USDA Natural Resources Conservation Service

Ecological site R063BY011SD
Clayey

Last updated: 9/11/2018
Accessed: 05/06/2024

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 American 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 northeastern corner of the MLRA, east of the Missouri River, is located in the glaciated section with deposits of glacial drift on the higher areas. The southwestern tip is located in the High Plains Section.

Elevations range from 1,310 feet to 1,640 feet on the bottomlands 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 the borders of MLRA 63B.

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 onto 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 the hazards of wind and water erosion, maintenance for 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 Clayey ecological site occurs throughout the MLRA. It is located on upland landscapes and does not receive additional moisture from runoff or overflow. Typical slopes range from 0 to 25 percent. Soils are deep with surface textures ranging from silty clay loam to clay 3 to 9 inches thick. The vegetation in the Reference State (1.0) consists of a mix of cool- and warm-season grasses, however, mid-statured cool-season grasses will be the dominant group. Western wheatgrass and green needlegrass are the dominant cool-season grasses, while big bluestem, sideoats grama, little bluestem, and blue grama are the dominant warm-season grasses. Forbs are common and diverse, and shrubs are present, but in minor amounts.

Associated sites

R063BY010SD	**Loamy** The Loamy site can be located adjacent to the Clayey site.
R063BY021SD	**Clayey Overflow** The Clayey Overflow site can be located on drainageways adjacent to the Clayey site.

Similar sites

R063BY010SD	**Loamy** The Loamy site will have less green needlegrass and more needle and thread.

R063BY021SD	**Clayey Overflow** Clayey Overflow site will have more big bluestem and higher forage 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 steeply sloping uplands.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Plain (3) Stream terrace
Flooding frequency	None
Elevation	396–610 m
Slope	0–25%
Water table depth	203 cm
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 MLRA 63B'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)	533-610 mm
Frost-free period (actual range)	110-126 days
Freeze-free period (actual range)	127-155 days
Precipitation total (actual range)	508-635 mm
Frost-free period (average)	118 days
Freeze-free period (average)	141 days

Precipitation total (average)	584 mm

Climate stations used

- (1) PICKSTOWN [USC00396574], Lake Andes, SD
- (2) LYNCH [USC00255040], Lynch, NE
- (3) WINNER [USC00399367], Winner, SD
- (4) NIOBRARA [USC00255960], Niobrara, NE
- (5) GANN VALLEY 4NW [USC00393217], Gann Valley, SD
- (6) STEPHAN 2 NW [USC00397992], Highmore, 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 the loam to clay textured surface soils with slopes of 0 to 25 percent. The soils in this site are moderately deep or deep, well drained, and formed in shale residuum and clayey alluvium. The surface layer is 3 to 18 inches thick and has slow to very slow permeability and low to moderately low saturated hydraulic conductivity. The subsoil is typically silty clay or clay, but can be clay loam in some soils. Carbonates, gypsum, or other salts are typically found in the subsoil or underlying layers in most soils. The subsoil is characterized by a high clay content resulting in very slow permeability and very low or low saturated hydraulic conductivity. Subsurface soil layers are non-restrictive to water movement and root penetration. When dry these soils crack due to the moderate to high shrink-swell potential of smectitic clays. When the soils are wet, surface compaction can occur with heavy traffic. This site is not flooded or ponded and there is no zone of water saturation within a depth of 72 inches. Available water capacity ranges from moderate to low throughout the soil.

This site typically should show slight to no evidence of rills, wind-scoured areas, or pedestalled plants. If present, water flow paths are broken, irregular in appearance or discontinuous. The soil surface is stable and intact. These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about five percent. Loss of 50 percent or more of the surface layer of the soils on this site can result in a shift in species composition and/or production.

Major soils correlated to the Clayey ecological site include: Labu, Millboro, Opal, Promise, and Verdel.

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

Table 4. Representative soil features

Parent material	(1) Residuum–clayey shale
Surface texture	(1) Clay (2) Silty clay (3) Silty clay loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Very slow to slow
Soil depth	64–203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–3%
Available water capacity (0-101.6cm)	10.16–15.24 cm

Calcium carbonate equivalent (0-101.6cm)	0–20%
Electrical conductivity (0-101.6cm)	0–8 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–6
Soil reaction (1:1 water) (0-101.6cm)	6.1–9
Subsurface fragment volume <=3" (Depth not specified)	0–7%
Subsurface fragment volume >3" (Depth not specified)	0–5%

Ecological dynamics

This 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/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.

Interpretations are primarily based on the Reference Plant Community (1.1). This 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. Plant Community phases, States, transitional pathways, and thresholds have been determined through similar studies and experience.

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 Plant Community (1.1). Blue grama and buffalograss will increase and eventually develop into a sod.
Western wheatgrass will increase initially and then begin to decrease. Green needlegrass, needle and thread, porcupinegrass, sideoats grama, big bluestem, and little bluestem will decrease in frequency and production. Excessive defoliation can cause threeawns and annuals to increase and dominate the site. The invasion of non-native cool-season grasses and extended periods of non-use and/or lack of fire will result in excessive litter and a plant community dominated by cool-season grasses such as western wheatgrass, Kentucky bluegrass, smooth bromegrass, and cheatgrass. This site is very susceptible to invasion of non-native cool-season grasses which can increase to the point they drive ecological processes.

The Reference State may be difficult to locate in MLRA 63B with the introduction and spread of non-native cool-season grasses. Plant Community 2.1 is most similar to the Reference Plant Community (1.1), but a restoration pathway to the Reference State is not believed to be achievable because of the persistence of non-native cool-season grasses.

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

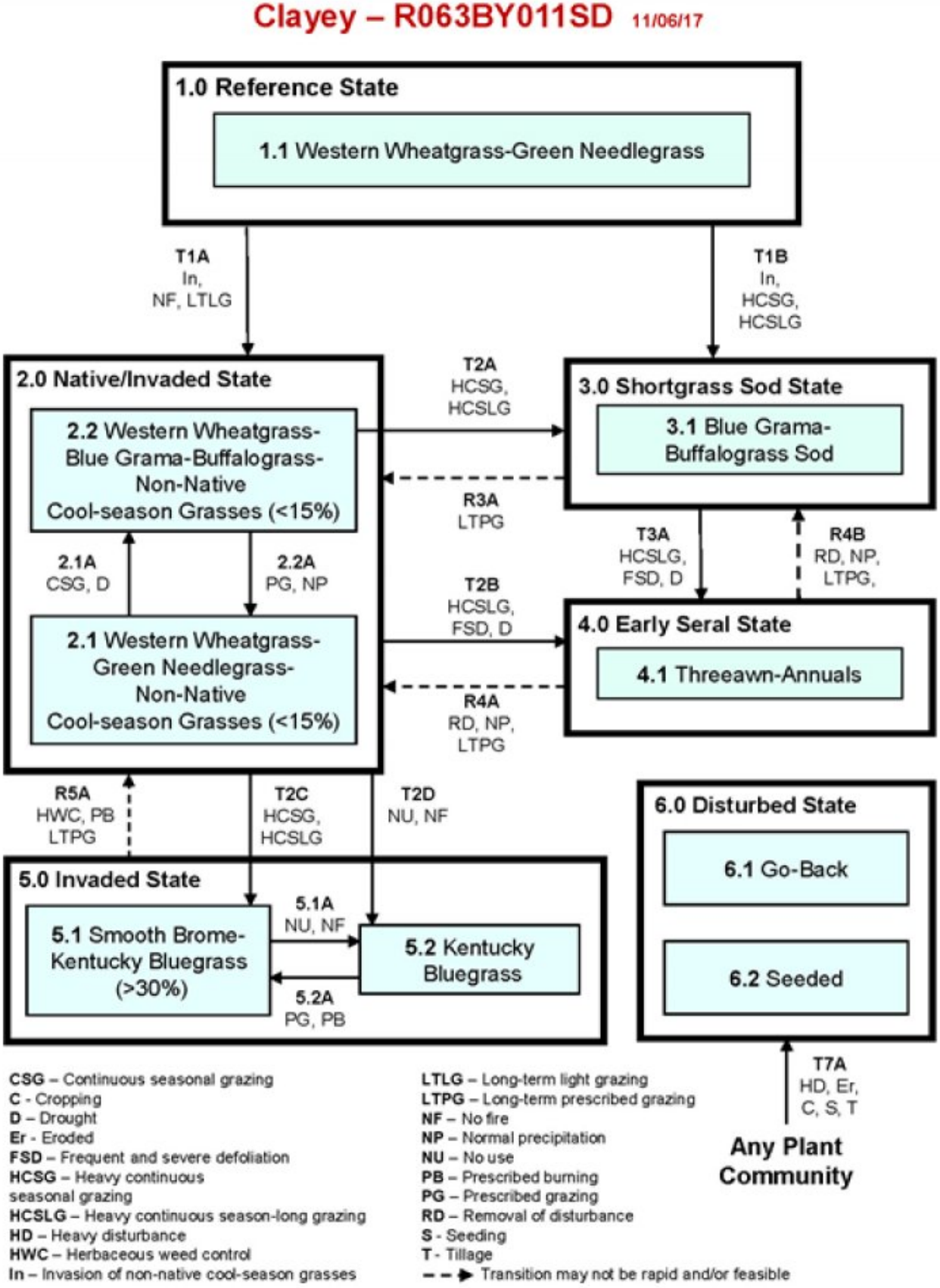

Figure 8. Clayey - R063BY011SD.

Diagram Legend - Clayey - R063BY011SD	
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.
T2D	Non-use, no fire.
T3A	Heavy, continuous season-long grazing, frequent and severe defoliation, drought.
T7A	Heavy disturbance, soil erosion, cropping, tillage, seeding introduced or forage 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 season-long grazing (spring), drought.
2.2A	Prescribed grazing, return to normal precipitation patterns following drought.
5.1A	Non-use, no fire
5.2A	Prescribed grazing, prescribed burning.

Figure 9. Clayey - R063BY011SD.

State 1
Reference State

This State represents what is believed to show the natural range of variability that dominated the dynamics in this ecological site prior to European settlement. This State was co-dominated by cool- and warm-season grasses. In pre-European times, the primary disturbance mechanisms for this site in the Reference condition included frequent 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 and taller warm-season grasses would have declined 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. An alternate plant community phase dominated by tall and mid- warm-season grasses such as big bluestem, sideoats grama, and little bluestem may also occur in the Reference State. This plant community phase could occur as a result of frequent spring fire or repeated high-intensity grazing in the early part of the growing season. As this community phase is not as common, it is not described in detail in this document.

Community 1.1
Western Wheatgrass-Green Needlegrass

Figure 10. Clayey - R063BY011SD - PCP 1.1.

Interpretations are based primarily on the Western Wheatgrass-Green Needlegrass Plant Community Phase. This is considered to be Reference Plant Community. The potential vegetation is about 85 percent grasses or grass-like

plants, 10 percent forbs, and 5 percent shrubs. The community is dominated by cool-season grasses. The major grasses include western wheatgrass, green needlegrass, big bluestem, and sideoats grama. Other grasses include blue grama, buffalograss, sedges, and porcupinegrass. This plant community was resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allowed for high tolerance to drought. This was a sustainable plant community in regard to site/soil stability, watershed function, and biologic integrity.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2040	2793	3503
Forb	140	235	359
Shrub/Vine	62	110	174
Total	**2242**	**3138**	**4036**

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

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. 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 will occur.

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

This Plant Community is similar to Western Wheatgrass-Green Needlegrass Plant Community (1.1), but it also contains minor amounts of non-native cool-season grass species such as Kentucky bluegrass and smooth bromegrass (up to about 15 percent by air-dry weight). The potential vegetation consists of about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs. The community is dominated by cool-season grasses. The major grasses include western wheatgrass, green needlegrass, big bluestem, and sideoats grama. Other grasses include blue grama, buffalograss, sedges, and porcupinegrass. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high tolerance to drought. 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 (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2040	2793	3503
Forb	140	235	359
Shrub/Vine	62	110	174
Total	**2242**	**3138**	**4036**

Figure 14. 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
Western Wheatgrass-Blue Grama-Buffalograss-Non-Native Cool-Season Grasses (<15%)

This plant community is a result of continuous seasonal grazing or from over utilization during extended drought periods. The potential plant community is made up of approximately 80 percent grasses and grass-like species, 10 percent forbs, and 10 percent shrubs. Dominant grasses include western wheatgrass, blue grama, and buffalograss. Grasses of secondary importance include sideoats grama, sedge, green needlegrass, Kentucky bluegrass, smooth bromegrass, and needle and thread. Forbs commonly found in this plant community include white sagebrush (cudweed sagewort), prairie coneflower, and western yarrow. When compared to the Western Wheatgrass-Green Needlegrass Plant Community (1.1), blue grama and buffalograss have increased. Green needlegrass and sideoats grama have decreased, and production of mid- and tall warm-season grasses has also been 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 (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1468	2000	2488
Shrub/Vine	106	177	269
Forb	106	177	269
Total	**1680**	**2354**	**3026**

Figure 16. 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 Western Wheatgrass-Blue Grama-Buffalograss-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 will convert this Plant Community to the Western Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grasses (< 15%) Plant Community (2.1).

Conservation practices

Prescribed Grazing

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 the Clayey ecological site is dramatically altered. Runoff is high and infiltration is low. The Shortgrass State is very resistant to change through grazing management alone.

Community 3.1
Blue Grama-Buffalograss Sod

Figure 17. Clayey - R063BY011SD - PCP 3.1.

This plant community evolved under heavy, continuous season-long grazing or from overutilization during extended drought periods. The potential plant community is made up of approximately 80 percent grasses and grass-like species, 10 percent forbs, and 10 percent shrubs. Dominant grasses include blue grama and buffalograss. Grasses of secondary importance include sedge and western wheatgrass. Forbs commonly found in this plant community include wild parsley and scarlet globemallow. When compared to the Western Wheatgrass-Green Needlegrass 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. The Blue Grama-Buffalograss Sod plant community phase is less productive than most other phases. The thick sod prevents other species from becoming established. Lack of litter and reduced plant vigor causes higher soil temperatures, poor water infiltration rates, and high evapotranspiration, which gives blue grama a competitive advantage over cool-season midgrasses. Soil erosion will be minimal due to the sod-forming habits of blue grama and buffalograss.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	762	1237	1580
Shrub/Vine	67	110	163
Forb	67	110	163
Total	**896**	**1457**	**1906**

Figure 19. 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

The Early Seral 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 phase 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 in this ecological site.

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 50 to 80 percent grasses and grass-like species, 10 to 25 percent forbs, and 5 to 25 percent shrubs. The dominant grass is threeawn. Other grasses may include annual bromegrass (field brome and downy brome), little bluestem, blue grama, buffalograss, sand dropseed, sedges, and western wheatgrass. The dominant forbs include fetid marigold, Cuman ragweed (western ragweed), white sagebrush (cudweed sagewort), pussytoes, and other invader-like species. The dominant shrubs include fringed sagewort and cactus. Other plant species from adjacent 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 percentage of bare ground. Compared to the Western Wheatgrass-Green Needlegrass Plant Community (1.1), red threeawn, annual brome grasses, and the percentage of bare ground has increased. Western wheatgrass, needlegrasses, and other cool-season grasses and grass-like species have decreased, as have the warm-season species including big bluestem, sideoats grama, little bluestem, plains muhly, and prairie dropseed. 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 (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	325	605	729
Shrub/Vine	39	135	252
Forb	84	157	252
Total	**448**	**897**	**1233**

Figure 21. 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. 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. 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. Infiltration and runoff will be moderately reduced, and biological activity in the soil is likely significantly reduced. 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.

Table 10. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1861	2608	3318
Forb	129	219	331
Shrub/Vine	28	87	163
Total	**2018**	**2914**	**3812**

Figure 23. 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

Community 5.2
Kentucky Bluegrass

This Plant Community is a result of extended periods of non-use and no fire. It is characterized by a dominance of Kentucky bluegrass. The dominance is at times so complete that other species are difficult to find on the site. A relatively thick duff layer can sometimes accumulate 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 will be significantly reduced when compared to the interpretive plant community (1.1). The period that palatability is high is relatively short, as Kentucky bluegrass matures rapidly. Biological activity in the soil is likely reduced significantly in this plant community.

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	796	1515	1732
Forb	84	291	308
Shrub/Vine	17	99	202
Total	**897**	**1905**	**2242**

Figure 25. 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

Pathway 5.1A
Community 5.1 to 5.2

Non-use and no fire will convert this plant community to the Kentucky Bluegrass Plant Community (5.2).

Pathway 5.2A
Community 5.2 to 5.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to heavy grazing and prescribed burning may convert this plant community to the Smooth Bromegrass-Kentucky Bluegrass (> 30%) Plant Community (5.1).

Conservation practices

Prescribed Grazing

State 6
Disturbed State

Any plant community can transition to the Disturbed State. 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 farmland, 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, refer to the USDA-NRCS e-FOTG for the appropriate Forage Suitability Group description.

Transition T1A
State 1 to 2

Invasion of non-native cool-season grasses such as Kentucky bluegrass and smooth bromegrass and the 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 accelerate this transition.

Transition T7A
State 1 to 6

Heavy disturbance including soil erosion, tillage, abandoned cropland, or seeding to improved pasture species will 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) will likely lead this State over a threshold to the Smooth Brome-Kentucky Bluegrass Plant Community (5.1).

Transition T2D
State 2 to 5

Non-use and no fire for extended periods of time (typically for 10 or more years) will likely lead this State over a threshold, resulting in a shift to the Kentucky Bluegrass Plant Community (5.2).

Transition T7A
State 2 to 6

Heavy disturbance including soil erosion, tillage, abandoned cropland, or seeding to improved pasture species will 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 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.

Transition T3A
State 3 to 4

Heavy, continuous season-long grazing and/or frequent severe defoliation in combination with drought will likely move the Bluegrama-Buffalograss Sod 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 will 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 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 will 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 phase over a threshold to the Native/Invasive 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. 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 will result in a transition to the Disturbed State (6.0).

Additional community tables

Table 12. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			785–1412	
	western wheatgrass	PASM	*Pascopyrum smithii*	785–1412	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–157	–
2	**Needlegrass**			471–785	
	green needlegrass	NAVI4	*Nassella viridula*	471–785	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	31–314	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–94	–
3	**Tall/Mid Warm Season**			314–628	
	big bluestem	ANGE	*Andropogon gerardii*	63–471	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	63–314	–
	little bluestem	SCSC	*Schizachyrium scoparium*	31–314	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	31–157	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–94	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–94	–
	switchgrass	PAVI2	*Panicum virgatum*	0–94	–
4	**Short Warm-Season Grasses**			157–471	
	blue grama	BOGR2	*Bouteloua gracilis*	157–314	–
	buffalograss	BODA2	*Bouteloua dactyloides*	63–251	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–94	–
	threeawn	ARIST	*Aristida*	0–94	–
5	**Other Native Grasses**			31–157	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–157	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–94	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–94	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	31–94	–
6	**Grass-Likes**			31–157	
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–157	–
	sedge	CAREX	*Carex*	31–157	–
Forb					
8	**Forbs**			157–314	
	false boneset	BREU	*Brickellia eupatorioides*	0–94	–
	Forb, native	2FN	*Forb, native*	31–94	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	31–94	–
	milkvetch	ASTRA	*Astragalus*	0–63	–
	beardtongue	PENST	*Penstemon*	31–63	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–63	–

	textile onion	ALTE	*Allium textile*	31–63	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–63	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–63	–
	prairie clover	DALEA	*Dalea*	0–63	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	31–63	–
	dotted blazing star	LIPU	*Liatris punctata*	31–63	–
	desertparsley	LOMAT	*Lomatium*	0–63	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	31–63	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	0–63	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–63	–
	scurfpea	PSORA2	*Psoralidium*	31–63	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	31–63	–
	goldenrod	SOLID	*Solidago*	31–63	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	31–63	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	31–63	–
	American vetch	VIAM	*Vicia americana*	31–63	–
	deathcamas	ZIGAD	*Zigadenus*	0–31	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–31	–
	prairie groundsel	PAPL12	*Packera plattensis*	0–31	–
	pussytoes	ANTEN	*Antennaria*	0–31	–
	spiny phlox	PHHO	*Phlox hoodii*	0–31	–
Shrub/Vine					
9	**Shrubs**			63–157	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–94	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–94	–
	rose	ROSA5	*Rosa*	31–63	–
	prairie sagewort	ARFR4	*Artemisia frigida*	31–63	–
	pricklypear	OPUNT	*Opuntia*	0–31	–

Table 13. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			753–1255	
	western wheatgrass	PASM	*Pascopyrum smithii*	753–1255	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–157	–
2	**Needlegrass**			157–471	
	green needlegrass	NAVI4	*Nassella viridula*	157–314	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	31–157	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–94	–
3	**Tall/Mid Warm Season**			314–628	
	big bluestem	ANGE	*Andropogon gerardii*	63–471	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	63–314	–
	little bluestem	SCSC	*Schizachyrium scoparium*	31–314	–

	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	31–157	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–94	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–94	–
	switchgrass	PAVI2	*Panicum virgatum*	0–94	–
4	**Short Warm-Season Grasses**			157–471	
	blue grama	BOGR2	*Bouteloua gracilis*	157–314	–
	buffalograss	BODA2	*Bouteloua dactyloides*	63–251	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–94	–
	threeawn	ARIST	*Aristida*	0–94	–
5	**Other Native Grasses**			31–157	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–157	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–94	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–94	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	31–94	–
6	**Grass-Likes**			31–157	
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–157	–
	sedge	CAREX	*Carex*	31–157	–
7	**Non-Native Grasses**			157–471	
	bluegrass	POA	*Poa*	94–471	–
	smooth brome	BRIN2	*Bromus inermis*	63–314	–
	cheatgrass	BRTE	*Bromus tectorum*	22–56	–
	field brome	BRAR5	*Bromus arvensis*	0–56	–
Forb					
8	**Forbs**			157–314	
	false boneset	BREU	*Brickellia eupatorioides*	0–94	–
	Forb, native	2FN	*Forb, native*	31–94	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	31–94	–
	milkvetch	ASTRA	*Astragalus*	0–63	–
	beardtongue	PENST	*Penstemon*	31–63	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–63	–
	textile onion	ALTE	*Allium textile*	31–63	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–63	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–63	–
	prairie clover	DALEA	*Dalea*	0–63	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	31–63	–
	dotted blazing star	LIPU	*Liatris punctata*	31–63	–
	desertparsley	LOMAT	*Lomatium*	0–63	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	31–63	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	0–63	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–63	–
	scurfpea	PSORA2	*Psoralidium*	31–63	

	scurfpea	PSORA2	*Psoralidium*	31–63	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	31–63	–
	goldenrod	SOLID	*Solidago*	31–63	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	31–63	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	31–63	–
	American vetch	VIAM	*Vicia americana*	31–63	–
	deathcamas	ZIGAD	*Zigadenus*	0–31	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–31	–
	prairie groundsel	PAPL12	*Packera plattensis*	0–31	–
	pussytoes	ANTEN	*Antennaria*	0–31	–
	spiny phlox	PHHO	*Phlox hoodii*	0–31	–
Shrub/Vine					
9	**Shrubs**			63–157	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–94	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–94	–
	prairie sagewort	ARFR4	*Artemisia frigida*	31–63	–
	rose	ROSA5	*Rosa*	31–63	–
	pricklypear	OPUNT	*Opuntia*	0–31	–

Table 14. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			353–471	
	western wheatgrass	PASM	*Pascopyrum smithii*	353–471	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–47	–
2	**Needlegrass**			118–353	
	green needlegrass	NAVI4	*Nassella viridula*	118–353	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	24–118	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–118	–
3	**Tall/Mid Warm Season**			118–235	
	big bluestem	ANGE	*Andropogon gerardii*	24–188	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–188	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	24–165	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–47	–
	switchgrass	PAVI2	*Panicum virgatum*	0–47	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–47	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–47	–
4	**Short Warm-Season Grasses**			235–706	
	blue grama	BOGR2	*Bouteloua gracilis*	235–471	–
	buffalograss	BODA2	*Bouteloua dactyloides*	118–235	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–118	–
	threeawn	ARIST	*Aristida*	0–118	–
5	**Other Native Grasses**			0–118	

	prairie Junegrass	KOMA	*Koeleria macrantha*	0–118	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–71	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–71	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–71	–
6	**Grass-Likes**			118–235	
	sedge	CAREX	*Carex*	118–235	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–24	–
7	**Non-Native Grasses**			24–471	
	smooth brome	BRIN2	*Bromus inermis*	0–353	–
	bluegrass	POA	*Poa*	24–235	–
	cheatgrass	BRTE	*Bromus tectorum*	24–118	–
	field brome	BRAR5	*Bromus arvensis*	0–56	–
Forb					
8	**Forbs**			118–235	
	white sagebrush	ARLU	*Artemisia ludoviciana*	24–94	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	24–71	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	24–71	–
	goldenrod	SOLID	*Solidago*	24–71	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	24–71	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	24–71	–
	American vetch	VIAM	*Vicia americana*	0–47	–
	deathcamas	ZIGAD	*Zigadenus*	0–47	–
	pussytoes	ANTEN	*Antennaria*	0–47	–
	textile onion	ALTE	*Allium textile*	0–47	–
	Forb, introduced	2FI	*Forb, introduced*	0–47	–
	Forb, native	2FN	*Forb, native*	0–47	–
	milkvetch	ASTRA	*Astragalus*	0–47	–
	false boneset	BREU	*Brickellia eupatorioides*	0–47	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–47	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–47	–
	dotted blazing star	LIPU	*Liatris punctata*	0–47	–
	desertparsley	LOMAT	*Lomatium*	0–47	–
	prairie groundsel	PAPL12	*Packera plattensis*	0–47	–
	beardtongue	PENST	*Penstemon*	0–47	–
	spiny phlox	PHHO	*Phlox hoodii*	0–47	–
	scurfpea	PSORA2	*Psoralidium*	0–47	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–47	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–24	–
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	0–24	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–24	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–24	–

	prairie clover	DALEA	*Dalea*	0–24	–
Shrub/Vine					
9	**shrubs**			118–235	
	prairie sagewort	ARFR4	*Artemisia frigida*	0–118	–
	pricklypear	OPUNT	*Opuntia*	0–71	–
	rose	ROSA5	*Rosa*	0–71	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–71	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–47	–

Table 15. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			73–219	
	western wheatgrass	PASM	*Pascopyrum smithii*	73–146	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–15	–
2	**Needlegrass**			29–73	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	29–73	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–29	–
	green needlegrass	NAVI4	*Nassella viridula*	0–29	–
3	**Tall/Mid Warm Season**			0–73	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–44	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–44	–
	big bluestem	ANGE	*Andropogon gerardii*	0–29	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–15	–
	switchgrass	PAVI2	*Panicum virgatum*	0–15	–
4	**Short Warm-Season Grasses**			656–874	
	buffalograss	BODA2	*Bouteloua dactyloides*	364–510	–
	blue grama	BOGR2	*Bouteloua gracilis*	291–437	–
	threeawn	ARIST	*Aristida*	15–146	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	15–73	–
5	**Other Native Grasses**			0–73	
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–73	–
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–44	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–44	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–44	–
6	**Grass-Likes**			73–219	
	sedge	CAREX	*Carex*	73–219	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–29	–
7	**Non-Native Grasses**			0–73	
	smooth brome	BRIN2	*Bromus inermis*	0–73	–
	cheatgrass	BRTE	*Bromus tectorum*	0–73	–

	bluegrass	POA	*Poa*	0–73	–
	field brome	BRAR5	*Bromus arvensis*	0–56	–
Forb					
8	**Forbs**			73–146	
	Forb, introduced	2FI	*Forb, introduced*	0–58	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	15–58	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	15–58	–
	prairie groundsel	PAPL12	*Packera plattensis*	0–44	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	15–44	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	15–29	–
	pussytoes	ANTEN	*Antennaria*	0–29	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–29	–
	Forb, native	2FN	*Forb, native*	0–29	–
	spiny phlox	PHHO	*Phlox hoodii*	0–29	–
	scurfpea	PSORA2	*Psoralidium*	0–29	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–29	–
	dotted blazing star	LIPU	*Liatris punctata*	0–29	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	15–29	–
	goldenrod	SOLID	*Solidago*	0–29	–
	deathcamas	ZIGAD	*Zigadenus*	0–29	–
	American vetch	VIAM	*Vicia americana*	0–15	–
	desertparsley	LOMAT	*Lomatium*	0–15	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–15	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–15	–
	beardtongue	PENST	*Penstemon*	0–15	–
	prairie clover	DALEA	*Dalea*	0–15	–
	fetid marigold	DYPA	*Dyssodia papposa*	0–15	–
	milkvetch	ASTRA	*Astragalus*	0–15	–
	false boneset	BREU	*Brickellia eupatorioides*	0–15	–
	textile onion	ALTE	*Allium textile*	0–15	–
Shrub/Vine					
9	**shrubs**			73–146	
	prairie sagewort	ARFR4	*Artemisia frigida*	0–73	–
	pricklypear	OPUNT	*Opuntia*	15–73	–
	rose	ROSA5	*Rosa*	0–29	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–29	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–29	–

Table 16. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			9–45	
	western wheatgrass	PASM	*Pascopyrum smithii*	9–45	–
2	**Needlegrass**			0–45	

2	**Needlegrass**			0–45	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–36	–
	green needlegrass	NAVI4	*Nassella viridula*	0–9	–
3	**Tall/Mid Warm Season**			0–18	
4	**Short Warm-Season Grasses**			90–404	
	threeawn	ARIST	*Aristida*	90–314	–
	buffalograss	BODA2	*Bouteloua dactyloides*	9–179	–
	blue grama	BOGR2	*Bouteloua gracilis*	9–179	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	9–72	–
5	**Other Native Grasses**			0–45	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–45	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–18	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–9	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–9	–
6	**Grass-Likes**			18–45	
	sedge	CAREX	*Carex*	18–45	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–9	–
7	**Non-Native Grasses**			0–72	
	field brome	BRAR5	*Bromus arvensis*	0–18	–
	smooth brome	BRIN2	*Bromus inermis*	0–18	–
	cheatgrass	BRTE	*Bromus tectorum*	0–18	–
	bluegrass	POA	*Poa*	0–18	–
Forb					
8	**Forbs**			90–224	
	Forb, introduced	2FI	*Forb, introduced*	0–90	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	18–45	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	9–45	–
	fetid marigold	DYPA	*Dyssodia papposa*	9–45	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	9–36	–
	spiny phlox	PHHO	*Phlox hoodii*	0–27	–
	goldenrod	SOLID	*Solidago*	0–18	–
	pussytoes	ANTEN	*Antennaria*	0–18	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	0–9	–
	deathcamas	ZIGAD	*Zigadenus*	0–9	–
	dotted blazing star	LIPU	*Liatris punctata*	0–9	–
Shrub/Vine					
9	**Shrubs**			45–224	
	prairie sagewort	ARFR4	*Artemisia frigida*	18–135	–
	pricklypear	OPUNT	*Opuntia*	9–90	–
	rose	ROSA5	*Rosa*	0–9	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–9	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–9	–

Table 17. Community 5.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			0–583	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–583	–
2	**Needlegrass**			0–437	
	green needlegrass	NAVI4	*Nassella viridula*	0–437	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–87	–
3	**Tall/Mid Warm Season**			0–146	
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–146	–
	big bluestem	ANGE	*Andropogon gerardii*	0–58	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–58	–
4	**Short Warm-Season Grasses**			0–146	
5	**Other Native Grasses**			0–146	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–146	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–58	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–29	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–29	–
6	**Grass-Likes**			0–87	
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–87	–
	sedge	CAREX	*Carex*	0–87	–
7	**Non-Native Grasses**			1020–2331	
	smooth brome	BRIN2	*Bromus inermis*	437–2186	–
	bluegrass	POA	*Poa*	146–874	–
	cheatgrass	BRTE	*Bromus tectorum*	58–437	–
	field brome	BRAR5	*Bromus arvensis*	0–112	–
Forb					
8	**Forbs**			146–291	
	Forb, introduced	2FI	*Forb, introduced*	58–233	–
	goldenrod	SOLID	*Solidago*	0–146	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	29–117	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–117	–
	Forb, native	2FN	*Forb, native*	0–87	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	0–87	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–58	–
	scurfpea	PSORA2	*Psoralidium*	0–58	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–29	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–29	–
	pussytoes	ANTEN	*Antennaria*	0–29	–
	milkvetch	ASTRA	*Astragalus*	0–29	–

	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–29	–
	dotted blazing star	LIPU	*Liatris punctata*	0–29	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–29	–
Shrub/Vine					
9	**Shrubs**			29–146	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–146	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–87	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–58	–
	pricklypear	OPUNT	*Opuntia*	0–58	–
	rose	ROSA5	*Rosa*	0–58	–

Table 18. Community 5.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrass**			0–90	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–90	–
2	**Needlegrass**			0–269	
	green needlegrass	NAVI4	*Nassella viridula*	0–269	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–54	–
4	**Short Warm-Season Grasses**			36–359	
	threeawn	ARIST	*Aristida*	18–269	–
	blue grama	BOGR2	*Bouteloua gracilis*	18–179	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–90	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–54	–
5	**Other Native Grasses**			0–90	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–90	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–18	–
	fall rosette grass	DIWI5	*Dichanthelium wilcoxianum*	0–18	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–18	–
6	**Grass-Likes**			18–179	
	sedge	CAREX	*Carex*	18–143	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–90	–
7	**Non-Native Grasses**			448–1255	
	bluegrass	POA	*Poa*	359–1076	–
	smooth brome	BRIN2	*Bromus inermis*	0–269	–
	cheatgrass	BRTE	*Bromus tectorum*	36–269	–
	field brome	BRAR5	*Bromus arvensis*	0–112	–
Forb					
8	**Forbs**			90–269	
	Forb, introduced	2FI	*Forb, introduced*	36–143	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	18–90	–

	goldenrod	SOLID	*Solidago*	0–90	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–72	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	18–72	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	0–54	–
	spiny phlox	PHHO	*Phlox hoodii*	0–36	–
	pussytoes	ANTEN	*Antennaria*	0–36	–
	Forb, native	2FN	*Forb, native*	0–36	–
	scurfpea	PSORA2	*Psoralidium*	0–18	–
Shrub/Vine					
9	**Shrubs**			18–179	
	prairie sagewort	ARFR4	*Artemisia frigida*	18–143	–
	pricklypear	OPUNT	*Opuntia*	18–72	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–54	–
	rose	ROSA5	*Rosa*	0–36	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–36	–

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 ESD). Because of this, 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.

The following stocking rates are based on 912 lbs./acre (air-dry weight) per Animal-Unit-Month (AUM), with a 25 percent harvest efficiency of preferred and desirable forage species. An AUM is defined as the equivalent amount of forage required by a 1,000 pound cow with calf up to 6 months of age for one month (refer to USDA NRCS, National Range and Pasture Handbook).

Plant Community: Western Wheatgrass-Green Needlegrass (1.1)
Average Annual Production (lbs./acre, air-dry): 2,800
Stocking Rate (AUM/acre): 0.77

Plant Community: Western Wheatgrass-Green Needlegrass-Non-Native Cool-Season Grasses (< 15%) (2.1)
Average Annual Production (lbs./acre, air-dry): 2,800
Stocking Rate (AUM/acre): 0.77

Plant Community: Western Wheatgrass-Blue Grama-Buffalograss-Non-Native Cool-Season Grasses (< 15%) (2.2)
Average Annual Production (lbs./acre, air-dry): 2,100
Stocking Rate (AUM/acre): 0.58

Plant Community: Blue Grama-Buffalograss Sod (3.1)
Average Annual Production (lbs./acre, air-dry): 1,300
Stocking Rate (AUM/acre): 0.36

Plant Community: Threeawn-Annuals (4.1)
Average Annual Production (lbs./acre, air-dry): 800
Stocking Rate (AUM/acre): 0.22

Plant Community: Smooth Bromegrass-Kentucky Bluegrass (5.1)
Average Annual Production (lbs./acre, air-dry): 2,600
Stocking Rate (AUM/acre): 0.71

Plant Community: Kentucky Bluegrass (5.2)
Average Annual Production (lbs./acre, air-dry): 1,700
Stocking Rate (AUM/acre): 0.47

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. The Clayey 63B ecological site is dominated by soils in hydrologic group D, with localized areas in hydrologic group C. Infiltration and runoff potential for this site varies from moderate to high, depending upon 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 with less than 50 percent ground cover 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; Rick Peterson, RMS, NRCS; and Dana Larsen, RMS, NRCS.

There are 15 SCS-Range-417s collected from 1969 to 1987 in Boyd, Buffalo, Gregory, Hyde, Knox and Tripp Counties, South Dakota.

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Acknowledgments

ESD updated by Rick L. Peterson on 11/3/17.
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.

Author(s)/participant(s)	Stan Boltz
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.

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

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

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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 typically less than 5 percent, and patches less than 2 inches in diameter.

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

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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):** 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 are typically be 5 to 6, normally 6. Surface organic matter adheres to the soil surface. Soil surface fragments will typically retain structure indefinitely when dipped in distilled water.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A-horizon should be 3 to 10 inches thick with mollic (dark) colors when moist. Structure typically is medium to fine granular or subangular blocky parting to granular.

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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 – when dry, B horizons can be hard and appear to be compacted, but no platy structure will be present.

---

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

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

    Sub-dominant: Mid and tall, warm-season grasses > short, warm-season grasses >

    Other: Forbs > grass-like species = shrubs

    Additional: Other grasses in other functional groups occur but 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.

14. **Average percent litter cover (%) and depth (in):** Litter cover about 80 to 90 percent, with depths about 0.5 to 1 inch.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Total annual production ranges from 2,000 pounds/acre to 3,600 pounds/acre, with the reference value being 2,800 pounds/acre (air-dry basis).

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 and smooth bromegrass.

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