USDA Natural Resources Conservation Service

Ecological site R066XY065NE
Closed Depression

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

General information

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

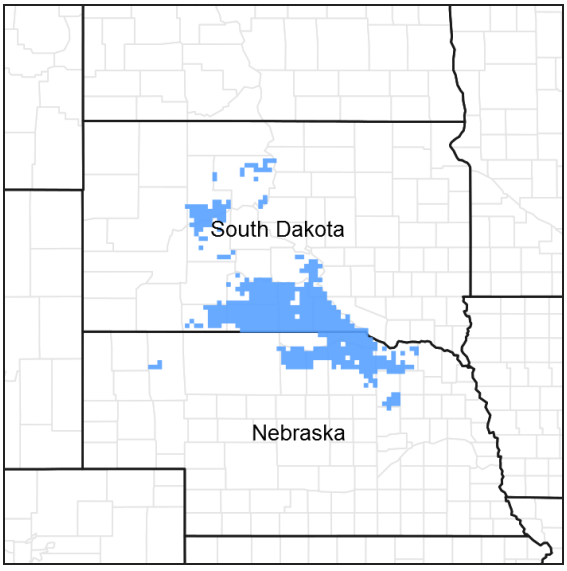


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 066X–Dakota-Nebraska Eroded Tableland

The Dakota-Nebraska Eroded Tableland (MLRA 66) occurs in north-central Nebraska (56 percent) and south-central South Dakota (44 percent). MLRA 66 is approximately 3.6 million acres and covers all or parts of 12 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 Closed Depression ecological site occurs on level to nearly level upland landscapes with slopes ranging from 0 to 1 percent. The site receives runoff from sites located higher on the landscape and occurs in depressions which have no outlet. The site is poorly to very poorly drained. Water will pond from seven to more than thirty days in the spring and after high rainfall events. The site also has a high water table ranges from the surface to eighteen inches

deep. The vegetation fluctuates significantly with precipitation cycles and can range from nearly pure stands of western wheatgrass in dry years to a community dominated by grass-likes, smartweeds, and annual forbs during wet years.

Associated sites

R066XY058NE	**Loamy 22-25 P.Z.** The Loamy 22-25 PZ ecological site is often found adjacent to or near the Closed Depression site on a higher landscape position.
R066XY026NE	**Loamy Overflow** The Loamy Overflow ecological site is often found adjacent to or near the Closed Depression site on a higher landscape position.

Similar sites

R066XY046NE	**Subirrigated** The Subirrigated ecological site is influenced by a water table within twenty to thirty-six inches but is not subject to ponding and is not located within a closed basin.
R066XY044NE	**Wet Land** The Wet Land ecological site is influenced by a water table within twenty inches of the surface. Wet Land sites may be located on swales but not located within closed basins.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Eleocharis palustris*

Physiographic features

This site occurs on upland depressions which are closed or without natural drainage. This site receives run-in water from areas higher on the landscape.

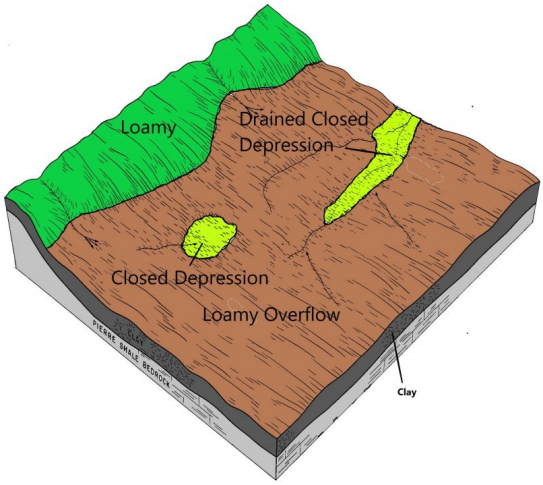


Figure 2. Block diagram

Table 2. Representative physiographic features

Landforms	(1) Upland > Closed depression (2) Tableland > Playa
Runoff class	Negligible
Flooding frequency	None

Ponding duration	Long (7 to 30 days)
Ponding frequency	Frequent
Elevation	579–914 m
Slope	0–1%
Ponding depth	15–30 cm
Water table depth	0–46 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 66 is considered to have a continental climate characterized by 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 this area's climate. Hourly winds average about 10 miles per hour annually, ranging from about 11 miles per hour during the spring to about 9 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)	113-126 days
Freeze-free period (characteristic range)	133-148 days
Precipitation total (characteristic range)	533-635 mm
Frost-free period (actual range)	98-128 days
Freeze-free period (actual range)	122-153 days
Precipitation total (actual range)	508-686 mm
Frost-free period (average)	117 days
Freeze-free period (average)	139 days
Precipitation total (average)	610 mm

Climate stations used

- (1) MARTIN 5 E [USC00395285], Martin, SD
- (2) HARRINGTON [USC00393574], Tuthill, SD
- (3) KILGORE 1NE [USC00254432], Kilgore, NE
- (4) MISSION 14 S [USC00395638], Mission, SD
- (5) MISSION [USC00395620], Mission, SD
- (6) WINNER [USC00399367], Winner, SD
- (7) GREGORY [USC00393452], Gregory, SD
- (8) FAIRFAX #2 [USC00392822], Fairfax, SD
- (9) BUTTE [USC00251365], Butte, NE

- (10) LYNCH [USC00255040], Lynch, NE
- (11) O NEILL [USC00256290], Oneill, NE
- (12) ATKINSON 3SW [USC00250420], Atkinson, NE
- (13) EWING [USC00252805], Ewing, NE
- (14) NIOBRARA [USC00255960], Niobrara, NE

Influencing water features

This site is a perched wet site, but due to restrictive soil layers, the hydrology functions independently of the water table.

Wetland description

Wetland Description: System Subsystem Class Sub-class
Cowardin, et al., 1979 Palustrine N/A Emergent Wetland Persistent

Soil features

The Closed Depression ecological site occurs on very deep, very poorly and poorly drained soils formed in clayey alluvium in closed basins on uplands. They have silt loam, silty clay to clay textured surface layers underlain by a very clayey subsoil layer which restricts internal drainage. Water perches on this layer and may even pond over the soil surface following large precipitation and run-in events during spring thaw. The soils crack when dry. When wet, heavy traffic can cause surface compaction.

This site should show no evidence of rills, wind scoured areas or pedestalled plants. Water flow paths are typically non-existent, or if present, appear broken and irregular in appearance or discontinuous with numerous debris dams or vegetative barriers. The soil surface is stable and intact.

The soil series correlated to this site are Bonesteel, Kolls, Lute, and Scott. 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).

Table 4. Representative soil features

Parent material	(1) Loess (2) Alluvium
Surface texture	(1) Silt loam (2) Silty clay (3) Clay
Family particle size	(1) Clayey
Drainage class	Very poorly drained to poorly drained
Permeability class	Very slow to moderate
Soil depth	152–203 cm
Surface fragment cover <=3"	0%
Available water capacity (Depth not specified)	8.38–18.8 cm
Calcium carbonate equivalent (Depth not specified)	0–10%
Electrical conductivity (Depth not specified)	0–4 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–20
Soil reaction (1:1 water) (Depth not specified)	5.1–8.4

Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

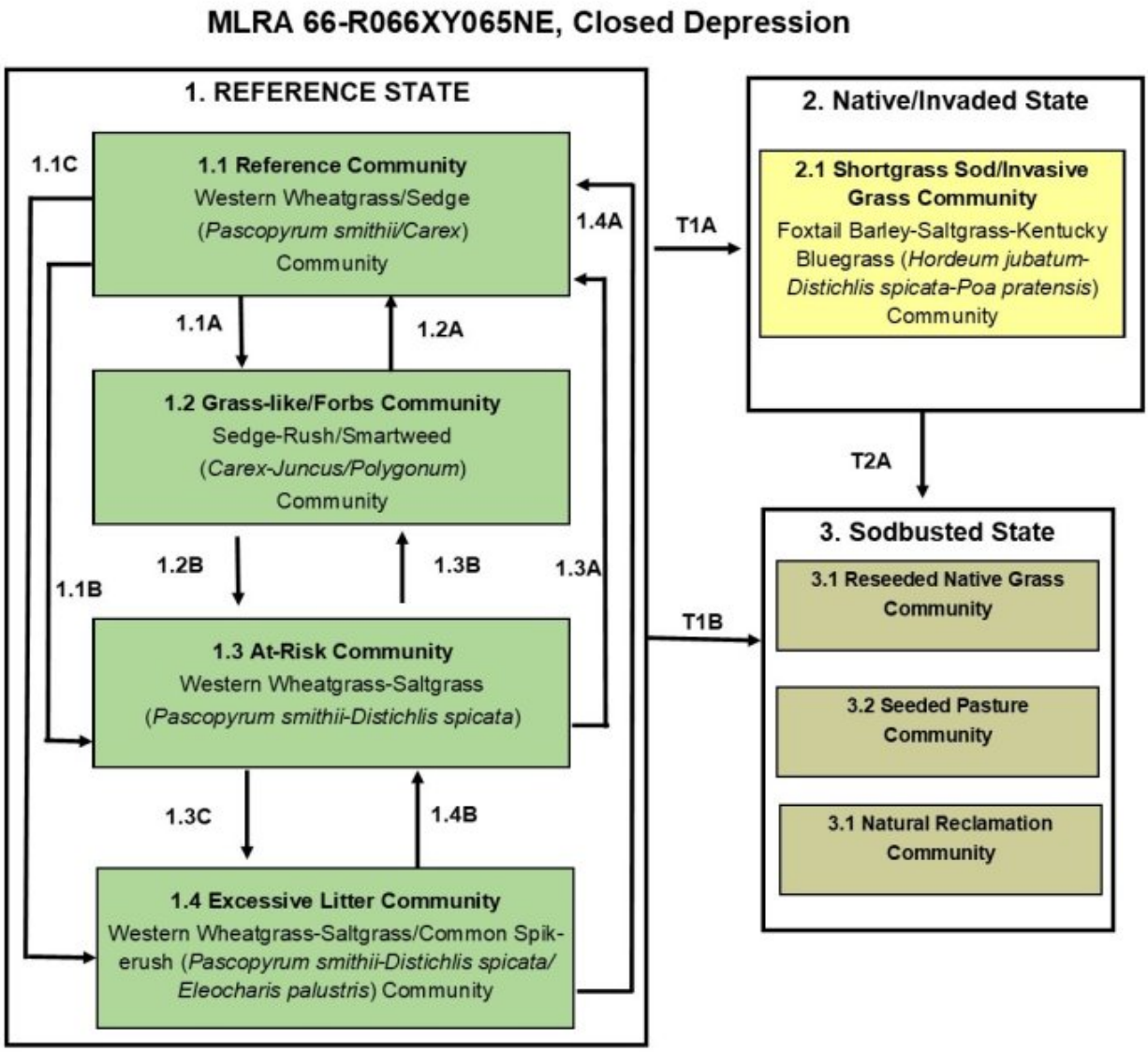
The Closed Depression ecological site developed under Northern Great Plains climatic conditions, natural influences of large herbivores, occasional fire, and other biotic and abiotic factors that typically influence soil and site development. Changes will occur in the plant communities due to short-term weather variations, impacts of native and exotic plant and animal species, and management actions. While the following plant community descriptions describe the more typical transitions between communities, severe disturbances, such as extended periods of well-below or well-above average precipitation, can cause significant shifts in plant communities and species composition.

This site is very sensitive to annual precipitation fluctuations. With above average precipitation, the site becomes very wet, leading to a much different plant community than what would be present with average to below average precipitation. In dry years, the plant community is dominated by grasses and grass-likes. In wetter years, the plant community fluctuates to one dominated by grass-likes and forbs. The two plant communities are influenced strongly by precipitation alone and together make up the natural complex of what could be considered the historic plant community.

The State and Transition Model (STM) is depicted below and includes a Reference State (1), a Native/Invaded Grass State (2), and a Sodbusted State (3). Each state represents the crossing of a major ecological threshold due to the alteration of the functional dynamic properties of the ecosystem. The primary properties observed to determine this change are soil stability, vegetative communities, and the hydrologic cycle. Each state may have one or more plant communities that fluctuate in species composition and abundance within the normal parameters of the state. Within each state, communities may degrade or recover in response to natural and man caused disturbances such as variation in the degree and timing of herbivory, presence or absence of fire, and climatic and local fluctuations in the precipitation regime. The processes that cause the movement between the states and communities are discussed in more detail in the state and community descriptions following the diagram.

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

State and transition model



Transitions and Restorations:
T1A: Heavy, continuous grazing or haying with inadequate recovery periods.
T1B: Tillage to facilitate production agriculture.
T2A: Tillage to facilitate production agriculture.

Community Pathways:
1.1A: High precipitation following extended dry cycle.
1.1B: Heavy, continuous grazing.
1.1C: Prolonged (>5 years) absence of herbivory and fire.
1.2A: Return to average or below precipitation.
1.2B: Return to average or above precipitation with heavy, continuous grazing.
1.3A: Prescribed grazing with adequate growing season recovery periods.
1.3B: High precipitation following extended dry cycle.
1.3C: Prolonged absence (> 5 years) of herbivory and fire.
1.4A: Prescribed grazing, prescribed burning.
1.4B: Prescribed grazing, prescribed burning.

Figure 9. State and Transition Model Diagram. MLRA 66, Closed Depression Ecological Site.

State 1
Reference State

The Reference State (1) describes the range of vegetative communities that occur on the Closed Depression ecological site where the range of natural variability under historic conditions and disturbance regimes is mostly intact. High perennial grass cover and production allows for increased vegetative production and overall soil quality. The Reference State includes four plant community phases which are the Reference or Western Wheatgrass (*Pascopyrum smithii*) Community (1.1), the Grass-like/Forb or Sedge-Rush/Smartweed (Carex-Juncus/Polygonum) Community (1.2), the At-Risk or Western Wheatgrass-Saltgrass (*Pascopyrum smithii-Distichlis spicata*) Community (1.3), and the Excessive Litter or Western Wheatgrass/Common Spikerush (*Pascopyrum smithii*/*Eleocharis palustris*) Community (1.4). The Reference Community is a representation of the native plant community phase that occupies a site that has been minimally altered by management and which occurs during a drier weather cycle while the Grass-like/Forb Community also represents the native plant community phase that has been minimally altered by management but which occurs during a wetter weather cycle. Degraded Native Grass and Excessive Litter Communities result from management decisions that are unfavorable for a healthy Reference Community.

Dominant plant species

- western wheatgrass (*Pascopyrum smithii*), grass
- slender wheatgrass (*Elymus trachycaulus*), grass
- Nuttall's alkaligrass (*Puccinellia nuttalliana*), grass
- foxtail barley (*Hordeum jubatum*), grass
- saltgrass (*Distichlis spicata*), grass
- Pursh seepweed (*Suaeda calceoliformis*), other herbaceous
- knotweed (*Polygonum*), other herbaceous
- Pennsylvania smartweed (*Polygonum pensylvanicum*), other herbaceous

Community 1.1
Reference Community

Interpretations are based primarily on the Reference or Western Wheatgrass/Sedge (*Pascopyrum smithii*/Carex) Community. This plant community evolved with grazing by large herbivores and occasional fire, and can be maintained with prescribed grazing, prescribed burning, or areas receiving occasional short periods of rest or deferment. In addition to grazing and fire, periodic ponding and drying were large factors in the development of this community. Following several years of average precipitation with shorter ponding intervals the plant community becomes dominated with perennial grasses such as western wheatgrass. Other grasses and grass-likes present include Nuttall’s alkaligrass, slender wheatgrass, sedges, and rushes. The occurrence of forbs will be considerably lower than those present during and after prolonged periods of ponding. Common forbs include American licorice, curlytop knotweed, Pennsylvania smartweed, Pursh seepweed, and western dock. The plant community is made up of 75 to 85 percent grasses and grass-likes, and 15 to 25 percent forbs.

Dominant plant species

- western wheatgrass (*Pascopyrum smithii*), grass
- Nuttall's alkaligrass (*Puccinellia nuttalliana*), grass
- sedge (*Carex*), other herbaceous
- rush (*Juncus*), other herbaceous
- spikerush (*Eleocharis*), other herbaceous
- American licorice (*Glycyrrhiza lepidota*), other herbaceous
- curlytop knotweed (*Polygonum lapathifolium*), other herbaceous
- pale dock (*Rumex altissimus*), other herbaceous

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2068	2647	3419
Forb	174	1276	1625
Total	**2242**	**3923**	**5044**

Figure 11. Plant community growth curve (percent production by month).

NE6634, Eroded Tableland, cool-season dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	15	28	30	10	2	5	5	0	0

Community 1.2
Grass-like/Forbs Community

The Grass-likes/Forbs or Sedge-Rush/Smartweed (Carex-Juncus/Polygonum) Community (1.2) occurs with a period of higher precipitation that follows an extended dry cycle. Grasses and grass-likes commonly occurring include sedge, spikerush, rush, foxtail barley, western wheatgrass, and bluegrasses. The forbs commonly found include western dock, mint, Pursh seepweed, lambsquarters, curlytop knotweed, evening-primrose, buttercup, and New England aster. The plant community is made up of about 5 to10 percent grasses, 30 to 40 percent grass-likes, and about 50 to 60 percent forbs.

Dominant plant species

- western wheatgrass (*Pascopyrum smithii*), grass
- sedge (*Carex*), other herbaceous
- rush (*Juncus*), other herbaceous
- common spikerush (*Eleocharis palustris*), other herbaceous
- needle spikerush (*Eleocharis acicularis*), other herbaceous
- curlytop knotweed (*Polygonum lapathifolium*), other herbaceous
- Pennsylvania smartweed (*Polygonum pensylvanicum*), other herbaceous
- pale dock (*Rumex altissimus*), other herbaceous

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1569	1973	2102
Forb	112	493	1037
Total	**1681**	**2466**	**3139**

Figure 13. Plant community growth curve (percent production by month). NE6634, Eroded Tableland, cool-season dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	15	28	30	10	2	5	5	0	0

Community 1.3
At-Risk Community

The At-Risk or Western Wheatgrass-Saltgrass (*Pascopyrum smithii-Distichlis spicata*) Community (1.3) is the result of heavy continuous grazing. Repeated defoliation depletes stored carbohydrates, resulting in weakening and eventual death of the most palatable grasses. Reduced plant vigor and lack of litter result in higher soil temperatures, poor water infiltration rates, high evapotranspiration, increased percolation of the high water table, and an increase in salt concentrations on the surface. Inland saltgrass and other salt tolerant species gain a competitive advantage over less tolerant species. Saltgrass and western wheatgrass are the dominant species. Secondary species include cool-season grasses and grass-likes, such as Nuttall’s alkaligrass, plains bluegrass, common spikerush, needle spikerush, and other sedges and rushes. Cool-season grasses including foxtail barley and fowl bluegrass have increased. Kentucky bluegrass, curly dock, and cocklebur may begin to invade the site. Common forbs include lambsquarters, Pennsylvania smartweed, curlytop knotweed, plantain, and povertyweed. This plant community is relatively stable and well adapted to increased salinity. Plant vigor, litter, frequency and production have decreased. The biotic integrity, hydrologic function, and nutrient cycles are becoming impaired. This plant community is less productive than the Reference Community (1.1).

Dominant plant species

- western wheatgrass (*Pascopyrum smithii*), grass
- saltgrass (*Distichlis spicata*), grass

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1569	1973	2102
Forb	112	493	1037
Total	**1681**	**2466**	**3139**

Community 1.4
Excessive Litter Community

The Excessive Litter Community (1.4) develops when the natural disturbances of livestock grazing and fire have been removed from the land for a prolonged period of time (more than five years). 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 the plants 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

- western wheatgrass (*Pascopyrum smithii*), grass
- saltgrass (*Distichlis spicata*), grass
- common spikerush (*Eleocharis palustris*), other herbaceous
- American licorice (*Glycyrrhiza lepidota*), other herbaceous
- curlytop knotweed (*Polygonum lapathifolium*), other herbaceous
- Pennsylvania smartweed (*Polygonum pensylvanicum*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

The Reference Community (1.1) will shift to the Grass-like/Forbs Community (1.2) when a period of high precipitation follows an extended dry cycle.

Pathway 1.1B
Community 1.1 to 1.3

Heavy continuous grazing will shift the Reference Community (1.1) to the At-Risk (1.3) Community.

Pathway 1.1C
Community 1.1 to 1.4

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

Pathway 1.2A
Community 1.2 to 1.1

The Grass-likes/Forbs Community (1.2) will return to the Reference Community (1.1) when the precipitation cycle returns to average or below with the accompanying reduction in both the frequency and depth of ponding, which favors native, perennial grasses.

Pathway 1.2B
Community 1.2 to 1.3

The Grass-likes/Forbs Community (1.2) will return to the At-Risk Community (1.3) with heavy, continuous grazing when the precipitation cycle returns to average or below with the accompanying reduction in both the frequency and depth of ponding, which favors grasses rather than grass-likes and forbs.

Pathway 1.3A
Community 1.3 to 1.1

Grazing management that includes moderate stocking rates and adequate, growing-season recovery periods will return the At-Risk Community (1.3) to the Reference Community (1.1).

Pathway 1.3B
Community 1.3 to 1.2

The At-Risk Community (1.3) will shift to the Grass-like/Forbs Community (1.2) when a period of high precipitation follows an extended dry cycle.

Pathway 1.3C
Community 1.3 to 1.4

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

Pathway 1.4A
Community 1.4 to 1.1

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

Pathway 1.4B
Community 1.4 to 1.3

Reintroduction of the natural processes of fire and herbivory will return the Excessive Litter Community (1.4) to the At-Risk Community (1.3).

State 2
Native/Invaded Grass State

The Native/Invaded Grass State (2) has transitioned from the Reference State (1) and much of the native cool-season midgrass and grass-like components have been replaced by warm-season shortgrass and introduced cool-season grasses, resulting in negative impacts on energy flow and nutrient cycling. Water infiltration is reduced due to the shallow root system and rapid runoff characteristics of the shortgrass sod community. The Native/Invaded Grass State (2) includes the Shortgrass Sod/Invasive Grass Community (2.1).

Dominant plant species

- saltgrass (*Distichlis spicata*), grass
- foxtail barley (*Hordeum jubatum*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- curlytop knotweed (*Polygonum lapathifolium*), other herbaceous
- Pennsylvania smartweed (*Polygonum pensylvanicum*), other herbaceous
- povertyweed (*Iva axillaris*), other herbaceous

Community 2.1
Shortgrass Sod/Invasive Grass Community

The Shortgrass Sod/Invasive Grass or Foxtail Barley-Saltgrass-Kentucky Bluegrass (*Hordeum jubatum-Distichlis spicata-Poa pratensis*) Community (2.1) develops with heavy continuous grazing. Patches of saltgrass sod are typical. Foxtail barley and fowl bluegrass are well distributed throughout the community. Nuttall's alkaligrass and western wheatgrass have been greatly reduced and typically occur only as remnant populations. This plant community is resistant to change due to the grazing tolerance of inland saltgrass and increased surface salts. A significant amount of production and diversity has been lost when compared to the Reference Community (1.1). Loss of key cool-season grasses and increased bare ground have negatively impacted energy flow and nutrient cycling. Water infiltration is reduced significantly due to the massive shallow root system and "root pan", characteristic of inland saltgrass. Due to the changes in soil stability and hydrologic function, as well as the loss of plant diversity, return to the Reference State (1) is unlikely. Renovation (seeding, mechanical, and chemical inputs) is not recommended due to the high salinity of the surface soil and saltgrass persistence.

Dominant plant species

- saltgrass (*Distichlis spicata*), grass
- foxtail barley (*Hordeum jubatum*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- curlytop knotweed (*Polygonum lapathifolium*), other herbaceous
- Pennsylvania smartweed (*Polygonum pensylvanicum*), other herbaceous
- povertyweed (*Iva axillaris*), other herbaceous

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	835	1143	1631
Forb	62	202	387
Total	**897**	**1345**	**2018**

Figure 16. Plant community growth curve (percent production by month). NE6634, Eroded Tableland, cool-season dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	15	28	30	10	2	5	5	0	0

State 3
Sodbusted State

The threshold to the Sodbusted State (3) 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 (3.1), be seeded to a tame pasture forage mixture resulting in the Seeded Pasture Community (3.2) or be abandoned with no seeding which will result in the Natural Reclamation Community (3.3). Permanent alterations of the soil 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 3.1
Reseeded Native Grass Community

The Reseeded Native Grass Community (3.1) does not contain native remnants, and varies considerably depending upon the seed mixture, the degree of soil erosion, the age of the stand, fertility management, and past grazing management. If management of the site before and during crop production resulted in elevated salinity levels in the soil surface, successful reseeding will be difficult. Native range and grasslands seeded to native species are ecologically different and should be managed separately. Factors such as functional group, species, stand density, and improved varieties all impact the production level and palatability of the seedings. Species diversity is often limited, and when grazed in conjunction with native rangelands, uneven forage utilization may occur. Total annual production during an average year varies significantly depending upon precipitation, management, and grass species seeded. Prescribed grazing including appropriate utilization levels, adequate growing-season recovery

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

Community 3.2
Seeded Pasture Community

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

Community 3.3
Natural Reclamation Community

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

Transition T1A
State 1 to 2

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

Transition T1B
State 1 to 3

The Reference State (1) is significantly altered by tillage to facilitate production agriculture. The disruption to the plant community, the soil and the hydrologic cycle make restoration to a true Reference State unlikely.

Transition T2A
State 2 to 3

The Native/Invaded State (2) is significantly altered by tillage to facilitate production agriculture. The disruption to the plant community, the soil and the hydrologic cycle make restoration unlikely.

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Rhizomatous Grass**			785–3335	
	western wheatgrass	PASM	*Pascopyrum smithii*	785–3335	–
2	**Cool-Season Bunchgrass**			196–1765	
	foxtail barley	HOJU	*Hordeum jubatum*	78–1373	–
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	78–588	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–196	–
	plains bluegrass	POAR3	*Poa arida*	39–196	–
	fowl bluegrass	POPA2	*Poa palustris*	39–196	–
	Grass, perennial	2GP	*Grass, perennial*	0–196	–
3	**Warm-Season Shortgrass**			39–392	
	saltgrass	DISP	*Distichlis spicata*	39–392	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–196	–
	Grass, perennial	2GP	*Grass, perennial*	0–196	–
4	**Grass-Like**			392–1765	
	common spikerush	ELPA3	*Eleocharis palustris*	196–1569	–
	needle spikerush	ELAC	*Eleocharis acicularis*	39–588	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–392	–
	sedge	CAREX	*Carex*	78–392	–
	rush	JUNCU	*Juncus*	0–196	–
Forb					
5	**Forb**			196–2354	
	American licorice	GLLE3	*Glycyrrhiza lepidota*	39–118	–
	curlytop knotweed	POLA4	*Polygonum lapathifolium*	39–118	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	39–118	–
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	39–118	–
	western dock	RUAQ	*Rumex aquaticus*	39–118	–
	Forb, perennial	2FP	*Forb, perennial*	0–118	–
	Forb, annual	2FA	*Forb, annual*	0–118	–
	mint	MENTH	*Mentha*	0–118	–
	creeping woodsorrel	OXCO	*Oxalis corniculata*	0–39	–
	mealy goosefoot	CHIN2	*Chenopodium incanum*	0–39	–
	evening primrose	OENOT	*Oenothera*	0–39	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–39	–
	pale dock	RUAL4	*Rumex altissimus*	0–39	–

Table 10. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Rhizomatous Grass**			370–986	
	western wheatgrass	PASM	*Pascopyrum smithii*	370–986	–

2	**Cool-Season Bunchgrass**			123–493	
	foxtail barley	HOJU	*Hordeum jubatum*	74–370	–
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	25–247	–
	plains bluegrass	POAR3	*Poa arida*	0–74	–
	fowl bluegrass	POPA2	*Poa palustris*	0–74	–
	Grass, perennial	2GP	*Grass, perennial*	0–49	–
3	**Warm-Season Shortgrass**			247–986	
	saltgrass	DISP	*Distichlis spicata*	247–986	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–74	–
	Grass, perennial	2GP	*Grass, perennial*	0–49	–
4	**Grass-Like**			123–616	
	common spikerush	ELPA3	*Eleocharis palustris*	49–370	–
	sedge	CAREX	*Carex*	0–197	–
	rush	JUNCU	*Juncus*	0–123	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–123	–
	needle spikerush	ELAC	*Eleocharis acicularis*	0–123	–
5	**Non-Native Cool-Season Grass**			25–247	
	Kentucky bluegrass	POPR	*Poa pratensis*	0–247	–
	cheatgrass	BRTE	*Bromus tectorum*	25–123	–
Forb					
6	**Forb**			123–863	
	curlytop knotweed	POLA4	*Polygonum lapathifolium*	49–247	–
	lambsquarters	CHAL7	*Chenopodium album*	49–247	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	0–247	–
	Forb, introduced	2FI	*Forb, introduced*	0–247	–
	Forb, native	2FN	*Forb, native*	0–123	–
	plantain	PLANT	*Plantago*	0–123	–
	povertyweed	IVAX	*Iva axillaris*	0–123	–
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	25–123	–
	cocklebur	XANTH2	*Xanthium*	0–123	–
	creeping woodsorrel	OXCO	*Oxalis corniculata*	0–123	–
	bushy knotweed	PORA3	*Polygonum ramosissimum*	0–123	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–74	–
	curly dock	RUCR	*Rumex crispus*	0–74	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–74	–
	mealy goosefoot	CHIN2	*Chenopodium incanum*	0–74	–
	evening primrose	OENOT	*Oenothera*	25–74	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–74	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–74	–
	New England aster	SYNO2	*Symphyotrichum novae-angliae*	25–74	–
	pale dock	RUAL4	*Rumex altissimus*	0–74	–
	western dock	RUAQ	*Rumex aquaticus*	25–74	–
	mint	MENTH	*Mentha*	25–49	–

	mint	MENTH	*Mentha*	25–49	
	buttercup	RANUN	*Ranunculus*	25–49	–
	cinquefoil	POTEN	*Potentilla*	0–25	–

Table 11. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Rhizomatous Grass**			370–986	
	western wheatgrass	PASM	*Pascopyrum smithii*	370–986	–
2	**Cool-Season Bunchgrass**			123–493	
	foxtail barley	HOJU	*Hordeum jubatum*	74–370	–
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	25–247	–
	plains bluegrass	POAR3	*Poa arida*	0–74	–
	fowl bluegrass	POPA2	*Poa palustris*	0–74	–
	Grass, perennial	2GP	*Grass, perennial*	0–74	–
3	**Warm-Season Shortgrass**			247–986	
	saltgrass	DISP	*Distichlis spicata*	247–986	–
	Grass, perennial	2GP	*Grass, perennial*	0–123	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–74	–
4	**Grass-like**			123–616	
	common spikerush	ELPA3	*Eleocharis palustris*	49–370	–
	sedge	CAREX	*Carex*	0–197	–
	rush	JUNCU	*Juncus*	0–123	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–123	–
	needle spikerush	ELAC	*Eleocharis acicularis*	0–123	–
5	**Non-Native Cool-Season Grass**			25–247	
	Kentucky bluegrass	POPR	*Poa pratensis*	0–247	–
	cheatgrass	BRTE	*Bromus tectorum*	25–123	–
Forb					
6	**Forb**			123–863	
	curlytop knotweed	POLA4	*Polygonum lapathifolium*	49–247	–
	lambsquarters	CHAL7	*Chenopodium album*	49–247	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	49–247	–
	Forb, introduced	2FI	*Forb, introduced*	0–247	–
	Forb, native	2FN	*Forb, native*	0–123	–
	plantain	PLANT	*Plantago*	49–123	–
	povertyweed	IVAX	*Iva axillaris*	49–123	–
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	0–123	–
	cocklebur	XANTH2	*Xanthium*	49–123	–
	creeping woodsorrel	OXCO	*Oxalis corniculata*	0–123	–
	bushy knotweed	PORA3	*Polygonum ramosissimum*	0–123	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–74	–
	curly dock	RUCR	*Rumex crispus*	49–74	–
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–74	–
	mealy goosefoot	CHIN2	*Chenopodium incanum*	0–74	–
	evening primrose	OENOT	*Oenothera*	0–74	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–74	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–74	–
	New England aster	SYNO2	*Symphyotrichum novae-angliae*	0–74	–
	pale dock	RUAL4	*Rumex altissimus*	0–74	–
	western dock	RUAQ	*Rumex aquaticus*	0–74	–
	cinquefoil	POTEN	*Potentilla*	0–74	–

Table 12. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Rhizomatous Grass**			0–67	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–67	–
2	**Cool-Season Bunchgrass**			269–673	
	foxtail barley	HOJU	*Hordeum jubatum*	269–673	–
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	0–40	–
	Grass, perennial	2GP	*Grass, perennial*	0–40	–
3	**Warm-Season Shortgrass**			135–538	
	saltgrass	DISP	*Distichlis spicata*	135–538	–
	Grass, perennial	2GP	*Grass, perennial*	0–40	–
4	**Grass-Likes**			67–269	
	common spikerush	ELPA3	*Eleocharis palustris*	27–202	–
	needle spikerush	ELAC	*Eleocharis acicularis*	0–67	–
	sedge	CAREX	*Carex*	0–67	–
	rush	JUNCU	*Juncus*	0–40	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–40	–
5	**Non-Native Cool-Season Grasses**			13–108	
	bluegrass	POA	*Poa*	0–67	–
	cheatgrass	BRTE	*Bromus tectorum*	13–67	–
Forb					
6	**Forbs**			67–336	
	lambsquarters	CHAL7	*Chenopodium album*	0–202	–
	curly dock	RUCR	*Rumex crispus*	0–135	–
	Forb, introduced	2FI	*Forb, introduced*	0–135	–
	Forb, native	2FN	*Forb, native*	0–67	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–67	–
	cocklebur	XANTH2	*Xanthium*	0–67	–
	creeping woodsorrel	OXCO	*Oxalis corniculata*	0–40	–
	bushy knotweed	PORA3	*Polygonum ramosissimum*	0–40	–
	curlytop knotweed	POLA4	*Polygonum lapathifolium*	0–40	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	0–40	–
	plantain	PLANT	*Plantago*	0–40	–
	povertyweed	IVAX	*Iva axillaris*	0–40	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–40	–
	mealy goosefoot	CHIN2	*Chenopodium incanum*	0–27	–
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	0–13	–

Animal community

LIVESTOCK - GRAZING INTERPRETATIONS:
Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide year-long forage for cattle, sheep, or horses. During the dormant period, the protein levels of the forage may be lower than the minimum needed to meet livestock (primarily cattle and sheep)requirements. The following table lists suggested stocking rates for cattle under continuous season-long grazing under normal growing

conditions. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity.

Production and Carrying Capacity*
Community 1.1, Reference Community: 3,500 lbs/acre, 0.96 AUM/acre
Community 1.2, Grass-likes/Forbs Community: 2,200 lbs/ac, 0.60 AUM/acre
Community 1.3, At-Risk Community: 2,200 lbs/ac, 0.60 AUM/acre
Community 2.1, Shortgrass Sod/Invasive Grass Community: 1,200 lbs/ac, 0.33 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.

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 D. Infiltration is very slow to slow and runoff potential is very 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 shortgrasses 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 Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

Rills, gullies, and water flow patterns are not present. Pedestals are only slightly present. Litter falls in place, and signs of movement are not common. Chemical and physical crusts are rare, and not significant for hydrologic considerations. Cryptogamic crusts may be present but are not significant for hydrologic considerations. Overall, this site has the appearance of being stable and productive except areas of white crust (salts) may be present.

Recreational uses

This site provides hunting opportunities for upland game species. The wide variety of plants which bloom from spring until fall have an esthetic 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)
Neligh, (Antelope)
O'Neill, (Holt)
Valentine, (Cherry)

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

Inventory data references

Information presented here has been derived from NRCS clipping data, other inventory data, and field observations from range trained personnel. Those involved in developing this site include Wayne Bachman, Soil Scientist, NRCS; Stan Boltz, Range Management Specialist, NRCS; Anna Ferguson, Soil Conservationist, NRCS; Roger Hammer, Soil Scientist, NRCS; Dana Larsen, Range Management Specialist, NRCS; Dave Schmidt, Rangeland Management Specialist, NRCS; Kim Stine, Rangeland Management Specialist, NRCS.

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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.

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Date	11/18/2024
Approved by	Suzanne Mayne-Kinney
Approval date	

Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is typically 5 percent or less. After prolonged periods of ponding, bare ground may approach 35 percent with patch sizes of 12 to 18 inches (30 to 45 cm).

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

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

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

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

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability ratings should typically be 4 to 6.

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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 3 to 14 inches (8 to 36 cm) thick. Soil is gray to light brownish gray, (values of 3 to 5) when dry and very dark gray, to black (values of 2 to 3) when moist. Structure ranges from moderate fine granular to moderate medium and coarse granular to weak fine subangular blocky..

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The functional/structural groups provide a combination of rooting depths and structure which positively influences infiltration. Combination of shallow and deep rooted species (mid & tall rhizomatous and tufted perennial cool-season grasses) with fine and coarse roots positively influences infiltration. Invasion of

introduced cool-season grasses such as annual bromes, Kentucky bluegrass, and smooth brome may have an adverse impact on infiltration and runoff. Woody encroachment may also negatively influence infiltration.

The expected composition of the plant community is 75 to 85 percent perennial grasses and grass-likes and 15 to 25 percent forbs. The perennial grass and grass-like component is made up of C3 rhizomatous grasses (20-85%); grass-likes (10-45%); C3, bunchgrasses (5-45%); and C4, shortgrasses (1-10%).

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. A compaction layer should not be present. When dry, the upper horizons can be hard and appear to be compacted, but no platy structure will be present. Heavy traffic (livestock or vehicular) when these soils are wet can produce a compaction layer.

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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, C3 rhizomatous grass, 700-2975 #/ac, 20-85% (1 species minimum): western wheatgrass.
2. Native forbs, 175-2100 #/ac, 5-60% (5 species minimum): American licorice, curlytop knotweed, Pennsylvania smartweed, Pursh seepweed, western dock and other species which vary from location to location.
3. Grass-likes, 350-1575 #/ac, 10-45% (3 species minimum): common spikerush, needle spikerush, sedges, rushes.
4. Native, perennial, C3 bunchgrass, 175-1575 #/ac, 5-45% (4 species minimum): foxtail barley, Nuttall's alkaligrass, slender wheatgrass, plains bluegrass, fowl bluegrass.

Phase 1.2
1. Native, perennial, C3 rhizomatous grass, 330-880 #/ac, 15-40% (1 species minimum): western wheatgrass.
2. Native, perennial, C4 shortgrass, 220-880 #/ac, 10-40% (1 species minimum): saltgrass, buffalograss.
3. Native forbs, 175-770 #/ac, 5-35% (8 species minimum): western dock, mint, Pursh seepweed, lambsquarters, curlytop knotweed, evening primrose, New England aster and other species that vary from location to location.
4. Grass-likes, 110-550 #/ac, 5 -25% (1 species minimum): common spikerush, needle spikerush, sedges, rushes.

Phase 1.3
1. Native, perennial, C3 rhizomatous grass, 330-880 #/ac, 15-40% (1 species minimum): western wheatgrass.
2. Native, perennial, C4 shortgrass, 220-880 #/ac, 10-40% (1 species minimum): saltgrass, buffalograss.
3. Forbs, 110-770 #/ac, 5-35% (7 species minimum): lambsquarters, Pennsylvania smartweed, curlytop knotweed, plantain, povertyweed, cocklebur, curly dock and other species that vary from location to location.
4. Grass-likes, 110-550 #/ac, 5 -25% (1 species minimum): common spikerush, needle spikerush, sedges, rushes.

Sub-dominant: Phase 1.2
1. Native, perennial, C3 bunchgrass, 110-440 #/ac, 5-20% (2 species minimum): foxtail barley, Nuttall's alkaligrass, slender wheatgrass, plains bluegrass, fowl bluegrass.

Phase 1.3
1. Native, perennial, C3 bunchgrass, 110-440 #/ac, 5-20% (2 species minimum): foxtail barley, Nuttall's alkaligrass, slender wheatgrass, plains bluegrass, fowl bluegrass.

Other: Minor - Phase 1.1
1. Native, perennial, C4 shortgrass, 35-350 #/ac, 1-10%: saltgrass, buffalograss.

Minor - Phase 1.2
1. Non-native, C3 grass, 22-220 #/ac, 1-10%: Kentucky bluegrass, cheatgrass

Minor - Phase 1.3
1. Non-native, C3 grass, 22-220 #/ac, 1-10%: Kentucky bluegrass, cheatgrass.

Additional: Reference Community (1.1) consists of five F/S groups. These groups are, in order of relative abundance, native, perennial, C3 rhizomatous grass; native forbs; grass-likes; native, perennial, C3 bunchgrass; native perennial, C4 shortgrass.

The Grass-like/Forbs Community (1.2) consists of six F/S groups which are in order of relative abundance native, perennial, C3 rhizomatous grass; native, perennial, C4 shortgrass; forbs; grass-likes; native, perennial, C3 bunchgrass; and non-native C3 grass.

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

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

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14. **Average percent litter cover (%) and depth (in):** Plant litter cover is evenly distributed throughout the site and is expected to be 55 to 80 percent and at a depth of 0.50 to 1.0 inch (1.25 to 2.6 cm).

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** The representative value (RV) for annual production is 3,500 pounds per acre on an air dry weight basis. Low and High production years should yield 2,000 and 4,500 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. Canada thistle, annual bromes, smooth brome, Kentucky bluegrass, curly dock, and cocklebur 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.
