will transition to the Shortgrass Sod State (4) with long-term (more than ten years), continuous, growing season long grazing or rotational grazing with inadequate growing season recovery periods. Continuous seasonal grazing (grazing during the same time frame each year) in the spring will also case this transition. Water infiltration and other hydrologic functions will be reduced due to the root-matting presence of sod-forming grasses. With the decline and loss of deeper-penetrating root systems, soil structure and biological integrity may be degraded to the point that recovery is unlikely. Once this occurs, it is highly unlikely that grazing management alone will return the community to the Reference State.

Transition T1C
State 1 to 5

Disruption of the natural fire regime and encroachment of invasive exotic and native woody specie can cause the Reference State (1) to transition to the Invaded Woody State (5).

Transition T1D
State 1 to 6

The Reference State (1) has been significantly altered by tillage to allow the site to be placed into production

agriculture. The disruption to the plant community, the soil, and the hydrology of the system make restoration to the Reference State unlikely.

Restoration pathway R2A
State 2 to 1

Long-term (15 or more years) prescribed grazing with adequate growing season recovery periods and appropriate stocking rates timed to coincide with the rapid growth phase of the cool-season grasses will return the Native/Invaded Grass State (2) to the Reference State (1). The length of time required depends upon the amount of native grasses remaining in the plant community. This restoration may not be feasible if soils and hydrology have been degraded to the extent that the site cannot support a plant community of the Reference State (1). Appropriately timed prescribed burning may accelerate this process.

Transition T2A
State 2 to 3

Continued long-term (more than ten years) continuous grazing or rotational grazing with inadequate growing season recovery periods during the summer will cause the Native/Invaded Grass State (2) to lose a significant proportion of the native grass species and cross a threshold to the Invaded Grass State (3). Water infiltration and other hydrologic functions will be reduced due to the root-matting presence of sod-forming grasses. With the decline and loss of deeper-penetrating root systems, soil structure and biotic integrity are catastrophically degraded.

Transition T2B
State 2 to 5

Disruption of the natural fire regime and encroachment of invasive exotic and native woody specie can cause the Native/Invaded Grass State (2) to transition to the Invaded Woody State (5).

Transition T2C
State 2 to 6

The Native/Invaded Grass State (2) has been significantly altered by tillage to allow the site to be placed into 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.

Restoration pathway R3A
State 3 to 2

With long-term (15 or more years) seasonal prescribed grazing in the spring or in the spring and fall the amount of non-native cool-season grasses can be reduced and be replaced by native grasses if an adequate amount of remnant native grasses are present in the plant community. This restoration will not be feasible when native grasses have been eliminated or nearly eliminated from the plant community or if soils and hydrology have been degraded to the extent that the site cannot support a plant community of the Native/Invaded Grass State (2). Appropriately timed prescribed burning may accelerate this process.

Transition T3A
State 3 to 5

Disruption of the natural fire regime and encroachment of invasive exotic and native woody specie can cause the Invaded Grass State (3) to transition to the Invaded Woody State (5).

Transition T3B
State 3 to 6

The Invaded Grass State (3) has been significantly altered by tillage to allow the site to be placed into production agriculture. The disruption to the plant community, the soil, and the hydrology of the system make restoration to the Invaded Grass State unlikely.

Restoration pathway R4A
State 4 to 1

Long term (more than 15 years) prescribed grazing with adequate growing season recovery periods may move the Shortgrass Sod State (4) to the Reference State (1) if adequate amounts of native, warm-season, tall- and midgrasses and native cool-season grasses remain in the plant community. This transition will not be feasible when the warm-season tall- and midgrasses and native cool-season grasses have been reduced to trace levels or if soils and hydrology have been degraded to the extent that the site cannot support a plant community of the Reference State (1).

Transition T4A
State 4 to 5

Disruption of the natural fire regime and encroachment of invasive exotic and native woody specie can cause the Shortgrass Sod State (4) to transition to the Invaded Woody State (5).

Transition T4B
State 4 to 6

The Shortgrass Sod State (4) has been significantly altered by tillage to allow the site to be placed into production agriculture. The disruption to the plant community, the soil, and the hydrology of the system make restoration to the Shortgrass Sod State unlikely.

Restoration pathway R5A
State 5 to 1

Prescribed burning, wildfire, timber harvest, and brush management will move the Invaded Woody State (5) 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), Invaded Grass State (3), Shortgrass Sod State (4), or Sodbusted State (6), cannot transition 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 R5B
State 5 to 2

Prescribed burning, wildfire, timber 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, Invaded Grass State (3), Shortgrass Sod State (4), or Sodbusted State (6), cannot transition 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 R5C
State 5 to 3

Prescribed burning, wildfire, timber harvest, and brush management will move the Invaded Woody State (4) toward the Invaded Grass 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), Invaded Grass State, Shortgrass Sod State (4), or Sodbusted State (6), cannot transition 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 R5D
State 5 to 4

Prescribed burning, wildfire, timber harvest, and brush management will move the Invaded Woody State (5) toward the Shortgrass Sod State (4). 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), Invaded Grass State (3), Shortgrass Sod State, or Sodbusted State (6), cannot transition 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 R5E
State 5 to 6

Prescribed burning, wildfire, timber harvest, and brush management will move the Invaded Woody State (5) toward the Sodbusted 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), Invaded Grass State (3), Shortgrass Sod State (4), or Sodbusted State, cannot transition 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.

Transition T6A
State 6 to 5

Disruption of the natural fire regime and encroachment of invasive exotic and native woody specie can cause the Sodbusted State (6) to transition to the Invaded Woody State (5).

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 Tall- and Midgrass**			387–902	
	little bluestem	SCSC	*Schizachyrium scoparium*	258–773	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	129–516	–
	big bluestem	ANGE	*Andropogon gerardii*	0–387	–
	Grass, perennial	2GP	*Grass, perennial*	0–26	–
2	**Cool-Season Bunchgrass**			387–773	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	129–387	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	129–387	–
	green needlegrass	NAVI4	*Nassella viridula*	0–258	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	26–129	–

	Grass, perennial	2GP	*Grass, perennial*	0–26	–
3	**Warm-Season Shortgrass**			258–516	
	blue grama	BOGR2	*Bouteloua gracilis*	258–516	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–129	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–129	–
	Grass, perennial	2GP	*Grass, perennial*	0–26	–
4	**Cool-Season Rhizomatous Grass**			129–387	
	western wheatgrass	PASM	*Pascopyrum smithii*	129–387	–
5	**Grass-Like**			129–258	
	sedge	CAREX	*Carex*	129–258	–
Forb					
6	**Forb**			129–387	
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	52–258	–
	milkvetch	ASTRA	*Astragalus*	26–129	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	26–129	–
	white prairie clover	DACA7	*Dalea candida*	26–129	–
	dotted blazing star	LIPU	*Liatris punctata*	52–129	–
	false boneset	BREU	*Brickellia eupatorioides*	0–129	–
	field sagewort	ARCA12	*Artemisia campestris*	0–129	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	26–129	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	26–103	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	26–77	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–52	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–52	–
	pussytoes	ANTEN	*Antennaria*	0–52	–
	Forb, perennial	2FP	*Forb, perennial*	0–52	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–52	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	26–52	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	0–26	–
	Forb, annual	2FA	*Forb, annual*	0–26	–
	thistle	CIRSI	*Cirsium*	0–26	–
	onion	ALLIU	*Allium*	0–26	–
Shrub/Vine					
7	**Shrub**			129–258	
	prairie sagewort	ARFR4	*Artemisia frigida*	52–129	–
	leadplant	AMCA6	*Amorpha canescens*	0–129	–
	rose	ROSA5	*Rosa*	0–129	–
	soapweed yucca	YUGL	*Yucca glauca*	0–77	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–77	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–52	–

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 Tall- and Midgrass**			639–1278	
	little bluestem	SCSC	*Schizachyrium scoparium*	639–1171	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	21–213	–
	composite dropseed	SPCO16	*Sporobolus compositus*	0–106	–
	big bluestem	ANGE	*Andropogon gerardii*	0–64	–
	Grass, perennial	2GP	*Grass, perennial*	0–21	–
2	**Warm-Season Shortgrass**			297–745	
	blue grama	BOGR2	*Bouteloua gracilis*	319–639	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–213	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–112	–
	threeawn	ARIST	*Aristida*	106–112	–
	Grass, perennial	2GP	*Grass, perennial*	0–21	–
3	**Cool-Season Bunchgrass**			0–106	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–106	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–64	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–21	–
	green needlegrass	NAVI4	*Nassella viridula*	0–21	–
	Grass, perennial	2GP	*Grass, perennial*	0–21	–
4	**Cool-Season Rhizomatous Grass**			0–64	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–64	–
5	**Grass-Likes**			213–319	
	sedge	CAREX	*Carex*	213–321	–
6	**Non-Native Grasses**			0–64	
	Kentucky bluegrass	POPR	*Poa pratensis*	0–64	–
	cheatgrass	BRTE	*Bromus tectorum*	0–64	–
Forb					
7	**Forbs**			106–213	
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	21–128	–
	tarragon	ARDR4	*Artemisia dracunculus*	21–128	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	43–128	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	43–106	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–64	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–64	–
	white prairie clover	DACA7	*Dalea candida*	0–64	–
	false boneset	BREU	*Brickellia eupatorioides*	0–64	–
	thistle	CIRSI	*Cirsium*	0–43	–
	milkvetch	ASTRA	*Astragalus*	21–43	–
	Forb, perennial	2FP	*Forb, perennial*	0–43	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–43	–
	large Indian breadroot	PEES	*Pediomelum esculentum*	0–21	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	0–21	–

	Forb, annual	2FA	*Forb, annual*	0–21	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–21	–
	onion	ALLIU	*Allium*	0–21	–
	pussytoes	ANTEN	*Antennaria*	0–21	–
Shrub/Vine					
8	**Shrubs**			106–213	
	prairie sagewort	ARFR4	*Artemisia frigida*	34–112	–
	soapweed yucca	YUGL	*Yucca glauca*	0–56	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–34	–
	rose	ROSA5	*Rosa*	0–22	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–22	–

Table 10. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Warm-Season Tall- and Midgrass**			56–224	
	little bluestem	SCSC	*Schizachyrium scoparium*	11–112	–
	composite dropseed	SPCO16	*Sporobolus compositus*	11–56	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	11–56	–
	Grass, perennial	2GP	*Grass, perennial*	0–11	–
2	**Cool-Season Bunchgrass**			0–90	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–56	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–34	–
	Grass, perennial	2GP	*Grass, perennial*	0–11	–
3	**Warm-Season Shortgrass**			224–504	
	blue grama	BOGR2	*Bouteloua gracilis*	224–448	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–112	–
	threeawn	ARIST	*Aristida*	22–112	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–112	–
	Grass, perennial	2GP	*Grass, perennial*	0–11	–
4	**Cool-Season Rhizomatous Grass**			0–56	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–56	–
5	**Grass-like**			168–280	
	sedge	CAREX	*Carex*	168–280	–
6	**Non-Native Grass**			0–112	
	Kentucky bluegrass	POPR	*Poa pratensis*	0–168	–
	cheatgrass	BRTE	*Bromus tectorum*	0–90	–
Forb					
7	**Forb**			56–168	
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	56–168	–
	tarragon	ARDR4	*Artemisia dracunculus*	11–67	–
	white heath aster	SYER	*Symphyotrichum ericoides*	22–67	–

	Cuman ragweed	AMPS	*Ambrosia psilostachya*	22–67	–
	pussytoes	ANTEN	*Antennaria*	0–56	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	11–56	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	11–45	–
	milkvetch	ASTRA	*Astragalus*	22–45	–
	thistle	CIRSI	*Cirsium*	0–34	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–34	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	11–34	–
	hoary verbena	VEST	*Verbena stricta*	0–22	–
	Forb, annual	2FA	*Forb, annual*	0–22	–
	Forb, perennial	2FP	*Forb, perennial*	0–22	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–22	–
	dotted blazing star	LIPU	*Liatris punctata*	0–22	–
	onion	ALLIU	*Allium*	0–11	–
Shrub/Vine					
8	**Shrub**			56–112	
	prairie sagewort	ARFR4	*Artemisia frigida*	34–112	–
	soapweed yucca	YUGL	*Yucca glauca*	0–56	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–34	–

Animal community

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

Production and Carrying Capacity*
Community 1.1, Reference Community: 2,300 lbs/acre, 0.63 AUM/acre
Community 1.2, At-Risk Community: 1,900 lbs/ac, 0.52 AUM/acre
Community 4.1, Shortgrass Sod Community: 1,000 lbs/acre, 0.27 AUM/acre

*Based upon the following conditions: continuous season-long grazing by cattle under average growing conditions, 25 percent harvest efficiency. Air dry forage requirements based on 3 percent of animal body weight, or 912 lbs/AU/month.

MLRA 66 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. This site is dominated by soils in hydrologic group B. Infiltration ranges from moderately slow to moderate. Runoff potential for this site varies from medium to high, depending on slope and ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where short-grasses form a strong sod and dominate the site. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (refer to Part 630, NRCS National Engineering Handbook).

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

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

Other information

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

South Dakota:
Burke, (Gregory)

Martin, (Bennett and Shannon)
Winner, (Tripp)
White River, (Mellette and Todd)

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel also were used. Those involved in developing this site include Wayne Bachman, Soil Scientist, NRCS; Stan Boltz, Range Management Specialist, NRCS; Anna Ferguson, Soil Conservationist, NRCS; Roger Hammer, Soil Scientist, NRCS; Dana Larsen, Range Management Specialist, NRCS; Dave Schmidt, Rangeland Management Specialist, NRCS; Kim Stine, Rangeland Management Specialist, NRCS.
Data Source Number of Records Sample Period State County
SCS-RANGE-417

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Approval

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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
Contact for lead author	jeffrey.nichols@usda.gov
Date	11/18/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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2. **Presence of water flow patterns:** Typically, none. Water flow patterns are not expected on gentle slopes. On steeper slopes (greater than 15 percent) water flow patterns may occur but will be barely visible and discontinuous.

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3. **Number and height of erosional pedestals or terracettes:** Typically, none. Bunchgrasses may be slightly pedestalled (0.5 inch/1.25 cm) with no exposed roots on steeper slopes (greater than 15 percent), becoming more common as slopes become steeper.

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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. Multi-year drought and/or wildfire can increase bare ground to 10 percent for up to two years following the disturbance.

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

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

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

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability ratings should typically be 5 to 6, normally 6. Surface organic matter adheres to the soil surface. Soil surface fragments will typically retain structure indefinitely when dipped in distilled water.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The A-horizon should be 4 to 12 inches (10.2-30.5 cm) thick. Soil is brown, grayish brown, to light brownish gray (values of 3 to 6) when dry and very dark grayish brown to dark grayish brown (values of 3 to 4) when moist. Structure is typically weak fine or very fine granular at least in the upper A-horizon.

   Crofton and Keota are the primary soil series correlated to the Thin Upland ecological site.

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 and 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 approximately 75 to 85 percent perennial grasses and grass-likes, 5 to 15 percent forbs, and 5 to 10 percent shrubs. The perennial grass and grass-like component is made up of C4, tall- and midgrasses (15-35%); C3, bunch grasses (15-30%); C4, short grasses (10-20%); C3, rhizomatous grasses (5-15%); grass-likes (5-10%).

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.

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 Tall- and Midgrass, 345-805#/ac, 15-35% (2 species minimum): big bluestem, little bluestem, sideoats grama.
    2. Native, perennial, C3, bunchgrass, 345-690 #/ac, 15-30% (3 species minimum): green needlegrass, needle and thread, porcupinegrass, prairie Junegrass.

Phase 1.2
1. Native, perennial, C4 tall- and midgrass, 570-1140, 30-60% (2 species minimum): big bluestem, little bluestem, sideoats grama, tall dropseed.
2. Native, perennial, C4, shortgrass, 285-665 #/ac, 15-35% (1 species minimum): blue grama, hairy grama, buffalograss, threeawn.

Phase 1.3
1. Native, perennial, C4 shortgrass, 200-450 #/ac, 20-45% (2 species minimum): threeawn, blue grama, hairy grama, buffalograss.
2. Grass-likes, 150-250 #/ac, 15-25% (1 species minimum): sedge.

Sub-dominant: Phase 1.1
1. Native, perennial, warm-season shortgrass, 230-460 #/ac, 10-20% (1 species minimum): blue grama, hairy grama, buffalograss.
2. Native, perennial, cool-season, rhizomatous grass, 115-345 #/ac, 5-15% (1 species minimum): western wheatgrass.
3. Native forb, 115-345 #/ac, 5-15% (8 species minimum): blacksamson echinacea, milkvetch, scarlet globemallow, white prairie clover, dotted blazing star, Cuman ragweed, white sagebrush, scarlet beeblossom, Nuttall's sensitive-briar.

Phase 1.2
1. Grass-likes, 190-285 #/ac, 10-15% (1 species minimum): sedge.

Phase 1.3
1. Native, perennial, C4 tall- and midgrass, 50-200 #/ac, 5-20% (3 species minimum): tall dropseed, little bluestem, sideoats grama.
2. Native forbs, 50-150 #/ac, 5-15% (8 species minimum): blacksamson echinacea, tarragon, white heath aster, Cuman ragweed, scarlet beeblossom, milkvetch, white sagebrush, scarlet globemallow, and other forbs that vary from location to location.

Other: Minor - Phase 1.1
1. Grass-like, 115-230 #/ac (5-10%): sedges
2. Shrub, 115-230 #/ac, 5-10%: prairie sagewort and other shrubs which vary from location to location.

Minor - Phase 1.2
1. Forbs, 95-190#/ac, 5-10%: forbs vary from location to location.
2. Shrubs, 95-190 #/ac, 5-10%: shrubs vary from location to location.
3. Native, perennial, C3 bunchgrass, 0-95 #/ac, 0-5%: green needlegrass, needle and thread, porcupinegrass, prairie Junegrass.
2. Non-native, C3 grasses, 0-57 #/ac, 0-3%: Kentucky bluegrass, cheatgrass.
3. Native, perennial, C3 rhizomatous grass, 0-95 #/ac, 0-5%: western wheatgrass.

Minor - Phase 1.3
1. Shrubs, 50-100 #ac, 5-10%: prairie sagewort and other shrubs that vary from location to location.
2. Non-native, C3 grass, 0-100 #/ac, 0-10%: Kentucky bluegrass, cheatgrass.
3. Native, perennial, C3 bunchgrass, 080 #/ac, 0-8%: needle and thread, prairie junegrass.
4. Native, perennial, C3 rhizomatous grass, 0-50 #/ac, 0-5%: western wheatgrass.

Additional: The Reference Community (1.1) consists of seven F/S groups which include, in order of abundance, native, perennial, C4 tall- and midgrass; native, perennial, C3 bunchgrass; native, perennial, C4 shortgrass; native, perennial, C3, rhizomatous grass = native forbs; grass-like = shrubs.

The Degraded Native Grass Community (1.2) includes eight F/S groups which include native, perennial, C4 tall- and midgrass; native, perennial, C4 shortgrass; grass-likes; native forbs = shrubs; native, perennial, C3 bunchgrass = non-native, C3 grass; and native, perennial, C3, rhizomatous grass.

The At-Risk Community (1.3) consists of eight F/S groups which include native, perennial, C4 shortgrass; grass-likes; native, perennial, C4, tall- and midgrass; native forbs; shrubs = non-native, C3 grasses; native, perennial, C3 bunchgrass; and native, perennial, C3 rhizomatous grass.

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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 70 to 80 percent and at a depth of 0.25 to 0.50 inch (0.65-1.3 cm). Litter cover during and following drought can range from 50 to 60 percent

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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 2,300 pounds per acre on an air dry weight basis. Low and High production years should yield 1,800 and 2,800 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), Kentucky bluegrass, smooth brome, absinth wormwood, common mullein, Kentucky bluegrass, smooth brome, eastern redcedar 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.
