USDA Natural Resources Conservation Service

Ecological site R063BY013SD
Claypan

Last updated: 9/27/2018
Accessed: 04/26/2024

General information

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

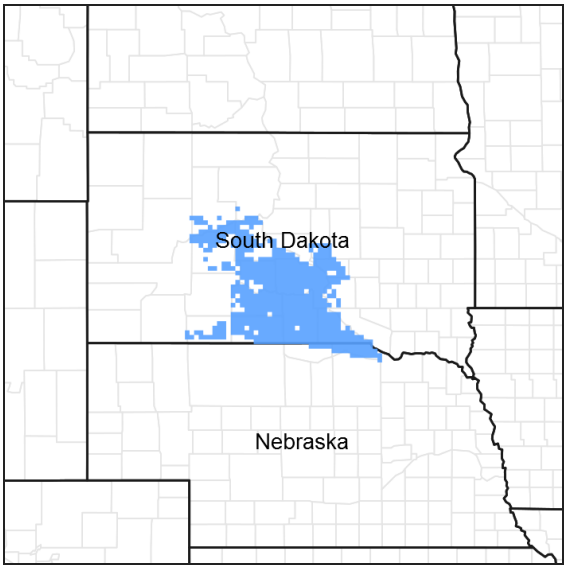


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 063B–Southern Rolling Pierre Shale Plains

MLRA Notes:
The Southern Rolling Pierre Shale Plains (MLRA 63B) is approximately 4,460 square miles in size. The majority of the MLRA is located in South Dakota (82 percent), and the remaining 18 percent is located in Nebraska. Interstate 90 crosses the northern portion through Chamberlin, SD. There are several Indian Reservations, including the Lower Brule, Crow Creek, Santee, and Yankton Reservations.
This MLRA is an area of old plateaus and terraces that have been deeply eroded, with nearly level to rolling long slopes and well-defined dendritic drainage systems. The rivers and creek valleys have smooth floors and steep walls. The majority of the MLRA is located in the unglaciated section of the Missouri Plateau, Great Plains Province. The northeast corner of the MLRA, east of the Missouri River, is located in the glaciated section with higher areas having deposits of glacial drift. The southwestern tip is located in the High Plains Section. Elevations range from 1,310 feet to 1,640 feet on the bottom lands along the Missouri River, and from 1,310 feet to 1,970 feet on the shale plains uplands.
The Missouri and Niobrara Rivers, and the confluence of the White and Missouri Rivers, occur within this MLRA. Lake Francis Case, Fort Randall Dam, and Lewis and Clark Lake are also within MLRA's borders.
Cretaceous Pierre Shale underlies most of the area. This is a marine sediment with layers of volcanic ash that has been altered to smectitic clays. These clays shrink as they dry and swell as they become wet, causing significant problems for road and structural foundations. Younger Niobrara chalk occurs in the southern part of the MLRA.

Alluvial sand and gravel underlie the valley floors along major streams.

Soils are shallow to very deep, generally well drained, and with loamy or clayey textures. Annual precipitation is 19 to 26 inches, mostly falling during the growing season, as frontal storms during the spring and convective thunderstorms in summer. The average annual temperature is 45°-50°F. The freeze-free period averages 165 days, and ranges from 145 to 185 days.

Vegetation is a transition between tall prairie grasses and mixed prairie grasses. Green needlegrass, porcupinegrass, western wheatgrass, and big bluestem are the major species. Little bluestem, buffalograss, sideoats grama, and sedges are dominant on the shallow soils. Buffaloberry, skunkbush sumac, and prairie rose are common on steep slopes along the major streams. Prairie cottonwood and a variety of willow species are common on flood plains along the major streams. Green ash, boxelder, chokecherry, bur oak, and buffaloberry occur in draws and narrow valleys. Encroachment of Rocky Mountain juniper and eastern redcedar on to the river breaks is becoming a concern.
The majority of the land is utilized for ranching (60 percent) and farming (27 percent). Major resource concerns for the area are wind erosion, water erosion, maintenance of the content of organic matter and soil productivity, and management of soil moisture.

Classification relationships

USDA - Land Resource Region G – Western Great Plains Range and Irrigated Region, Major Land Resource Area (MLRA) 63B – Southern Rolling Pierre Shale Plains (USDA-NRCS, Ag Handbook 296).

EPA - Level IV Ecoregions of the Continental United States:

Northwestern Glaciated Plains - 42f – Southern Missouri Coteau Slopes, 42g – Ponca Plains, 42h – Southern River Breaks, 42p – Holt Tablelands

North Western Great Plains - 43C – River Breaks, 43f – Subhumid Pierre Shale Plains, 43r – Niobrara River Breaks.

Ecological site concept

The Claypan sites occurs throughout the MLRA. It is located on gently undulating to rolling sedimentary uplands with slopes ranging from 0 to 4 percent. Soil are formed from soft siltstone, shales and alluvium. The soil surface texture is loam to silt loam, 4 to 12 inches thick, subsurface textures are silt loam to clay. The Btn horizon creates a claypan, of extremely hard sodium effected clay (natric) which occurs between 8 and 11 inches of the surface. This root restricting layer has round-topped or “biscuit-shaped” columnar structure. Vegetation in the Reference State consists primarily of cool-season rhizomatous wheatgrasses and needlegrasses, short, warm-season grasses and sedges. Prickly pear or brittle cactus are typically present in the plant community but in minor amounts.

Associated sites

R063BY010SD	**Loamy** The Loamy site can be located adjacent to the Claypan site.
R063BY011SD	**Clayey** The Clayey site can be found adjacent to the Claypan site.
R063BY021SD	**Clayey Overflow** The Clayey Overflow site can be found on drainageways adjacent to the Claypan site.
R063BY015SD	**Thin Claypan** The Thin Claypan site can be found adjacent to or intermixed with the Claypan site.

Similar sites

R063BY011SD	**Clayey** Clayey site will have more green needlegrass and higher production.

R063BY010SD	**Loamy** Loamy site will have big bluestem in the plant community and higher production.
R063BY015SD	**Thin Claypan** The Thin Claypan site will have more short gasses and lower production.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Nassella viridula*

Physiographic features

This site occurs on nearly level to gently sloping uplands.

Table 2. Representative physiographic features

Landforms	(1) Plain (2) Stream terrace (3) Flood plain
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	None to rare
Elevation	1,300–2,000 ft
Slope	1–4%
Water table depth	48–80 in
Aspect	Aspect is not a significant factor

Climatic features

MLRA 63B is considered to have a continental climate – cold winters and hot summers, low humidity, light rainfall, and ample 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 air masses move freely across the plains and account for rapid changes in temperature.

Annual precipitation typically ranges from 18 to 25 inches per year. The average annual temperature is about 48°F. January is the coldest month with average temperatures ranging from about 15°F (Stephan, SD), to about 22°F (Winner, SD). July is the warmest month with temperatures averaging from about 73°F (Stephan, SD), to about 76°F (Winner, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 56°F. This large annual range attests to the continental nature of this area's climate. Hourly winds are estimated to average about 11 miles per hour (mph) annually, ranging from about 13 mph during the spring to about 10 mph 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 mph.

Growth of cool-season plants begins in early to mid-March, slowing or ceasing in late June. Warm-season plants begin growth about mid-May and continue to early or mid-September. 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)	113-122 days
Freeze-free period (characteristic range)	130-154 days
Precipitation total (characteristic range)	21-24 in
Frost-free period (actual range)	110-126 days

Freeze-free period (actual range)	127-155 days
Precipitation total (actual range)	20-25 in
Frost-free period (average)	118 days
Freeze-free period (average)	141 days
Precipitation total (average)	23 in

Climate stations used

- (1) PICKSTOWN [USC00396574], Lake Andes, SD
- (2) STEPHAN 2 NW [USC00397992], Highmore, SD
- (3) WINNER [USC00399367], Winner, SD
- (4) LYNCH [USC00255040], Lynch, NE
- (5) NIOBRARA [USC00255960], Niobrara, NE
- (6) GANN VALLEY 4NW [USC00393217], Gann Valley, SD
- (7) WOOD [USC00399442], Wood, SD

Influencing water features

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

Soil features

The common features of soils in this site are loam, silt loam, or silty clay loam textured surface soils and slopes of 0 to 4 percent. The soils in this site are deep, moderately well to well-drained, and formed in alluvium or residuum derived from soft siltstone and shale. The surface layer is 4 to 12 inches thick and has moderate permeability and moderately high saturated hydraulic conductivity. About 5 to 15 inches below the surface, the soil abruptly changes to an extremely hard, clayey Btn horizon that has round-topped or “bun shaped” columnar structure. These Btn horizons are high in sodium and are restrictive to water movement and root penetration. The high sodium content decreases plant growth and productivity. Below the Btn horizons, the subsoil texture can be clay, clay loam, silty clay loam, or silty clay. Carbonates, gypsum, and other salts can also be present. Permeability is very slow and saturated hydraulic conductivity is very low or low in this layer. This site is not flooded or ponded but it may briefly hold water in the spring during snow melt or after heavy rains. Some soils have a zone of water saturation within a depth of 40 to 60 inches. Available water capacity ranges from moderate in the surface to low or very low in the subsoil.

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. These soils are mainly susceptible to water erosion. The hazard of water erosion increases where vegetation is diminished. Low available water capacity and very slow permeability strongly influences the soil-water-plant relationship.

Major soils correlated to the Claypan ecological site include: Carter, Mosher

Access Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm) for specific local soils information.

Table 4. Representative soil features

Parent material	(1) Alluvium–shale (2) Residuum–shale
Surface texture	(1) Silt loam (2) Silty clay loam
Family particle size	(1) Clayey
Drainage class	Moderately well drained to well drained

Permeability class	Very slow
Depth to restrictive layer	8–11 in
Soil depth	10–20 in
Available water capacity (0-40in)	3–5 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–16 mmhos/cm
Sodium adsorption ratio (0-40in)	5–20
Soil reaction (1:1 water) (0-40in)	5.6–9
Subsurface fragment volume <=3" (Depth not specified)	0–12%

Ecological dynamics

This site developed under Northern Great Plains climatic conditions, light to severe grazing by bison and other large herbivores, sporadic natural or man-caused wildfire (often of light intensities), and other biotic and abiotic factors that typically influence soil/site development. Changes will occur in the plant communities due to short-term weather variations, impacts of native and/or exotic plant and animal species, and management actions. While the following plant community descriptions specify more typical transitions between communities that will occur, severe disturbances, such as periods of well below average precipitation, and the introduction of non-native cool-season grasses can cause significant shifts in plant communities and/or species composition.

The plant community upon which interpretations are primarily based is the Western Wheatgrass-Green Needlegrass-Blue Grama Plant 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 also have been used.

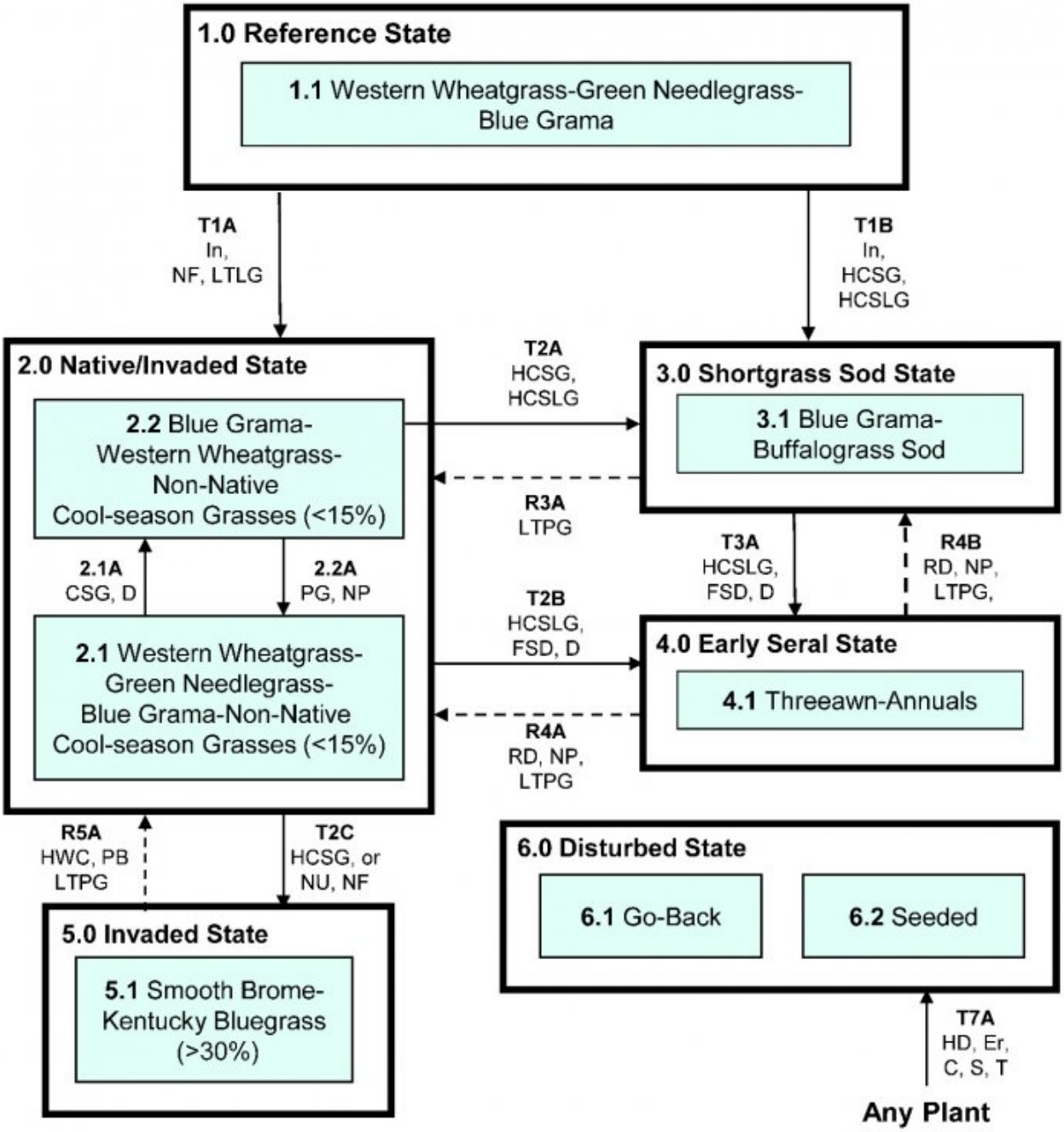
Heavy continuous season-long grazing (during the typical growing season of May through October) and/or repeated seasonal grazing (e.g., every spring, every summer) without adequate recovery periods following each grazing occurrence causes this site to depart from the Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community. Blue grama and buffalograss will increase and eventually develop into a sod. Western wheatgrass will increase initially and then begin to decrease. Green needlegrass will decrease in frequency and production.

The Reference State may be difficult to locate in this MLRA with the introduction of non-native cool-season grasses. Plant community phase 2.1 is most similar to the Reference Plant Community but because of the persistence of non-native cool-season grasses, a restoration pathway to the Reference State is not believed to be achievable.

The following is a diagram that illustrates the common plant community phases that can occur on the site and the transition pathways between communities. These are the most common plant community phases based on current knowledge and experience, and changes may be made as more data is collected. Narratives following the diagram contain more detail pertaining to the ecological processes.

State and transition model

Claypan – R063BY013SD 11/06/17



CSG – Continuous seasonal grazing
C – Cropping
D – Drought
Er – Eroded
FSD – Frequent and severe defoliation
HCSG – Heavy, continuous seasonal grazing
HCSLG – Heavy, continuous season-long grazing
HD – Heavy disturbance
HWC – Herbaceous weed control
In – Invasion of non-native cool-season grasses
LTLG – Long-term light grazing
LTPG – Long-term prescribed grazing
NF – No fire
NP – Normal precipitation
NU – No use
PB – Prescribed burning
PG – Prescribed grazing
RD – Removal of disturbance
S – Seeding
T – Tillage
– – ➤ Transition may not be rapid and/or feasible

Diagram Legend - Claypan - R063BY013SD	
T1A	Invasion and establishment of non-native cool-season grasses, no fire, long-term light grazing.
T1B	Invasion and establishment of non-native cool-season grasses, heavy, continuous seasonal grazing, or heavy, continuous season-long grazing.
T2A	Heavy, continuous seasonal grazing, or heavy, continuous season-long grazing.
T2B	Heavy, continuous season-long grazing, frequent and severe defoliation, drought.
T2C	Heavy, continuous seasonal grazing, or no use and no fire.
T3A	Heavy, continuous season-long grazing, frequent and severe defoliation, drought.
T7A	Heavy disturbance, soil erosion, cropping, tillage, seeding introduced grasses.
R3A	Long-term prescribed grazing. Transition may not be rapid or meet management goals.
R4A	Removal of grazing disturbance, long-term prescribed grazing, return to normal precipitation patterns. Transition may not be rapid or meet management goals.
R4B	Removal of grazing disturbance, long-term prescribed grazing, return to normal precipitation patterns. Transition may not be rapid or meet management goals.
R5A	Herbaceous weed control, prescribed burning, long-term prescribed grazing.
2.1A	Continuous seasonal grazing (spring), drought.
2.2A	Prescribed grazing, return to normal precipitation patterns following drought.

State 1
Reference State

This State represents the natural range of variability that dominated the dynamics of this ecological site. This state was dominated by cool-season grasses and subdominant short, warm-season grasses. In pre-European times, the primary disturbance mechanisms for this site in the Reference condition included fire and grazing by large herding ungulates. Timing of fires and grazing coupled with weather events dictated the dynamics that occurred within the natural range of variability. Cool-season grasses could decline and a corresponding increase in short, warm-season grasses would have occurred. The Reference State can be difficult to find in this MLRA with the introduction and spread of non-native cool-season grasses.

Community 1.1
Western Wheatgrass-Green Needlegrass-Blue Grama

Figure 8. Claypan - R063BY013SD - PCP 1.1.

Interpretations are based primarily on the Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community Phase (this is also considered to be Reference Plant Community 1.1). The potential vegetation was about 75 percent grasses or grass-like plants, 10 percent forbs, and 15 percent shrubs. The community was dominated by cool-season grasses with warm-season grasses being subdominant. The major grasses included western wheatgrass, green needlegrass, blue grama, needle and thread, and sideoats grama. Other grass or grass-like species included slender wheatgrass, porcupine grass, buffalograss, and sedges. This plant community was resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allowed for high drought tolerance. This was a sustainable plant community in regards to site/soil stability, watershed function, and biologic integrity.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1310	1650	1930
Shrub/Vine	95	200	345
Forb	95	150	225
Total	**1500**	**2000**	**2500**

Figure 10. Plant community growth curve (percent production by month). SD6302, Pierre Shale Plains, cool-season dominant, warm-season subdominant.. Cool-season dominant, warm-season subdominant, uplands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	23	34	15	6	5	4	0	0

State 2
Native/Invaded State

This State represents the more common range of variability that exists with higher levels of grazing management but in the absence of periodic fire followed by short-term intensive grazing. This State is dominated by native and non-native cool-season grasses, and native warm-season grasses. It can be found on areas that are properly managed with grazing and/or prescribed burning, and sometimes on areas receiving occasional short periods of rest. Native Cool-season species can decline and a corresponding increase in short, warm-season grasses or non-native cool-season grasses will occur.

Community 2.1
Western Wheatgrass-Green Needlegrass-Blue Grama-Non-Native Cool-Season Grasses (< 15%)

This plant community phase is similar to Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community (1.1), but it also contains minor amounts of non-native invasive grass species such as Kentucky bluegrass and smooth bromegrass (up to about 15 percent by air-dry weight). The potential vegetation is about 75 percent grasses or grass-like plants, 10 percent forbs, and 15 percent shrubs. The community is dominated by cool-season grasses with warm-season grasses being subdominant. The major grasses include western wheatgrass, green needlegrass, blue grama, needle and thread, and sideoats grama. Other grass or grass-like species include slender wheatgrass, porcupine grass, buffalograss, and sedges. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community in regards to site/soil stability, watershed function, and biologic integrity.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1310	1650	1930
Shrub/Vine	95	200	345
Forb	95	150	225
Total	**1500**	**2000**	**2500**

Figure 12. Plant community growth curve (percent production by month). SD6302, Pierre Shale Plains, cool-season dominant, warm-season subdominant.. Cool-season dominant, warm-season subdominant, uplands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	23	34	15	6	5	4	0	0

Community 2.2
Blue Grama-Western Wheatgrass-Non-Native Cool-Season Grasses (< 15%)

This plant community evolves under continuous seasonal grazing or from over utilization during extended drought periods. The potential plant community is made up of approximately 75 percent grasses and grass-like species, 10 percent forbs, and 15 percent shrubs. Dominant grass and grass-like species include blue grama, western wheatgrass, sedges, and buffalograss. Grasses of secondary importance include green needlegrass, needle and thread, inland saltgrass, and sideoats grama. Forbs commonly found in this plant community include cudweed sagewort, goldenrod, heath aster, scurfpea, and western yarrow. Dominant shrubs include brittle cactus, plains pricklypear, broom snakeweed, and fringed sagewort. When compared to the Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community (1.1), blue grama and buffalograss increase. Western wheatgrass, green needlegrass, and sideoats grama decrease, and production is also reduced. This plant community is moderately resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	950	1320	1545
Shrub/Vine	75	160	275
Forb	75	120	180
Total	**1100**	**1600**	**2000**

Figure 14. Plant community growth curve (percent production by month). SD6303, Pierre Shale Plains, cool/warm-season codominant.. Cool-season, warm-season codominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	20	28	21	10	5	3	0	0

Pathway 2.1A
Community 2.1 to 2.2

Continuous seasonal grazing which includes grazing at moderate to heavy stocking levels at the same time of year each year, or a combination of disturbances such as extended periods of below average precipitation coupled with periodic heavy grazing will shift this community to the Blue Grama-Western Wheatgrass-Non-Native Cool-Season Grasses (< 15%) Plant Community (2.2).

Pathway 2.2A
Community 2.2 to 2.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing possibly including periodic rest, and a return to normal precipitation patterns will convert this plant community to the Western Wheatgrass-Green Needlegrass-Blue grama-Non-Native Cool-Season Grasses (< 15%) Plant Community (2.1).

State 3
Shortgrass Sod State

The Shortgrass Sod State is dominated by shortgrass species and upland sedges. This State is the result of grazing patterns that do not provide adequate recovery time for cool-season wheatgrasses and needlegrasses. The hydrologic function of this site is dramatically altered. Runoff is high and infiltration is low. This State is very resistant to change through grazing management alone.

Community 3.1
Blue Grama-Buffalograss Sod

This plant community evolved under heavy, continuous season-long grazing or from over utilization during extended drought periods. The potential plant community is made up of approximately 70 percent grasses and grass-like species, 10 percent forbs, and 20 percent shrubs. Dominant grasses typically include blue grama and buffalograss. Kentucky bluegrass may also be present. Grass and grass-like species of secondary importance include sedge and western wheatgrass. Forbs commonly found in this plant community include cudweed sagewort, sweetclover, and western yarrow. Dominant shrubs include brittle cactus, fringed sagewort, plains pricklypear, and broom snakeweed. When compared to the Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community (1.1), blue grama and buffalograss are dominant on this plant community. Cool-season grasses have decreased significantly. This vegetation state is very resistant to change. The herbaceous species present are well adapted to grazing; however, composition can be altered through long-term prescribed grazing. This plant community is less productive than most other phases. The thick sod prevents other species from getting established. Lack of litter and reduced plant vigor causes higher soil temperatures, poor water infiltration rates, and high evapotranspiration which gives blue grama and other short, warm-season grasses a competitive advantage over most other grasses. Soil erosion will be minimal due to the sod forming habit of blue grama and buffalograss.

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	590	960	1295
Shrub/Vine	55	150	275
Forb	55	90	130
Total	**700**	**1200**	**1700**

Figure 16. Plant community growth curve (percent production by month). SD6305, Pierre Shale Plains, warm-season dominant.. Warm-season dominant, uplands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	5	15	25	30	15	7	1	0	0

State 4
Early Seral State

This State is the result of very heavy concentrated disturbance such as concentrated rodent activity, or livestock concentration. This State can also develop as a result of invasion by highly competitive weed species such as Canada thistle, hound’s tongue, leafy spurge, or knapweeds. Extended periods of drought accompanied by heavy grazing can also push an ‘At Risk’ Plant Community to this State. In most cases, this phase is dominated by pioneer perennial and annual grass and forb species. Bare ground is also much higher than on any other Plant Community phase.

Community 4.1
Threeawn-Annuals

This plant community developed under continuous heavy grazing or other excessive disturbances (e.g., heavy use areas, defoliation by rodents, etc.). The potential plant community is made up of approximately 60 percent grasses and grass-like species, 25 percent forbs, and 15 percent shrubs. The dominant grass is threeawn. Other grasses may include annual bromegrass (Japanese brome and downy brome), sedge, blue grama, Kentucky bluegrass, and western wheatgrass. The dominant forbs include sweetclover, western ragweed, cudweed sagewort, and other invader-like species. The dominant shrubs include fringed sagewort and cactus. Other plant species, from adjacent Ecological Sites, can become minor components of this plant community. This plant community is susceptible to invasion of Canada thistle and other non-native species because of the relatively high percent of bare ground. Compared to the Western Wheatgrass-Green Needlegrass-Blue Grama Plant Community (1.1), red threeawn, annual bromegrass, and percent of bare ground has increased. Western wheatgrass, needlegrasses, and other

cool-season grasses have decreased as have the warm-season species including sideoats grama. Plant diversity is low (plant richness may be high, but areas are often dominated by a few species). The ecological processes are difficult to restore because of the loss of plant diversity and overall soil disturbance. Soil erosion is potentially very high because of the bare ground and shallow rooted herbaceous plant community. Water runoff will increase and infiltration will decrease due to animal related soil compaction and loss of root mass due to low plant diversity and vigor. This plant community will require significant economic inputs and time to move towards another plant community. This movement is highly variable in its succession. This is due to the loss of diversity (including the loss of the seed bank), within the existing plant community, and the plant communities on adjacent sites. This community can be renovated to improve the production capability; however, if management changes are not made the vegetation could revert back to a Threeawn-Annual community.

Table 9. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Forb	55	105	1000
Grass/Grasslike	220	435	740
Shrub/Vine	25	60	95
Total	**300**	**600**	**1835**

Figure 18. Plant community growth curve (percent production by month). SD6303, Pierre Shale Plains, cool/warm-season codominant.. Cool-season, warm-season codominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	20	28	21	10	5	3	0	0

State 5
Invaded State

This State is the result of invasion and dominance of non-native cool-season grass species. This State is characterized by the dominance of smooth brome and/or Kentucky bluegrass. On upland sites, heavy grazing will tend to result in an increase of smooth bromegrass. Non-use and no fire will benefit Kentucky bluegrass due to an increasing thatch layer that effectively blocks the introduction of other plants into the system. Plant litter accumulation tends to favor the more shade tolerant introduced grass species. The nutrient cycle is impaired, and the result is typically a higher level of nitrogen which also favors the introduced species. Increasing plant litter decreases the amount of sunlight reaching plant crowns thereby shifting competitive advantage to shade tolerant, introduced grass species. Studies indicate that soil biological activity is altered, and this shift apparently exploits the soil microclimate and encourages growth of the introduced grass species. Once the threshold is crossed, a change in grazing management alone cannot cause a reduction in the invasive grass dominance. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community composition. Plant communities dominated by Kentucky bluegrass have significantly less cover and diversity of native grasses and forb species (Toledo, D. et al., 2014).

Community 5.1
Smooth Bromegrass-Kentucky Bluegrass (> 30%)

This Plant Community is a result of heavy, continuous seasonal grazing or non-use and no fire. It is characterized by a dominance of smooth bromegrass and Kentucky bluegrass. The dominance is at times so complete that other species are difficult to find on the site. This plant community is typically dominated by smooth bromegrass under grazing. Infiltration and runoff will be moderately reduced as will energy capture. Production can be equal to or higher than the Reference Plant Community (1.1), however the period that palatability is high is relatively short, as these cool-season species mature rapidly. With non-use and no fire this site will tend to be dominated by Kentucky bluegrass. A thick duff layer accumulates at or above the soil surface. Nutrient cycling is greatly reduced, and native plants have great difficulty becoming established. Infiltration is greatly reduced and runoff is high. Production in this case will likely be significantly less. In either case, the period that palatability is high is relatively short, as these

cool-season species mature rapidly.

Table 10. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1130	1760	1950
Shrub/Vine	35	120	225
Forb	35	120	225
Total	**1200**	**2000**	**2400**

Figure 20. Plant community growth curve (percent production by month). SD6301, Pierre Shale Plains, cool-season dominant.. Cool-season dominant on uplands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	4	12	25	36	10	5	4	4	0	0

State 6
Disturbed State

This State can be transition to from any Plant Community. The two separate vegetative Plant Communities are highly variable in nature. They are derived through different management scenarios, and are not related successionally. Infiltration, runoff, and soil erosion varies depending on the vegetation present on the site.

Community 6.1
Go-Back

The Go-back plant community can be reached whenever severe mechanical disturbance occurs (e.g., tilled and abandoned land, either past or present). During the early successional stages, the species that mainly dominate are annual grasses and forbs, later being replaced by both native and introduced perennials. The vegetation on this site varies greatly, sometimes being dominated by threeawn, bluegrass, smooth brome, annual bromegrass, broom snakeweed, sweetclover, and non-native thistles. Other plants that commonly occur on the site can include western wheatgrass, prickly lettuce, horseweed, kochia, foxtail, and sunflowers. Bare ground is prevalent due to the loss of organic matter and lower overall soil health.

Community 6.2
Seeded

The Seeded Plant Community is normally those areas seeded to pubescent or intermediate wheatgrass, alfalfa, switchgrass, or other forage species. For adapted species and expected production, refer to the USDA-NRCS eFOTG for the appropriate Forage Suitability Group description.

Transition T1A
State 1 to 2

Invasion of non-native grasses such as Kentucky bluegrass and smooth bromegrass, and disruption of natural disturbance regimes such as periodic fire followed by short-term high intensity grazing, or long-term light grazing will lead this plant community phase over a threshold to the Native/Invaded State (2.0).

Transition T1B
State 1 to 3

Heavy, continuous seasonal grazing (stocking levels well above carrying capacity for extended portions of the growing season and at the same time of year each year, typically beginning early in the season) or heavy, continuous season-long grazing will convert the Reference State (1.0) to the Shortgrass Sod State (3.0). In addition, invasion of non-native grasses such as Kentucky bluegrass and smooth bromegrass, and disruption of

natural disturbance regimes such as periodic fire followed by short-term high intensity grazing, will exacerbate this transition.

Transition T7A
State 1 to 6

Heavy disturbance including soil erosion, tillage, abandoned cropland, or seeding to improved pasture species result in a transition to the Disturbed State (6.0).

Transition T2A
State 2 to 3

Heavy, continuous seasonal grazing (stocking levels well above carrying capacity for extended portions of the growing season, and at the same time of year each year, typically beginning early in the season) or heavy, continuous season-long grazing will convert this plant community to the Shortgrass Sod State (3.0).

Transition T2B
State 2 to 4

Heavy, continuous season-long grazing or a combination of disturbances such as extended periods of below average precipitation coupled with frequent and severe defoliation will shift this community to the Early Seral State (4.0).

Transition T2C
State 2 to 5

Heavy, continuous seasonal grazing (stocking levels well above carrying capacity for extended portions of the growing season, and at the same time of year each year, typically beginning after early cool-season grasses have reached boot stage) or, non-use and no fire will likely lead this State over a threshold to the Invaded State (5.0).

Transition T7A
State 2 to 6

Heavy disturbance including soil erosion, tillage, abandoned cropland, or seeding to improved pasture species result in a transition to the Disturbed State (6.0).

Restoration pathway R3A
State 3 to 2

Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) may lead this plant community phase over a threshold to the Native/Invaded Grass State (2.0). This will likely take a long period of time, possibly up to 10 years or more, and recovery may not be attainable.

Conservation practices

Prescribed Grazing

Transition T3A
State 3 to 4

Heavy, continuous season-long grazing and/or frequent severe defoliation as a result of rodent occupation will likely move this plant community to the Early Seral State (4.0).

Transition T7A

State 3 to 6

Heavy disturbance including soil erosion, tillage, abandoned cropland, or seeding to improved pasture species result in a transition to the Disturbed State (6.0).

Restoration pathway R4A
State 4 to 2

Removal of disturbance in combination with long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) and a return to normal precipitation patterns may lead this plant community over a threshold to the Native/Invaded State (2.0). This will likely take a long period of time, possibly up to 10 years or more, and recovery may not be attainable. Depending on the slope, aspect, and size, and if adequate perennial plants exist, this change can occur more rapidly.

Restoration pathway R4
State 4 to 2

Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) may lead this plant community phase over a threshold to the 2.0 Native/Invasive Grass State. This will likely take a long period of time, possibly up to 10 years or more, and recovery may not be attainable. Depending on the slope, aspect, and size, and if adequate perennial plants exist, this change can occur more rapidly.

Conservation practices

Prescribed Grazing

Restoration pathway R4B
State 4 to 3

Removal of disturbance in combination with long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) and a return to normal precipitation patterns may lead this plant community over a threshold to the Shortgrass Sod State (3.0). This will likely take a long period of time, possibly up to 10 years or more, and recovery may not meet management goals.

Transition T7A
State 4 to 6

Heavy disturbance including soil erosion, tillage, abandoned cropland, or seeding to improved pasture species result in a transition to the Disturbed State (6.0).

Restoration pathway R5A
State 5 to 2

Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) may lead this plant community over a threshold to the Native/Invaded State (2.0). Herbaceous weed control (i.e., herbicide) and or prescribed burning may also be needed to suppress cool-season invasive grasses. This will likely take a long period of time, possibly up to 10 years or more, and recovery may not be attainable. Success depends on whether native reproductive propagules remain intact on the site.

Conservation practices

Prescribed Grazing

Transition T7A
State 5 to 6

Heavy disturbance including soil erosion, tillage, abandoned cropland, or seeding to improved pasture species result in a transition to the Disturbed State (6.0).

Additional community tables

Table 11. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			300–700	
	western wheatgrass	PASM	*Pascopyrum smithii*	300–700	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–100	–
2	**Cool-Season Bunchgrass**			200–600	
	green needlegrass	NAVI4	*Nassella viridula*	200–500	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	40–200	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–100	–
3	**Short Warm-Season Grasses**			100–300	
	blue grama	BOGR2	*Bouteloua gracilis*	100–200	–
	buffalograss	BODA2	*Bouteloua dactyloides*	20–100	–
	saltgrass	DISP	*Distichlis spicata*	20–60	–
	threeawn	ARIST	*Aristida*	20–40	–
4	**Tall Warm-Season Grasses**			40–200	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–200	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–200	–
5	**Other Native Grasses**			20–100	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–80	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	20–60	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–40	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–40	–
6	**Grass-Likes**			60–200	
	needleleaf sedge	CADU6	*Carex duriuscula*	40–160	–
	threadleaf sedge	CAFI	*Carex filifolia*	20–100	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–60	–
Forb					
8	**Forbs**			100–200	
	white sagebrush	ARLU	*Artemisia ludoviciana*	20–60	–
	Forb, native	2FN	*Forb, native*	20–60	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	20–40	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–40	–

	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	20–40	–
	tropical paspalum	PAPL2	*Paspalum pleostachyum*	20–40	–
	scurfpea	PSORA2	*Psoralidium*	20–40	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	20–40	–
	goldenrod	SOLID	*Solidago*	20–40	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	20–40	–
	white heath aster	SYER	*Symphyotrichum ericoides*	20–40	–
	American vetch	VIAM	*Vicia americana*	20–40	–
	deathcamas	ZIGAD	*Zigadenus*	0–20	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–20	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–20	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–20	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–20	–
	textile onion	ALTE	*Allium textile*	0–20	–
	pussytoes	ANTEN	*Antennaria*	0–20	–
	milkvetch	ASTRA	*Astragalus*	0–20	–
Shrub/Vine					
9	**Shrubs**			100–300	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–100	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–100	–
	prairie sagewort	ARFR4	*Artemisia frigida*	20–100	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	20–100	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	20–100	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–60	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–40	–

Table 12. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			300–600	
	western wheatgrass	PASM	*Pascopyrum smithii*	300–600	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–100	–
2	**Cool-Season Bunchgrass**			100–500	
	green needlegrass	NAVI4	*Nassella viridula*	100–400	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	40–100	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–100	–
3	**Short Warm-Season Grasses**			100–300	
	blue grama	BOGR2	*Bouteloua gracilis*	100–200	–
	buffalograss	BODA2	*Bouteloua dactyloides*	20–100	–
	saltgrass	DISP	*Distichlis spicata*	20–60	–
	threeawn	ARIST	*Aristida*	20–40	–
4	**Tall Warm-Season Grasses**			0–100	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–100	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–100	

	prairie sandreed	CALO	*Calamovilfa longifolia*	0–100	–
5	**Other Native Grasses**			20–100	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–80	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	20–60	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–40	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–40	–
6	**Grass-Likes**			60–200	
	needleleaf sedge	CADU6	*Carex duriuscula*	40–160	–
	threadleaf sedge	CAFI	*Carex filifolia*	20–100	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–60	–
7	**Non-Native Cool-Season Grasses**			100–300	
	smooth brome	BRIN2	*Bromus inermis*	60–300	–
	bluegrass	POA	*Poa*	20–200	–
	brome	BROMU	*Bromus*	20–60	–
Forb					
8	**Forbs**			100–200	
	white sagebrush	ARLU	*Artemisia ludoviciana*	20–60	–
	Forb, native	2FN	*Forb, native*	20–60	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	20–40	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–40	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	20–40	–
	tropical paspalum	PAPL2	*Paspalum pleostachyum*	20–40	–
	scurfpea	PSORA2	*Psoralidium*	20–40	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	20–40	–
	goldenrod	SOLID	*Solidago*	20–40	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	20–40	–
	white heath aster	SYER	*Symphyotrichum ericoides*	20–40	–
	American vetch	VIAM	*Vicia americana*	20–40	–
	deathcamas	ZIGAD	*Zigadenus*	0–20	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–20	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–20	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–20	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–20	–
	textile onion	ALTE	*Allium textile*	0–20	–
	pussytoes	ANTEN	*Antennaria*	0–20	–
	milkvetch	ASTRA	*Astragalus*	0–20	–
Shrub/Vine					
9	**Shrubs**			100–300	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–100	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–100	–
	prairie sagewort	ARFR4	*Artemisia frigida*	20–100	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	20–100	–

	plains pricklypear	OPPO	*Opuntia polyacantha*	20–100	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–60	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–40	–

Table 13. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			80–320	
	western wheatgrass	PASM	*Pascopyrum smithii*	80–320	–
2	**Cool-Season Bunchgrass**			16–160	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	16–160	–
	green needlegrass	NAVI4	*Nassella viridula*	0–160	–
3	**Short Warm-Season Grasses**			240–560	
	blue grama	BOGR2	*Bouteloua gracilis*	160–400	–
	buffalograss	BODA2	*Bouteloua dactyloides*	32–160	–
	saltgrass	DISP	*Distichlis spicata*	16–80	–
	threeawn	ARIST	*Aristida*	16–64	–
4	**Tall Warm-Season Grasses**			0–80	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–80	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–80	–
5	**Other Native Grasses**			16–80	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–80	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	16–48	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–32	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–32	–
6	**Grass-Likes**			80–240	
	needleleaf sedge	CADU6	*Carex duriuscula*	32–160	–
	threadleaf sedge	CAFI	*Carex filifolia*	16–112	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–48	–
7	**Non-Native Grasses**			32–160	
	brome	BROMU	*Bromus*	16–160	–
	Kentucky bluegrass	POPR	*Poa pratensis*	16–160	–
	smooth brome	BRIN2	*Bromus inermis*	0–80	–
Forb					
8	**Forbs**			80–160	
	white sagebrush	ARLU	*Artemisia ludoviciana*	16–64	–
	sweetclover	MELIL	*Melilotus*	0–64	–
	Forb, introduced	2FI	*Forb, introduced*	0–48	–
	Forb, native	2FN	*Forb, native*	16–48	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	16–48	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–32	–
	woolly plantain	PLPA2	*Plantago patagonica*	16–32	–

	scurfpea	PSORA2	*Psoralidium*	16–32	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–32	–
	yellow salsify	TRDU	*Tragopogon dubius*	0–32	–
	goldenrod	SOLID	*Solidago*	16–32	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	16–32	–
	white heath aster	SYER	*Symphyotrichum ericoides*	16–32	–
	common dandelion	TAOF	*Taraxacum officinale*	0–16	–
	American vetch	VIAM	*Vicia americana*	0–16	–
	deathcamas	ZIGAD	*Zigadenus*	0–16	–
	pepperweed	LEPID	*Lepidium*	0–16	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–16	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–16	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–16	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–16	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–16	–
	milkvetch	ASTRA	*Astragalus*	0–16	–
	textile onion	ALTE	*Allium textile*	0–16	–
	pussytoes	ANTEN	*Antennaria*	0–16	–
Shrub/Vine					
9	**Shrubs**			80–240	
	prairie sagewort	ARFR4	*Artemisia frigida*	16–112	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	16–112	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	16–80	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–64	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–64	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	16–48	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–32	–

Table 14. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			840–1080	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–60	–
2	**Cool-Season Bunchgrass**			0–36	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–24	–
	green needlegrass	NAVI4	*Nassella viridula*	0–12	–
3	**Short Warm-Season Grasses**			300–660	
	blue grama	BOGR2	*Bouteloua gracilis*	240–480	–
	buffalograss	BODA2	*Bouteloua dactyloides*	24–240	–
	threeawn	ARIST	*Aristida*	24–120	–
	saltgrass	DISP	*Distichlis spicata*	12–96	–
5	**Other Native Grasses**			12–60	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–60	–

	grass-like)				
	Sandberg bluegrass	POSE	*Poa secunda*	0–36	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–24	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	12–24	–
6	**Grass-Likes**			120–240	
	needleleaf sedge	CADU6	*Carex duriuscula*	60–180	–
	threadleaf sedge	CAFI	*Carex filifolia*	24–120	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–60	–
7	**Non-Native Grasses**			0–120	
	Kentucky bluegrass	POPR	*Poa pratensis*	0–120	–
	brome	BROMU	*Bromus*	0–60	–
Forb					
8	**Forbs**			60–120	
	sweetclover	MELIL	*Melilotus*	0–72	–
	Forb, introduced	2FI	*Forb, introduced*	0–60	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	12–48	–
	pepperweed	LEPID	*Lepidium*	0–36	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	12–36	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	12–36	–
	goldenrod	SOLID	*Solidago*	12–36	–
	yellow salsify	TRDU	*Tragopogon dubius*	0–36	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	12–24	–
	white heath aster	SYER	*Symphyotrichum ericoides*	12–24	–
	common dandelion	TAOF	*Taraxacum officinale*	0–24	–
	woolly plantain	PLPA2	*Plantago patagonica*	12–24	–
	scurfpea	PSORA2	*Psoralidium*	12–24	–
	Forb, native	2FN	*Forb, native*	0–24	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–16	–
	pussytoes	ANTEN	*Antennaria*	0–12	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–12	–
Shrub/Vine					
9	**Shrubs**			60–240	
	prairie sagewort	ARFR4	*Artemisia frigida*	12–108	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	12–96	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	12–84	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	12–60	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–36	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–36	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–12	–

Table 15. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					

Grass/Grasslike					
1	**Wheatgrass**			0–12	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–12	–
3	**Short Warm-Season Grasses**			150–300	
	threeawn	ARIST	*Aristida*	120–270	–
	blue grama	BOGR2	*Bouteloua gracilis*	6–60	–
	saltgrass	DISP	*Distichlis spicata*	6–60	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–18	–
5	**Other Native Grasses**			0–30	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–30	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–6	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–6	–
6	**Grass-Likes**			12–60	
	needleleaf sedge	CADU6	*Carex duriuscula*	6–48	–
	threadleaf sedge	CAFI	*Carex filifolia*	6–30	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–12	–
7	**Non-Native Grasses**			30–120	
	brome	BROMU	*Bromus*	30–90	–
	Kentucky bluegrass	POPR	*Poa pratensis*	6–60	–
Forb					
8	**Forbs**			60–150	
	Forb, introduced	2FI	*Forb, introduced*	30–90	–
	sweetclover	MELIL	*Melilotus*	0–48	–
	pepperweed	LEPID	*Lepidium*	0–42	–
	common dandelion	TAOF	*Taraxacum officinale*	0–30	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	6–18	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–16	–
	woolly plantain	PLPA2	*Plantago patagonica*	6–12	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	6–12	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–12	–
	goldenrod	SOLID	*Solidago*	0–12	–
	yellow salsify	TRDU	*Tragopogon dubius*	0–12	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–6	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–6	–
	Forb, native	2FN	*Forb, native*	0–6	–
	scurfpea	PSORA2	*Psoralidium*	0–6	–
Shrub/Vine					
9	**Shrubs**			30–90	
	brittle pricklypear	OPFR	*Opuntia fragilis*	12–60	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	6–48	–
	prairie sagewort	ARFR4	*Artemisia frigida*	6–30	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–12	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–12	–

Table 16. Community 5.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			0–60	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–60	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–20	–
2	**Cool-Season Bunchgrass**			0–160	
	green needlegrass	NAVI4	*Nassella viridula*	0–140	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–60	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–40	–
3	**Short Warm-Season Grasses**			0–140	
	threeawn	ARIST	*Aristida*	0–100	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–60	–
	saltgrass	DISP	*Distichlis spicata*	0–40	–
4	**Tall Warm-Season Grasses**			0–80	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–40	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–40	–
5	**Other Native Grasses**			0–100	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–100	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–20	–
6	**Grass-Likes**			0–60	
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–40	–
	needleleaf sedge	CADU6	*Carex duriuscula*	0–40	–
	threadleaf sedge	CAFI	*Carex filifolia*	0–40	–
7	**Non-Native Grasses**			800–1500	
	smooth brome	BRIN2	*Bromus inermis*	600–1400	–
	Kentucky bluegrass	POPR	*Poa pratensis*	300–700	–
	brome	BROMU	*Bromus*	100–300	–
Forb					
8	**Forbs**			40–200	
	sweetclover	MELIL	*Melilotus*	0–160	–
	common dandelion	TAOF	*Taraxacum officinale*	0–120	–
	Forb, introduced	2FI	*Forb, introduced*	0–100	–
	scurfpea	PSORA2	*Psoralidium*	20–80	–
	yellow salsify	TRDU	*Tragopogon dubius*	0–60	–
	pepperweed	LEPID	*Lepidium*	0–60	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	20–40	–
	Forb, native	2FN	*Forb, native*	0–40	–
	goldenrod	SOLID	*Solidago*	20–40	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–20	–

	white heath aster	SYER	*Symphyotrichum ericoides*	0–20	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–20	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–20	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–20	–
	textile onion	ALTE	*Allium textile*	0–20	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–20	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–20	–
Shrub/Vine					
9	**Shrubs**			40–200	
	prairie sagewort	ARFR4	*Artemisia frigida*	0–100	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–80	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–80	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–80	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–60	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–40	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–20	–

Animal community

Animal Community – Grazing Interpretations
The following table lists annual suggested initial stocking rates with average growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of conservation planning. Often, the current plant composition does not entirely match any particular plant community (as described in this Ecological Site Description). Therefore, a resource inventory is necessary to document plant composition and production. More accurate carrying capacity estimates should eventually be calculated using the following stocking rate information along with animal preference data and actual stocking records, 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.

Plant Community: Western Wheatgrass-Green Needlegrass-Blue Grama (1.1)
Average Annual Production (lbs./acre, air-dry): 2000
Stocking Rate (AUM/acre): 0.55

Plant Community: Western Wheatgrass-Green Needlegrass-Blue Grama-Non-Native Cool-Season Grasses (< 15%) (2.1)
Average Annual Production (lbs./acre, air-dry): 2000
Stocking Rate (AUM/acre): 0.55

Plant Community: Blue Grama-Western Wheatgrass-Non-Native Cool-Season Grasses (< 15%) (2.2)
Average Annual Production (lbs./acre, air-dry): 1600
Stocking Rate (AUM/acre): 0.44

Plant Community: Blue Grama-Buffalograss Sod (3.1)
Average Annual Production (lbs./acre, air-dry): 1200
Stocking Rate (AUM/acre): 0.33

Plant Community: Threeawn/Annuals (4.1)
Average Annual Production (lbs./acre, air-dry): 600
Stocking Rate (AUM/acre): 0.16

Plant Community: Smooth Bromegrass/Kentucky Bluegrass (5.1)
Average Annual Production (lbs./acre, air-dry): 2000
Stocking Rate (AUM/acre): 0.55

Based on 912 lbs./acre (air-dry weight) per Animal Unit Month (AUM), and on 25 percent harvest efficiency of preferred and desirable forage species (refer to USDA NRCS, National Range and Pasture Handbook).

Total annual production on-site may contain vegetation deemed undesirable or untargeted by the grazing animal. Therefore, AUM values may have been reduced to reflect only preferred or desirable forage species.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage. During the dormant period, the forage for livestock will likely be lacking protein to meet livestock requirements, and added protein will allow ruminants to better utilize the energy stored in grazed plant materials. A forage quality test (either directly or through fecal sampling) should be used to determine the level of supplementation needed.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group D. Infiltration and runoff potential for this site varies from moderate to high depending on soil hydrologic group, 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. Dominance by blue grama, buffalograss, bluegrass, and/or smooth bromegrass will result in reduced infiltration and increased runoff. 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).

Recreational uses

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

Wood products

No appreciable wood products are typically present on this site.

Other products

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

Other information

Revision Notes: “Previously Approved” Provisional
This Provisional ecological site concept has passed Quality Control (QC) and Quality Assurance (QA) to ensure that the site meets the 2014 NESH standards for a Provisional ecological site. This is an updated “Previously Approved” ESD which represents a first-generation tier of documentation that, prior to the release of the 2014 National Ecological Site Handbook (NESH), met all requirements as an “Approved” ESD as laid out in the 1997, rev.1, 2003 National Range and Pasture Handbook (NRPH). The document fully described the Reference State and Community Phase in the State-and-Transition model. All other alternative states are at least described in narrative form. The “Previously Approved” ESD has been field-tested for a minimum of five years and is a proven functional document for conservation planning. The “Previously Approved” ESD does not contain all tabular and narrative entries as required in the current “Approved” level of documentation, but it is expected that the “Previously Approved” ESD will continue refinement toward an “Approved” status.

Site Development and Testing Plan:
Future work, as described in a Project Plan, is necessary to validate the information in this Provisional Ecological Site Description. This will include field activities to collect low-, medium-, and high-intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. The final field review, peer review, quality control, and quality assurance reviews of the ESD will be required to produce the final document.

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Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel were also used. Those involved in developing this site include: April Boltjes, Range Management Specialist (RMS), NRCS; Stan Boltz, RMS, NRCS; and Dana Larsen, RMS, NRCS.

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Approval

David Kraft, 9/27/2018

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ESD updated by Rick L. Peterson on 11/7/17
Editorial Review by Carla Green-Adams.

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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Contact for lead author	Stan Boltz, stanley.boltz@sd.usda.gov, 605-352-1236
Date	02/20/2009
Approved by	Stan Boltz
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None.

2. **Presence of water flow patterns:** None, or barely visible and discontinuous.

3. **Number and height of erosional pedestals or terracettes:** None.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is typically less than 15 percent, and patches are less than 2 inches in diameter.

5. **Number of gullies and erosion associated with gullies:** None should be present.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None.

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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 smallest size class litter is possible, but not normal.

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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 aggregate stability ratings should typically be 4 to 6. Surface organic matter adheres to the soil surface. Soil surface fragments will typically retain structure indefinitely when dipped in distilled water.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A-horizon should be 4 to 8 inches thick with mollic (dark) colors when moist. Structure typically is granular or subangular blocky parting to granular or platy.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Combination of shallow and deep rooted species (mid & tall rhizomatous and tufted perennial cool-season grasses) with fine and coarse roots positively influences infiltration.

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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 – natural pan appears at roughly 4 to 16 inches with “biscuit-top” appearance at top of pan.

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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: Wheatgrasses (mid, cool-season) > mid and tall, cool-season bunchgrasses >

    Sub-dominant: Short, warm-season grasses = shrubs >

    Other: Tall and mid, warm-season grasses = grass-like species = forbs

    Additional: Other grasses in other functional groups occur in minor amounts.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very little evidence of decadence or mortality. Bunch grasses have strong, healthy centers and shrubs are vigorous.

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14. **Average percent litter cover (%) and depth (in):** Litter cover typically 55 to 65 percent, and in contact with the soil surface. Depth of litter is roughly 0.25 to 0.5 inches.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Total annual production ranges from 1,500 to 2,500 pounds/acre, with the reference value being 2,000

pounds/acre (air-dry basis).

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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:** State and local noxious weeds; also Kentucky bluegrass.

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17. **Perennial plant reproductive capability:** Perennial grasses should have vigorous rhizomes or tillers.
